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# County of Bruce & Town of Saugeen Shores
# Bruce County Road 25 Re-Construction: Project File

## Schedule 'B' Municipal Class Environmental Assessment

**GMBP File: 218428**

**April 21, 2020 (Version 2)**

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**SCHEDULE 'B' MUNICIPAL CLASS ENVIRONMENTAL ASSESSMENT**

**BRUCE COUNTY ROAD 25 RE-CONSTRUCTION: PROJECT FILE**
**COUNTY OF BRUCE & TOWN OF SAUGEEN SHORES**

**APRIL 21, 2020 (VERSION 2)**

**GMBP FILE: 218428**

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# 1. INTRODUCTION

In September 2015, the County of Bruce (County), as the proponent, with the Town of Saugeen Shores (Town), as a principle partner, initiated a Master Plan under the Municipal Class Environmental Assessment (EA), appropriately to plan various road and drainage undertakings within a broad area central to Saugeen Shores along Bruce Roads 25 and 33 (BR25 and BR33) in a comprehensive manner. The intention of the Master Plan was to establish an overall context and to assist with the planning of individual projects toward an appropriate overall development strategy. The *Preferred Master Plan* identified several projects for implementation to address the identified problems and opportunities related to the surface asphalt and drainage deficiencies identified for each road.

One of the projects included the re-construction of Bruce Road 25 from the Town's planned alignment of Bruce Street (from the north) to Goderich Street, where shown on **Figure 1**. The *Notice of Study Completion* for the Master Plan, issued on May 9, 2017, identified re-construction of this section of road as a potential Schedule 'B' project due to the consideration for additional lanes (i.e. a 4-lane cross section), which could proceed, following an EA process, using the Master Plan as a basis. The Master Plan is available on the County and Town websites, as well as at the County and Town municipal offices, for reference.

The purpose of this Project File is to document the Schedule 'B' EA process, which addresses Phases 1 and 2 of the EA **(Figure 2)**, verify the direction envisioned in the Master Plan, and to document the process toward establishing a *Preferred Solution* for the BR25 re-construction, from Goderich Street to the planned Bruce Street intersection, as outlined on **Figure 3**. The general format of the Project File is as follows:

i. Outline the Project Statement;
ii. Identify the range of Alternative Solutions considered to address the problem or opportunity;
iii. Evaluate the anticipated 'environmental' effects and proposed mitigation;
iv. Provide an assessment and evaluation of the alternative solutions considered; and
v. Discuss the rationale for the consideration of a *Recommended Solution*.

This Project File is considered a 'living document'. The *Notice of Project Initiation*, provided in **Appendix A**, was first issued on February 25th, 2020. The Notice included an invitation to the public, stakeholders, agencies and indigenous communities to review and provide comment on Version 1 of the Project File, dated February 25th, 2020. Comments received through the process were considered and the rationale for the selection of a *Preferred Solution* is presented in this updated Project File (Version 2).

This Version 2 of the Project File (Final Report) updates the previous Version 1 and is completed as part of Phase 2 of the EA process. It includes a summary of the key comments and feedback received during the consultation period completed in early 2020, commitments to mitigate any remaining negative impacts of the project, and a re-assessment of the *Preliminary Recommended Solution*. It is noted that the documentation provided in this Version of the Project File continues to support the same *Recommended Solution*.

During the Bruce County Transportation and Environmental Services Committee meeting on April 16th, 2020, Committee accepted the *Recommended Preferred Solution*, thus directing the completion of Phase 2 of the EA process, finalization of the Project File and issuance of the *Notice of Project Completion*. The *Notice of Project Completion* was issued on April 21st, 2020.

## 2. MUNICIPAL CLASS ENVIRONMENTAL ASSESSMENT PLANNING PROCESS

Municipal infrastructure projects are subject to the Ontario Environmental Assessment Act (EA Act). The Class Environmental Assessment (Class EA) is an approved self-assessment process under the EA Act for a specific group or “class” of projects. Projects are considered approved subject to compliance with an approved Class EA process. The Municipal Class EA (Municipal Engineers Association October 2000, as amended in 2007, 2011 and 2015) applies to municipal infrastructure projects including roads, water and wastewater.

The Municipal Class EA outlines a comprehensive planning process (illustrated in **Figure 2**) that provides a rational approach to consider the environmental and technical advantages and disadvantages of alternatives and their trade-offs in order to determine a *Preferred Solution* to address an identified problem (or opportunity), as well as consultation with agencies, indigenous communities, directly affected stakeholders and the public throughout the process. The key principles of successful environmental assessment planning include:

- Consultation;
- Consideration of a reasonable range of alternatives;
- Consideration of effects on natural, social, cultural, and economic environments and technical components;
- Clear documentation and systematic evaluation; and
- Traceable decision making.

The classification of projects and activities under the Municipal Class EA is as follows:

**Schedule A:** Includes normal or emergency operational and maintenance activities, which are limited in scale and have minimal adverse environmental effects. These undertakings are pre-approved, and the proponent can proceed without further assessment and approval.

**Schedule A+:** Introduced in 2007, these minor projects are pre-approved. The public is to be advised prior to the implementation of the project.

**Schedule B:** Includes projects which have the potential for adverse environmental effects. This includes improvements to, and minor expansions of, existing facilities. These projects are approved subject to a screening process which includes consulting with stakeholders who may be directly affected and relevant review agencies and indigenous communities.

**Schedule C:** Includes the construction of new facilities and major expansions to existing facilities. These undertakings have the potential for significant environmental effects and must proceed under the planning and documentation procedures outlined in the Municipal Class EA document.

This Schedule ‘B’ Project File includes documentation of the Schedule ‘B’ EA process specific to the re-construction of Bruce Road 25, which is in accordance with the requirements of the Municipal Class EA process and includes Phases 1 and 2, depicted on **Figure 2**:

- Phase 1 consists of identifying the problem or opportunity, and optional (discretionary) public consultation if deemed suitable.
- Phase 2 involves identifying reasonable alternatives to the problem or opportunity, compiling an inventory of the natural, cultural, social, technical and economic environments, evaluating each alternative and recommending a preferred alternative that will address the problem, and provide any

measures necessary to mitigate potential environmental impacts. As part of the Phase 2 process, public, agency and indigenous community consultation is required before the preferred solution is selected to ensure all possible impacts are identified, and assessed, as part of the evaluation process. A summary of the key comments/feedback obtained during the Phase 2 consultation period is provided.

For Schedule ‘B’ or ‘C’ projects, a *Notice of Project Initiation* is advertised and the *Preferred Solution* (and for Schedule ‘C’ projects, the *Preferred Design)* is developed through the process; to be confirmed by Council. The entire process is documented in a Schedule ‘B’ Project File, or Schedule ‘C’ Environmental Study Report, which is made available for public, agency and indigenous community review during a 30 calendar day period following the issuance of the *Notice of Project Completion*. Project Notices specific to this Project File are provided in **Appendix A.**

For Schedule ‘B’ or ‘C’ projects, if concerns are raised during the minimum 30 calendar day review period, following advertisement of the *Notice of Completion*, that cannot be resolved through discussions with the County and the Town, then members of the public, interested groups or technical agencies may request the Minister of the Ministry of the Environment, Conservation and Parks (MECP) to issue a ‘*Part II Order’* for the project. Within the Part II Order request, the Minister may be requested to refer the matter to mediation, impose additional project conditions, and/or request an elevated scope of study. A Part II Order request requires the completion of a ‘Part II Order Request’ Form (i.e. form ID No.012-2206E). The form can be found online on Service Ontario’s Central Forms Repository website (http://www.forms.ssb.gov.on.ca/) by searching ‘Part II Order’ or ‘012-2206E’ (i.e. the form number).

The completed form and any supporting information must be submitted to the MECP, prior to the end of the review period (minimum of 30 days is required), outlining the unresolved issue and requesting the Minister to review the matter.

**Part II Order requests are submitted to:**

Minister, Ministry of the Environment, Conservation and Parks
777 Bay Street, 5th Floor
Toronto, ON M7A 2J3
Fax: 416-314-8452
Minister.MECP@ontario.ca

Copies of the request must also be sent to the Director of the Environmental Approvals Branch at the MECP and to the County of Bruce at the addresses below:

Director, Environmental Assessment and Permissions Branch
Ministry of the Environment, Conservation and Parks
135 St. Clair Avenue West, 1st Floor
Toronto, ON M4V 1P5
enviropermissions@ontario.ca

County of Bruce
Attn: Jim Donohoe, P.Eng.
30 Park Street
P.O. Box 398, Walkerton, ON N0G 2V0
jdonohoe@brucecounty.on.ca

The decision whether or not a Part II Order is appropriate or necessary rests with the Minister of the MECP. If no Part II Order request is outstanding by the end of the minimum 30 calendar day review period, the project is considered to have met the requirements of the Class EA, and the County may proceed to design and construct the project subject to resolving any commitments documented in this Project File during the subsequent design phases and obtaining any other outstanding environmental approvals. For further information regarding Part II Order requests and process, please refer to:

https://www.ontario.ca/environment-and-energy/class-environmental-assessments-part-ii-order

# 3. BACKGROUND

## 3.1 Master Plan

The County of Bruce was considering reconstructing the existing BR25 roadway, between Saugeen Beach Road and Goderich Street, as well as to construct a new roadway to re-align BR33 to intersect BR25 at the planned extension of Bruce Street, as illustrated on **Figure 1**. The County as proponent, with the Town as a principle partner, completed a Master Plan for Roads and Drainage to establish appropriate direction for the infrastructure within the broader Study Area. The Master Plan followed Phases 1 and 2 of the EA planning process and included a Phase 1 'Discretionary' public consultation, the mandatory Phase 2 public consultation and a *Notice of Completion* (May 2017). Copies of Notices issued in relation to the Master Plan are included in **Appendix A**.

The Master Plan documentation includes much of the supporting information for this Bruce Road 25 Re-Construction Project File. A Master Plan drawing, provided in **Appendix B,** illustrates the main features of, and direction resulting from, the Master Plan process. The Master Plan documentation is available on the County and Town websites.

A Bruce County Committee Report, dated February 15, 2018, provided in **Appendix B**, includes a summary of the Master Plan results and an intended implementation schedule for individual projects identified within the Master Plan. The intended implementation schedule, as updated herein, is summarized as follows:

**TABLE 1: Summary of Master Plan Projects Identified and Estimated Implementation Schedule**

| Phase | Description | Anticipated EA Schedule | Implementation (Anticipated) |
|---|---|---|---|
| 1 | Bruce Road 25: Trunk storm sewer from Ridge Street to Lake Huron, including a full urbanized road section from Lake Range Road to Saugeen Beach Road. | Schedule 'A' (Complete) | 2019 (Completed) |
| 2 | Two lane urbanized road section from Lake Range Road to Bruce Street, including the local storm sewer and sanitary sewers. | Schedule 'A' (Complete) | 2020 |
| 3 | Subject of this Project File:<br>Four lane urbanized cross section on BR25 from Bruce Street to Goderich Street, including municipal services. | Schedule 'B' | 2021 |
| 4 | Construction of the new Bruce Road 33 realignment and rehabilitation of current Bruce Road 33 (i.e. Lake Range Road). | Schedule 'B' (Complete) | 2022 |
| 5 | Includes the re-construction of Lake Range Road from Baker Road to BR25, prior to the County divesting this road section to the Town. | Schedule 'A' | TBD |
| '6' | May be considered separately by the Town to include installation of a storm sewer system within the Baker Subdivision, to coincide with sanitary sewer and pumping station installation, at a yet to be determined date, and subject to funding. | | |

The review of the Alternatives for the section of Bruce Road 25 between Goderich Street and the future Bruce Street (i.e. Phase 3), including the road cross section, is the subject of this Schedule 'B' EA process.

It is noted that, subsequent to the completion of the Master Plan, the Schedule 'B' EA process was initiated on January 9, 2018 to review the re-alignment of Bruce Road 33 envisioned in the Master Plan. The *Notice of Completion* for the Bruce Road 33 Re-alignment was advertised on November 26, 2019 with the conclusion that the re-alignment should proceed as planned in the Master Plan. With the completion of the BR33 EA process, the direction envisioned in the Master Plan is advanced to the next planning phase, which involves urbanizing BR25 between Goderich Street and the planned Bruce Street/BR33 intersection. The existing segment of BR33 from its intersection with BR25, south to the where the re-alignment meets its original configuration, will be referred to herein as Lake Range Road.

## 3.2 Drainage Consideration

The Master Plan for Roads and Drainage (2017) resolved the direction for drainage planning within the broader Study Area. The preferred plan for drainage included generally maintaining flows within the catchment area within which the flows arise. Subsequent to the Master Plan, a truck storm sewer system was planned along Bruce Road 25 and the Phase **I** outlet portion was constructed in 2019. The storm sewer system along Bruce Road 25 between Lake Range Road and Goderich Street, including the portion subject of this EA, is planned to provide capacity to convey runoff from the 1:100-year return rainfall event. Water quality provisions include a system of perforated pipes in clear stone trenches connected below the storm sewer inverts to store and percolate into the ground ‘first flush’ runoff water.

As individual developments proceed in the area, they too will be required appropriately to address stormwater quantity and quality.

## 3.3 Roads: Existing Condition and Potential Opportunities

The Study Area for Phase 3 of the Master Plan comprises Bruce Road 25, between Goderich Street and its future intersection with BR33/Bruce Street, where shown on **Figure 1**. Goderich Street is a north-south four-lane urban section arterial road. BR25 is an east-west rural two-way, two-lane rural cross section, which extends from a signalized intersection at Goderich Street (Highway 21) westerly to Lake Huron. Currently, BR25 has a gravel shoulder on each side of the roadway and no sidewalks or bike lanes. Lake Range Road is also a two-lane rural road section, which extends from a stop-controlled ‘tee’ intersection with BR25, southerly beyond the limits of the Study Area **(Figure 3)**. The County is the operating authority for BR25 as well as BR33, which was previously up-loaded from the Town to the County and is used by many residents of the Town to access the neighbouring Bruce Power site.

Currently, the road surfaces are in a deteriorated condition, with maintenance scheduled within the County’s 5-year plan. The existing ‘tee’ intersection of Lake Range Road with BR25 is located near the top of a bluff and, although the intersection is adequate for local road service, sight lines do not meet current design criteria for a secondary highway. The planned re-alignment of BR33 to intersect BR25 at the future Bruce Street location will address the sight line issues previously identified. The Schedule ‘B’ process for this Phase of the Master Plan (i.e. Phase 4) was completed in January 2020. Construction is anticipated for 2022.

The land uses surrounding BR25 include residential houses, commercial development and farmland on the north and south side of the roadway. The County considers that current traffic volumes would justify neither a need for additional lanes nor an urbanized cross section on either of BR25 or BR33. However, the Town’s Local Official Plan identifies future residential lands uses in the area, which would extend Stickel Street, Bruce Street, and Ridge Street southerly to intersect with BR25, where shown on **Figure 3**. The location of the Stickel Street intersection is based on the Lake Ridge Estates Plan of Subdivision. As part of the development plans for the subdivision, the adjacent section of BR25, from Stickel Street to Goderich Street will be constructed to an urban standard, complete with watermain, sanitary sewer and storm sewer infrastructure, curbs and multi-purpose trail.

The Town’s Local Official Plan further considers the future extension of Bruce Street northerly through the former Town of Port Elgin (from BR25 northerly to Concession Road 10), as a secondary major traffic route parallel to Goderich Street (Highway 21 Connecting Link). Schedule B of the Town’s Official Plan, showing the approximate location of the Town’s proposed collector road, is provided in **Appendix C**. It is noted that the location of the Bruce Street intersection represented on the Figures herein is not fixed but is planned as an extension to the existing road allowance, which is expected to be finalized through a separate subdivision planning process.

As a result of the additional road connections from the north, there could be a change in traffic flow patterns and a potentially significant impact on the traffic volume on BR25, between Lake Range Road and Goderich Street, which may require additional lanes and/or traffic signals. It is anticipated that the re-alignment of Bruce Road 33 will help to address the anticipated change in traffic patterns and flow, thereby improving the overall traffic circulation. Further, the Lake Ridge Estates Subdivision, planned at the north-westerly corner of Goderich Street and BR25, is required to extend full urban services (i.e. watermain, storm and sanitary sewer services), and to create an urban cross section along BR25. The ultimate cross section needs to be planned appropriately, in consideration of potential future lane requirements and a multi-purpose recreational path planned by the Town along the BR25 corridor.

## 3.4 Road Jurisdiction

Currently, the County is responsible for BR25 from the signalized intersection at Goderich Street (i.e. Highway 21) westerly to the intersection of Saugeen Beach Road at Lake Huron, where shown on **Figure 3**. As per the recommendations of the Master Plan, the County intends to divest to the Town the portion of BR25 from the planned Bruce Street intersection westerly to Saugeen Beach Road since more local issues are expected to predominate with planned development within the urban designation. In addition, divestiture of Lake Range Road from BR25 to the confluence between the re-aligned BR33 and remnant Lake Range Road, was considered as part of the re-alignment of Bruce Road 33. Bruce Road 33, as re-aligned, will remain part of the County road network.

Therefore, upon completion of the EA processes for BR25 and BR33, it is likely that the County (i.e. the proponent) will maintain jurisdiction over BR25 between Goderich Street and the planned Bruce Street/BR33 intersection. The portion of BR25 between the planned Bruce Street, west to Saugeen Beach Road, and the cut-off section of Lake Range Road will be divested to the Town.

## 3.5 Previous Studies and Planning: Bruce Road 25 (West of Goderich Street)

In January 2009, a report entitled *'Bruce Road 25 Needs Assessment Study'* was prepared by GMBP (formerly Gamsby and Mannerow Limited) to inform the Master Plan process. The purpose of the report was to estimate the potential traffic generated by planned development and to recommend the configuration of the planned intersections. Key findings of this initial *'Needs Assessment Study'* are summarized as follows:

i. Intersection upgrades would not be necessary for the BR25/Goderich Street intersection.
ii. A minimum 3-lane cross section, from Goderich Street to Stickel Street was recommended, however, both the County and Town prefer a 4-lane road cross section between the future Bruce Street and Goderich Street, to minimize traffic conflicts, and to improve traffic safety.
iii. Traffic signals would not be warranted on BR25 at the three planned intersections at the future Stickel Street, Bruce Street or Ridge Street.

The County subsequently proposed the re-alignment of BR33 to intersect BR25 at the future Bruce Street intersection location. As a result, an *'Addendum to the BR25 Needs Assessment Study (June 2012)'* was prepared to consider the configurations of these alternatives. Key findings of the Addendum to the BR25 Needs Assessment Study are summarized as follows:

i. Considering that a multi-purpose trail linkage is planned on the north side of BR25, from Goderich Street to Saugeen Beach Road, a signalized intersection at a re-aligned BR33 intersection would be recommended to provide a safe crossing for pedestrian traffic.
ii. Centre left turn lanes on BR25 from Goderich Street to Bruce Street should be considered in the preliminary design, as a minimum.

iii. A dedicated left turn lane for each of the four legs of the Bruce Street/BR33 and BR25 intersection should be considered in the preliminary design for this intersection.

The Master Plan process was subsequently completed with the intention to identify a broad ‘systems’ approach toward addressing the identified problems and/or opportunities. As shown on the Drawing provided in **Appendix B**, the Preliminary Preferred Master Plan included the following elements specific to the re-construction of Bruce Road 25 and Bruce Road 33:

i. Re-align BR33 to intersect BR25 at the planned Bruce Street location.
ii. A 4-lane urban cross section on BR25 from Goderich Street (Highway 21) to the planned Bruce Street intersection.
iii. A dedicated left turn lane on eastbound BR25 at Goderich Street.
iv. A stop-controlled ‘Tee’ intersection on the planned Stickel Street at BR25.
v. Traffic signals at the planned Bruce Street/BR25 intersection.
vi. A 2-lane urban cross section on BR25 from the planned Bruce Street intersection to Saugeen Beach Road.
vii. A stop-controlled ‘Tee’ intersection on the planned Ridge Street at BR25.
viii. An Active Transportation Route from Goderich Street to Saugeen Beach Road on north side of BR25.

To complete a more detailed review and assessment of alternatives identified in the Master Plan, specific to Bruce Road 25, Paradigm Transportation Solutions Limited (Paradigm) was retained to complete a Transportation Needs Assessment, concurrent with their Transportation Master Plan work for the Town, to verify (or otherwise) the intersection configurations and basic lane requirements for the subject section of Bruce Road 25. Harbourside Transportation Consultants (Harbourside) was also retained to complete a more detailed assessment of the intersection configuration options for the intersection of BR25 with BR33/Bruce Street. These studies included consideration for current and future traffic volume estimates, including potential trips generated by nearby future planned developments, to derive recommendations specific to Bruce Road 25. The findings of these additional traffic studies, used to better inform the alternatives for the reconstruction of BR25, are discussed in more detail in **Section 8.1** of this Project File.

# 4. GOVERNANCE: OFFICIAL PLANS & POLICIES

## 4.1 Official Plans: Transportation Objectives

### 4.1.1 Bruce County

As an upper tier government, the County establishes land use planning policies within the Bruce County Official Plan (BCOP, last consolidated in June 2013). The BCOP identifies land uses with a broad area perspective, including such designations as ‘primary urban community’, ‘agricultural areas’ and ‘hazard land areas’, as illustrated in the Schedule A Land Use Plan. The BCOP also identifies a County-wide transportation plan as illustrated in the Schedule B Transportation Plan. Schedules A and B of the BCOP are provided in **Appendix C**. BR25 is identified as an ‘arterial road’, and forms part of the connection between the ‘primary urban community’ of Port Elgin with the ‘secondary urban community’ of the Bruce Nuclear Power Development.

As outlined in the Bruce Road 25 Class EA Transportation Assessment (Paradigm, November 2019), the BCOP provides a policy framework to guide the development of the County, including transportation. Some of the objectives for transportation include the following:

- To minimize the environmental and financial costs associated with the development of transportation systems and facilities in the County.
- To maintain and enhance the carrying capacity of the existing and proposed County road system.
- To recognize, promote and encourage recreational transportation routes including canoe routes, cross-country ski, snowmobile, hiking and bicycle trails.

### 4.1.2 Town of Saugeen Shores

As a lower tier government, the Town establishes more local land use planning policies within the Town of Saugeen Shores Local Official Plan (SSLOP, consolidated September 2014), which ultimately guides development within the Town. The Schedule A Land Use Plan identifies predominantly residential land uses adjacent to BR25 and BR33. The SSLOP Schedule B Transportation Plan designates Bruce Road 25 as an arterial road and an active transportation route. In addition, Bruce Street is identified as a proposed collector road to align with a southerly connection to the future re-alignment of BR33 (an arterial road) at a new intersection, where shown on **Figure 3**. SSLOP Schedules A and B are included in **Appendix C**.

As outlined in the Transportation Assessment completed by Paradigm (November 2019), some of the transportation related objectives outlined in the SSLOP include the following:

- To promote an improved system of arterial, collector and local roads which provide for the safe and efficient movement of local and through traffic.
- To promote and guide the establishment of bicycle and pedestrian routes between parks facilities, the core area, the water front, the rail trail, community facilities and residential and employment areas and to require, wherever possible for new developments, pathways, trails and access points that reduce car traffic and promote pedestrian and bicycle travel.
- To promote the development of a street and sidewalk network that is accessible.

## 4.2 Complete Streets Policy

In 2015, the Counties of Grey and Bruce developed a Complete Street Policy and Implementation Guide. Complete streets concepts aim to provide safe and comfortable transportation for all modes of travel and ensure all road users, including cyclists and pedestrians, are given equal consideration during the planning process. To achieve the goals, the document recommends that Complete Streets concepts be considered during Municipal Class EA processes and integrated into the overall planning and design for relevant roadways. Consistent with the SSLOP for the Town, complete streets concepts are considered as part of the subject planning for Bruce Road 25.

## 4.3 Transportation Master Plan: Town of Saugeen Shores

Consistent with the Official Plan for the Town of Saugeen Shores, the Town of Saugeen Shores Transportation Master Plan (PIC material: August 7, 2019) is expected to recommend a dedicated cycling facility along Bruce Road 25, including the section between Bruce Road 33 and Goderich Street as part of the Towns goal to achieve *‘a linked, accessible active transportation network, including sidewalks, bicycle lanes and trails with connections to community facilities and the waterfront while reducing exposure to air pollutants’*. Therefore, consistent with the Official Plan and the Town’s Transportation Master Plan, the alternatives considered herein will presume that an active transportation route will be included as part of the BR25 re-construction. The active transportation route will be connected to the multi-use trail previously extended along BR25 between Shipley Avenue and Saugeen Beach Road as part of the implementation of Phase 1 of the Master Plan for Roads and Drainage (2017).

# 5. PROBLEM / OPPORTUNITY – PROJECT STATEMENT

The County has identified a need to advance specific project planning for the re-construction of Bruce Road 25, as identified in the Master Plan for Roads and Drainage (2017). The basic intentions of this project are outlined in the Master Plan, which are to improve road surfaces on BR25 and BR33, to plan safe and efficient road infrastructure within the settlement area boundary, and to support the Town's active transportation initiatives within the subject area; with regard to planned development. The Schedule 'B' EA planning process is project specific but generally follows the same process as for the more general Master Plan.

Considering the significant degree of overlap between the Master Plan and this specific Schedule 'B' EA, the following Project Statement is adapted from the Master Plan for this project specific environmental assessment process.

The Project Statement for this potential Schedule 'B' EA is as follows:

> *"The proponent intends to plan safe and efficient road infrastructure, and to support the Town's transportation initiatives with regard to planned development, within the settlement area boundary, by advancing a preferred BR25 re-construction initiative, as outlined in the Master Plan for Roads and Drainage (May 2017)."*

The County is, therefore, undertaking this Schedule 'B' EA process under the Municipal Class Environmental Assessment to ensure that this project is planned appropriately, and to verify that the preferred solution identified in the more general Master Plan remains appropriate for this specific BR25 re-construction initiative.

# 6. ALTERNATIVE SOLUTIONS (ROADS)

## 6.1 General Considerations for Road Systems Alternatives

**Planned Development**

The primary existing roads within the Study Area are Goderich Street (Highway 21 Connecting Link), BR25 and BR33. Goderich Street is a four-lane urban section arterial road and Bruce Roads 25 and 33 are two-lane rural section arterial roads. Although current traffic volumes would not warrant changes to the existing number of lanes, planned development within the Town will extend two local roads (Stickel Street and Ridge Street) and one collector road (Bruce Street) southerly to intersect BR25; under existing conditions this would create four off-set 'tee' intersections between Goderich Street and the existing BR33 alignment (i.e. Lake Range Road). These planned road intersections would be expected to increase traffic volumes on BR25, specifically between Bruce Street and Goderich Street. However, it is anticipated that the re-alignment of Bruce Road 33 will help address, at least in part, the anticipated change in traffic patterns and flow associated with the planned intersections and will improve the overall traffic circulation.

**Key Considerations**

Key considerations specific to the re-construction of BR25 between Goderich Street and the intersection of BR33/future Bruce Street, identified as part of the Master Planning process, to be considered herein, include the following:

i. The expected increase in traffic flows, as a result of recent and planned developments to the north of BR25, may require additional traffic lanes, and/or traffic signals at the new intersections on BR25.
ii. The planned Lake Ridge Estates subdivision requires water and sanitary sewer services to be installed on BR25 for its own uses, and the Town wishes to consider installing the balance of the planned infrastructure concurrent with the re-construction of BR25.
iii. A new east-west trail along the BR25 corridor could connect two existing north-south trails.

iv. During the Master Plan process, questions were raised by the public regarding the potential to incorporate a roundabout rather than a signalized intersection at BR33/Bruce Street.

Alternatives specifically evaluated herein relate to the road configuration to be considered as part of the re-construction of BR25, including the number of lanes and the configuration of the intersection of BR25 with BR33/Bruce Street. The review and assessment of the recommended configurations for the BR25 intersection with BR33/future Bruce Street was completed by Harbourside. The *'Traffic Control Evaluation'* is included in **Appendix D** and is summarized in **Section 8.1.2** of this Project File.

Further, the County and the Town have committed to the inclusion of full urban services and the provision for a new east west multi-use trail along the Bruce Road 25 corridor in the overall design and construction of Bruce Road 25. Therefore, these provisions will be further considered during the design phase.

## 6.2 Alternative Solutions

The Preliminary Preferred Master Plan recommended a four-lane urbanized cross section on Bruce Road 25 from BR33/Bruce Street to Goderich Street. This MCEA process is being completed to sufficiently address the requirements for the proposed re-construction of BR25 considered in the Master Plan. Alternative solutions considered to address the Project Statement are summarized as follows:

**Alternative 1: Do Nothing**
With the 'Do Nothing' Alternative, the study area road network would remain as presently configured. This alternative would provide no improvement over existing conditions. Further, it does not account for new intersections of Stickel Street, Bruce Street and Ridge Street with Bruce Road 25. As this alternative does not address the issues identified in the Master Plan including, but not limited to, the pavement conditions and accommodations for planned development, it is not considered relevant or appropriate.

**Alternative 2: Construct a Two-Lane Urbanized Cross Section along Bruce Road 25 (Goderich Street to BR33/Bruce Street)**
Maintains the existing two-lane cross section for Bruce Road 25, which includes one-lane per direction of travel between the existing intersection with Goderich Street and the future intersection with Bruce Street.

**Alternative 3: Construct a Four-Lane Urbanized Cross Section along Bruce Road 25 (Goderich Street to BR33/Bruce Street)**
Considers expanding the cross section for Bruce Road 25, to include two-lanes per direction of travel between the existing intersection with Goderich Street and the future intersection with Bruce Street, providing for increased capacity.

Concurrent with the review of these alternatives, a review of alternatives for the intersection of BR25 with BR33/Bruce Street also was completed for a signalized intersection versus roundabout alternatives.

It is noted that consistent with the Transportation Master Plan and the recommendations of the Transportation Needs Assessment for BR25 completed by Paradigm (November 2019), the alternatives considered herein assume that a buffered multi-use trail along the north side of BR25, with appropriate crossing treatments at the intersections, will be included as part of the BR25 re-construction efforts.

A summary and discussion of each of these alternative solutions is presented in the following sections.

# 7. BACKGROUND STUDIES

Several background studies were prepared to inventory the technical, social, natural, cultural and economic ‘environments’ and to evaluate the impacts of the alternative solutions considered for the re-construction of Bruce Road 25. While several of these studies/documents were included as part of the documentation for the Master Plan, a more detailed assessment of the Town’s traffic needs was required to assess the alternatives considered herein.

To better inform the BR25 re-construction alternatives, Paradigm was retained to complete a ‘*Transportation Needs Assessment’* to verify (or otherwise) the intersection configurations and basic lane requirements for the subject section of Bruce Road 25. Harbourside Transportation Consultants (Harbourside) was also retained to complete a more detailed assessment of the intersection configuration options for the intersection of BR25 with BR33/Bruce Street. The following traffic studies are included in **Appendix D**.

i. Bruce Road 25 Class EA Transportation Assessment – Bruce County. Paradigm Transportation Solutions Limited. November 2019.
ii. Traffic Control Evaluation, Bruce County Road 25 and Road 33. Harbourside Transportation Consultants. December 23, 2019.

Several other studies are provided within the Appendices to this Project File, as follows:

**Appendix E**

iii. Archaeological Assessment (Stage 1 and 2). Bruce Road 25 Re-Construction, Town of Saugeen Shores, Bruce County, Ontario. Mayer Heritage Consultants Inc. July 2008.
iv. Criteria for Evaluating Potential for Built Heritage Resources and Cultural Heritage Landscapes – A Checklist for the Non-Specialist. Ministry of Heritage, Sport, Tourism and Culture Industries (MHSTCI, formerly the MTCS).

**Appendix F**

v. Species-At-Risk (SAR) Survey. Bruce County Road 25 Upgrade: Eastern Portion and Hwy 21 Intersection Area. Class Environmental Assessment Process/Reporting: Municipal Infrastructure Project. Aquatic and Wildlife Services (AWS) Environmental Consulting Inc. August 1, 2019.

**Appendix G**

vi. Geotechnical Investigation – Road Reconstruction / Realignment Projects. Bruce County Roads 25 and 33. Saugeen Shores, Ontario. Chung & Vander Doelen Engineering Ltd. January 30, 2018.

A summary and discussion of background information, including the findings of each study, is provided in the following Sections of this Project File.

# 8. INVENTORY OF ENVIRONMENTS

## 8.1 Technical Environment

### 8.1.1 Traffic Studies

The County considers that, under existing conditions, traffic volumes would justify neither a need for additional lanes nor an urbanized cross section on either of BR25 or BR33 (i.e. Lake Range Road). However, to address the Town's planned development, including the extension of Stickel Street and Ridge Street southerly to intersect with BR25 and the future extension of Bruce Street northerly to Concession Road 10 as a secondary major traffic route parallel to Goderich Street (Highway 21 Connecting Link), the future needs should be considered.

As previously discussed, it is expected that the additional road connections could effect a change in traffic flow patterns and increase the traffic volume on BR25, between Bruce Street and Goderich Street. Although it is expected that some of the traffic increase will be re-directed to Bruce Street, additional lanes and/or traffic signals may be required along the subject section of BR25 to address these changes. As a result, the ultimate cross section needs to be planned appropriately, in consideration of potential future lane requirements and the multi-purpose recreational path planned by the Town along the BR25 corridor.

The Bruce Road 25 Transportation Assessment (November 2019) was completed in support of the proposed widening of Bruce Road 25, both to evaluate the basic lane requirements for the subject section of Bruce Road 25 and to review the intersection configurations. A copy of this assessment is provided in **Appendix D**. As indicated by the Town, the analyses presumed that Bruce Street would connect with BR25 and Concession 10 as development in that area proceeds by the 2031 planning horizon.

The transportation assessment concluded that, from an operational perspective, a four-lane cross section was not necessary to accommodate future traffic forecasts and that the future intersection of Bruce Road 25 with BR33/Bruce Street would operate at acceptable levels of service under two-way stop control, traffic control signals or roundabout control. In summary, the report generally recommended the following:

1. Maintaining a two-lane cross section on Road 25.
2. Providing two-way stop control at the intersection of BR25 with BR33/Bruce Street with one lane per direction on each approach and stop control on BR33 and Bruce Street.
3. Providing a buffered multi-use trail along the north side of BR25 with appropriate crossing treatments at intersections.

Further, the Bruce County Road 33 Re-Alignment Schedule 'B' Project File (November 2019) recommended that the ultimate configuration of the intersection with BR25 with BR33/Bruce Street also consider a roundabout. A review of the alternatives for the intersection was completed by Harbourside and is detailed in a technical memorandum included in **Appendix D** of this Project File. A summary is provided in the following Section of this Project File.

### 8.1.2 Intersection Design Review

The re-construction of BR25, regardless of the cross-sectional width, would allow for the County Road to be upgraded to a secondary highway standard. Based on future traffic forecasts, the future intersection of BR25 with BR33/Bruce Street would operate at acceptable levels of service under two-way stop control, traffic control signals or roundabout control. In consideration of these three types of traffic control identified, five traffic control options were considered in the Traffic Control Evaluation (December 2019) completed by Harbourside, including the following:

**TABLE 3: Traffic Control Options Identified and Reviewed**

| Option | Cross Section | Type of Control |
|---|---|---|
| 0 | 2-lane (one per direction) | Two-way stop control |
| 1 | | Traffic control signal |
| 2 | | Roundabout |
| 3 | 4-lane (two per direction) | Traffic control signal |
| 4 | | Roundabout |

A review and evaluation of the five alternatives for the intersection, including the development of the roundabout options and the identification of a preferred traffic control option was completed by Harbourside and is detailed in a technical memorandum included in **Appendix D** of this Project File.

Based on the evaluation and assessment of the options considered in the traffic control evaluation, the single-lane roundabout was determined to be the preferred traffic control option for the intersection of Bruce Road 25 with BR33/Bruce Street. When comparing the traffic control options, some of the key considerations included the following:

- Construction Costs: Based on Class ’D’ cost estimates, construction costs for the traffic control signals and roundabout (same number of lanes) are similar (i.e. ±10%).
- Operation and Maintenance Costs: Traffic signals have higher operations and maintenance costs. These costs are generally associated with power, equipment inspections, replacement and pavement markings.
- Life Cycle Cost Analysis: Suggests that over a 20-year period, the single lane roundabout option has a lower Net Present Value of total costs and higher benefit-cost ratio than other options.
- Land Acquisition: While traffic control signals could likely be established within the existing Rights-of-Way, roundabout options will require additional land acquisition.
- Safety: Roundabouts reduce the frequency and severity of collisions. However, it is recognized that in regions where few (or no) roundabouts exist, a higher collision rate may be experienced for a short period after being built.
- Active Transportation: Pedestrians (and bicycles that opt to dismount) have the right-of-way at a roundabout and are only required to cross one or two travel lanes at once. Lower speeds through the roundabout increase safety for bicycles while travelling through the intersection.
- Operations: Roundabouts are generally more efficient, having lower delays and shorter queues than traffic control signals.

In summary, when the 20-year life-cycle costs are considered, the single lane roundabout option provides the best value for the County and provides the best results for safety, traffic operations and greenhouse gas emissions.

### 8.1.3 Road Design Parameters

As outlined in the Transportation Needs Assessment (Paradigm, 2019), according to the TAC Geometric Design Guide for Canadian Roads and the MTO Design Supplement for the TAC Geometric Design Guide for Canadian Roads (June 2017), lane widths should be a minimum of 3.0 meters for a design speed of 70 km/hr (assuming 20 km over the posted speed limit) and an Average Annual Daily Traffic value (AADT) of greater than 1,000 vehicles per day.

A detailed road design will be completed during the subsequent design phase for BR25, using Ministry of Transportation Ontario (MTO) and/or Transportation Association of Canada (TAC) parameters. Project constructability would follow conventional road construction processes.

### 8.1.4 Geotechnical / Environmental Screening

Field work for the geotechnical investigation was completed during the week of November 20th, 2017. Borehole data was referenced to confirm sub-surface soil and groundwater conditions. No geotechnical or environmental issues were identified that would affect the proposed construction. The geotechnical report is provided in **Appendix G.**

### 8.1.5 Surface Water Management Planning

The BR25 re-construction considered in the Master Plan would introduce new impervious surfaces to a currently pervious area, which will increase the rate of runoff from that surface. Further, runoff from road surfaces may contain contaminants, which could adversely affect the natural environment.

The storm sewer design concept for the re-construction of BR25 was established as part of Phases 1 and 2 of the Master Plan. A stormwater management report, *'Final Storm Sewer Design Brief – Bruce County Road 25 Reconstruction'* (February 2019), was prepared for the outlet storm sewer on BR25. The report generally describes how stormwater quantity and quality will be addressed with the reconstruction of BR25 as envisioned in the Master Plan. The basis for drainage planning is to maintain surface drainage within the originating catchment area, as resolved through the Master Plan process.

In general, the system is designed as a trunk sewer system draining westerly along BR25 to an outlet at Lake Huron and includes provisions for stormwater quality management. Phase 1 of the Master Plan, which included the installation of the trunk storm sewer from Ridge Street to Lake Huron, was completed in 2019 and Phase 2, which will include the extension of the local storm sewers from Lake Range Road to Ridge Street, is planned for 2020. Phase 2 will also include a system of sub-surface infiltration trenches to store and percolate 'first flush' runoff into the ground to protect surface water quality.

This subject Phase 3 is planned with an extension of each of the trunk storm sewer system, local road drainage system and sub-surface infiltration trench system, to address surface water quantity and quality. Water quality treatment for runoff from contributing upstream areas along Goderich Street are planned to be treated by an oil/grit separator unit on BR25, immediately to the west of Goderich Street, prior to entering the BR25 trunk storm sewer system.

### 8.1.6 Water and Sanitary Sewer Service Planning

The Town is considering pre-servicing with watermain and sanitary sewer in conjunction with the reconstruction of BR25. This would further support the Planned Development lands along the route. Since BR25 may be constructed in advance of land development activities, the Town is considering front-ending, and later recovering, those servicing costs from the developers, at such a time that the lands are developed.

The watermain would complete a loop connection on BR25 between the Ridge Street and Goderich Street intersections. Based on the Master Servicing plan, a 250 mm diameter watermain is planned.

Sanitary sewers would be installed on BR25 at an adequate depth for future extension to service other Planned Development Lands. The new sanitary sewer on BR25 would also achieve a planned diversion of sewage flows from Goderich Street to Ridge Street, as envisioned in the Servicing Master Plan (2014).

## 8.2 Social Environment

In evaluating the roads alternatives with respect to the social environment, the key criteria of comparison include the following:

i. Ability to support future development interests.
ii. Safety: Reduction in the occurrences of off-set tee intersections with planned streets along the north side of BR25.
iii. Active Transportation: Enhancement of the connectivity of the active transportation routes in the area.
iv. Property Impacts: Impacts to directly affected landowners related to property acquisition needs required to support road construction.

During the consultations completed as part of the Master Plan, some land owners adjacent to BR25 indicated a concern with respect to increased traffic, road widening, safety and land use. From a social environment perspective, the following is noted:

- Regardless of the alternative selected, access to existing residences would be maintained, as possible, during construction.
- With the exception of the ‘Do Nothing’ alternative, the ability to support future development interests would be enhanced via the re-construction of BR25. Further, the safety and efficiency of movement for the driving and pedestrian public would be accommodated as planned Town roads are extended from the north to BR25.
- The re-alignment of BR33 will reduce the number of off-set tee intersections. Alternatives considered as part of the reconstruction of BR25 will not result in a further reduction.
- A wider urban road cross section would have a greater aesthetic impact than maintaining a 2-lane cross section between Goderich Street and the re-aligned BR33; however, impacts may be appropriately mitigated with a landscaping plan.

### 8.2.1 Impacts to Private Property

The predominant social issue related to the proposed BR25 re-construction is impacts to private property. At a Stakeholder’s meeting on July 20, 2010, all parties generally agreed with the project direction, although some concern was expressed with regard to the potential impact road widening would have on existing dwellings. The meeting minutes are included in **Appendix B**. Upon confirmation of the *Preferred Solution* to this EA Process, the County will continue (or initiate) discussions with the directly affected landowners.

As would be expected, the land acquisition requirements for the wider road cross section being considered as Alternative 3 would be greater than for the two-lane alternative. Preliminary design drawings for the alternatives considered suggest that the acquisition of privately-owned lands along BR25 between Goderich Street and Bruce

Street may be beneficial for a two-lane cross section but would be required for a four-lane cross section. Anticipated land acquisition requirements are depicted on **Figure 4** and **Figure 5** and are summarized in the following **Table 2**.

**TABLE 2: Summary and Comparison of Impacts to Private Property**

| **Area** | **Alternative 2: 2-Lane Cross Section** | **Alternative 3: 4-Lane Cross Section** |
|---|---|---|
| **Road Allowance (North Side):** Goderich Street to future Bruce Street | ▪ The County previously has taken ROW widenings along BR25. The existing County ROW is ±25.4 meters wide, except at Goderich Street where it is ±20.1 meters wide.<br>▪ As shown on **Figure 4**, the southern extent of the property parcel situated to the northwest of the intersection of BR25 and Goderich Street (i.e. 10 Bruce Road 25) extends ±5.2 meters further south than the property boundaries for the remaining property parcels to the north of BR25. While acquisition of this area may be beneficial, it will not likely be required. | As shown on **Figure 5**, the southern extent of the property parcel situated to the northwest of the intersection of BR25 and Goderich Street (i.e. 10 Bruce Road 25) extends ±5.2 meters further south than the property boundaries for the remaining property parcels to the north of BR25. Acquisition of this area would be required. |
| **Road Allowance (South Side):** Goderich Street to future Bruce Street | Extension of the right-of-way to the south into the property parcels, beyond the existing limits of the BR25 ROW, would not be required. | Extension of the right-of-way to the south, beyond the existing limit of the BR25 ROW, would be required, specifically in the area directly to the west of Goderich Street. An 'operational' (or working) easement may also be required in some areas. Property use could be mitigated through building setbacks, as practicable. |
| **Bruce Street Intersection:** Intersection of BR25 with the future Bruce Street/BR33 (Discussed in more detail below) | ▪ Traffic control signals could be accommodated within the existing BR25 and the proposed Bruce Street / BR33 rights-of-way.<br>▪ The roundabout option would require an estimated 25 m$^2$ of additional lands. | ▪ Traffic control signals could be accommodated within the existing BR25 and the proposed Bruce Street / BR33 rights-of-way.<br>▪ The roundabout option would require an estimated 300 m$^2$ of additional lands. |
| **Goderich Street Intersection:** Intersection of BR25 with the Goderich Street | The limit of the study area for the reconstruction of BR25 extends to the westerly limit of the Goderich Street ROW. Therefore, no land acquisition specific to this project will be required. However, intersection improvements, which may be considered at a later date, may require additional lands. Should land acquisition be required from the northwest and/or southwest quadrant of this intersection, the alternatives for this intersection could be considered and additional lands could be acquired concurrently with the required negotiations, as appropriate. | |

**Traffic Control Options: Intersection of BR25 with the Bruce Street**

Based on the Traffic Control Evaluation completed by Harbourside, while no land acquisition would be required for the construction of traffic control signals at the intersection of BR33/Bruce Street with BR25, the roundabout options would require additional lands. Based on a preliminary assessment, it is estimated that a single lane roundabout (i.e. the recommended traffic control option for this intersection) would require ±25 $m^2$, or a small area from each quadrant of the intersection. Further, it is estimated that the construction of a roundabout for a four-lane cross section on BR25 would require an estimated ±300 $m^2$. Conceptual drawings of the traffic control options, showing the property lines, are provided in the Harbourside Report **(Appendix D)**.

Daylighting triangles are expected to be acquired with the lands to be acquired by the County for BR33 to the south, while lands to the north for the Bruce Street ROW would be acquired from the developer. Therefore, if the County wishes to pursue the roundabout option in conjunction with the re-construction of BR25 considered herein, or in the future (i.e. at such a time that Bruce Street is extended to BR25), then the County may consider the inclusion of the land acquisition needs associated with the roundabout option(s) in its negotiations with the landowners for the BR33 re-alignment and, for the lands to the north, may wish to pursue negotiations with the developer.

### 8.2.2 Active Transportation Route (ATR)

Bruce Road 25 is considered an On-Road Connector and part of the Town's Trail Map and the Great Lakes Waterfront Trail, but currently does not have any dedicated pedestrian or cycling facilities. Based on the assessment and comments received as part of the Master Plan (July 2016), the construction of an ATR from Goderich Street to Saugeen Beach Road along the north side of BR25 was identified as a component of the proposed works for Bruce County Road 25.

The addition of active transportation infrastructure along BR25 was further considered in the Transportation Needs Assessment completed by Paradigm (November 2019). Consistent with the findings of previous studies, when compared to buffered bicycle lanes on both sides of BR25, a Multi-Use Trail on the north side of BR25 was preferred. A multi-use trail system (i.e. ATR) would provide a dedicated facility for all modes of active transportation, accommodate differing ability levels, and provide consistency with other trails in the area. Therefore, regardless of the road cross section, an ATR along the north side of BR25 is considered to be a part of the overall plan and was considered as part of the construction of Phase 1 of the Master Plan, completed in 2019. In other words, an ATR has already been constructed along the section of BR25 between Shipley Avenue to Saugeen Beach Road.

## 8.3 Cultural Environment

### 8.3.1 Archaeology

A Stage 1 & 2 Archeological Assessment was completed by Mayer Heritage Consultants Inc. (July 2008) in order to determine if any direct and/or indirect impacts would occur by proposed construction activities on archaeological resources that may be present. A copy of the report is provided in **Appendix E**.

The assessment ascertained that, based on the soil and topography which was determined to be suitable for human habitation, the proximity to water, and the historic significance of the geographic region, the study area exhibited high potential for the discovery of pre-contact Aboriginal and Euro-Canadian archaeological resources. As a result, Stage 2 investigation work was completed.

The Stage 2 archaeological assessment of the Study Area was conducted on July 24th, 2008 using test pitting methodology. Test pits were dug to subsoil at 5-meter intervals along the entire 1.2-kilometer length of the Study Area along BR25 between Lake Huron and Goderich Street. No artifacts were encountered during the Stage 2 general survey. Therefore, the report generally concluded that because there are no archaeological resources located within the study area, no additional assessment or mitigative measures are warranted for the subject lands. However, it is noted that compliance legislation must be adhered to in the event of the discovery of deeply buried cultural material or features.

### 8.3.2 Cultural Heritage Landscape Evaluation

The need for a Cultural Heritage assessment was screened out using the MTCS screening tool, provided in **Appendix E**.

## 8.4 Natural Environment

### 8.4.1 Species-At-Risk (SAR) Survey

A Species-At-Risk survey, review and impact assessment was completed by AWS to further inform the Environmental Assessment for the re-construction of Bruce Road 25. The review incorporated the terrestrial flora and fauna investigations and fisheries habitat assessment of earlier natural heritage reports completed to inform the Master Plan. Based on the results of the background literature review and on-site investigations, it was concluded that no SAR, or identified functioning habitat, occur within the study area. Therefore, the proposed road reconstruction activities would be in compliance with the Provincial Endangered Species Act and the Federal Species at Rick Act.

In accordance with the Federal Migratory Birds Act, it is noted that tree cutting activities should not be carried out during the active woodland and grassland nesting and rearing period for terrestrial based birds. Additionally, vegetation removal should not occur during the overlapping spring and summer season of the nectar gathering period for bumble bees to minimize any negative impacts from road upgrade works. As a result, no tree or shrub felling should occur from April 1st to August 31st, without further detailed investigation by a qualified person for nesting activity protection measures during the active nesting/rearing period.

### 8.4.2 Source Water Protection

Recent amendments to the EA Process require proponents to consider whether the project is located within a Source Water Protection Area and, if so, to document whether any project activities are a prescribed drinking water threat. As part of the EA process, this project was reviewed with respect to the requirements under the Clean Water Act, 2006. The study area is located within the Saugeen Valley Source Protection Area and falls under the Saugeen-Grey Sauble-Northern Bruce Peninsula Source Protection Plan. Based on the Saugeen, Grey Sauble and Northern Bruce Peninsula Source Protection Vulnerable Areas Mapping Application, the Study Area is situated within a Significant Groundwater Recharge Area (SGRA) and a Highly Vulnerable Aquifer (HVA) with a vulnerability score of 6. However, it is noted that the study area is not within the Source Water Protection Area for the Saugeen Shores drinking water system (i.e. the area is around the water intake for the Southampton Water Treatment Plant). As shown on the Figures included in **Appendix F**, the study area is beyond the vulnerable area for the Intake Protection Zone.

The SVCA Risk Management Office was consulted via the *Notice of Project Initiation*. This correspondence is included in **Appendix F**. The SVCA Risk Management Office provided comments specific to Source Water Protection on February 26th, 2020, included in **Appendix H,** which confirmed that the project does not fall within a highly vulnerable source protection area (i.e. wellhead protection area or intake protection zone) where Source Protection Plan policies apply.

### 8.4.3 Climate Change

The natural environment also includes potential impacts of the project on Climate Change, and of Climate Change on the project. In consideration of the broader implication of the plan for Bruce Roads 25 and 33, the project intends to increase the efficiency of traffic flow resulting in reduced travel time, improve travel safety, and build upon the active transportation network in the area, all of which would result in reduced greenhouse gas emissions relative to a "Do Nothing" alternative. In consideration of public comments received, the proponent has committed to a landscaping plan that will introduce trees along the new alignment to provide shade and snow screening.

## 8.5 Economic Environment

To address project costs, the County and Town have considered cost sharing and budgets to address the project costs. Meeting Minutes, dated August 11, 2017 outline intended project cost sharing between the County and the Town for various projects outlined in the Master Plan, including for the planned BR25 re-construction. The meeting minutes are included in **Appendix B.**

Preliminary project construction costs for the two-lane and four-lane urban cross section alternatives were prepared as part of this assessment and are summarized in **Table 4**. Project construction costs include for road works, storm sewers, sanitary sewers and watermains.

**TABLE 4: Ranking of Relative Capital and Maintenance Costs**

| ALTERNATIVE | | ESTIMATED COST |
|---|---|---|
| 1 | Do Nothing | Increased Traffic Inefficiencies |
| 2 | 2-Lane Cross Section with Active Transportation Route | ± $2,900,000 |
| 3 | 4-Lane Cross Section with Active Transportation Route | ± $3,400,000 |

Note: Additional project costs for land acquisition, Ontario Land Survey, easement registration, utility relocation, HST and other professional fees are not included in the estimated construction cost.

The economic environment considers relative construction costs and longer-term operation and maintenance costs. Typically, the 'Do Nothing' option would be considered to have no capital cost and, therefore, would rank first in terms of economic environment. However, while construction costs would be lowest under this scenario, the cost associated with lost opportunities would be significant. Future development in the area would not be supported by envisioned services and traffic efficiency and safety would not improve. Therefore, the Do Nothing alternative would not be pro-active, nor would it address the identified problems/opportunities. Although Alternative 2 and Alternative 3 would incur greater construction costs than the 'Do Nothing' scenario, investment in the infrastructure in this area is required to support future development. Eventual cost sharing with private developments adjacent to BR25 may be possible to mitigate a portion of these greater construction costs.

Based on preliminary cost estimates, it is anticipated that the 2-lane cross section alternative would reduce the projects costs by an estimated $500,000 when compared to Alternative 3, the four-lane cross section. Based on the need for additional lands along the southerly extent of the BR25 ROW, land acquisition costs for Alternative 3 are also anticipated to be greater.

It is noted that cost estimates provided herein were prepared with limited design details and are based on probable conditions affecting the project. Therefore, they are intended to reflect the relative magnitude of the project costs. A more detailed assessment of overall project costs would be evaluated during the design phase.

# 9. EVALUATION OF ALTERNATIVES

The Master Plan process identified and evaluated alternative solutions, with the re-construction of BR25 confirmed as the Preferred Solution. The Preliminary Preferred Master Plan considered a four-lane urban cross section on BR25 from Goderich Street (Highway 21) to the planned Bruce Street intersection. As the Master Plan considered additional lanes, that is a widening from a two-lane rural cross section to a four-lane urban cross section, it was considered that a Schedule 'B' EA process may be required.

Additional background studies were completed to address project specific requirements in support of the Schedule 'B' EA process and to help inform the impacts each alternative would have on each of the environments. The process toward the selection of a *Preliminary Recommended Solution* specific to the reconstruction of BR25 involved the following:

i) Identification of the impacts and mitigating measures of an alternative solution on each environment;
ii) An assessment of the degree of impact each alternative would have on each environment; and
iii) An evaluation based on comparative analysis of the alternative which best addresses the Project Statement.

As part of the review and assessment of alternatives for Bruce Road 25, Paradigm Transportation Solutions Limited (Paradigm) completed a Transportation Needs Assessment (November 2019) to determine the basic lane requirements for the subject section of Bruce Road 25. The study analyzed current and future traffic volume estimates, including potential trips generated by nearby future planned developments to derive recommendations specific to Bruce Road 25 as part of the review and confirmation (or otherwise) of the findings of the Master Plan. The Transportation Needs Assessment concluded that, from a technical perspective, a two-lane urban cross section would be sufficient for the planning horizon.

## 9.1 Assessment of Alternatives

The technical, social, cultural, natural, and economic impacts identified for each of the roads alternatives allows for the evaluation of a preferred roads solution by assessing them through the comparison of their respective impacts for each 'environment'. A summary of the impacts and an assessment of each of the alternative solutions on each of the environments is provided in **Table 5**. The summary Table provides a ranking of each of the identified potential impacts on each of the alternatives considered, as follows:

**Red = Least Favoured**
**Yellow = Partially Favoured / Net Neutral**
**Green = Favoured**

Ultimately, the most 'favourable' ranking would be considered as the *Recommended Preferred Solution*.

# TABLE 5: ASSESSMENT OF ROAD RECONSTRUCTION ALTERNATIVES
## Bruce Road 25 (Goderich Street to Future Bruce Street)

| ENVIRONMENT | ALTERNATIVE 1<br>Do Nothing | ALTERNATIVE 2<br>Two-Lane Urban Cross-Section | ALTERNATIVE 3<br>Four-Lane Urban Cross-Section |
|---|---|---|---|
| **CULTURAL** | | | |
| **Ranking** | Net neutral for all alternatives considered. | | |
| **SOCIAL** | | | |
| 1. Impacts to Private Property | Would not encroach on adjacent properties. | Roadway and active transportation route could be accomodated within existing ROW.<br>The requirement to acquire lands at the intersection of BR25 with Bruce Street and BR33 would be dependent upon the preferred traffic control option.<br>Access to existing residences would be maintained. | Additional property would be required to accomodate roadway and active transportation route .<br>The requirement to acquire lands at the intersection of BR25 with Bruce Street and BR33 would be dependent upon the preferred traffic control option.<br>Access to existing residences would be maintained. |
| 2. Aesthetic Impacts of Roadway Reconstruction | Appearance of a unmaintained road allowance is undesirable. | Roadway would be within the existing ROW and will likely improve the aesthetics of the roadway relative to the existing condition. | A wider road would have a greater aesthetic impact than maintaining a 2-lane cross section. However, impacts could be appropriately mitigated with a landscaping plan. |
| 3. Ability to Support Future Development | The safety and efficiency of movement for the driving and pedestrian public would not be accommodated as planned Town roads are extended from the north. | The ability to support future development interests would be enhanced via the re-construction of BR25. | |
| 4. Active Transportation Route (ATR) | Would complicate the desired construction of an ATR along the north side of BR25. | Would support the construction of an ATR from Goderich Street to Saugeen Beach Road along the north side of BR25, as per the Town's Official Plan. | |
| **Ranking** | | **Favoured** | |
| **NATURAL** | | | |
| 1. Species at Risk (SAR) | No SAR, or identified functioning habitat, occur within the study area. Therefore, the proposed road reconstruction activities would be in compliance with the Provincial Endangered Species Act and the Federal Species at Risk Act. | | |
| 2. Climate Change | No change. | Overall, the project intends to increase the efficiency of traffic flow, resulting in reduced travel time and improved travel safety, and build upon the active transportation network in the area. This would result in reduced greenhouse gas emissions. | |
| **Ranking** | | **Favoured** | |
| **TECHNICAL** | | | |
| 1. Continuity of Master Plan | Would not address issues identified within the Master Plan and would limit (or negate) the benefit of previous completed works along BR25. | Road reconstruction along BR25 between Goderich Street and the future Bruce Street is considered as part of Phase 3 of the Master Plan, which is intended to address both road and drainage deficiencies in the Area. Construction of Phase 1 was completed in 2019. | |
| 2. Ability to Address Future Traffic Needs | Would not address future traffic forecasts and needs. | The Bruce Road 25 Class EA Transportation Assessment (Paradigm, November 2019) concluded that, from an operational perspective, a two-lane cross section would sufficiently accommodate future traffic forecasts. | The Bruce Road 25 Class EA Transportation Assessment (Paradigm, November 2019) concluded that, from an operational perspective, a four-lane cross-section was not necessary to accommodate future traffic forecasts. |
| **Ranking** | | **Favoured** | |
| **ECONOMIC** | | | |
| 1. Construction Costs | Least costly alternative. | ± $2,900,000 | ± $3,400,000 |
| 2. Future Development (Town Economy) | Investment in the infrastructure is required to support future development. | Investment in the infrastructure in this area would support future development. | |
| 3. Operation & Maintenance | High: Routine repairs and more frequent maintenance would likely be required. Road would eventually require replacement. | Limited road repairs would be required. A smaller road surface results in lower operations (i.e. winter clearing) and maintenance costs. | Limited road repairs would be required. A wider road allowance would result in higher operations (i.e. winter clearing) and maintenance costs. |
| **Ranking** | | **Favoured** | |
| **OVERALL RANKING** | | **Recommended** | |

| **Relative Ranking:** | Favoured and/or Positive Impact | Net Neutral | Least Favoured / Negative Impact |
|---|---|---|---|

## 9.2 Preliminary Recommended Solution

Based on the results of the relative ranking presented in **Table 5**, Alternative 2, to construct a two-lane urban cross section along Bruce Road 25 (Goderich Street to BR33), complete with a single lane roundabout intersection at Bruce Street, was identified as the *Preliminary Recommended Solution.* As a two-lane urban section is considered appropriate from a technical perspective and is preferred, the project could be considered to be a Schedule 'A+' activity under the Municipal Class Environmental Assessment Roads Project Schedule No.19, which describes the following activity:

> *'Reconstruction where the reconstructed road or other linear paved facilities (e.g. HOV lanes) will be for the same purpose, use, capacity, and at the same location (e.g. addition or reduction of cycling lanes/facilities or parking lanes, provided no change in the number of motor vehicle lanes).'*

However, in consideration of previous public interest, additional land required for intersection improvements considered herein, and the County's prior commitment to resolve Phase 3 of the Master Plan as a Schedule 'B' EA project, the County committed to reviewing and confirming the choice of Schedule at the completion of Phase 2 of the EA process.

The *Preliminary Recommended Solution* was circulated with the Project File (Version 1, dated February 25, 2020) to the public, agencies, and Indigenous Communities for review and comment. Comments regarding the *Preliminary Recommended Solution* were considered and are presented in this updated Project File (Version 2).

# 10. CONSULTATION

Consultation early in and throughout the process is a key feature of environmental assessment planning. Schedule 'B' Municipal Class EA processes have two mandatory points of contact; the *Notice of Project Initiation* (i.e. Consultation - Phase 2) and the *Notice of Project Completion*.

## 10.1 Master Plan Notifications

The Master Plan process included a *Notice of Project Initiation*, dated September 22, 2015, followed by a Discretionary Public Information Centre, held on October 7, 2015. A Phase 2 Public Information Centre was advertised on May 2, 2016 and was held on May 18, 2016. A *Notice of Completion* for the Master Plan process was issued May 9, 2017. Copies of the Notices issued as part of the Master Planning process are included in **Appendix A**.

## 10.2 Notice of Project Initiation

A *Notice of Project Initiation* was prepared and first issued on February 25th, 2020. A copy of the Notice is provided in **Appendix A**. Consistent with the consultation processes previously completed as part of the Master Plan, the Notice was advertised in the Shoreline Beacon Newspaper on February 25th and March 3rd, 2020 and was circulated to utility companies, agencies, and Indigenous Communities via email. The Notice was also mailed to Indigenous Communities, directly affected property owners within the Study Area, as well as to individuals engaged in previous project planning on February 25th, 2020. A Figure outlining the Notification Area is included in **Appendix A**.

The *Notice of Project Initiation* invited the public, agencies and Indigenous Communities to review the Schedule ‘B’ EA Project File (i.e. Version 1), which included the background technical reports, and to provide comment on the *Preliminary Recommended Solution* for the re-construction of BR25.

Upon receipt of comments, new information was incorporated into the review and assessment of a *Recommended Preferred Solution*, presented to County Council (i.e. the T&ES Committee) for acceptance (or otherwise) on April 16th, 2020.

# 11. CONSULTATION: FEEDBACK

## 11.1 Public and Stakeholder Consultation

With the circulation of the Schedule ‘B’ EA Project File (Version 1: February 25, 2020), the public were invited to provide comments regarding the *Preliminary Recommended Solution* for the re-construction of Bruce Road 25. In addition to comments from the Beachers’ Organization, a total of six comments from the general public were received. These comments can generally be summarized as follows:

### BEACHERS’ ORGANIZATION

Feedback from the Beachers’ Organization was provided in e-mail correspondence on February 27th, 2020 and was re-iterated in an article published in the Shoreline Beacon on March 4, 2020. In general, the Beachers’ Organization does not support the Recommended Preferred Alternative, suggesting that the two-lane alternative would not be able to handle the traffic in an area planned for significant growth and citing residential growth, Bruce Power traffic and growing demands due to increased seasonal residents and tourist traffic as factors that may impact traffic movement in the area. It was further stated that ‘it seems out of sync with current let alone future traffic demands.’

Response:

The purpose of the Master Plan was to consider initiatives across a broad area and to identify specific projects that would require additional study through a Schedule 'B' or 'C' Environmental Assessment process. It is noted that, based on previous public engagement, several adjacent landowners did not support a widening of the road across the frontage of their properties. In consideration of the time elapsed since the previous Traffic Reports were completed (i.e. 2009 and 2012) and the Town's more recent planning, which includes for the extension of Bruce Street as a collector road, the Town’s traffic planning consultant for their current Master Transportation Plan process was retained (i.e. Paradigm) to review existing and foreseeable traffic conditions and to provide recommendations specific to the road cross section. Based on the findings of the assessment completed by Paradigm, it was concluded that Bruce Road 25 and its intersections within the Study Area are currently operating at satisfactory levels of service and operating conditions are expected to remain acceptable into the future. Therefore, a two-lane cross section for Bruce Road 25 was supported by the traffic evaluations that were completed.

### PUBLIC COMMENTS

1. Of the six public comments received, five supported the Recommended Preferred Alternative for a two-lane cross section along Bruce Road 25 between Goderich Street and the future Bruce Street. One provided no comment specific to the road cross section.
2. Overall, speed through the residential area was generally cited as a concern related to the four-lane cross section alternative. The recommended two-lane cross section and use of a roundabout were cited as a means to effectively slow down traffic along Bruce Road 25 between Goderich Street and the future Bruce Street.

3. In general, a roundabout at the intersection of the future Bruce Street, BR33 and BR25 was supported primarily due to the ability of this option to simultaneously slow down traffic while efficiently managing traffic during both peak and off-peak periods (i.e. lower delays and shorter queues).
4. One of the comments did not support the roundabout option due to concerns regarding the difficultly navigating this traffic control option. Paradigm was consulted and suggested that while it is recognized that roundabouts may initially be difficult to navigate, at times resulting in a higher collision rate in the short-term immediately after being built, over the long-term roundabouts provide the best results for safety and traffic operations. Short-term increases in collision rates, when noted, are typically reported in areas (or regions) where there are few existing roundabouts and roundabout intersections are new to the majority of drivers. We note that, initially, only two legs of the roundabout will be constructed, with the Bruce Road 33 leg intended to be added in 2022. The Bruce Street leg will be added at some point in the future concurrent with subdivision development within the Town. This step-wise approach will gradually introduce the roundabout operations to new users.
5. One of the residents suggested that some of the existing issues along the subject section of road could be averted with design and operations including, but not limited to, the recommended construction of a roundabout intersection and a ‘well designed’ left turn lane at Highway 21. This will be considered in the design phase.

A summary of the Public Comments received (recorded sic erat scriptum), including a general response, is included in **Appendix H**. A review of the alternatives, based on comments/feedback provided, was incorporated into the re-assessment of the *Recommended Preferred Solution* presented to the County’s Transportation and Environmental Services Committee on April 16th, 2020.

## 11.2 Agency and Indigenous Community Consultation

Agencies with a regulatory role that may require future permits/approvals, and Indigenous Communities that may have a direct interest in the study, are to be contacted at each ‘mandatory point of contact’ required as part of the EA process to invite feedback. The Schedule ‘B’ Project File (Version 1: February 25, 2020) was circulated to key agencies, utilities and Indigenous Communities on October 25th, 2020 to solicit comments and feedback. A complete list of those contacted, including documentation of contact attempts and communications, is included in **Appendix A**.

Comments received during the consultation period from agency groups, utility companies and Indigenous Communities are summarized in the following **Table 6**.

## TABLE 6: GENERAL SUMMARY OF AGENCY, UTILITY & INDIGENOUS COMMUNITY COMMENTS RECEIVED

| Agency (Issue Date) | Overview of Comments | General Response and/or Follow-up Requirements |
|---|---|---|
| **SVCA: Risk Management Office**<br>**(Feb 26, 2020)** | Confirmed that the project does not fall within a high vulnerable source protection area (wellhead protection area or intake protection zone) where Source Protection Policies apply. Further, the project activities are not considered a prescribed drinking water threat, therefore activities associated with the project will not change or create new vulnerable source protection areas. | Noted. |
| **Ministry of Heritage, Sport, Tourism and Culture Industries**<br>**(March 6, 2020 to March 27, 2020)** | The MHSTCI provided clarification of their interest in how the EA project relates to its mandate in conserving Ontario's cultural heritage and the requirements with respect to the determination of a project's potential impact on cultural heritage resources. | The MHSTCI was provided clarification regarding how potential impacts to cultural heritage resources was addressed in the Project File. The MHSTCI confirmed that this satisfied the MHSTCI reporting requirements. The MHSTCI will continue to be consulted through the remainder of the EA process. |
| **SVCA: Environmental Planning and Regulations**<br>**(March 24, 2020)** | The project was reviewed in accordance with the SVCA's mandate and the Environmental Planning and Regulations Policies Manual (amended October 2018). The SVCA referenced comments previously provided (dated February 8, 2018) that were associated with this project as part of the larger proposal in the area. With respect to the plan for BR25 (i.e. Phase 3 of the Master Plan), a permit for the proposed works may not be required. | As noted in the Project File, the design development phase will address requirements of the SVCA and MECP and will be advanced, if necessary, following the completion of the Environmental Assessment Process. |
| **MECP**<br>**(March 10, 2020)** | 1. Provided Source Water Protection (SWP) clarification that the study area is located within the Saugeen Valley Source Protection Area.<br>2. Indigenous Consultation Requirements identified for the Project. | 1. SWP concerns are addressed in Section 8.4.2 of this Project File. Further, the SVCA Risk Management Office was consulted via the Notice of Project Initiation. Correspondence provided from the SVCA Risk Management Office on February 26th, 2020 confirmed that, based on the location of the project and the proposed works, project activities are not considered a prescribed drinking water threat, and that any activities associated with the project will not change or create new vulnerable source protection areas.<br>2. It is noted that correspondence was provided via email and lettermail to Indigenous Communities on February 25th, 2020. Consistent with the requirements of the EA Process, continued notification and consultation will be provided through the remainder of the EA Process. |
| **Indigenous Communities** | *No comments were received.* | |

Note: Notification correspondence is included in **Appendix A** and Comments & Feedback are provided in **Appendix H**.

### 11.3 Summary of Consultation

The *Preliminary Recommended Solution* for the re-construction of BR25 was circulated on February 25th, 2020 via a *Notice of Project Initiation*, along with the Project File (Version 1) to the public, stakeholders, agencies and Indigenous Communities for review and comment. Comments were considered and are presented in this Project File (Version 2). Based on the comments, no new information was received through the consultation process that would suggest a change to the *Preliminary Recommended Solution*: to construct a two-lane cross section along BR25 (Goderich Street to Bruce Street), complete with a single lane roundabout intersection at Bruce Street.

## 12. RECOMMENDED PREFERRED SOLUTION

Based on the identified project statement, the review of available information, and the completion of background reports and consultation, Alternative 2, to construct a two-lane urban cross section along Bruce Road 25 (Goderich Street to BR33), complete with a single lane roundabout intersection at Bruce Street, was identified as the *Recommended Preferred Solution* for consideration and acceptance (or otherwise) by County Council (T&ES Committee).

As a two-lane urban section is considered appropriate from a technical perspective and is preferred, the project could be considered to be a Schedule ‘A+’ activity under the Municipal Class Environmental Assessment Roads Project Schedule No.19, which describes the following activity:

> *‘Reconstruction where the reconstructed road or other linear paved facilities (e.g. HOV lanes) will be for the same purpose, use, capacity, and at the same location (e.g. addition or reduction of cycling lanes/facilities or parking lanes, provided no change in the number of motor vehicle lanes).’*

However, in consideration of previous public interest, additional land required for intersection improvements considered herein, and the County’s prior commitment to resolve Phase 3 of the Master Plan as a Schedule ‘B’ EA project, the County has opted to consider Phase 3 of the Master Plan, more specifically the re-construction of Bruce Road 25, as a Schedule ‘B’ EA project.

As previously discussed, it is noted that the County and the Town have committed to the inclusion of full urban services (i.e. watermain, storm and sanitary sewer) and the provision for a new east↔west multi-use trail along the Bruce Road 25 corridor in the overall design and construction of Bruce Road 25. These provisions will be further considered during the design phase.

With respect to the single lane roundabout, based on Harbourside’s evaluation and assessment of the traffic control options, a single-lane roundabout was determined to be the preferred traffic control option for the intersection of Bruce Road 25 with BR33/Bruce Street. However, the development of a roundabout at this intersection would likely require the acquisition of some lands from each quadrant of the subject intersection. While the County could consider the purchase of these lands to facilitate the construction of the roundabout concurrently with the re-construction of Bruce Road 25, a northbound stop-controlled tee intersection would be appropriate on BR33 until such a time that Bruce Street is extended to BR25.

## 13. COMMITTEE RESOLUTION

In consideration of the County of Bruce Committee Report presented to the members of the Transportation and Environmental Services Committee on April 16th, 2020, respecting the BR25 Environmental Assessment, specifically the re-construction of the section of road between Goderich Street and the future Bruce Street, Council approved the *Recommended Preferred Solution*, Alternative 2: to construct a two-lane urban cross section along Bruce Road 25 (Goderich Street to BR33), complete with a single lane roundabout intersection at Bruce Street. A copy of the Committee Report is provided in **Appendix I**.

A *Notice of Project Completion* was first issued on April 21, 2020. A copy of the Notice is included in **Appendix A.** The Notice was advertised in the Shoreline Beacon on April 21st and April 28th, 2020. The Notice was circulated to agencies, Indigenous Communities and utility companies via email. The Notice was also mailed to Indigenous Communities, directly affected property owners within the Study Area, interested persons, as well as to individuals engaged in previous project planning.

The Notice initiates the 30 calendar day review period during which time the Minister of the MECP may be requested to issue a Part II Order to the County to complete further study on the Schedule ‘B’ project, as outlined in **Section 2**. Therefore, if there is no request received by May 21st, 2020, the project will proceed to design development and construction.

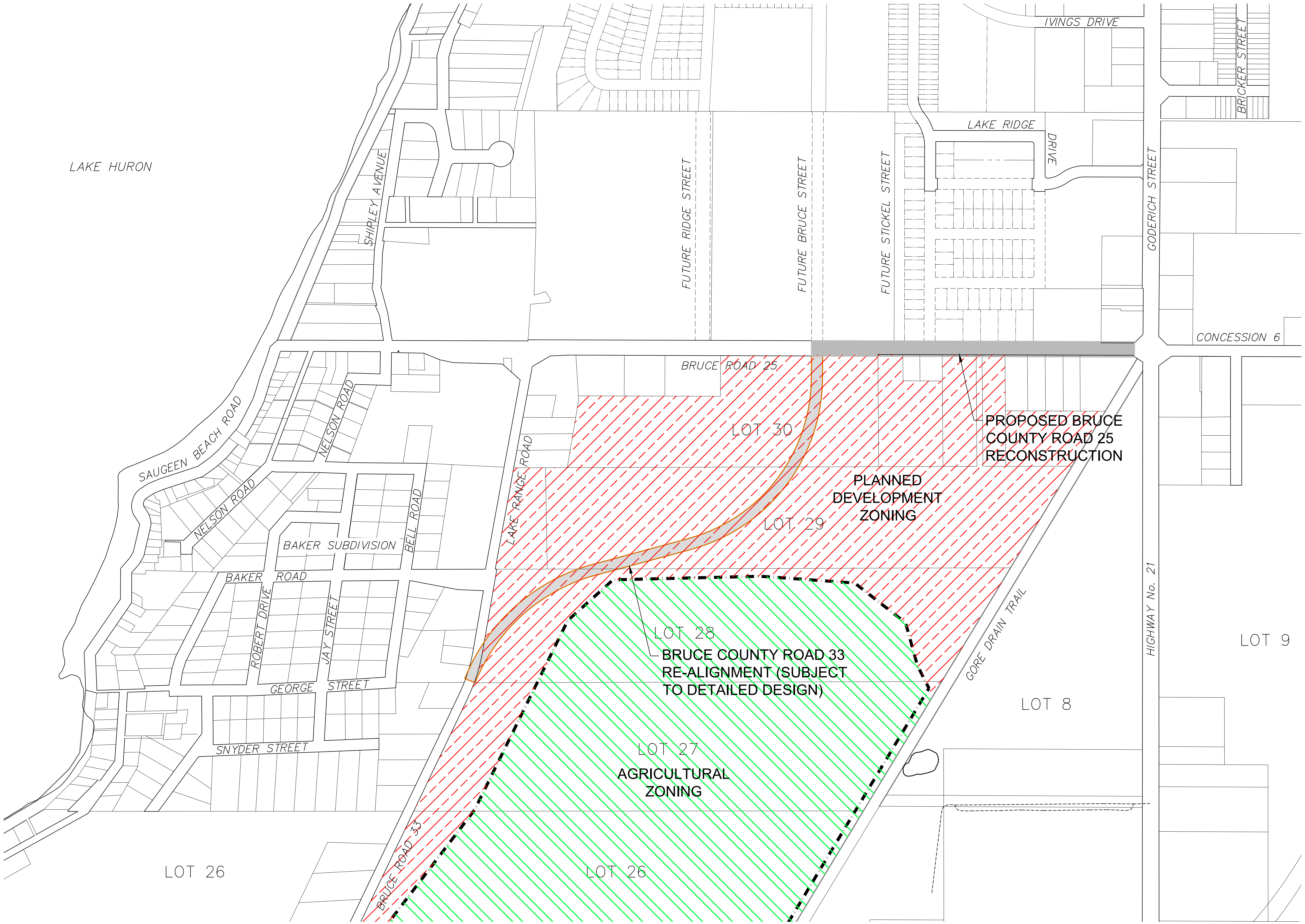
## 14. NEXT STEPS

The *Notice of Project Completion* is dated April 21st, 2020. The next steps in the process are summarized as follows:

i. Address the review period required to permit the opportunity for any participant to request the Minister of the MECP to enact Part II of the Act (i.e. a Part II Order), which would require additional study to verify the project direction.

ii. If a Part II Order request in not made during the 30-day public review period, the *Preferred Solution* to the Schedule ‘B’ EA process may proceed to design development and construction.

# FIGURES



# 218428
# Bruce County Road 25
# Reconstruction
# Town of Saugeen Shores
# County of Bruce

LEGEND

🟥 PLANNED DEVELOPMENT

🟩 AGRICULTURAL

┄ PLANNED ROADWAYS

NOT TO SCALE

JANUARY 2020

## SITE LOCATION PLAN

Figure No. 1

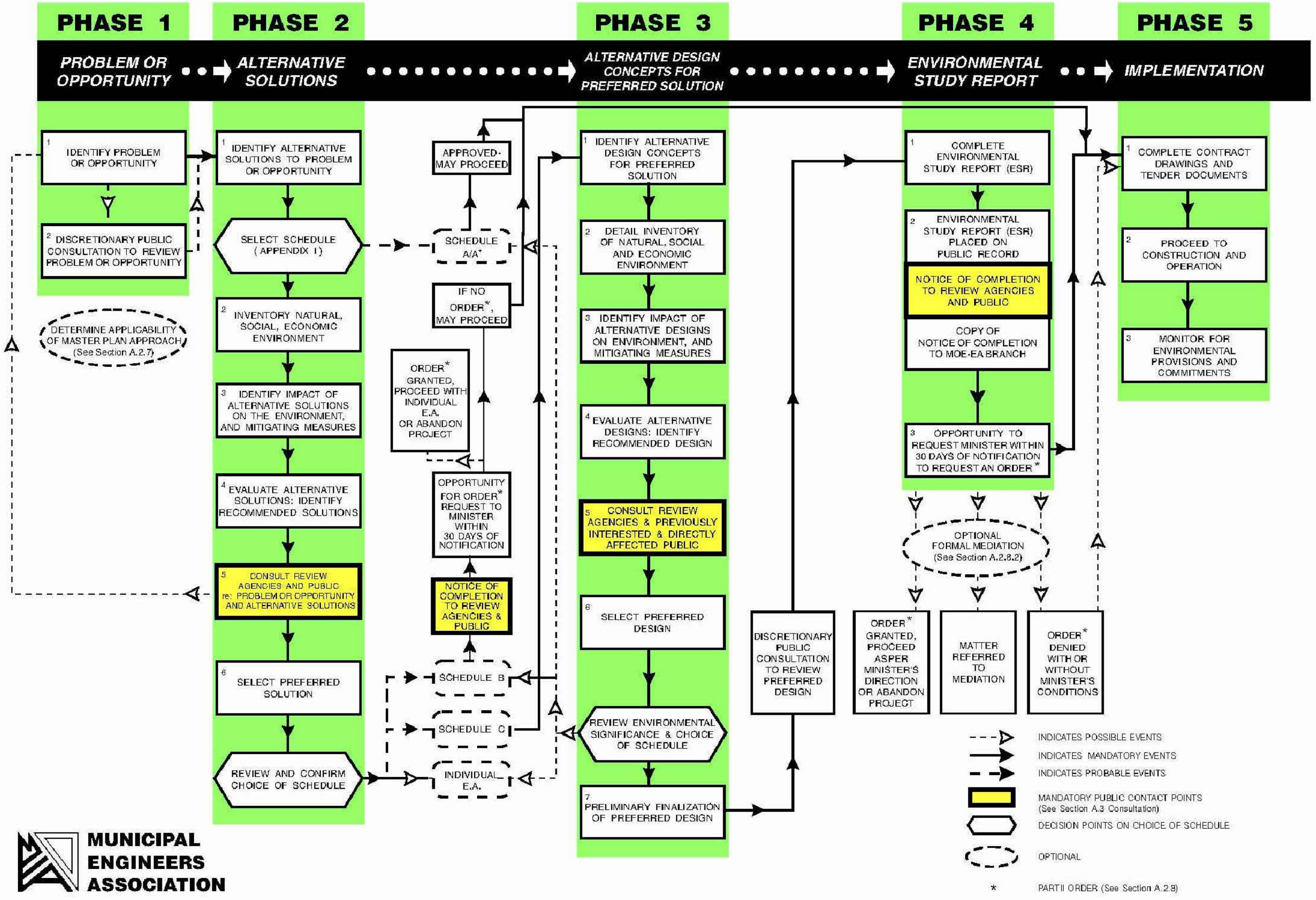
GM BluePlan
ENGINEERING

FILE:C:\Civil 3D Projects\218428 EA Figures-K.dwg LAYOUT:Site Location (SWM)
LAST SAVED BY:Kboers, 1/30/2020 8:27:10 AM PLOTTED BY:Ken Boers - GM BluePlan 1/30/2020 9:13:06 AM

218428
Bruce County Road 25
Reconstruction
Town of Saugeen Shores
County of Bruce

# EXHIBIT A.2 MUNICIPAL CLASS EA PLANNING AND DESIGN PROCESS

***NOTE:*** *This flow chart is to be read in conjunction with Part A of the Municipal Class EA*



**MUNICIPAL ENGINEERS ASSOCIATION**

NOT TO SCALE
JANUARY 2020

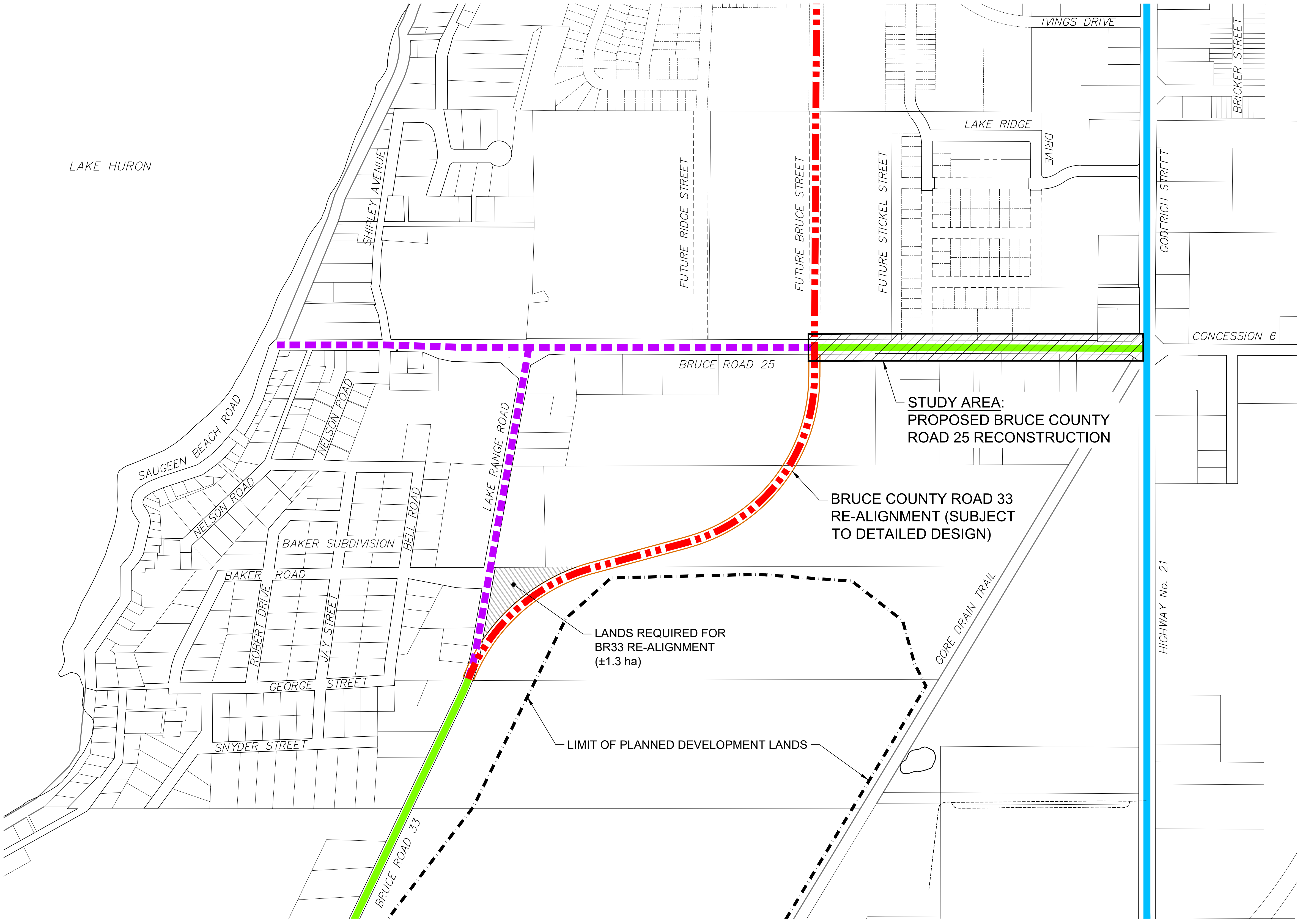
EA PROCESS CHART

Figure No. 2

BluePlan ENGINEERING

FILE:C:\Civil 3D Projects\218428 EA Figures-K.dwg LAYOUT:EA Process
LAST SAVED BY:Kboers, 1/30/2020 8:27:10 AM PLOTTED BY:Ken Boers - GM BluePlan 1/30/2020 9:13:07 AM

# 218428
# Bruce County Road 25 Reconstruction
# Town of Saugeen Shores
# County of Bruce



## LEGEND

🟦 PROVINCIAL HIGHWAY

🟩 BRUCE COUNTY ROAD

🟪 PROPOSED DIVESTURE FROM COUNTY TO TOWN (AS PER MASTER PLAN)

🟥 PROPOSED COLLECTOR ROAD

NOT TO SCALE

JANUARY 2020

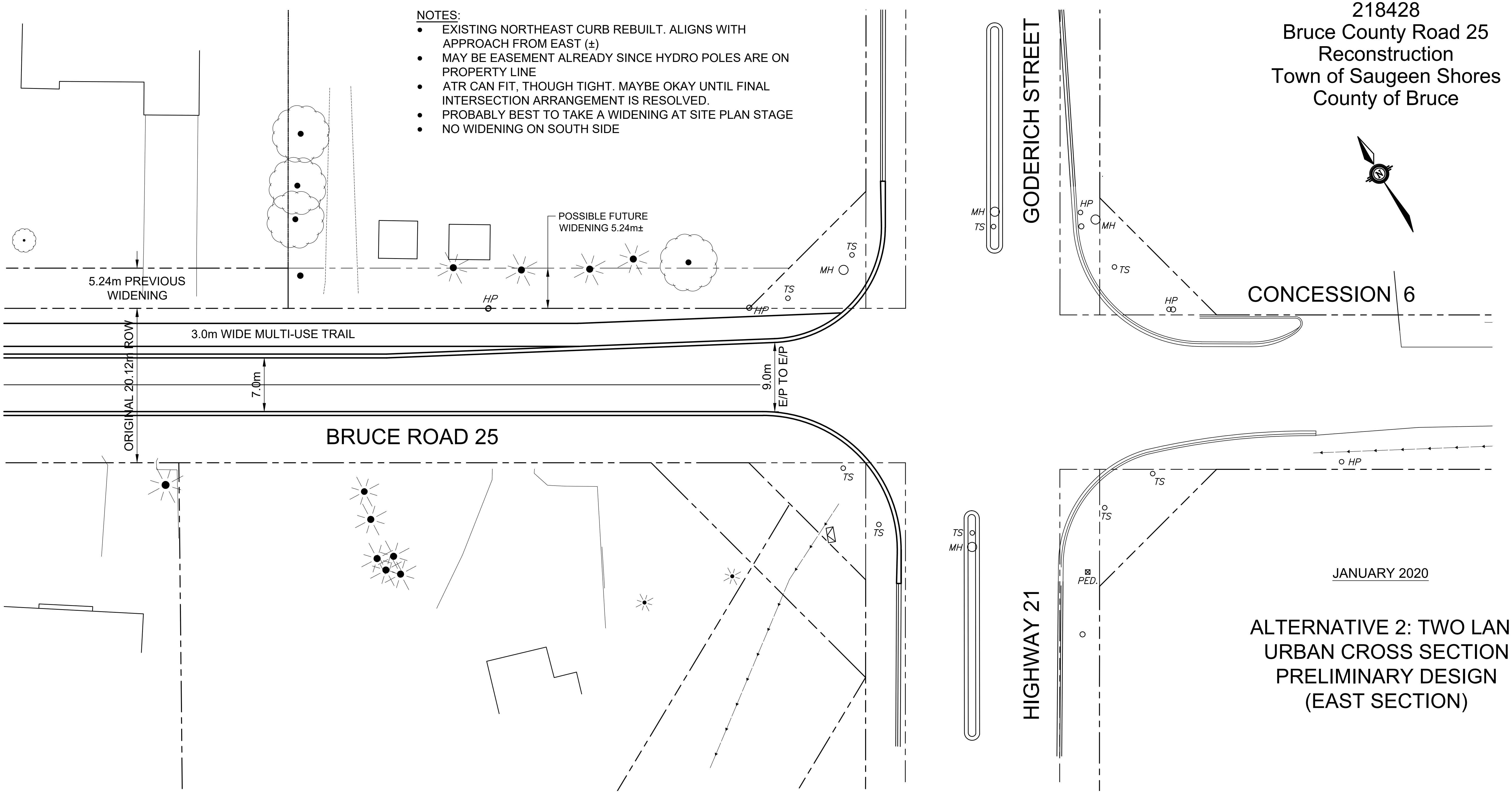
## TRANSPORTATION PLANNING

Figure No. 3

GM BluePlan ENGINEERING

FILE:C:\Civil 3D Projects\218428 EA Figures-K.dwg LAYOUT:Transportation Planning
LAST SAVED BY:Kboers, 1/30/2020 8:27:10 AM PLOTTED BY:Ken Boers - GM BluePlan 1/30/2020 9:13:08 AM

NOTES:
- EXISTING NORTHEAST CURB REBUILT. ALIGNS WITH APPROACH FROM EAST (±)
- MAY BE EASEMENT ALREADY SINCE HYDRO POLES ARE ON PROPERTY LINE
- ATR CAN FIT, THOUGH TIGHT. MAYBE OKAY UNTIL FINAL INTERSECTION ARRANGEMENT IS RESOLVED.
- PROBABLY BEST TO TAKE A WIDENING AT SITE PLAN STAGE
- NO WIDENING ON SOUTH SIDE



PARTIAL SITE PLAN
SCALE 1:500

218428
Bruce County Road 25
Reconstruction
Town of Saugeen Shores
County of Bruce

JANUARY 2020

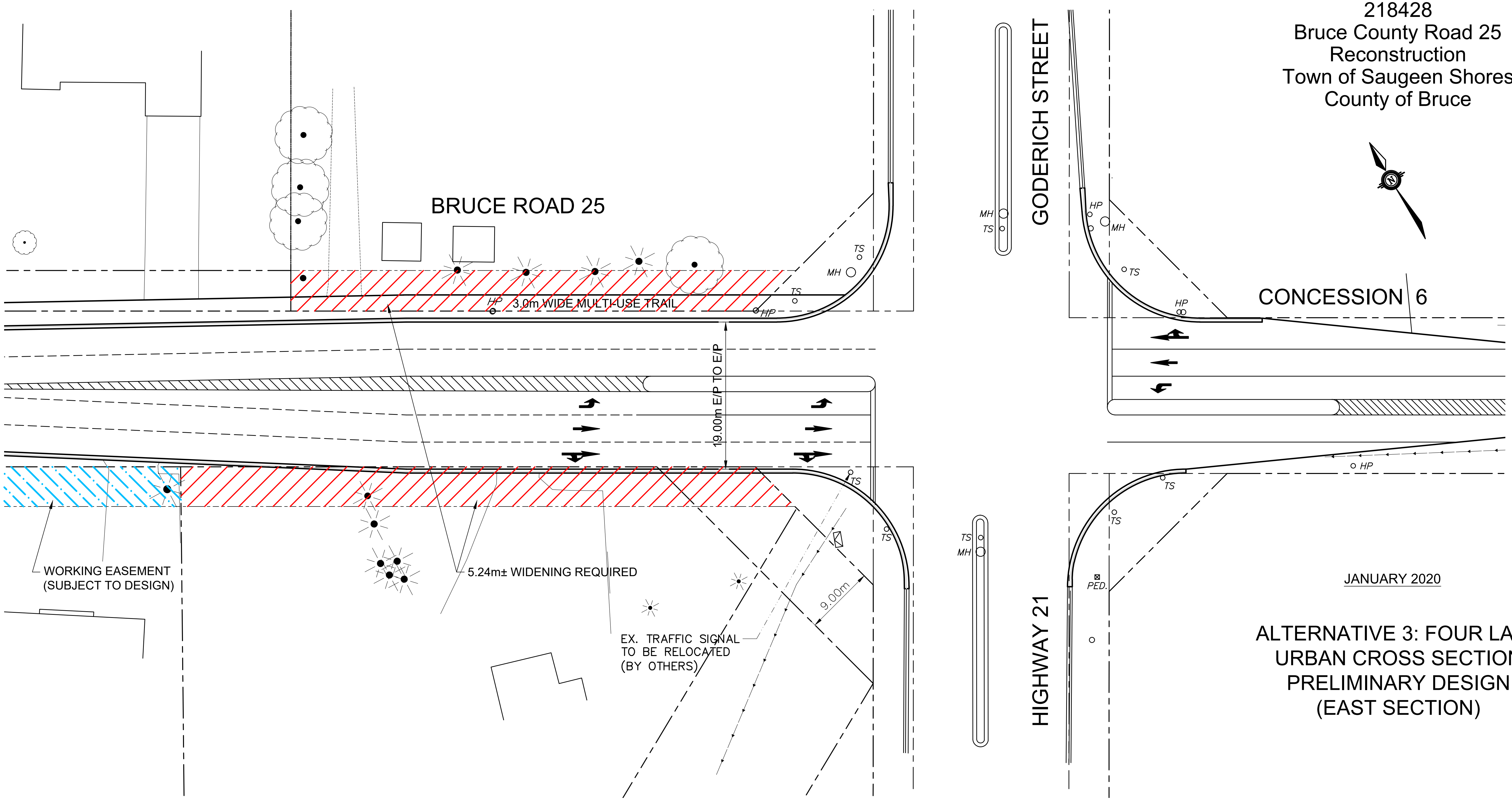
ALTERNATIVE 2: TWO LANE
URBAN CROSS SECTION
PRELIMINARY DESIGN
(EAST SECTION)

Figure No. 4

GM BluePlan
ENGINEERING

FILE:C:\Civil 3D Projects\217300-1 GP-K Phase 2.dwg LAYOUT:2 Lane Option
LAST SAVED BY:Kboers, 1/30/2020 12:09:41 PM PLOTTED BY:Ken Boers - GM BluePlan 2/21/2020 8:34:03 AM

218428
Bruce County Road 25
Reconstruction
Town of Saugeen Shores
County of Bruce



PARTIAL SITE PLAN
SCALE 1:500

JANUARY 2020

ALTERNATIVE 3: FOUR LANE
URBAN CROSS SECTION
PRELIMINARY DESIGN
(EAST SECTION)

Figure No. 5

GM BluePlan
ENGINEERING

FILE:C:\Civil 3D Projects\217300-1 GP-K Phase 2.dwg LAYOUT:4 Lane Option
LAST SAVED BY:Kboers, 1/30/2020 12:09:41 PM PLOTTED BY:Ken Boers - GM BluePlan 2/21/2020 8:34:09 AM

# APPENDIX A:
# NOTICES

# MASTER PLAN FOR ROADS AND DRAINAGE
# BRUCE COUNTY ROADS 25 AND 33
# NOTICE OF PROJECT INITIATION
# DISCRETIONARY PUBLIC INFORMATION CENTRE

---

The County of Bruce as Proponent, with the Town of Saugeen Shores, is studying road and drainage alternatives in the area of Bruce County Roads 25 and 33 (BR25 & BR33), located centrally in Saugeen Shores, and is inviting interested members of the public to attend an Information Centre.

The County has identified various deficiencies with its road and drainage infrastructure within the Study Area. Through initial discussions with the Town, other related issues having a broader scope have emerged which the County wishes to consider at a Master Planning level to ensure individual projects are completed in context with an appropriate overall plan. The purpose of the Discretionary Public Information Centre is to describe the identified issues within the Study Area and to receive input from the public on the issues as well as potential alternative solutions.

Issues related to roads include deteriorated travelled surfaces, poor sight lines at the intersection of BR25 and BR33, and planned future intersections at Stickel, Bruce and Ridge Streets. Preliminary Alternatives for Road Works include; Do Nothing but resurfacing, Re-align the BR33 intersection with the future Ridge Street intersection, or Re-align the BR33 intersection the with the future Bruce Street intersection.

Issues related to drainage include limited capacity along BR25, poor drainage through the Baker Subdivision, and inadequate drainage outlets within the Study Area. Preliminary Alternatives for Drainage works include; Do Nothing, Improve an outlet westerly on BR25 to Lake Huron, Divert flows from BR25 southerly along BR33 to a new constructed outlet westerly across Lot 26 to the existing Gore Drain outlet below Saugeen Beach Road, or Divert flows southerly along BR33 to the existing Gore Drain outlet below Lake Range Road (BR33)..

The Master Plan is being conducted under the **Municipal Class Environmental Assessment (EA)** project planning process and is intended to follow, as a minimum, Phases 1 and 2 of the EA Process, in support of Schedule B and/or Schedule C projects, which may be identified for implementation through the process.

As part of this process a Phase I – Discretionary **Public Information Centre** is planned at the Town of **Saugeen Shores Rotary Hall on October 7th, 2015 at 7:00 p.m. – 9:00 p.m.**, at which time project information will be displayed and the Project Team will be available for discussions.

The public is invited to provide written comments for incorporation into the planning considerations for this project. A future Public Information Centre, planned as part of the process, will be scheduled at a future date at which time a Problem / Opportunity Statement and Alternative Solutions will be more fully developed. Additional information is provided on the municipal web sites.

**This Notice issued September 22nd, 2015.**

The County of Bruce
Mr. Brian Knox, P.Eng.
Box 398, 30 Park St.
Walkerton, ON N0G 2V0
Tel: (519) 881-2400
www.brucecounty.on.ca

The Town of Saugeen Shores
Mr. Dave Burnside
600 Tomlinson Drive
P.O. Box 820
Port Elgin, ON N0H 2C0
Tel: (519) 832-2008
www.saugeenshores.ca

GM BluePlan Engineering Limited
Consulting Professional Engineers
Mr. John Slocombe, P.Eng.
1260 2nd Avenue East, Unit 1
Owen Sound, ON N4K 2J3
Tel: (519) 376-1805
www.gmblueplan.ca

# MASTER PLAN FOR ROADS AND DRAINAGE
# BRUCE COUNTY ROADS 25 AND 33
# NOTICE OF PHASE 2
# PUBLIC INFORMATION CENTRE

---

The County of Bruce as Proponent, with the Town of Saugeen Shores, is studying road and drainage alternatives in the area of Bruce County Roads 25 and 33 (BR25 & BR33), located centrally in Saugeen Shores, and is inviting interested members of the public to attend an Information Centre.

The County has identified various deficiencies with its road and drainage infrastructure within the Study Area. Through initial discussions with the Town, other related issues having a broader scope have emerged which the County wishes to consider at a Master Planning level to ensure individual projects are completed in context with an appropriate overall plan. The purpose of the Phase 2 Public Information Centre is to describe the identified issues within the Study Area and to receive input from the public on the evaluation of alternative solutions to the identified problems.

Issues related to roads include deteriorated travelled surfaces, poor sight lines at the intersection of BR25 and BR33, and planned future intersections at Stickel, Bruce and Ridge Streets. Alternatives for Road Systems include; Do Nothing but resurfacing, Re-align the BR33 intersection with the future Ridge Street intersection, or Re-align the BR33 intersection the with the future Bruce Street intersection.

Issues related to drainage include limited capacity along BR25, poor drainage through the Baker Subdivision, and inadequate drainage outlets within the Study Area. Alternatives for Drainage systems include; Do Nothing, Improve Existing Conditions, Construct a new outlet westerly on BR25 to Lake Huron, Divert flows northerly to the existing South End Drain Outlet, Divert flows from BR25 southerly along BR33 to a new constructed outlet westerly through the Baker Subdivision, Divert flows from BR25 southerly along BR33 to a new constructed outlet across Lot 26 to the existing Gore Drain outlet below Saugeen Beach Road, or Divert flows southerly along BR33 to the existing Gore Drain outlet below Lake Range Road (BR33).

The Master Plan is being conducted under the **Municipal Class Environmental Assessment (EA)** project planning process and is intended to follow, as a minimum, Phases 1 and 2 of the EA Process, in support of Schedule B and/or Schedule C projects, which may be identified for further study and implementation through the process.

As part of this process a Phase 2 **Public Information Centre** is planned at the Town of **Saugeen Shores Rotary Hall on Wednesday, May 18th, 2016 at 7:00 p.m. – 9:00 p.m**., at which time project information will be displayed and a recommended solution presented. The Project Team will be available for discussions.

The public is invited to provide written comments for incorporation into the planning considerations for this project. Upon receipt of comments from the public, a Project File will consolidate the Master Planning process and a Preferred Solution will be recommended for acceptance by County and Town Councils. Additional information is provided on the municipal web sites.

**This Notice issued May 2nd, 2016.**

The County of Bruce
Mr. Brian Knox, P.Eng.
Box 398, 30 Park St.
Walkerton, ON N0G 2V0
Tel: (519) 881-2400
www.brucecounty.on.ca

The Town of Saugeen Shores
Mr. Len Perdue
600 Tomlinson Drive
P.O. Box 820
Port Elgin, ON N0H 2C0
Tel: (519) 832-2008
www.saugeenshores.ca

GM BluePlan Engineering Limited
Consulting Professional Engineers
Mr. John Slocombe, P.Eng.
1260 2nd Avenue East, Unit 1
Owen Sound, ON N4K 2J3
Tel: (519) 376-1805
www.gmblueplan.ca

# MUNICIPAL CLASS ENVIRONMENTAL ASSESSMENT
# NOTICE OF STUDY COMPLETION

---

## COUNTY OF BRUCE
## BRUCE COUNTY ROADS 25 AND 33
## MASTER PLAN FOR ROADS AND DRAINAGE

---

### RECOMMENDED MASTER PLAN

The County of Bruce as Proponent, with the Town of Saugeen Shores, have prepared a Master Plan, following Phases 1 and 2 of the Municipal Class Environmental Assessment, for the area of Bruce County Road 25 and 33, located centrally in the Town of Saugeen Shores.

Based on the study findings and input from technical agencies and the public, the Master Plan accepted by Councils is as shown on the attached Key Plan. The Master Plan identifies the recommended infrastructure to service the future growth of the Town while minimizing environmental impacts. The recommended Master Plan incorporates the comments received from the public and agencies during the course of the study. The main components are listed below. While the Master Plan addresses need and justification at a broad level, more detailed studies for each of the projects included in the Master Plan will be done at a later date following the Municipal Class EA.

| **TYPE OF PROJECT** | **DESCRIPTION** |
|---|---|
| Schedule B Projects - Roads | ▪ Re-align Bruce Road 33 to intersect Bruce Road 25 at future Bruce Street alignment.<br>▪ Provide additional lanes on Bruce Road 25 between future Bruce Street intersection to Goderich Street (4-lane urban cross-section).<br>▪ While the Master Plan addresses Phases 1 and 2 of the Municipal Class EA, additional investigations will be carried out at a later date. |
| Schedule A Projects – Drainage | ▪ Construct new storm sewer along Bruce Road 25 including outfall to Lake Huron.<br>▪ Construct local storm sewer system within Baker Subdivision to coincide with sanitary sewer installation. |

The Master Plan is available for review at the following locations:

Saugeen Shores Municipal Office, Bruce County

This Notice issued Tuesday May 9, 2017.

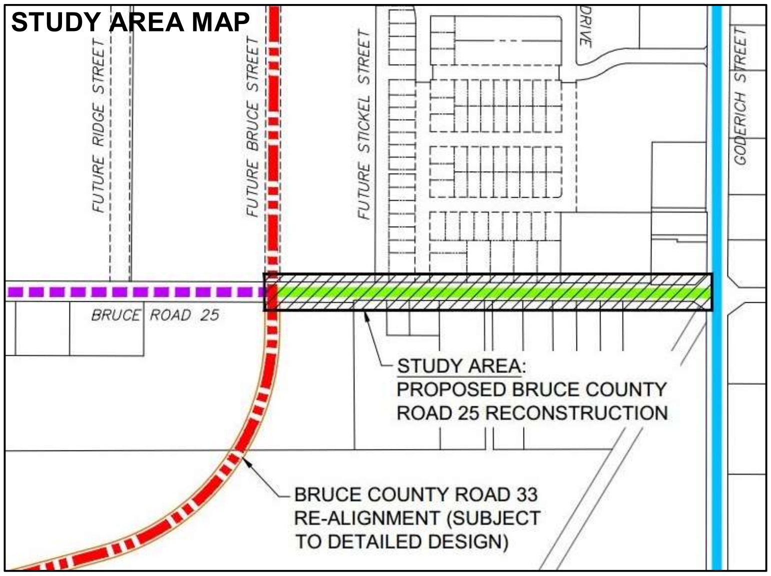
The County of Bruce
Mr. Brian Knox, P.Eng.
Box 70, 30 Park St.
Walkerton, Ontario N0G 2V0
Tel: (519) 881-2400

The Town of Saugeen Shores
600 Tomlinson Drive
P.O. Box 820
Port Elgin, ON  N0H 2C0
Tel: (519) 832-2008

GM BluePlan Engineering Limited
Mr. John Slocombe, P.Eng.
1260 2nd Avenue East, Unit 1
Owen Sound, ON  N4K  2J3
Tel: (519) 376-1805

# BRUCE COUNTY ROAD 25 RE-CONSTRUCTION
# MUNICIPAL CLASS ENVIRONMENTAL ASSESSMENT (EA): SCHEDULE 'B'

## NOTICE OF PROJECT INITIATION



In May 2017, the County of Bruce (County), as the proponent, with the Town of Saugeen Shores (Town), as a principle partner, completed a Master Plan to plan various road and drainage undertakings within a broad area central to Saugeen Shores along Bruce Roads 25 and 33 (BR25 & BR33). The Master Plan identified several projects including the re-construction of BR25 from the Town's planned alignment of Bruce Street (from the north) to Goderich Street, where shown on the Study Area Map provided.

The County has initiated this process, appropriately to plan the re-construction of BR25 as considered in the Master Plan. The project is being planned under Schedule 'B' of the Municipal Class Environmental Assessment (MCEA), as outlined in the MCEA Manual prepared by the Municipal Engineers Association (2015). Alternative solutions that are being considered include the following:

Alternative 1: Do Nothing
Alternative 2: Construct a two-lane urbanized cross section along BR25 (Goderich Street to future Bruce Street)
Alternative 3: Construct a four-lane urbanized cross section along BR25 (Goderich Street to future Bruce Street)

Although the Master Plan considered a 4-lane urban cross section, the background studies completed since then have identified Alternative 2, re-construction of BR25 with a two-lane urbanized cross section between Goderich Street and the future Bruce Street, as the *Preliminary Recommended Solution*.

The Master Plan and the Schedule 'B' Project File (Version 1) for the BR25 re-construction, which includes background reports and provides a review and assessment of the alternatives considered, are available on the County and Town websites and at their offices for viewing purposes.

With the circulation of this *Notice of Project Initiation* and the Project File (Version 1), public, stakeholder, agency and indigenous community comments are invited for incorporation into the planning of this project. Written comments will be received by the Study Team until March 24th, 2020. Contact information is provided below. Upon receipt of comments, the Study Team will update the Project File and re-evaluate a *Recommended Preferred Solution* for consideration by County Council. Subject to the comments received, the verification of the *Preferred Solution* and the receipt of necessary approvals, the County intends to proceed with the planning, design and construction of this project in 2021.

This *Notice of Project Initiation* is advertised in the Shoreline Beacon and is also posted on the County and Town websites, where additional information is provided.

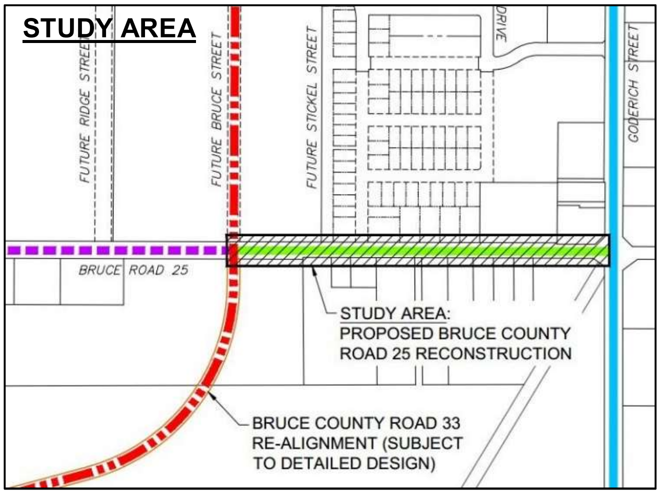
This Notice first issued on February 25th, 2020.

The County of Bruce
Mr. Jim Donohoe, P.Eng.
30 Park Street, Box 398
Walkerton, ON  N0G 2V0
jdonohoe@brucecounty.on.ca
Tel: 519-881-2400
www.brucecounty.on.ca

The Town of Saugeen Shores
Ms. Amanda Froese, P.Eng.
600 Tomlinson Drive, Box 820
Port Elgin, ON  N0H 2C0
amanda.froese@saugeenshores.ca
Tel: 519-832-2008
www.saugeenshores.ca

GM BluePlan Engineering Limited
Mr. John Slocombe, P.Eng.
1260-2nd Avenue East, Unit 1
Owen Sound, ON  N4K 2J3
john.slocombe@gmblueplan.ca
Tel: 519-376-1805
www.gmblueplan.ca

# BRUCE COUNTY ROAD 25 RE-CONSTRUCTION
# MUNICIPAL CLASS ENVIRONMENTAL ASSESSMENT (EA): SCHEDULE 'B'
## NOTICE OF PROJECT COMPLETION



In May 2017, the County of Bruce (County), as the proponent, with the Town of Saugeen Shores (Town), as a principle partner, completed a Master Plan to plan various road and drainage undertakings within a broad area central to Saugeen Shores along Bruce Roads 25 and 33 (BR25 & BR33). The Master Plan identified several projects including the re-construction of BR25 from the Town's planned alignment of Bruce Street (from the north) to Goderich Street, where shown on the Study Area Map provided.

In February 2020, the County initiated a Schedule 'B' Municipal Class Environmental Assessment (EA) process, appropriately to plan the re-construction of BR25 as considered in the Master Plan. Alternative solutions that were considered included the following:

Alternative 1: Do Nothing
Alternative 2: Construct a two-lane urbanized cross section along BR25 (Goderich Street to future Bruce Street)
Alternative 3: Construct a four-lane urbanized cross section along BR25 (Goderich Street to future Bruce Street)

Based on the *Preferred Solution* accepted by County Council on April 16th, 2020, the County intends to proceed with the construction of a two-lane urban cross-section along BR25, between Goderich Street and the future Bruce Street, complete with a roundabout intersection at Bruce Street. Documentation of the development and review of the alternatives considered, including a summary of the planning and consultation process, a detailed evaluation and assessment of the alternatives and the rationale for the selection of Alternative 2 as the *Preferred Solution*, is provided in the Project File (Version 2). The Master Plan (July 2016) and the Bruce County Road 25 Re-Construction Project File, are available on the County and Town websites and are also available at their offices for viewing purposes (subject to re-opening of office buildings which are currently closed as a precaution to limit further spread of COVID-19).

This Notice of Project Completion initiates the 30 calendar day review period. Interested persons are requested to provide written comment to the County of Bruce and/or GM BluePlan Engineering by May 21st, 2020.

The County of Bruce
Mr. Jim Donohoe, P.Eng.
30 Park Street, Box 398
Walkerton, ON N0G 2V0
jdonohoe@brucecounty.on.ca
Tel: 519-881-2400
www.brucecounty.on.ca

The Town of Saugeen Shores
Ms. Amanda Froese, P.Eng.
600 Tomlinson Drive, Box 820
Port Elgin, ON N0H 2C0
amanda.froese@saugeenshores.ca
Tel: 519-832-2008
www.saugeenshores.ca

GM BluePlan Engineering Limited
Mr. John Slocombe, P.Eng.
1260-2nd Avenue East, Unit 1
Owen Sound, ON N4K 2J3
john.slocombe@gmblueplan.ca
Tel: 519-376-1805
www.gmblueplan.ca

If concerns arise regarding this project, that cannot be resolved through discussions with the County, then members of the public, interested groups or technical agencies may request the Minister of the Ministry of the Environment, Conservation and Parks (MECP) to issue a '*Part II Order'* for the project. Within the Part II Order request, the Minister may be requested to refer the matter to mediation, impose additional project conditions, and/or request an elevated scope of study (i.e. an individual environmental assessment). A Part II Order request requires the completion of a 'Part II Order Request' Form (Form ID No.012-2206E), which can be found on Service Ontario's website (http://www.forms.ssb.gov.on.ca/).

Requests may be received by the Minister at the address below until May 21st, 2020. If there is no request received by May 21st, 2020, the project will proceed to design and construction. A copy of the request must also be sent to the Director of the Environmental Assessment and Permissions Branch (MECP) and the County of Bruce.

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

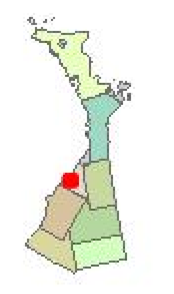
Director, Environmental Assessment and Permissions Branch
Ministry of the Environment, Conservation and Parks
135 St. Clair Avenue West, 1st Floor
Toronto, ON M4V 1P5
enviropermissions@ontario.ca

This *Notice of Project Completion* is advertised in the Shoreline Beacon and is also posted on the County and Town websites, where additional information is provided.

This Notice first issued on April 21st, 2020.

# County of Bruce

## Bruce Road 33



Legend

- ● Rural Community point, labelled
- — Ferry
- — Provincial Highway
- — County Road
- — Municipal or Other Road (small scale)
- ☐ Propane Facility Buffer
- ▨ Wetland
- ■ Body of Water
- ■ Built-up area
- ☐ Adjacent Counties
- ■ Lake Huron and Georgian Bay

Notes

landowner mail out circulation area

1.3 0 0.64 1.3 Kilometers

NAD_1983_UTM_Zone_17N

# CIRCULATION LIST: AGENCIES INDIGENOUS COMMUNITIES
# BRUCE ROAD 25 RE-CONSTRUCTION
# SCHEDULE B EA
# PROJECT FILE

| AGENCY | CONTACT INFORMATION | | ADDRESS | INFORMATION SENT | | | | | | | | | | COMMENTS/RESPONSE RECEIVED (DESCRIPTION) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | DATE SENT or RECEIVED | VIA | | | DOCUMENT | | | | | DESCRIPTION | |
| | | | | | E-mail | Mail | Phone | Notice of Project Initiation | Project File (V1: Feb 2020) | Notice of Project Completion | Project File (V2: April 2020) | Other | | |
| **MUNICIPAL AGENCIES** | | | | | | | | | | | | | | |
| **County of Bruce** | Contact | Tessa Fortier | County of Bruce | 25-Feb-20 | S | | | X | X | | | | | |
| | | Planning and Development | Planning and Development | 21-Apr-20 | S | | | | | X | X | | | |
| | Telephone | (226) 909-1601 (Ext. 2) | 1243 McKenzie Road | | | | | | | | | | | |
| | E-mail | tfortier@brucecounty.on.ca | Port Elgin, ON N0H 2C6 | | | | | | | | | | | |
| | Contact | Kerri Meier | | | | | | | | | | | | |
| | | Environmental Coordinator | | | | | | | | | | | | |
| | Telephone | (519) 881-2400 (Ext. 307) | | | | | | | | | | | | |
| | E-mail | kmeier@brucecounty.on.ca | | | | | | | | | | | | |
| | Contact | Miguel Pelletier | | | | | | | | | | | | |
| | | Director of Transportation | | | | | | | | | | | | |
| | Telephone | (519) 881-2400 (Ext. 307) | | | | | | | | | | | | |
| | E-mail | mpelletier@brucecounty.on.ca | | | | | | | | | | | | |
| **Town of Saugeen Shores** | Contact | Amanda Froese, Director | Town of Saugeen Shores | 25-Feb-20 | S | | | X | X | | | | | |
| | | Infrastructure and Development Services | P.O. Box 820 | 21-Apr-20 | S | | | | | X | X | | | |
| | Telephone | (519) 832-2008 (Ext. 119) | 600 Tomlinson Drive | | | | | | | | | | | |
| | Fax | (519) 832-2140 | Port Elgin, ON N0H 2C0 | | | | | | | | | | | |
| | E-mail | amanda.froese@saugeenshores.ca | | | | | | | | | | | | |
| **Saugeen Valley Conservation Authority (SVCA)** | Contact | Erik Downing | Saugeen Conservation | 25-Feb-20 | S | | | X | X | | | | | |
| | | Manager, Environmental Planning & Reg. | 1078 Bruce Road 12 | 24-Mar-20 | R | | | | | | | X | | Outlining SVCA regulatory requirements |
| | Telephone | (519) 367-3040 (Ext. 241) | P.O. Box 150 | 21-Apr-20 | S | | | | | X | X | | | |
| | Fax | (519) 367-3041 | Formosa, ON N0G 1W0 | | | | | | | | | | | |
| | E-mail | e.downing@svca.on.ca | | | | | | | | | | | | |
| **Source Water Protection** | Contact | Carl Seider, Project Manager | Drinking Water source Protection | 25-Feb-20 | S | | | X | X | | | | | Including consultation correspondence |
| | Telephone | (519) 470-3000 (ext.201) | c/o Grey Sauble Conservation Authority | 26-Feb-20 | R | | | | | | | X | | Response to consultation request |
| | Fax | (519) 470-3005 | R.R.#4; 237897 Inglis Falls Road | 21-Apr-20 | S | | | | | X | X | | | |
| | E-mail | c.seider@waterprotection.ca | Owen Sound, ON N4K 5N6 | | | | | | | | | | | |
| | E-mail | mail@waterprotection.ca | | | | | | | | | | | | |
| **Grey-Bruce Health Unit** | Contact | Public Health Inspector | Grey Bruce Health Unit | 25-Feb-20 | S | | | X | X | | | | | |
| | Telephone | (519) 376-9420 | 101 17th Street East | 21-Apr-20 | S | | | | | X | X | | | |
| | Fax | (519) 376-5043 | Owen Sound, ON N4K 0A5 | | | | | | | | | | | |
| | E-mail | publichealth@publichealthgreybruce.on.ca | | | | | | | | | | | | |

# CIRCULATION LIST: AGENCIES INDIGENOUS COMMUNITIES
# BRUCE ROAD 25 RE-CONSTRUCTION
# SCHEDULE B EA
# PROJECT FILE

| AGENCY | CONTACT INFORMATION | | ADDRESS | INFORMATION SENT | | | | | | | | | DESCRIPTION | COMMENTS/RESPONSE RECEIVED (DESCRIPTION) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | DATE SENT or RECEIVED | VIA | | | DOCUMENT | | | | | | |
| | | | | | E-mail | Mail | Phone | Notice of Project Initiation | Project File (V1: Feb 2020) | Notice of Project Completion | Project File (V2: April 2020) | Other | | |
| **PROVINCIAL AGENCIES** | | | | | | | | | | | | | | |
| **Ministry of the Environment,** | Contact | Ian Mitchell, P.Eng. | MECP | 25-Feb-20 | S | | | X | X | | | | | |
| **Conservation and Parks** | | District Engineer | Owen Sound Area Office | 21-Apr-20 | S | | | | | X | X | | | |
| **Owen Sound Area Office** | Telephone | (519) 371-6191 | 101 17th Street East, 3rd Floor | | | | | | | | | | | |
| | Fax | (519) 371-2905 | Owen Sound, ON N4K 0A5 | | | | | | | | | | | |
| | E-mail | ian.mitchell@ontario.ca | | | | | | | | | | | | |
| **Ministry of the Environment,** | Contact | Rob Wrigley | MECP - Southwest Region | 25-Feb-20 | S | | | X | X | | | | | Project Information Form included. |
| **Conservation and Parks** | | Manager | Technical Support Section | | | | | | | | | | | Craig Newton was contact for previous Phases |
| **Southwestern Region** | | Southwest Region | 733 Exeter Road | 21-Apr-20 | S | | | | | X | X | | | |
| | Telephone | (519) 280-3077 | London, ON N6E 1L3 | | | | | | | | | | | |
| | Fax | (519) 873-5020 | | | | | | | | | | | | |
| | Email | rob.wrigley@ontario.ca | | | | | | | | | | | | |
| | Email | eanotification.swregion@ontario.ca | | | | | | | | | | | | |
| **Ministry of the Environment,** | Contact | Barb Slattery | MECP - West Central Region | 25-Feb-20 | S | | | X | X | | | | | Project Information Form included. |
| **Conservation and Parks** | | EA/Planning Coordinator | Technical Support Section | | | | | | | | | | | Barb Slattery reviewed the Phase 4 Sch B EA (following Craig Newton's retirement). |
| **West Central Region** | | West Central Region | Ellen Fairclough Bldg 12th Flr | | | | | | | | | | | |
| | Telephone | (905) 521-7864 | 119 King St W | 10-Mar-20 | R | | | | | | | X | | Outline of Aboriginal and SWP Consultation Requirements |
| | Fax | | Hamilton, ON L8P 4Y7 | | | | | | | | | | | |
| | Email | barbara.slattery@ontario.ca | | 21-Apr-20 | S | | | | | X | X | | | |
| **Ministry of the Environment,** | Contact | Callee Robinson | MECP | 25-Feb-20 | S | | | X | X | | | | | |
| **Conservation and Parks** | | Project Officer | Environmental Approvals Branch | 21-Apr-20 | S | | | | | X | X | | | |
| **Environmental Assessment and** | | Environmental Assessment Services | 135 St.Clair Ave W, 1st Floor | | | | | | | | | | | |
| **Approvals Branch** | Telephone | (416) 314-0286 | Toronto, ON M4V 1P5 | | | | | | | | | | | |
| | Fax | | | | | | | | | | | | | |
| | Email | callee.robinson@ontario.ca | | | | | | | | | | | | |
| **Ministry of the Environment,** | Contact | Director | MECP | 25-Feb-20 | S | | | X | X | | | | | Project Information Form included. |
| **Conservation and Parks** | Telephone | (416) 314-7288 | Environmental Approvals Branch | 21-Apr-20 | S | | | | | X | X | | | |
| **Environmental Assessment and** | Fax | (416) 314-8452 | 135 St.Clair Ave W, 1st Floor | | | | | | | | | | | |
| **Approvals Branch** | E-mail | EAASIBgen@ontario.ca | Toronto, ON M4V 1P5 | | | | | | | | | | | |
| | | mea.notices.eaab@ontario.ca | | | | | | | | | | | | Notice of Completion only |
| **Ministry of Natural Resources and** | Contact | Jodi Benvenuti | Ministry on Natural Resources and Forestry | 25-Feb-20 | S | | | X | X | | | | | |
| **Forestry** | Telephone | (519) 371-8471 | Owen Sound Area Office | 21-Apr-20 | S | | | | | X | X | | | |
| | Fax | (519) 372-3305 | 1450 7th Avenue East | | | | | | | | | | | |
| | E-mail | jodi.benvenuti@ontario.ca | Owen Sound, ON N4K 2Z1 | | | | | | | | | | | |
| **Ministry of Natural Resources and** | Contact | Ken Mott, District Planner | Ministry on Natural Resources and Forestry | 25-Feb-20 | S | | | X | X | | | | | Services Grey, Bruce, Simcoe and Dufferin |
| **Forestry** | Telephone | (705) 725-7546 | Midhurst District | 21-Apr-20 | S | | | | | X | X | | | |
| | Fax | (705) 725-7584 | 2284 Nursery Road | | | | | | | | | | | |
| | E-mail | ken.mott@ontario.ca | Midhurst, ON L9X 1N8 | | | | | | | | | | | |
| **Ministry of Agriculture, Food and** | Contact | Carolyn Hamilton | Ministry of Agriculture, Food and Rural Affairs | 25-Feb-20 | S | | | X | X | | | | | |
| **Rural Affairs** | | Director, Rural Programs Branch | Rural Programs Branch | 21-Apr-20 | S | | | | | X | X | | | |
| | Telephone | (519) 826-3419 | Ontario Government Building | | | | | | | | | | | |
| | Fax | | 1 Stone Road West, 4th Floor NW | | | | | | | | | | | |
| | E-mail | carolyn.hamilton@ontario.ca | Guelph, Ontario N1G 4Y2 | | | | | | | | | | | |
| **Ministry of Transportation** | Contact | Steve Hood | Ministry of Transportation | 25-Feb-20 | S | | | X | X | | | | | |
| | | Technical Services Supervisor | 1450 7th Ave E | 21-Apr-20 | S | | | | | X | X | | | |
| | Telephone | (519) 372-4036 | Owen Sound, ON N4K 2Z1 | | | | | | | | | | | |
| | E-mail | steve.hood@ontario.ca | | | | | | | | | | | | |
| **Ministry of Tourism, Culture and** | Contact | Karla Barboza, Team Lead - Heritage (Acting) | MTCS | 25-Feb-20 | S | | | X | X | | | | | |
| **Sport** | Telephone | (416) 314-7120 | 401 Bay Street | March 6 to 27 | S/R | | | | | | | X | | Consultation/Clarification |
| **Culture Division** | Fax | | Toronto, ON M7A 0A7 | 21-Apr-20 | S | | | | | X | X | | | |
| **Heritage Program Unit** | E-mail | karla.barboza@ontario.ca | | | | | | | | | | | | |

# CIRCULATION LIST: AGENCIES INDIGENOUS COMMUNITIES
# BRUCE ROAD 25 RE-CONSTRUCTION
# SCHEDULE B EA
# PROJECT FILE

| AGENCY | CONTACT INFORMATION | | ADDRESS | INFORMATION SENT | | | | | | | | | | COMMENTS/RESPONSE RECEIVED (DESCRIPTION) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | DATE SENT or RECEIVED | VIA | | | DOCUMENT | | | | | DESCRIPTION | |
| | | | | | E-mail | Mail | Phone | Notice of Project Initiation | Project File (V1: Feb 2020) | Notice of Project Completion | Project File (V2: April 2020) | Other | | |
| **FEDERAL AGENCIES** | | | | | | | | | | | | | | |
| **Environment and Climate Change Canada** | Contact | Environmental Assessment Coordinator | Environment and Climate Change Canada | 25-Feb-20 | S | | | X | X | | | | | |
| | Telephone | (416) 739-4734 | Ontario Region | 21-Apr-20 | S | | | | | X | X | | | |
| | Fax | (416) 739-4776 | 4905 Dufferin Street | | | | | | | | | | | |
| | E-mail | ec.ecoactionon.ec@canada.ca | Toronto, Ontario M3H 5T4 | | | | | | | | | | | |
| **Indigenous and Northern Affairs Canada** | Contact | Environmental Assessment Coordinator | Indigenous and Northern Affairs | 25-Feb-20 | S | | | X | X | | | | | |
| | Telephone | (416) 973-4004 | Ontario Region | 21-Apr-20 | S | | | | | X | X | | | |
| | Fax | (416) 954-6201 | 25 St Clair Ave East, 8th Floor | | | | | | | | | | | |
| | E-mail | InfoPubs@aadnc-aandc.gc.ca | Toronto, Ontario M4T 1M2 | | | | | | | | | | | |
| **UTILITIES** | | | | | | | | | | | | | | |
| **Bell Access Network** | Contact | Nicolas Kellar | Bell Access Network | 25-Feb-20 | S | | | X | X | | | | | |
| | Telephone | (519) 371-5450 | 870-4th Avenue East | 21-Apr-20 | S | | | | | X | X | | | |
| | Fax | (519) 376-3563 | Owen Sound, ON | | | | | | | | | | | |
| | E-mail | nicholas.kellar@bell.ca | N4K 2N7 | | | | | | | | | | | |
| **Hydro One Networks Inc.** | Contact | Kevin Brackley | Hydro One Networks Inc. | 25-Feb-20 | S | | | X | X | | | | | |
| | Telephone | (888) 664-9376 | 45 Sargeant Drive, Box 6700 | 21-Apr-20 | S | | | | | X | X | | | |
| | Fax | (905) 944-3251 | Barrie, ON | | | | | | | | | | | |
| | E-mail | Zone5PlanningDept@HydroOne.com | L4N 4V9 | | | | | | | | | | | |
| | cc. | kevin.brackley@hydroone.com | | | | | | | | | | | | |
| | cc. | tammy.scott@hydroone.com | | | | | | | | | | | | |
| **Eastlink** | Contact | Dan Oswald | Eastlink | 25-Feb-20 | S | | | X | X | | | | | |
| | Telephone | (519) 793-3111 | 77 Main Street | 21-Apr-20 | S | | | | | X | X | | | |
| | Fax | | Lion's Head, ON N0H 1W0 | | | | | | | | | | | |
| | E-mail | dan.oswald@corp.eastlink.ca | | | | | | | | | | | | |
| **Bruce Telecom (BMTS)** | Contact | Head Office | BMTS - Tiverton - Head Office | 25-Feb-20 | S | | | X | X | | | | | |
| | Telephone | (519) 368-2000 | 3145 Highway 21 | 21-Apr-20 | S | | | | | X | X | | | |
| | Fax | | P.O. Box 80 | | | | | | | | | | | |
| | E-mail | admin@brucetelecom.com | Tiverton, ON N0G 2T0 | | | | | | | | | | | |
| **Union Gas Limited** | Contact | Kevin Schimus | Union Gas | 25-Feb-20 | S | | | X | X | | | | | |
| | Telephone | (519) 377-0214 | 603 Krumpf Drive | 21-Apr-20 | S | | | | | X | X | | | |
| | Fax | (519) 376-2591 | P.O. Box 340 | | | | | | | | | | | |
| | E-mail | kschimus@uniongas.com | Waterloo, ON N2J 4A4 | | | | | | | | | | | |
| **Rogers Cable** | Contact | Tony Dominguez | Rogers Cable | 25-Feb-20 | S | | | X | X | | | | | |
| | Telephone | (705) 737-4660 ext. 6923 | 1 Sperling Drive | 21-Apr-20 | S | | | | | X | X | | | |
| | Fax | (705) 737-3840 | Barrie, ON L4M 6B8 | | | | | | | | | | | |
| | E-mail | Tony.Dominguez@rci.rogers.com | | | | | | | | | | | | |

# CIRCULATION LIST: AGENCIES INDIGENOUS COMMUNITIES
# BRUCE ROAD 25 RE-CONSTRUCTION
# SCHEDULE B EA
# PROJECT FILE

| AGENCY | CONTACT INFORMATION | | ADDRESS | INFORMATION SENT | | | | | | | | | | COMMENTS/RESPONSE RECEIVED (DESCRIPTION) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
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| | | | | | E-mail | Mail | Phone | Notice of Project Initiation | Project File (V1: Feb 2020) | Notice of Project Completion | Project File (V2: April 2020) | Other | | |
| **INDIGENOUS COMMUNITIES - Consultations Completed by the County of Bruce** | | | | | | | | | | | | | | |
| **Historic Saugeen Metis** | Contact | Archie Indoe (President) | Historic Saugeen Metis | 25-Feb-20 | S | S | | X | X | | | | | |
| | | George Govier (Consultation Coordinator) | 204 High Street | 21-Apr-20 | S | S | | | | X | X | | | |
| | Telephone | (519) 483-4000 | Box 1492 | | | | | | | | | | | |
| | Contact | Chris Hatchey | Southampton, ON N0H 2L0 | | | | | | | | | | | |
| | | hsmasstlrcc@bmts.com | | | | | | | | | | | | |
| | E-mail | saugeenmetisadmin@bmts.com | | | | | | | | | | | | |
| **Saugeen First Nation** | Contact | Lester Anoquot (Chief) | Saugeen First Nation | 25-Feb-20 | S | S | | X | X | | | | | |
| | | Cheree Urscheler (Band Administrator) | Saugeen Band Office | 21-Apr-20 | S | S | | | | X | X | | | |
| | Telephone | (519) 797-2781 | 6493 Highway 21, R.R.#1 | | | | | | | | | | | |
| | Fax | (519) 797-2978 | Southampton, ON N0H 2L0 | | | | | | | | | | | |
| | E-mail | lester.anoquot@saugeen.org | | | | | | | | | | | | |
| **Metis Nation of Ontario (MNO)** | Contact | James Wagar | Metis Nation of Ontario | 25-Feb-20 | S | S | | X | X | | | | | |
| **Great Lakes Metis Council** | | Consultation Assessment Coordinator | Owen Sound Office | 21-Apr-20 | S | S | | | | X | X | | | |
| **Owen Sound Office** | Telephone | (519) 370-0435 | 380-9th Street East | | | | | | | | | | | |
| | E-mail | jamesw@metisnation.org | Owen Sound, ON N4K 1P1 | | | | | | | | | | | |
| | E-mail | joannem@metisnation.org | | | | | | | | | | | | |
| | E-mail | consultations@metisnation.org | | | | | | | | | | | | |
| **Saugeen Ojibway Nation** | Contact | Doran Ritchie | Saugeen Ojibway Nation | 25-Feb-20 | S | S | | X | X | | | | | |
| **Environmental Office** | | Infrastructure Planning Coordinator | Environment Office | 21-Apr-20 | S | S | | | | X | X | | | |
| | Telephone | (519) 534-5507 (ext. 226) | 25 Maadookii Road | | | | | | | | | | | |
| | Fax | (519) 534-5525 | Neyaashiinigmiing, Ont. | | | | | | | | | | | |
| | E-mail | d.ritchie@saugeenojibwaynation.ca | N0H 2T0 | | | | | | | | | | | |
| **Chippewas of Nawash Unceded** | Contact | Chief Gregory Nadjiwon | Chippewas of Nawash Unceded FN | 25-Feb-20 | S | S | | X | X | | | | | |
| **First Nation** | Telephone | (519) 534-1689 | #135 Lakeshore Blvd. | 21-Apr-20 | S | S | | | | X | X | | | |
| | Fax | (519) 534-2130 | Neyaashiinigmiing, Ont. | | | | | | | | | | | |
| | E-mail | chiefsdesk@nawash.ca | R.R#5 Wiarton, ON N0H 2T0 | | | | | | | | | | | |
| | E-mail | cnadministrator@nawash.ca | | | | | | | | | | | | |

# CIRCULATION LIST: AGENCIES INDIGENOUS COMMUNITIES
# BRUCE ROAD 25 RE-CONSTRUCTION
# SCHEDULE B EA
# PROJECT FILE

| AGENCY | CONTACT INFORMATION | | ADDRESS | INFORMATION SENT | | | | | | | | | | COMMENTS/RESPONSE RECEIVED (DESCRIPTION) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | DATE SENT or RECEIVED | VIA | | | DOCUMENT | | | | | DESCRIPTION | |
| | | | | | E-mail | Mail | Phone | Notice of Project Initiation | Project File (V1: Feb 2020) | Notice of Project Completion | Project File (V2: April 2020) | Other | | |
| **Private Groups: Circulated by the County (mail) and/or GMBP (email)** | | | | | | | | | | | | | | |
| **Lake Ridge Estates** | Contact | Andy Kuperus | Lake Ridge Estates | 25-Feb-20 | S | S | | X | X | | | | | |
| | Telephone | (519) 832-2058 | P.O. Box 614 | 21-Apr-20 | S | | | | | X | X | | | |
| | Fax | (519) 389-4547 | R.R.#3 | | | | | | | | | | | |
| | E-mail | l.kuperus@bmts.com | Port Elgin, ON N0H 2C0 | | | | | | | | | | | |
| **Port Elgin & Saugeen Township Beacher's Organization** | Contact | David Shemilt | Port Elgin & Saugeen Township | 25-Feb-20 | S | S | | X | X | | | | | |
| | Contact | Dave Reynolds, Director | Beacher's Organization | 21-Apr-20 | S | | | | | X | X | | | |
| | Contact | Greg Schmaltz, President | P.O. Box 377 | | | | | | | | | | | |
| | Telephone | (519) 386-0934 | Port Elgin, ON N0H 2C0 | | | | | | | | | | | |
| | E-mail | davereynolds5959@gmail.com | | | | | | | | | | | | |
| | E-mail | manager@beachers.org | | | | | | | | | | | | |
| **CAW Family Education Centre** | Contact | | CAW Family Education Centre | 25-Feb-20 | S | S | | X | X | | | | | |
| | Telephone | (519) 389-3200 | R.R.#1 Bruce County Road 25 | 21-Apr-20 | S | | | | | X | X | | | |
| | Fax | | 115 Shipley Avenue | | | | | | | | | | | |
| | E-mail | confcentre@unifor.org | Port Elgin, ON N0H 2C5 | | | | | | | | | | | |
| **Unifor (CAW)** | Contact | Graeme Brown | Unifor (CAW) | 25-Feb-20 | S | S | | X | X | | | | | |
| | Telephone | (416) 495-3799 | 205 Placer Court | 21-Apr-20 | S | | | | | X | X | | | |
| | Fax | (416) 495-6559 | North York, ON M2H 3H9 | | | | | | | | | | | |
| | E-mail | Graeme.Brown@unifor.org | | | | | | | | | | | | |
| **Cuesta Planning Consultants** | Contact | David Ellingwood | Cuesta Planning Consultants | 25-Feb-20 | S | S | | X | X | | | | | |
| | Telephone | (519) 372-9790 | 978 First Avenue West | 21-Apr-20 | S | | | | | X | X | | | |
| | Fax | | Owen Sound, ON N4K 4K5 | | | | | | | | | | | |
| | E-mail | cuesta@cuestaplanning.com | | | | | | | | | | | | |
| **Barry's Construction and Insulation Ltd.** | Contact | Barry's Construction and Insulation Ltd. | Barry's Construction and Insulation Ltd. | 25-Feb-20 | S | S | | X | X | | | | | |
| | Telephone | (519) 934-3374 | 7839 Highway 21 | 21-Apr-20 | S | | | | | X | X | | | |
| | Fax | | P.O. Box 30 | | | | | | | | | | | |
| | E-mail | stu@barrysconstruction.ca | Allenford, ON N0H 1A0 | | | | | | | | | | | |
| **Interested Public: Members of the community that previously engaged in the planning process for the Master Plan and the re-alignment of Bruce Road 33 were issued Notices via mail or email depending on the contact information previously provided.** | | | | | | | | | | | | | | |

GM BluePlan
ENGINEERING

PEOPLE | ENGINEERING | ENVIRONMENTS

February 25, 2020
Our File: 218428

Via Email: c.seider@waterprotection.ca

Drinking Water Source Protection
c/o Grey Sauble Conservation Authority
Risk Management Office
237897 Inglis Falls Road, RR#4
Owen Sound, ON N4K 5N6

Attention: Mr. Carl Seider

Re: Source Water Protection Consultation
Reconstruction of Bruce Road 25
Goderich Street to Bruce Street
Town of Saugeen Shores
County of Bruce

Dear Carl,

GM BluePlan Engineering has been retained by the County of Bruce, as the proponent, with the Town of Saugeen Shores, as principle partner, to undertake a Schedule 'B' Municipal Class Environmental Assessment (EA) planning process appropriately to plan the re-construction of Bruce Road 25 from the Town's planned alignment of Bruce Street (from the north) to Goderich Street. A Project File (February 2020) has been prepared to address the EA process (Municipal Engineers Association, 2015) and is available on the County and Town websites. The Project File discusses the findings, to date, of Phase 1 and, in part, Phase 2 of the Environmental Assessment process.

As a simplified summary, the project proposes the re-construction of Bruce Road 25 between Goderich Street and the future Bruce Street, where shown on the attached *Notice of Project Initiation*, and will include the installation of watermains and storm and sanitary sewer services, and the extension of an active transportation route along the north side of subject section of road. This will result in road works, potentially outside of the existing rights-of-way, including grading and paving, as well as landscaping of adjacent areas. The creation of lands that would include chemical or fuel storage are not included as part of this plan.

Based on our preliminary review, the Study Area is situated within the Saugeen Valley Source Protection Area. According to the Saugeen-Grey Sauble-Northern Bruce Peninsula Source Protection Plan, the Study Area is not situated within a wellhead protection area (WHPA) or intake protection zone (IPZ) and therefore cannot be considered a significant drinking water threat. Although it does not alter the evaluation of drinking water threats, it is recognized that the site is situated within a significant groundwater recharge area (SGRA) and a highly vulnerable aquifer (HVA), with a vulnerability score of 6.

We have reviewed the recommended Bruce Road 25 re-construction and associated activities in relation to the *Tables for Drinking Water Threats*. Based on the potential scope of the project, it not anticipated that:

i. Any project activities will be considered a prescribed drinking water threat; or
ii. Any activities will change or create new vulnerable areas.

As part of the EA process, we are reviewing the project with respect to requirements under the Clean Water Act. At this time, we are requesting confirmation of the above, as well as whether you are aware of any other potential considerations and policies in the Source Protection Plan that may apply to the project.

Should you have any questions, please feel free to contact our office.

Yours truly,

GM BLUEPLAN ENGINEERING LIMITED
Per:

Matthew Nelson, P.Eng., P.Geo.
AN/mr

cc: County of Bruce: Jim Donohoe, via Email – jdonohoe@brucecounty.on.ca
File No. 218428

County of Bruce Transportation &
Environmental Services Department
30 Park Street, P.O. Box 398, Walkerton, ON N0G 2V0
(519) 881-2400

brucecounty.on.ca

February 21, 2020

Chippewas of Nawash Unceded First Nation
135 Lakeshore Boulevard
Neyaashiinigmiing
RR# 5
Wiarton ON N0H 2T0

Attention: Chief Gregory Nadjiwon

**Re: Schedule B Environmental Assessment - Bruce Road 25 Reconstruction**

The County of Bruce and Town of Saugeen Shores completed a Master Plan for Roads and Drainage for Bruce Road 25 and Bruce Road 33 in May 2017. The Master Plan identified several projects which have been planned in the following phases:

Phase 1: Bruce Road 25 – Trunk storm sewer from Ridge Street to Lake Huron, including a full urbanized road section from Lake Range Road (Bruce Road 33) to Saugeen Beach Road. This phase was completed in 2019.

Phase 2: Bruce Road 25 – Two lane urbanized road section from Lake Range Road (Bruce Road 33) to Bruce Street, including local storm sewer, watermain and sanitary sewers. This phase is scheduled to be constructed in 2020.

Phase 3: Bruce Road 25 - Four lane urbanized cross section on Bruce Road 25 from Bruce Street to Goderich Street, including municipal services. This phase is being planned under the current Schedule B Environmental Assessment process.

Phase 4: Bruce Road 33 – Construction of the new Bruce Road 33 realignment. The Schedule B Environment Assessment is completed; construction is anticipated for 2022.

The County has initiated a Schedule B Environmental Assessment (EA) process to plan the re-construction of Bruce Road 25 (Phase 3) as considered in the Master Plan. The Notice of Project Initiation is enclosed.

The EA Project File will be available on the County of Bruce and the Town of Saugeen Shores websites and at the County of Bruce Administration Building and Town of Saugeen Shores Municipal Office on February 25, 2020. Comments are invited for incorporation into the planning of this project and will be received by GMBluePlan Engineering and/or the County until March 24, 2020.

We will continue to provide correspondence as the project progresses. Please contact the County should you have any questions, comments or require additional information.

Yours truly,

Jim Donohoe, P.Eng
Engineering Manager

Encls.

c: John Slocombe, GM BluePlan Engineering Ltd.
Amanda Froese, Town of Saugeen Shores
Kerri Meier, County of Bruce

45.0°N 81.3°W
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County of Bruce Transportation &
Environmental Services Department
30 Park Street, P.O. Box 398, Walkerton, ON N0G 2V0
(519) 881-2400

brucecounty.on.ca

February 21, 2020

Metis Nation of Ontario
Unceded Great Lakes Metis Council
380-9th Street
Owen Sound, ON N4K 1P1

Attention: James Wagar

**Re: Schedule B Environmental Assessment - Bruce Road 25 Reconstruction**

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Yours truly,

Jim Donohoe, P.Eng
Engineering Manager

Encls.

c: John Slocombe, GM BluePlan Engineering Ltd.
Amanda Froese, Town of Saugeen Shores
Kerri Meier, County of Bruce

County of Bruce Transportation &
Environmental Services Department
30 Park Street, P.O. Box 398, Walkerton, ON N0G 2V0
(519) 881-2400

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February 21, 2020

Historic Saugeen Metis
P.0 Box 1492
204 High Street
Southampton, ON N0H 2L0

Attention: George Govier

**Re: Schedule B Environmental Assessment - Bruce Road 25 Reconstruction**

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Yours truly,

Jim Donohoe, P.Eng
Engineering Manager

Encls.

c: John Slocombe, GM BluePlan Engineering Ltd.
Amanda Froese, Town of Saugeen Shores
Kerri Meier, County of Bruce

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County of Bruce Transportation &
Environmental Services Department
30 Park Street, P.O. Box 398, Walkerton, ON N0G 2V0
(519) 881-2400

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February 21, 2020

Saugeen First Nation
Chippewas of Saugeen First Nation No. 29
6493 Highway 21, RR#1
Southampton, ON N0H 2L0

Attention: Cheree Urscheler

**Re: Schedule B Environmental Assessment - Bruce Road 25 Reconstruction**

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Yours truly,

Jim Donohoe, P.Eng
Engineering Manager

Encls.

c: John Slocombe, GM BluePlan Engineering Ltd.
Amanda Froese, Town of Saugeen Shores
Kerri Meier, County of Bruce

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County of Bruce Transportation &
Environmental Services Department
30 Park Street, P.O. Box 398, Walkerton, ON N0G 2V0
(519) 881-2400

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February 21, 2020

Saugeen Ojibway Nation
SON Environmental Office
25 Maadookii Subdivision
RR#5, Wiarton, ON N0H 2T0

Attention: Doran Ritchie

**Re: Schedule B Environmental Assessment - Bruce Road 25 Reconstruction**

The County of Bruce and Town of Saugeen Shores completed a Master Plan for Roads and Drainage for Bruce Road 25 and Bruce Road 33 in May 2017. The Master Plan identified several projects which have been planned in the following phases:

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Yours truly,

Jim Donohoe, P.Eng
Engineering Manager

Encls.

c: John Slocombe, GM BluePlan Engineering Ltd.
Amanda Froese, Town of Saugeen Shores
Kerri Meier, County of Bruce

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**County of Bruce Transportation &**
**Environmental Services Department**
30 Park Street, P.O. Box 398, Walkerton, ON N0G 2V0
(519) 881-2400

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April 21, 2020

Chippewas of Nawash Unceded First Nation
135 Lakeshore Boulevard
Neyaashiinigmiing
RR# 5 Wiarton ON N0H 2T0

Attention: Chief Gregory Nadjiwon

**Re: Schedule 'B' Environmental Assessment - Bruce Road 25 (Phase 3)**

The County of Bruce and Town of Saugeen Shores completed a Master Plan for Roads and Drainage for Bruce Road 25 and Bruce Road 33 in May 2017. The Master Plan identified several projects including the reconstruction of Bruce Road 25 (BR25), from the Town's planned alignment of the future Bruce Street to Goderich Street (Highway 21). The Bruce Road 25 project was undertaken in accordance with the Municipal Class Environmental Assessment (EA) Planning Process as a Schedule 'B' Project. On February 25, 2020, the County issued a *Notice of Project Initiation* outlining three alternative solutions:

Alternative 1: Do Nothing
Alternative 2: Construct a two-lane urbanized cross section along BR25
Alternative 3: Construct a four-lane urbanized cross section along BR25

The Master Plan (May 2017) and Bruce Road 25 Project File (Version 1) was available for viewing on the County and Town websites, with comments requested by March 24, 2020. The County, Town and Consultant reviewed the comments received through the process and Recommended the Preferred Solution as Alternative 2: Construct a two-lane urbanized cross section along BR25. The Preferred Solution was accepted by the County's Transportation and Environmental Services Committee on April 21, 2020. This project will include a roundabout at the planned alignment of the future Bruce Street. In addition, the County and the Town have committed to the inclusion of full urban services and the provision for a multi-use trail along BR25 in the overall design and construction of this project. The County is therefore proceeding with issuing the enclosed *Notice of Project Completion*.

Please contact our office if you have any questions, comments or require additional information.

Yours truly,

Jim Donohoe
Engineering Manager

Encl.

cc: John Slocombe, GM BluePlan Engineering Ltd
Amanda Froese, Town of Saugeen Shores

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**County of Bruce Transportation &**
**Environmental Services Department**
30 Park Street, P.O. Box 398, Walkerton, ON N0G 2V0
(519) 881-2400

brucecounty.on.ca

April 21, 2020

Historic Saugeen Metis
P.O. Box 1492, 204 High Street
Southampton, ON N0H 2L0

Attention: George Govier

**Re: Schedule ‘B’ Environmental Assessment - Bruce Road 25 (Phase 3)**

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Yours truly,

Jim Donohoe
Engineering Manager

Encl.

cc: John Slocombe, GM BluePlan Engineering Ltd
Amanda Froese, Town of Saugeen Shores

**County of Bruce Transportation &**
**Environmental Services Department**
30 Park Street, P.O. Box 398, Walkerton, ON N0G 2V0
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**brucecounty.on.ca**

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April 21, 2020

Metis Nation of Ontario
Great Lakes Metis Council
380-9th Street
Owen Sound, ON N4K 1P1

Attention: James Wagar

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**County of Bruce Transportation & Environmental Services Department**
30 Park Street, P.O. Box 398, Walkerton, ON N0G 2V0
(519) 881-2400

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Please contact our office if you have any questions, comments or require additional information.

Yours truly,

Jim Donohoe
Engineering Manager

Encl.

cc: John Slocombe, GM BluePlan Engineering Ltd
Amanda Froese, Town of Saugeen Shores

**County of Bruce Transportation & Environmental Services Department**
30 Park Street, P.O. Box 398, Walkerton, ON N0G 2V0
(519) 881-2400

brucecounty.on.ca

April 21, 2020

Saugeen First Nation
Chippewas of Saugeen First Nation No.29
6493 Highway 21, RR#1
Southampton, ON N0H2L0

Attention: Cheree Urscheler

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**County of Bruce Transportation &**
**Environmental Services Department**
30 Park Street, P.O. Box 398, Walkerton, ON N0G 2V0
(519) 881-2400

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Please contact our office if you have any questions, comments or require additional information.

Yours truly,

Jim Donohoe
Engineering Manager

Encl.

cc: John Slocombe, GM BluePlan Engineering Ltd
Amanda Froese, Town of Saugeen Shores

BRUCE
county

**County of Bruce Transportation &**
**Environmental Services Department**
30 Park Street, P.O. Box 398, Walkerton, ON N0G 2V0
(519) 881-2400

brucecounty.on.ca

April 21, 2020

Saugeen Ojibway Nation
SON Environmental Office
25 Maadookii Subdivision
RR#5, Wiarton ON N0H 2T0

Attention: Doran Ritchie

**Re: Schedule 'B' Environmental Assessment - Bruce Road 25 (Phase 3)**

The County of Bruce and Town of Saugeen Shores completed a Master Plan for Roads and Drainage for Bruce Road 25 and Bruce Road 33 in May 2017. The Master Plan identified several projects including the reconstruction of Bruce Road 25 (BR25), from the Town's planned alignment of the future Bruce Street to Goderich Street (Highway 21). The Bruce Road 25 project was undertaken in accordance with the Municipal Class Environmental Assessment (EA) Planning Process as a Schedule 'B' Project. On February 25, 2020, the County issued a *Notice of Project Initiation* outlining three alternative solutions:

Alternative 1: Do Nothing
Alternative 2: Construct a two-lane urbanized cross section along BR25
Alternative 3: Construct a four-lane urbanized cross section along BR25

The Master Plan (May 2017) and Bruce Road 25 Project File (Version 1) was available for viewing on the County and Town websites, with comments requested by March 24, 2020. The County, Town and Consultant reviewed the comments received through the process and Recommended the Preferred Solution as Alternative 2: Construct a two-lane urbanized cross section along BR25. The Preferred Solution was accepted by the County's Transportation and Environmental Services Committee on April 21, 2020. This project will include a roundabout at the planned alignment of the future Bruce Street. In addition, the County and the Town have committed to the inclusion of full urban services and the provision for a multi-use trail along BR25 in the overall design and construction of this project. The County is therefore proceeding with issuing the enclosed *Notice of Project Completion*.

45.0°N 81.3°W
BRUCE
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30 Park Street, P.O. Box 398, Walkerton, ON N0G 2V0
(519) 881-2400

brucecounty.on.ca

Please contact our office if you have any questions, comments or require additional information.

Yours truly,

Jim Donohoe
Engineering Manager

Encl.

cc: John Slocombe, GM BluePlan Engineering Ltd
Amanda Froese, Town of Saugeen Shores

# APPENDIX B:
# MASTER PLAN – PREFFERED SOLUTIONS

Gamsby and Mannerow
ENGINEERS

# RECONSTRUCTION OF BRUCE COUNTY ROAD 25
# (GODERICH ST. TO HIGHLAND STREET)
# MINUTES OF MEETING
## Our File: M-1552

**DATE:** July 20, 2010

**ATTENDEES:**
Mayor Mike Smith - Warden/Mayor
Brian Knox, P.Eng.– County of Bruce (Highways Department)
John Slocombe, P. Eng.– Gamsby and Mannerow Ltd.
Larry Allison - Town of Saugeen Shores
Dave Burnside - Town of Saugeen Shores
Roger Carson - Direct Landowner
Pete Ens - Direct Landowner
Pete Ens (Jr.) - Direct Landowner
Andy Kuperus - Direct Landowner
Marcie and Rick Leeder - Direct Landowner
Grant Snyder - Direct Landowner
Steven Snyder - Direct Landowner
Keith Snyder - Direct Landowner
Ray Fenton - Direct Landowner
Amy Walton and Dave Fenton - Direct Landowner
Tom Fenton - Direct Landowner

**COPIES TO:** All attendees

**DISCUSSION:** | **ACTION BY**

1. Brian Knox extended greetings to all in attendance.

2. Brian Knox provided a brief background of the project. One of the identified needs for the project is to improve drainage within the County Road 25 (CR25) catchment to mitigate existing flooding issues on CR25 and to resolve drainage concerns related to existing and future development within the catchment area.

   A second identified need for the project is to accommodate expected future traffic flow patterns once the three planned roads are extended from the north to intersect CR25. Bruce Street has been planned by the Town as a collector road to parallel Goderich Street across the length of Port Elgin. Because of this, a re-alignment of CR33 is being considered to improve north-south traffic flow and to improve upon the deficiencies at the existing CR25/CR33 intersection. An alternate alignment of CR33 with the future Highland Street is also being considered.

**DISCUSSION:** **ACTION BY**

A third identified need for the project is related to the anticipated urbanization of the area. CR25 is being considered for a 4-lane cross-section from Goderich Street, but the westerly limit would be dependent upon the re-alignment location, if any, of CR33.

3. John Slocombe briefly outlined the Municipal Class Environmental Assessment (EA) process and indicated that this meeting of stakeholders is intended to provide information to the directly affected property owners, and to further identify some of the issues/concerns, related to the project alternatives.

   It was noted that the EA process is still in the "Review of Alternatives" Phase, and that several background studies have been prepared.

4. John Slocombe summarized the problems of interest and the consideration to date.

   i) **Drainage:** The Lake Range Estates Subdivision, being developed by Andy Kuperus, requires a drainage outlet. Attempts were made to re-direct flows to the adjacent South-End Drain but, due to the expense and technical difficulties, this option was determined not to be practical during the subdivision planning process. Existing drainage facilities on CR25 are inadequate to accept any additional flow and, therefore, a storm sewer along CR25 to Lake Huron has been considered. A third option, to direct flows from the easterly portion of the CR25 catchment area southerly along a re-aligned CR33 to the existing Gore Drain outlet, has also been considered, but a large SWM pond would be required such that downstream flows would not be increased.

   ii) **Traffic Circulation/Urbanization:** The County has expressed an interest in, ultimately, re-aligning CR33 to the Bruce Street intersection to maintain a controlled cross intersection at the location of the anticipated higher traffic volume. This would improve safety for the driving public by reducing 4-tee intersections to one heavier use cross intersection and two lighter use tee intersections. Further, there is an interest in reconstructing CR25 to a 4-lane urban cross-section from Goderich Street to the Bruce Street/CR33 intersection. CR33 would be constructed to a rural standard. The balance of CR25, west of Bruce Street, would be turned over to the Town, as would the existing CR33 south of CR25 to the intersection with the re-aligned CR33.

5. General Discussion ensued with several questions/comments received from the stakeholders:

   - Amy Walton and Dave Fenton indicated their concern that a road widening would impact on their dwelling, located west of the future Highland Street intersection.

| **DISCUSSION:** | **ACTION BY** |
|---|---|
| ➢ Marcie and Rick Leeder indicated that they have no intention to develop their land or to allow Bruce Street to be extended through their property at this time. | |
| ➢ Ray Fenton indicated that development in the area is essentially frozen until a solution is found particularly for drainage. | |
| ➢ Dave Burnside indicated that Bruce Street is planned with a 14m asphalt width but the number of lanes for traffic is not yet established or designed as a collector. | |
| ➢ Brian Knox noted that traffic is relatively light on CR25/33 but road connections from the north would increase traffic flows. | |
| ➢ The current design speed on CR33 is 50 km/hr but the County is considering raising posted limit on re-aligned CR33 to 80 km/hr. | |
| ➢ Mr. Snyder questioned if water/sanitary services be extended along CR33? | |
| ➢ Brian Knox indicated a vision of a rural section for CR33, with no services. Services could be extended in the future along Town-owned roads, as development progresses further. | |
| ➢ Larry Allison indicated part of the project area is within urban area and should ultimately be serviced. Dave Burnside noted that the Servicing Master Plan identifies trunk services and that planning would have included those areas in catchment for trunk services. | |
| ➢ Brian Knox indicated that developers would have to pay to put services in first because it is unlikely that the County or Town would front-end those costs. | |
| ➢ Brian Knox noted that timing for a drainage solution (storm sewer) should precede road connections, but the intent of the EA is to plan the entire project. | |
| ➢ The Leeders questioned if Bruce Street goes through will zoning follow to allow development? It was noted that Landowners would need to apply for zoning changes to support the development they intended establishing a Bruce Street ROW may create a natural severance but would not change existing zoning. | |
| ➢ Brian Knox noted that the intent of this EA planning process is to establish long term objectives, even if the entire project is not fully built in one phase. | |

**DISCUSSION:** **ACTION BY**

6. There was general discussion on traffic circulation.

   - Andy Kuperus underlined the need to resolve the drainage issue first and asked if there was some consensus on a forward direction.

   - There appeared to be a consensus on the following:

     i) That a storm sewer on CR25 to the Lake was an appropriate solution to drainage for the CR25 catchment area.
     ii) That, ultimately, Bruce Street and CR33 should re-align to a cross-intersection, the timing of which may be at some point in the future.
     iii) That urbanization to the west limit of LRE may be appropriate for the short term, with extending the urban section to the future Bruce Street taken under advisement. Brian Knox indicated a preference to complete the construction on CR25 to the limit of the urban section as one project.

7. Next steps were identified as follows:
   i) Consolidate alternative solutions.
   ii) Complete the evaluation of alternative solutions.
   iii) Advertise and hold a Public Meeting.
   iv) Select a Preferred Solution.
   v) Review and confirm choice of Project Schedule.
   vi) Upon advertisement of Notice of Completion, a 30 day review period is allowed for the public to request the Minister to apply a Part 2 order.

The stakeholders will be advised as the project planning progresses.

---

These are the minutes as noted. Please report any errors or omissions to the author.

Yours truly,

GAMSBY AND MANNEROW LIMITED
Per:

J. B. Slocombe, P.Eng.
JBS/ah
cc: All Present
File No. M-1552

Gamsby and Mannerow
ENGINEERS

**BRUCE ROAD 25 AND BRUCE ROAD 33 REALIGNMENT**
**Town of Saugeen Shores – Port Elgin**
**August 11, 2017 -10am**

MEETING MINUTES

Attendees:
Amanda Froese, Town of Saugeen Shores
Adam Stanley, Town of Saugeen Shores
Len Perdue, Town of Saugeen Shores
John Slocombe, GM BluePlan
Brian Knox, Bruce County Highways
Kerri Meier, Bruce County Highways

## Master Plan – Bruce Road 25 & Bruce Road 33 Realignment

Background on the outcome of the Master Plan for Roads and Drainage was provided:

Drainage:

- Construct a new 1:100 year capacity storm sewer on Bruce Road 25 from Goderich St. to Lake Range Road
- Construct a new 1:5 year capacity storm sewer on Bruce Road 25 from Lake Range Road to Lake Huron
- Provide a 1:100 year overland flow route within an urban road cross section on Bruce Road 25 from Lake Range Road westerly to spill to the watercourse west of Shipley Ave
- Provide a secondary local storm sewer system on Bruce Road 25 west of Lake Range Road to collect and treat road runoff prior to discharging to the watercourse outlet west of Shipley Ave
- Construct a local area storm sewer system within Baker Subdivision at the time of the sanitary sewer installation

Road:

- Re-align Bruce Road 33 to intersect Bruce Road 25 at the planned Bruce Street Location
- A 4-lane urban cross section on Bruce Road 25 from Goderich Street (Highway 21) to the planned Bruce Street intersection
- A dedicated left turn lane on eastbound Bruce Road 25 at Goderich Street
- A stop-controlled “Tee” intersection on the planned Stickel Street at Bruce Road 25
- Traffic signals at the planned Bruce Street/Bruce Road 25 intersection
- A 2-lane urban cross section on Bruce Road 25 from the planned Bruce Street intersection to Saugeen Beach Road
- A stop-controlled “Tee” intersection on the planned Ridge Street at Bruce Road 25
- A Multi-Use Trail from Goderich Street to Saugeen Beach Road on the north side of Bruce Road 25
- Transfer of Bruce Road 33 from Bruce Road 25 southerly to about Baker Road from the County to the Town
- Transfer of Bruce Road 25 from the planned Bruce Street intersection westerly to Saugeen Beach Road from the County to the Town

**Development charges**

- Town inquired into whether the County has considered incorporating development charges
- Brian noted that this has not been a past practice of the County.

**Land Purchases**

- The County has been in discussion with Tom Fenton and Peter Ens about land purchases. Both landowners are interested in moving forward and have questions regarding severances and servicing of properties.
- Brian asked John to prepare a plan of the County Road 33 realignment and include the remaining parcels of land owned by Tom Fenton and Peter Ens.
- Amanda suggested that the Town and County planners set up a meeting with the two landowners to review the project and implications on their properties.
- There are four properties at the intersection of Bruce Road 25 and Goderich St that require land purchases to accommodate the five lanes. Two properties are within County jurisdiction and two are within the Towns.

**Proposed 2017 Work**

- Geotechnical work for the entire project will be facilitated by GMBluePlan
- GMBluePlan to undertake engineering for the project and specifically 2018 work including a rough estimate of the work scheduled for each year.
- GMBluePlan to investigate whether undertaking the installing the 2018 storm sewer would be best coordinated with the required road work between Saugeen Beach Road and the planned Bruce Street
- County and Saugeen Shores to develop cost-sharing agreement.
- GMBluePlan to prepare a plan identifying tree removal to accommodate the project in order that adjacent landowners can be approached.
- It was agreed that the Master Plan facilitates the land purchase for the CR 33 realignment. The County would pursue the re-alignment land purchases.
- The County will complete the Schedule B project and provide notice to landowners (via mail out) and public (via newspaper).
- Town to review the Master Servicing Study to confirm requirements for services along the new Bruce Road 33.

**Proposed 2018 Work**

- Schedule A+
- Construct a new 1:100 year capacity storm sewer on Bruce Road 25 from the Kaparus SWM pond to Lake Range Road
- Construct a new 1:5 year capacity storm sewer on Bruce Road 25 from Lake Range Road to Lake Huron
- Provide a 1:100 year overland flow route within an urban road cross section on Bruce Road 25 from Lake Range Road westerly to spill to the watercourse west of Shipley Ave, it was thought that storm work would be shared on a 50-50 basis between County and Town. Town and County to review timing and costs.
- Provide a secondary local storm sewer system on Bruce Road 25 west of Lake Range Road to collect and treat road runoff prior to discharging to the watercourse outlet west of Shipley Ave. Town to review timing and costs.
- Implement the findings of the GMBluePlan investigation of storm sewer and potentially construct the 2-lane urban cross section work between Saugeen Beach Road and the planned Bruce Street, including a 3 meter wide multiuse trail in the north boulevard

and water and sanitary services where required. There were ongoing discussions on the cost-sharing of this work.

- Consider whether the project or the developer would construct the apron for a stop-controlled "Tee" intersection on the planned Ridge Street at Bruce Road 25.
- Road work will be contracted out by the County
- Bruce Road 25 from planned Bruce Street to the Saugeen Beach Road will be transfer to Saugeen Shores once Bruce Road 33 realignment is completed.

**Proposed 2019 Work**

- Schedule B – Notice in papers and mail outs to direct landowners (County)
- Construct a 4-lane urban cross section on Bruce Road 25 from Goderich Street (Highway 21) to the planned Bruce Street intersection with a dedicated left turn lane on eastbound Bruce Road 25 intersection and including a stop-controlled "Tee" intersection on the planned Stickel Street at Bruce Road 25. Include a 3 m wide multi-use trail on north boulevard and including water and sanitary services where required.
- GMBluePlan to provide the Town with CAD files to prepare PHM125 drawings for the traffic signals at the Goderich St. intersection. These signals will be the responsibility of the Town of Saugeen Shores
- GMBluePlan to provide the County with CAD files to prepare the PHM125 drawings for the traffic signals at the Bruce Road 25 and Bruce Road 33 alignment (Bruce Street). These signals will be the responsibility of the County.
- Road work will be contracted out by the County
- Potential to start Storm water management pond at the Bruce Road 33 realignment

**Proposed 2020 Work**

- Schedule B – Notice in papers and mail outs to direct landowners (County)
- Construct the realignment of Bruce Road 33 to intersect Bruce Road 25 at the planned Bruce Street Location
- County is of the opinion that BR 33 would be constructed as a rural road
- Discussions regarding the urban planning limit as well as potential for sideroad locations were held, these details will be further reviewed with planning departments and current landowners.
- It was noted that the road will require an elevated road platform for storm drainage purposes.
- The potential to provide servicing of BR 33 to the urban planning limit is being considered.
- There was discussion on the rehabilitation of the section of Lake Range Road, currently Bruce Road 33, from Bruce Road 25 to the beginning of the realignment. It appeared clear that the County would be involved in the apron from the realigned Bruce Road 33 onto Lake Range Road.
- Traffic signals at the Bruce Road 25 and Bruce Road 33 alignment (Bruce Street) will be the responsibility of the County.
- Transfer of Bruce Road 33 from Bruce Road 25 southerly to about Baker Road from the County to the Town.
- Transfer of Bruce Road 25 from the planned Bruce Street intersection westerly to Saugeen Beach Road from the County to the Town.

**Preliminary Cost Sharing**

**2017**

- Engineering - County

**2018**

- Geotechnical Investigation – County
- Land purchases/Legal – County and Saugeen Shores based on property
- Storm Sewer Servicing – 50/50 County/Town
- Potential roadwork from planned Bruce Street to Saugeen Beach Road to be further discussed.

**2019**

- Traffic Lanes – County
- Curb and Gutter – County
- Storm Service – 50/50 split
- Servicing – Saugeen Shores
- Multi-Use Trail – Saugeen Shores
- Traffic Signals – County (Bruce St.), Saugeen Shores (Goderich St)

**2020**

- Traffic Lanes – County
- Servicing – Saugeen Shores

Proposed Tender dates for Annual Projects

- February / March tender
- April / May construction

**Action Items**

County

- Initiate meeting with Town, County Planning, Fenton and Ens
- Land purchases

GMBluePlan

- Undertake engineering for the project and specifically 2018 work including a rough estimate of the work scheduled for each year.
- Prepare a plan identifying tree removal to accommodate the project in order that adjacent landowners can be approached.
- Geotechnical Investigation

Saugeen Shores

- Land purchases
- Extent of servicing on BR 25 and BR 33 realignment

**Corporation of the County of Bruce** **brucecounty.on.ca**
**Transportation and Environmental Services**

# Committee Report

**To:** Warden Paul Eagleson
Members of the Transportation and Environmental Services Committee

**From:** Brian Knox
Engineer

**Date:** February 15, 2018

**Re:** Bruce Road 33 Environmental Assessment

---

## Recommendation:

The report Bruce Road 33 Environmental Assessment is for information.

## Background:

In January the Department submitted an information report to support the 'Notice of Project Initiation' for the potential realignment of Bruce Road 33. The notice was published in the Shoreline Beacon, posted on the County and Town website and circulated to landowners, agencies and Indigenous communities on January 9, 2018. The Department has received comments, with a large number referring to components of the Master Plan that are outside of the Bruce Road 33 EA Schedule B project. At this time, the Engineer believes it to be beneficial to review the process of the Master Plan for Bruce Road 25 and Bruce Road 33 for Roads and Drainage that was initiated in September 2015, the various projects derived from the Master Plan and the specific Bruce Road 33 Schedule B project.

### Bruce Road 25 & 33 - Master Plan

At the April 20, 2017 meeting, Committee approved the preferred solution for the Bruce County Road 25 and 33 Municipal Class Environmental Assessment Master Plan for roads and drainage. The Department and Town of Saugeen Shores completed the Master Plan by issuing the Notice of Completion on May 9, 2017. The outcome of the Master Plan included a number of projects as follows:

Schedule A Projects - Drainage

- Construct new storm sewer along Bruce Road 25 including outfall to Lake Huron.
- Construct local storm sewer system within Baker subdivision to coincide with sanitary sewer installation.

Schedule B Projects - Roads

- Re-align Bruce Road 33 to intersect Bruce Road 25 at future Bruce Street alignment.
- Provide additional lanes on Bruce Road 25 between future Bruce Street intersection and Goderich Street (4-lane urban cross-section)

The Master Plan addressed Phase 1 and 2 of the Municipal Class EA process that supports the Schedule A projects while the Schedule B projects require additional technical studies, documentation and review period. The following is an overview of the proposed work over a four-year period (2018-2021). A drawing identifying the work is attached.

Phase 1 – Schedule A (2018): Bruce Road 25 – trunk storm sewer from Lake Ridge Estates to Lake Huron, including a full urbanized road section from Shipley Avenue to Saugeen Beach Road.

Phase 2 - Schedule A (2019): Two lane urbanized road section from Shipley Avenue to Bruce Street, including the local storm sewer.

Phase 3 – Schedule B (2020): Four lane urbanized cross section from Bruce Street to Goderich Street, including municipal services.

Phase 4 – Schedule B (2021): Construction of the new Bruce Road 33 realignment and rehabilitation of current Bruce Road 33 (new Lake Range Road).

**Bruce Road 33 Realignment - Schedule B - Environmental Assessment**

The County of Bruce, Town of Saugeen Shores and GM BluePlan initiated the Bruce Road 33 Realignment Environmental Assessment as an outcome of the Master Plan for Roads and Drainage for Bruce Road 25 and Bruce Road 33.

Bruce Road 33 Realignment is being undertaken in accordance with the Municipal Class Environmental Assessment (EA) Planning Process as a Schedule B Project. The Notice of Project initiation was issued on January 9, 2018 outlining three alternative solutions:

i) Do nothing but resurfacing,
ii) Intersection and capacity improvements on BR 25, and
iii) Re-align the BR33 intersection with the future Bruce Street intersection.

The Master Plan and Schedule B EA project file relating to the Bruce Road 33 Realignment was available for viewing by agencies, public, landowners and Indigenous Communities with comments due on February 6, 2018.

The Department and Town of Saugeen Shores received a number of comments regarding the Bruce Road 33 Realignment as well as questions regarding the future work on Bruce Road 25, which was reviewed under the Master Plan process. A summary of the comments regarding Bruce Road 33 Realignment are as follows:

- General acceptance of the realignment of Bruce Road 33 with the future Bruce Street which would assist in traffic flow and safety concerns.
- Tree planting on the new realignment which would be beneficial during winter.
- Review of placing a roundabout at the intersection of future Bruce Street and future Bruce Road 33; a signalized intersection was considered as the preferred solution for pedestrian safety reasons and the planned Active Transportation Route.
- Drainage was considered under the Master Plan process and will be further advanced as the Bruce Road 25 design is developed.
- There was interest in the alignment of Baker Street and the location of the connection to the proposed Bruce Road 33 new alignment.

The Schedule B project will be reviewed further taking into consideration the comments received during the comment period. A preferred solution for the Bruce Road 33 Schedule B EA will be recommended at the March Committee for approval, prior to the Notice of Completion being issued.

### Bruce Road 25 - Drainage

The Department, Town and GM BluePlan are reviewing the feedback pertaining to the Bruce Road 25 Schedule "A" projects, specifically the drainage outlet and will be providing further information to agencies, public, landowners and Indigenous Communities.

### Response to Comments

In order to manage the comments and to move forward on this undertaking Saugeen Shores and the Department have agreed that the project team composed of the Town Saugeen Shores, consultant GM Blue Plan and the Department will continue to work together on discussing the comments received, however the Town of Saugeen Shores will respond to comments on the Schedule A projects as outlined in Phases 1 and 2 above and the Department will respond to Schedule B projects as outlined in Phases 3 and 4 above.

### Financial/Staffing/Legal/IT Considerations:

There are no financial, staffing, legal or IT considerations associated with this report.

**Interdepartmental Consultation:**

Not applicable.

**Link to Strategic Goals and Elements:**

Goal #6 – Explore alternative options to improve efficiency, service
Element #D – Coordinate working with other agencies

**Approved by:**

Kelley Coulter
Chief Administrative Officer

February 6 2018

# Schedule B - Environmental Assessment - Bruce Road 33 Realignment Project Schedule

| Date | Activity | Responsibility |
|---|---|---|
| November 2017 | Geotechnical Investigation (includes BR25) | County / GMBluePlan |
| December 1 2017 | Landowner information package circulated | County |
| Ongoing 2017-2018 | Land purchases/OLS survey | County |
| December 18 2018 | Correspondence to First Nation/Metis | County |
| January 9 2018 | Schedule B EA - Notice of Project Initiation<br>• Shoreline Beacon - County<br>• Landowner Mail-out - County<br>• Agency Contact - GMBluePlan | County / GMBluePlan |
| February 6 2018 | Response deadline | GMBluePlan |
| February 15 2018 | Report to Highways Committee with information report/comments received | County |
| March 22, 2018 | Report to Highways Committee with recommended preferred solution | County |
| March 30 2018 | Schedule B EA - Notice of Completion<br>• Shoreline Beacon - County<br>• Landowner Mail-out - County<br>• Agency Contact - GMBluePlan<br>• First Nation/Metis - County | County / GMBluePlan |
| April 30 2018 | Schedule B EA - 30 day review period ends | GMBluePlan |
| May 7 2018 | Reports due to Highways Committee | County |
| May 17 2018 | Highways Committee | County |
|  |  |  |

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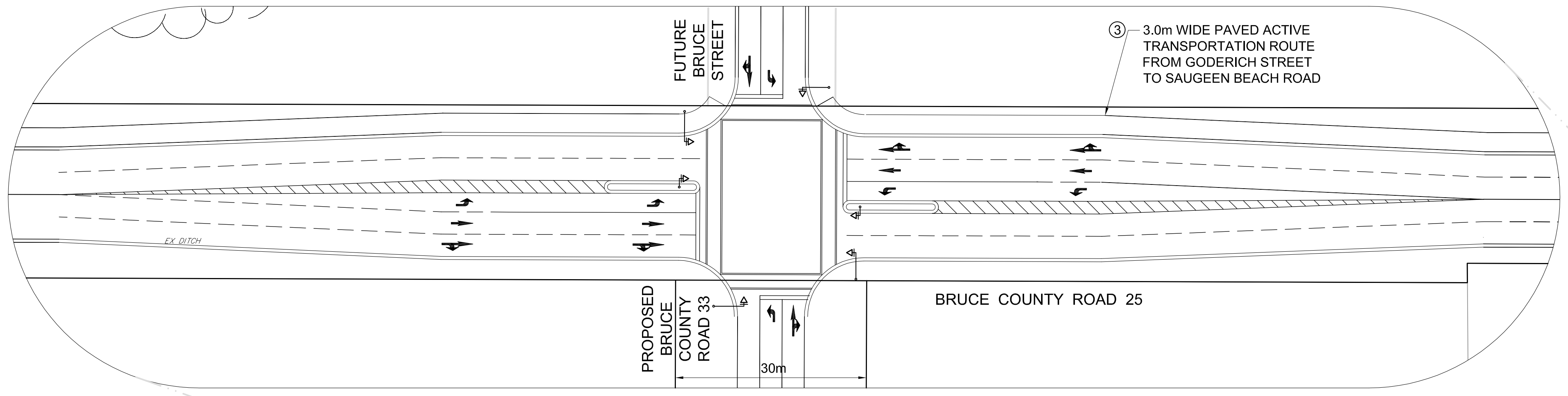
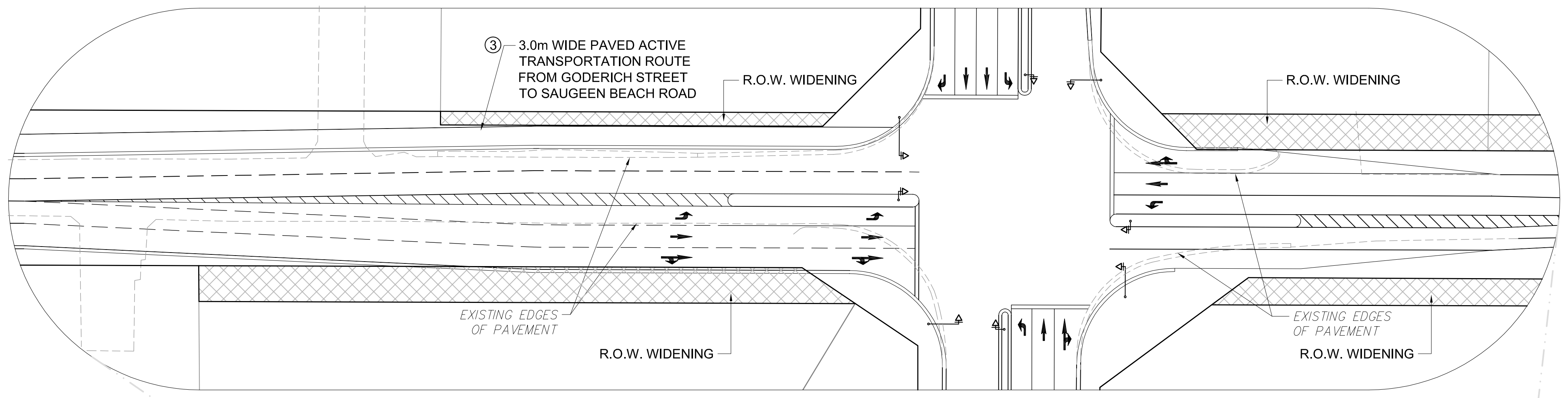
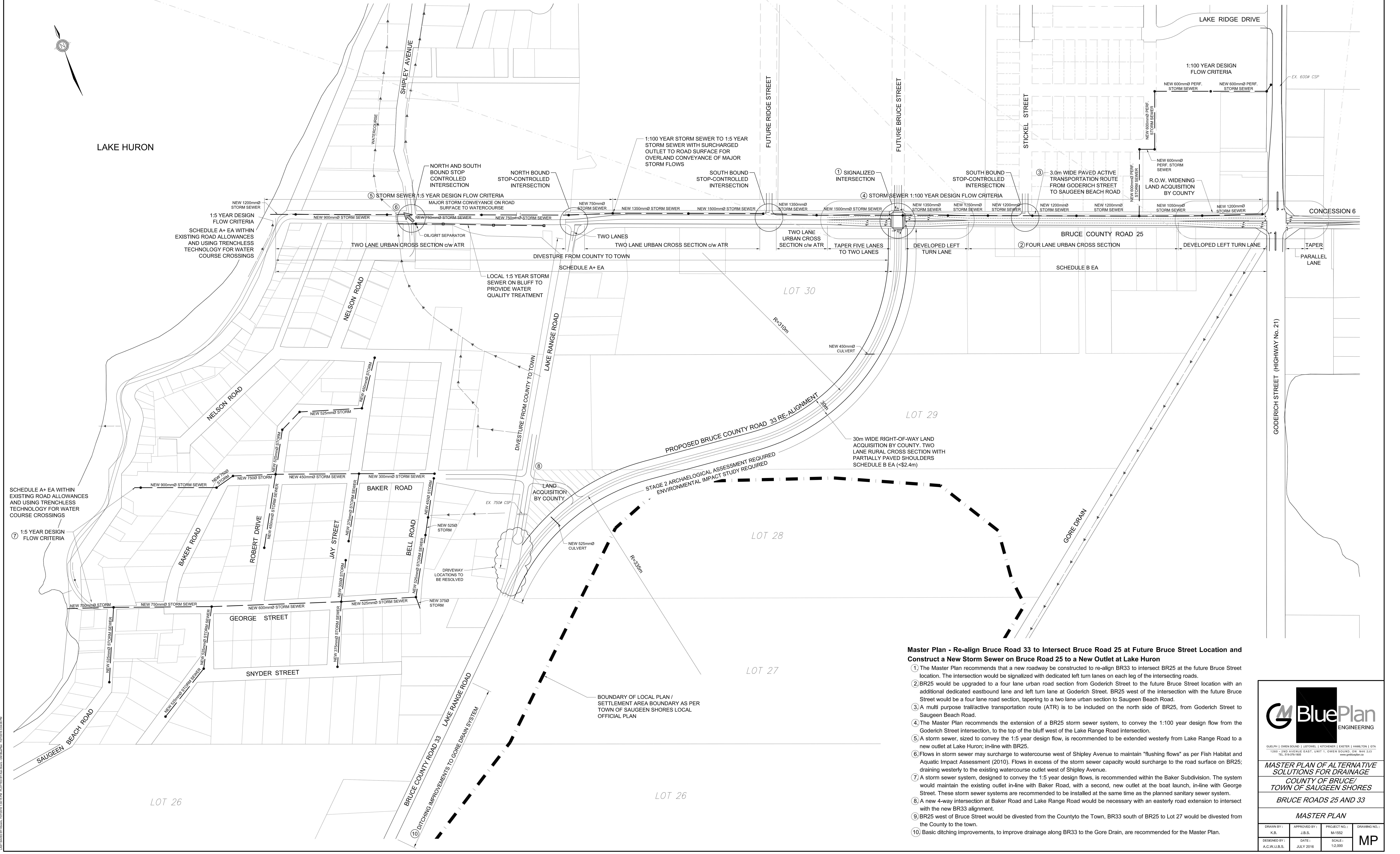


PROPOSED SIGNALIZED INTERSECTION OF BRUCE COUNTY ROADS 25 AND 33



UPGRADED SIGNALIZED INTERSECTION OF BRUCE COUNTY ROADS 25 AND 33



**Master Plan - Re-align Bruce Road 33 to Intersect Bruce Road 25 at Future Bruce Street Location and Construct a New Storm Sewer on Bruce Road 25 to a New Outlet at Lake Huron**

① The Master Plan recommends that a new roadway be constructed to re-align BR33 to intersect BR25 at the future Bruce Street location. The intersection would be signalized with dedicated left turn lanes on each leg of the intersecting roads.
② BR25 would be upgraded to a four lane urban road section from Goderich Street to the future Bruce Street location with an additional dedicated eastbound lane and left turn lane at Goderich Street. BR25 west of the intersection with the future Bruce Street would be a four lane road section, tapering to a two lane urban section to Saugeen Beach Road.
③ A multi purpose trail/active transportation route (ATR) is to be included on the north side of BR25, from Goderich Street to Saugeen Beach Road.
④ The Master Plan recommends the extension of a BR25 storm sewer system, to convey the 1:100 year design flow from the Goderich Street intersection, to the top of the bluff west of the Lake Range Road intersection.
⑤ A storm sewer, sized to convey the 1:5 year design flow, is recommended to be extended westerly from Lake Range Road to a new outlet at Lake Huron; in-line with BR25.
⑥ Flows in storm sewer may surcharge to watercourse west of Shipley Avenue to maintain "flushing flows" as per Fish Habitat and Aquatic Impact Assessment (2010). Flows in excess of the storm sewer capacity would surcharge to the road surface on BR25; draining westerly to the existing watercourse outlet west of Shipley Avenue.
⑦ A storm sewer system, designed to convey the 1:5 year design flows, is recommended within the Baker Subdivision. The system would maintain the existing outlet in-line with Baker Road, with a second, new outlet at the boat launch, in-line with George Street. These storm sewer systems are recommended to be installed at the same time as the planned sanitary sewer system.
⑧ A new 4-way intersection at Baker Road and Lake Range Road would be necessary with an easterly road extension to intersect with the new BR33 alignment.
⑨ BR25 west of Bruce Street would be divested from the Countyto the Town, BR33 south of BR25 to Lot 27 would be divested from the County to the town.
⑩ Basic ditching improvements, to improve drainage along BR33 to the Gore Drain, are recommended for the Master Plan.

GM BluePlan
ENGINEERING
GUELPH | OWEN SOUND | LISTOWEL | KITCHENER | EXETER | HAMILTON | GTA
1260 - 2ND AVENUE EAST, UNIT 1, OWEN SOUND, ON N4K 2J3
TEL. 519-376-1805 www.gmblueplan.ca

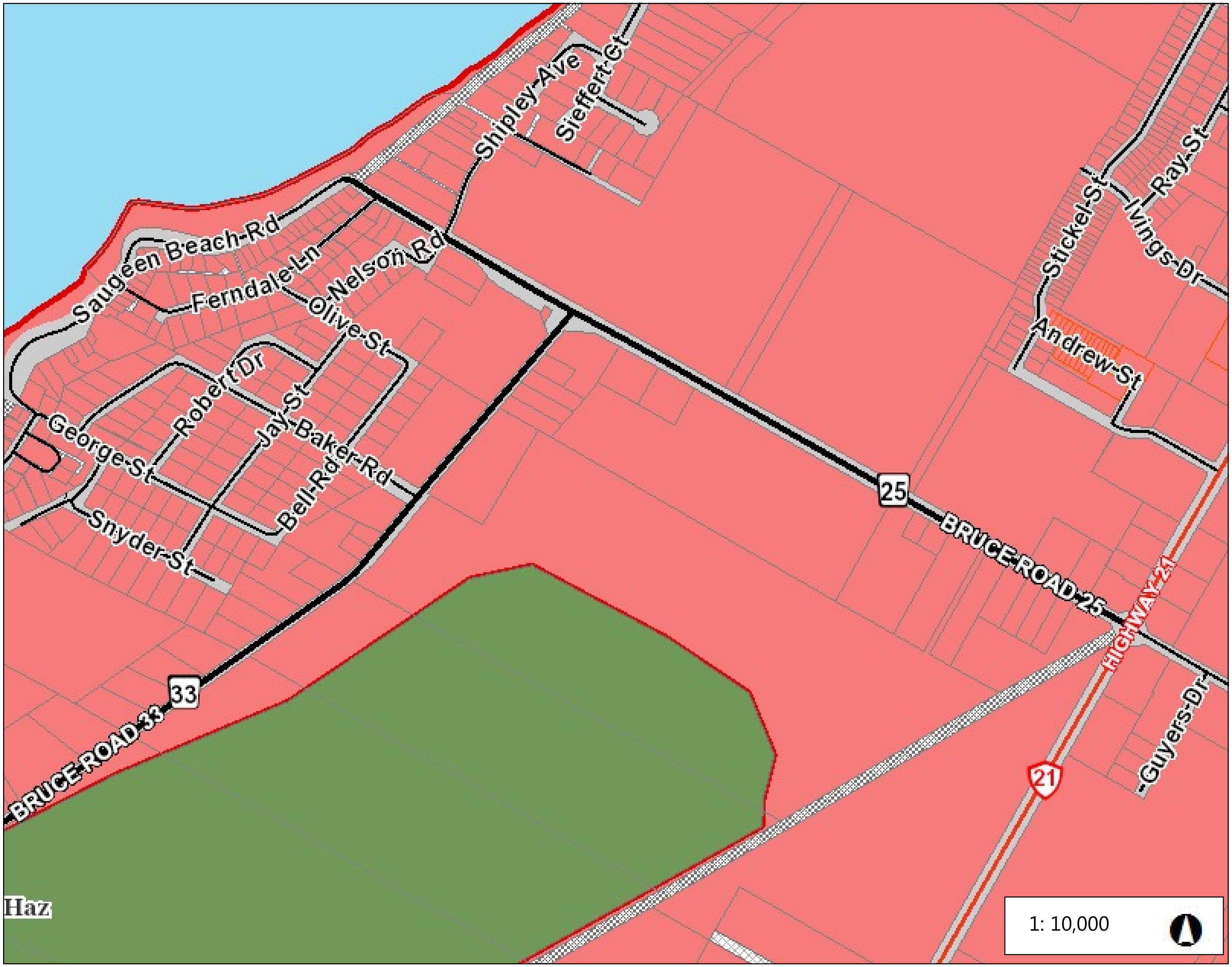
MASTER PLAN OF ALTERNATIVE SOLUTIONS FOR DRAINAGE
COUNTY OF BRUCE/
TOWN OF SAUGEEN SHORES
BRUCE ROADS 25 AND 33
MASTER PLAN

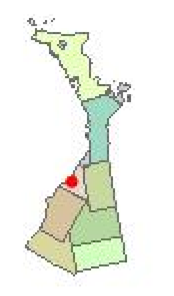
| DRAWN BY : | APPROVED BY : | PROJECT NO. : | DRAWING NO. : |
|---|---|---|---|
| K.B. | J.B.S. | M-1552 | MP |
| DESIGNED BY : | DATE : | SCALE : | |
| A.C.W./J.B.S. | JULY 2016 | 1:2,000 | |

# APPENDIX C:
# OFFICIAL PLANS

# County of Bruce

## Bruce County Official Plan: Schedule A (Land Use)





Legend

- BCOP hazard labels
- Municipal or Other Road (large scale labels)
- Ferry
- Provincial Highway
- County Road
- Municipal or Other Road
- Road Allowance/Right-of-way
  - Private Road Allowance
  - Right-of-Way
  - Road Allowance or Condo Road
  - Unopened Road Allowance
- 🟥 Hamlet
- ▨ Hazard
- BCOP Plan Designation
  - 🟩 Agricultural
  - Bruce Nuclear Power Development
  - Escarpment Natural Area
  - Estate Residential Development
  - Inland Lake Development
  - Major Open Space
  - Primary Urban Community
  - Secondary Urban Community
  - Rural
  - Rural Recreational
  - Travel Trailer Park/Commercial Campgrou
- Body of Water (small scale)
- Adjacent Counties (small scale)
- Wetland
- Adjacent Counties
- Lake Huron and Georgian Bay
- Adjacent Counties
- Lake Huron and Georgian Bay
- Adjacent Counties

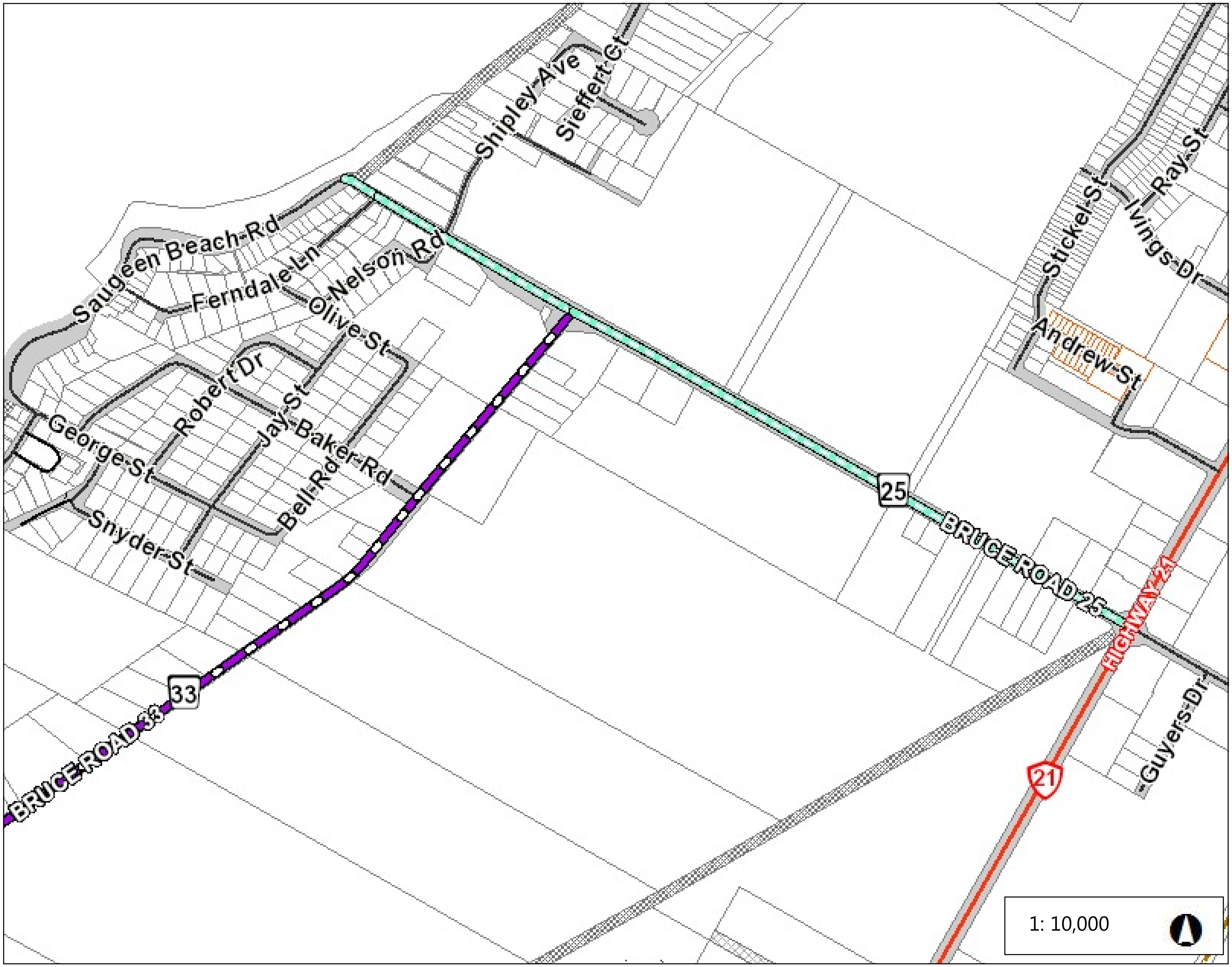
Notes

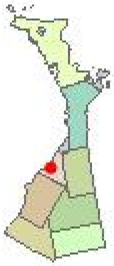
0.5 0 0.25 0.5 Kilometers

NAD_1983_UTM_Zone_17N

# County of Bruce

## Bruce County OP: Schedule B (Transportation Plan)





Legend

Municipal or Other Road (large scale labels)

Airport

Classified Roads

Arterial Urban

Arterial Rural

Collector Urban

Collector Rural

Bruce County Rail Trail

Municipal Road

Provincial Highway

County Road

Municipal or Other Road

Road Allowance/Right-of-way

Private Road Allowance

Right-of-Way

Road Allowance or Condo Road

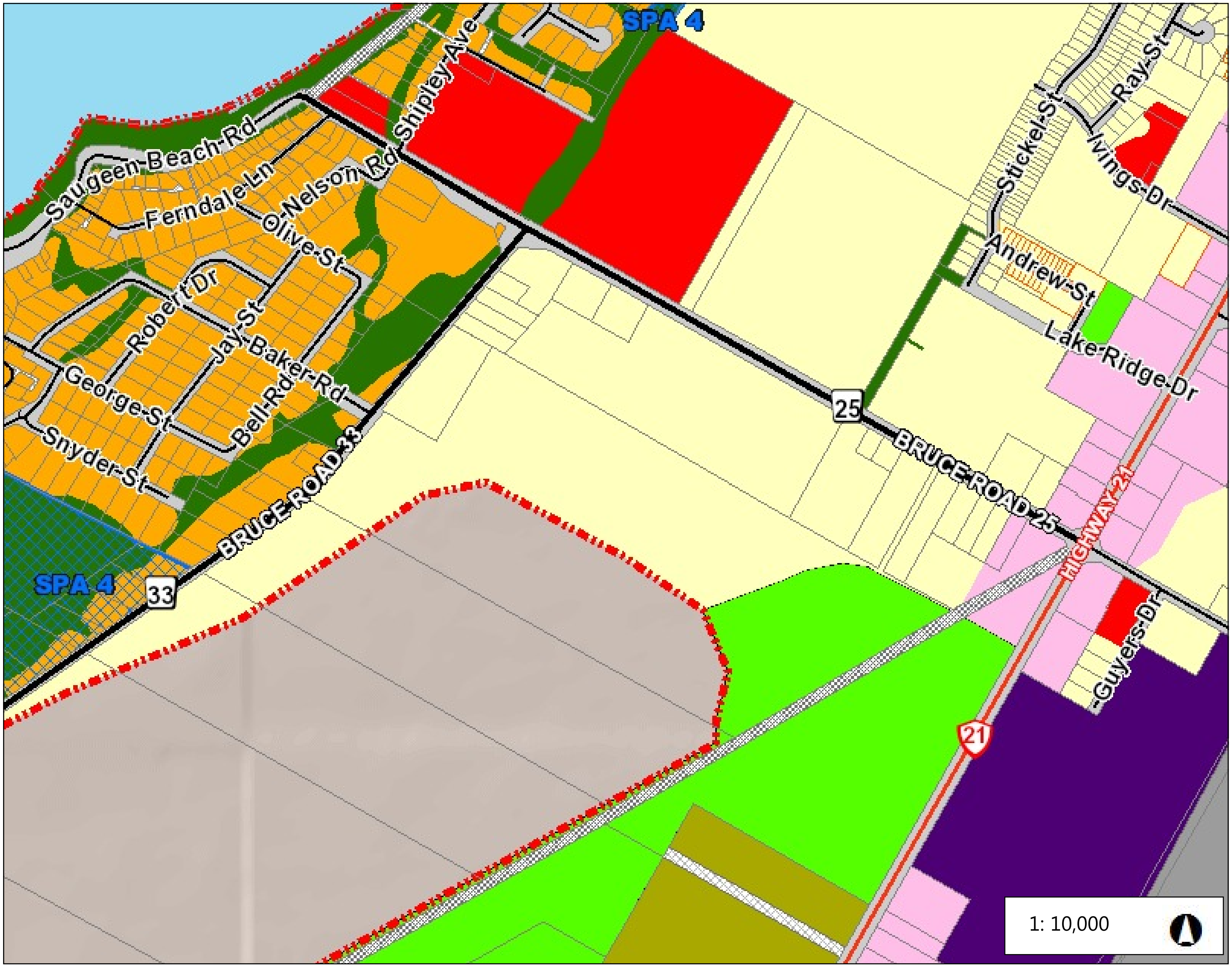
Unopened Road Allowance

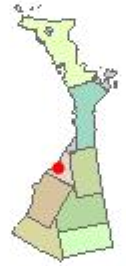
Notes

NAD_1983_UTM_Zone_17N

# County of Bruce

## Town of SS OP: Schedule A





Legend

Local OP SPA labels (SS)

Municipal or Other Road (large scale labels)

Provincial Highway

County Road

Municipal or Other Road

Road Allowance/Right-of-way

- Private Road Allowance
- Right-of-Way
- Road Allowance or Condo Road
- Unopened Road Allowance

Special Policy Area

Overlay

- Methane Buffer
- Significant Woodland

Boundary of Local Plan/Settleme
Area

SS Plan Designation

- Residential
- Commercial
- Open Space
- Resort Recreational
- High Density Residential
- Medium Density Residential
- Low Density Residential
- Shoreline Residential
- Recreational
- Core Commercial Area
- Office Residential
- Highway Commercial
- Marine Commercial
- Employment
- Extractive Industrial
- Institutional
- Parks and Open Space
- Environmental Hazard

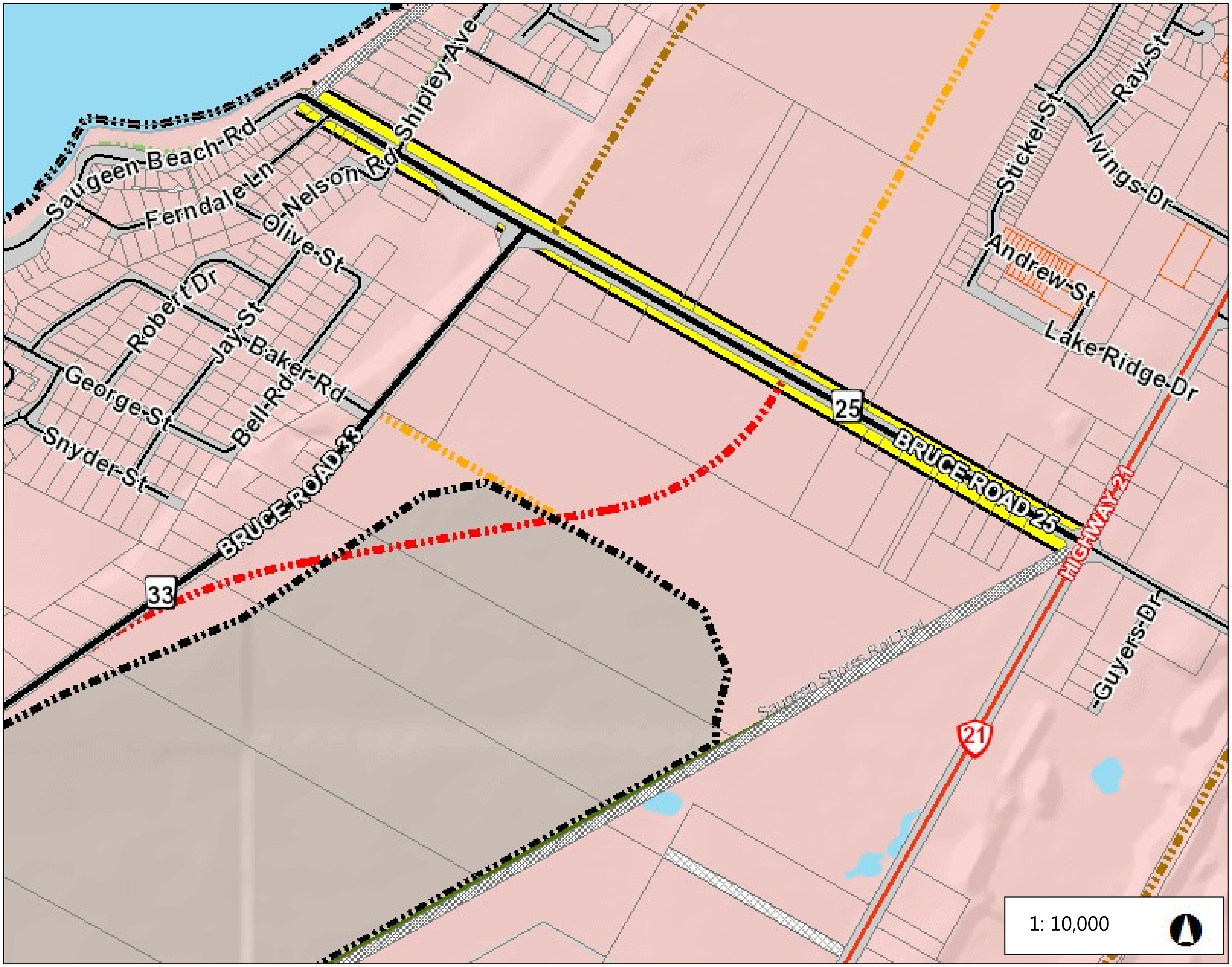
Notes

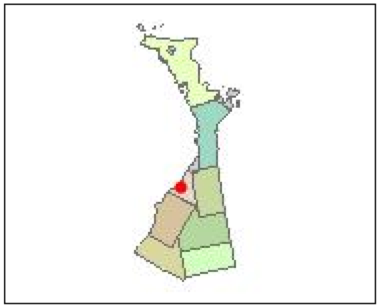
0.5 0 0.25 0.5 Kilometers

NAD_1983_UTM_Zone_17N

# County of Bruce

## Town of SS OP: Schedule B





Legend

- Municipal or Other Road (large scale labels)
- Provincial Highway
- County Road
- Municipal or Other Road
- Road Allowance/Right-of-way
  - Private Road Allowance
  - Right-of-Way
  - Road Allowance or Condo Road
  - Unopened Road Allowance
- Trail
  - Existing Trail
  - Proposed Trail
  - Saugeen Shores Rail Trail
  - Proposed Active Transportation Route
- Boundary of Local Plan/Settleme Area
- Roads and Proposed Roads
  - Arterial Road
  - Collector Road
  - Proposed Arterial
  - Proposed Collector
  - Local Road
- 🟨 Active Transportation
- 🟦 Body of Water (small scale)
- ☐ Adjacent Counties (small scale)
- Wetland
- ☐ Adjacent Counties
- 🟦 Lake Huron and Georgian Bay
- ☐ Adjacent Counties
- 🟦 Lake Huron and Georgian Bay
- ☐ Adjacent Counties
- Wetland
- 🟦 Body of Water

Notes

0.5 0 0.25 0.5 Kilometers

NAD_1983_UTM_Zone_17N

# APPENDIX D:
# TRAFFIC PLANNING STUDIES

# Bruce Road 25 Class EA Transportation Assessment

## Bruce County

**Paradigm Transportation Solutions Limited**

**November 2019**

**Project No. 190077**

ptsl.com

# Project Summary

## Project Number
190077

**November 2019**

## Client
**Bruce County**
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Walkerton ON N0G 2V0

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# Bruce Road 25 Class EA Transportation Assessment

Signatures and Seals

Eugene G. Chartier

Signature

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E. G. CHARTIER
90370727
Nov. 13 2019
PROVINCE OF ONTARIO

Engineer's Seal

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# 1 Introduction

## 1.1 Overview

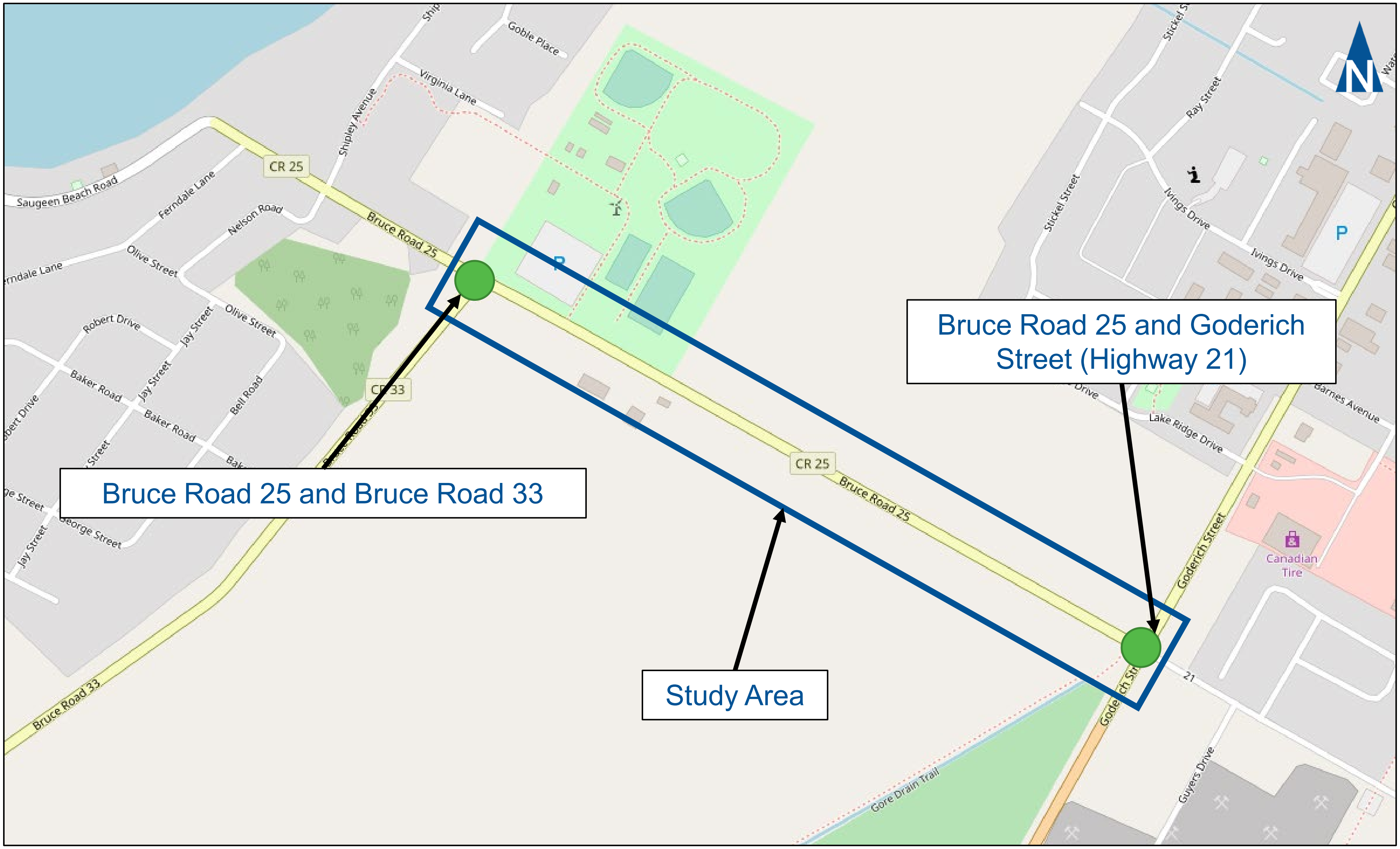
Bruce County (the County) is completing a Municipal Class Environmental Assessment (EA) study for the proposed widening of Bruce Road 25 from Highway 21 to planned Bruce Street in the Town of Saugeen Shores. The widening project was initially recommended in the *Bruce Roads 25 and 33 Roads and Drainage Master Plan* completed by the County of Bruce (the County) in 2016. The master plan identified road improvements germane to this class EA.

This report summarizes the transportation needs assessment completed to determine intersection configurations and basic lane requirements for the subject section of Bruce Road 25. The study analyzed current and future traffic volume estimates, including potential trips generated by nearby planned developments, to derive the recommendations. **Figure 1.1** illustrates the study area for this assessment.

## 1.2 Report Organization

The remainder of the report is organized as follows:

- Section 2 provides the **Planning Context**, summarizing findings from other studies, projects, and initiatives considered for this study;
- Section 3 presents the **Transportation Analysis** completed for the current (2019) and future (2040) horizon years considering the existing configuration for Bruce Road 25 and the three planned new roadways and intersections;
- Section 4 summarizes the **Development and Assessment of Alternatives** to meet projected requirements; and
- Section 5 provides the **Conclusions and Recommendations** of this assessment.



## Study Area

**Figure 1.1**

# 2. Planning Context

The following studies, projects and initiatives provide a planning context for the Bruce Road 25 Class EA Transportation Needs Assessment.

## 2.1 Province of Ontario

The Province of Ontario has several policies that impact community and transportation infrastructure development including:

- The 2014 **Provincial Policy Statement** (PPS) provides policy direction, focussing transportation on the movement of people and goods through a safe and energy efficient transportation system. It also promotes a multimodal transportation system, including transit and active transportation.
- The ***Accessibility for Ontarians with Disabilities Act, 2005*** (AODA) includes standards and regulations to ensure equitable access for all Ontarians, including accessibility standards in the planning, designing and building of transportation facilities.
- The 2013 **#CycleON: Ontario's Cycling Strategy** encourages the growth and safety of cycling in the province. It promotes, among other items, the design of healthy, active and prosperous communities, the improvement of cycling infrastructure, and the improvement of safety on roads.

## 2.2 Bruce County

### 2.2.1 Official Plan

The County's Official Plan was last consolidated in 2013. It provides a policy framework to guide the development of the County including transportation. Some of the objectives for transportation include:

- Minimize the environmental and financial costs associated with the development of transportation systems and facilities in the County;
- Encourage all jurisdictions to consult with each other in transportation upgrading and maintenance programs;
- Maintain and enhance the carrying capacity of the existing and proposed County road system; and
- Recognize, promote and encourage recreational transportation routes including canoe routes, cross-country ski, snowmobile, hiking and bicycle trails.[1]

---

[1] County of Bruce. *Official Plan*. Consolidation June 2013. https://brucecounty.on.ca/services/planning-development/bruce-county-official-plan

### 2.2.2 Complete Streets Policy and Implementation Guide for Grey Bruce

In 2015, the Counties of Grey and Bruce developed a *Complete Street Policy and Implementation Guide*. Complete Streets aim to provide safe and comfortable transportation for all modes of travel. The document makes several recommendations, including:

- Integrate Complete Streets into relevant roadways planning, design and implementation assignments consistent with the Municipal Class EA Process; and
- Use the Municipal Class EA process as an opportunity to incorporate Complete Streets concepts and principles into capital works projects.[2]

## 2.3 Town of Saugeen Shores

### 2.3.1 Official Plan

The Town's Official Plan, consolidated in 2014, guides development within the municipality. Some of the transportation related objectives include:

- *To promote an improved system of arterial, collector and local roads which provide for the safe and efficient movement of local and through traffic;*
- *To promote and guide the establishment of bicycle and pedestrian routes between parks facilities, the core area, the waterfront, the rail-trail, community facilities and residential and employment areas and to require, wherever possible for new developments, pathways, trails and access points that reduce car traffic and promote pedestrian and bicycle travel; and*
- *To promote the development of a street and sidewalk network that is accessible.*[3]

Official Plan Schedule 'B', Transportation Plan with Trails designates Bruce Road 25 as an arterial road and an active transportation route. The schedule also designates Bruce Road 33 as an arterial road, with a proposed realignment to meet Bruce Road 25 at a new intersection with the proposed Bruce Street collector road[4].

---

[2] Grey Bruce Healthy Communities Partnership, Grey Bruce Health Unit. *Complete Streets Policy & Implementation Guide for Grey Bruce*. March 2015. https://www.publichealthgreybruce.on.ca/Portals/0/Topics/HealthyCommunities/GreyBruceCompleteStreetsGuide.pdf

[3] Town of Saugeen Shores. *Town of Saugeen Shores Official Plan*. Consolidated September 2014. https://www.saugeenshores.ca/en/invest-and-plan/resources/Documents/Town_of_Saugeen_Shores_Official_Plan.pdf

[4] Town of Saugeen Shores. *Official Plan Schedule 'B' – Transportation Plan with Trails*. March 2014. https://www.saugeenshores.ca/en/invest-and-

### 2.3.2 Transportation Master Plan

The Town of Saugeen Shores is currently developing a Transportation Master Plan. Based on information presented at a public information centre on 7 August 2019, the Plan is expected to include the following vision and goals for transportation in the Town:[5]

Vision:

> *A Town comprised of unique communities connected by a diverse transportation system that prioritizes the safe and efficient movement of people in an environmentally sensitive manner, now and into the future.*

Goals:

- *Travel Options: Offer universally accessible and affordable multimodal choices for travel and goods movement.*
- *Personal Health: Provide a linked, accessible active transportation network, including sidewalks, bicycle lanes and trails with connections to community facilities and the waterfront while reducing exposure to air pollutants.*
- *Vibrant Local Economy: Support local business through accessibility by walking, cycling, transit, and vehicles.*
- *Sense of Place: Support overall neighbourhood livability, quality of life and strong sense of community.*
- *Environmentally Sustainable: Direct growth, development and infrastructure to areas that minimize disruptions to the natural environment.*

Based on the analysis completed for the Plan, the intersection of Bruce Road 25 with Goderich Street/Highway 21 is currently operating at Level of Service A or B, with an overall intersection delay between 0 and 20 seconds. Operating conditions are expected to remain the same into the future. During public consultation, no issues were identified at the intersection.

The Plan is proposing to:

- Identify dedicated cycling facilities on Bruce Road 25 between the beach and Guyers Drive and future Bruce Street between Bruce Road 25 and Devonshire Road;
- Denote future Ridge Street as a signed cycling route between Bruce Road 25 and Catherine Street;

---

plan/resources/Documents/Town_of_Saugeen_Shores_Official_Plan_Schedule_B.pdf

[5] Town of Saugeen Shores. *Town of Saugeen Shores Transportation Master Plan Public Information Centre Board*. 7 August 2019. https://www.saugeenshores.ca/en/living-in-our-community/transportation.aspx

- Retain the arterial road designations for Bruce Road 25 and Bruce Road 33;
- Designate Bruce Street as a collector road between Bruce Road 25 and existing Bruce Street, which is currently a collector road; and
- Recommend bicycle facilities on Bruce Road 25 between Bruce Road 33 and Goderich Street.

The Plan is nearing completion, but still requires Town Council approval before coming into effect.

### 2.3.3 Bicycle Friendly Community

In fall 2018, the Town of Saugeen Shores was awarded the Bronze Bicycle Friendly Community designation. In preparation to obtain this designation, the Town has held a Bicycle Friendly Communities Workshop in May 2017. As part of this workshop, the following vision was established:

*By 2022, Saugeen Shores aspires to be a great place for people to ride their bikes. Over the next five years:*

- *The community will have defined itself as a destination for all sorts of cycling, both utilitarian and recreational. The existing trails within Saugeen Shores, combined with the relatively low-volume local roads, make the area an ideal destination for cycle tourism, providing visitors with small town charm, beautiful coastline vistas and wide-open rural riding. The character of the community is such that there are many opportunities for everyday cycling, providing residents with the opportunity to ride to local shops and amenities more often.*
- *Connections between trails and community amenities will be strengthened, making it easier and more comfortable for residents and tourists alike to access local businesses.*
- *There will be programs in place to educate residents about the importance of safely sharing the road with all road users, and residents will be encouraged to walk and bike more often through a coordinated series of programs.*
- *A higher number of children in Saugeen Shores will regularly walk or bike to school, and cycling will be a common activity for residents of all ages and abilities.*[6]

---

[6] Share the Road Cycling Coalition. *Saugeen Shores Bicycle Friendly Communities Workshop Summary Report and Recommendations*. May 2017. https://www.saugeenshores.ca/en/town-hall/resources/Documents/FINAL-Saugeen-Shores-Summary-Report--Recommendations.pdf

# 3. Transportation Analysis

This section documents current traffic conditions, operational deficiencies, and constraints experienced by the public travelling through the study area. The concerns and constraints identified at this stage will be fundamental to the process of defining future problems and opportunities and establishing need justification for any improvements in the corridor.

A site visit was conducted by Paradigm staff on Monday 10 June 2019 to observe existing transportation conditions. Information was also gathered from Google Maps (Streetview), and information provided by the County and the Town of Saugeen Shores.

## 3.1 Road Network

The study area comprises Bruce Road 25, between Goderich Street (Highway 21) to the east, and existing Bruce Road 33 to the west, a segment approximately 1.10 kilometres in length. Within the study area, Bruce Road 25 is an east-west two-way two-lane road with a posted speed limit of 60 km/h. The speed limit changes to 50 km/h approximately 60 metres east of the intersection with Bruce Road 33.

Bruce Road 25 has a rural cross section, with gravel shoulders and grass ditches on either side. Both roadways are subject to load restrictions during the thawing months in the spring.[7]

Lane and shoulder widths seemed consistent throughout the study area and were measured approximately 500 metres from Goderich Street. The widths were measured as:

- Westbound gravel shoulder: approximately 2.1 metres;
- Westbound lane: approximately 3.6 metres;
- Eastbound lane: approximately 3.6 metres; and
- Eastbound gravel shoulder: approximately 2.1 metres.

Within the study area, Bruce Road 25 is straight and begins to slope downwards approximately 50 metres east of Bruce Road 33 to Saugeen Beach Road to the west.

To the east, Bruce Road 25 intersects with Goderich Street. In the area, Goderich Street has a four-lane cross-section. The intersection is currently signalized and has the following configuration:

- North leg (Goderich Street):

---

[7] Bruce County. *Highways Department 2018 – Load Posted Roads in Spring*. 2018. https://brucecounty.on.ca/sites/default/files/2018%20Load%20Posted%20Roads_1.pdf

  - Two northbound receiving lanes;
  - One southbound left-turn lane;
  - Two southbound through lanes; and
  - One southbound right-turn lane;
- South leg (Goderich Street):
  - Two southbound receiving lanes;
  - One northbound left-turn lane;
  - One northbound through lane; and
  - One northbound shared through/right-turn lane;
- East leg (Concession Road 6):
  - One eastbound receiving lane;
  - One westbound left-turn lane; and
  - One westbound shared through/right-turn lane;
- West leg (Bruce Road 25):
  - One receiving westbound lane;
  - One eastbound left-turn lane; and
  - One eastbound shared through/right-turn lane.

To the west, Bruce Road 25 intersects with Bruce Road 33 in a three-leg intersection. The intersection is stop controlled on the south leg (Bruce Road 33) only. Both roadways have one-lane per direction through the intersection, with no turning lanes.

Both intersections are illuminated. Bruce Road 25 is not illuminated between the intersections.

The land uses surrounding Bruce Road 25 include residential houses, commercial development and farmland on the north and south side of the roadway. Approximately 50 metres to the east of Bruce Road 33 is a driveway entrance to the parking lot for Unifor Family Education Centre. There are 23 accesses along Bruce Road 25 for both residential and commercial uses between Goderich Street and Bruce Road 33.

## 3.2 Transit and Active Transportation Networks

There is currently no transit service operating on Bruce Road 25.

Bruce Road 25 has gravel shoulders on either side of the roadway and no sidewalks. The roadway is considered an On-Road Connector for the trail network and is part of the Great Lakes Waterfront Trail. No pedestrian or cyclist activity was observed during the site visit in June 2019, but it is expected that both cyclist and pedestrian activity would increase during the months of July and August.

## 3.3 Traffic Volumes

### 3.3.1 Count Information

Intersection traffic volumes were obtained through eight-hour turning movement counts at the intersections of Bruce Road 25 with Goderich Street and Bruce Road 33. These turning movement counts identified the AM and PM peak hours along with heavy vehicle percentages for each turning movement.

Midblock volumes were identified by using the greater of the two entering and two exiting volumes along Bruce Road 25 at the Goderich Street and Bruce Road 33 intersections.

**Figure 3.1** illustrates the 2019 traffic volumes.

### 3.3.2 Traffic Forecasts

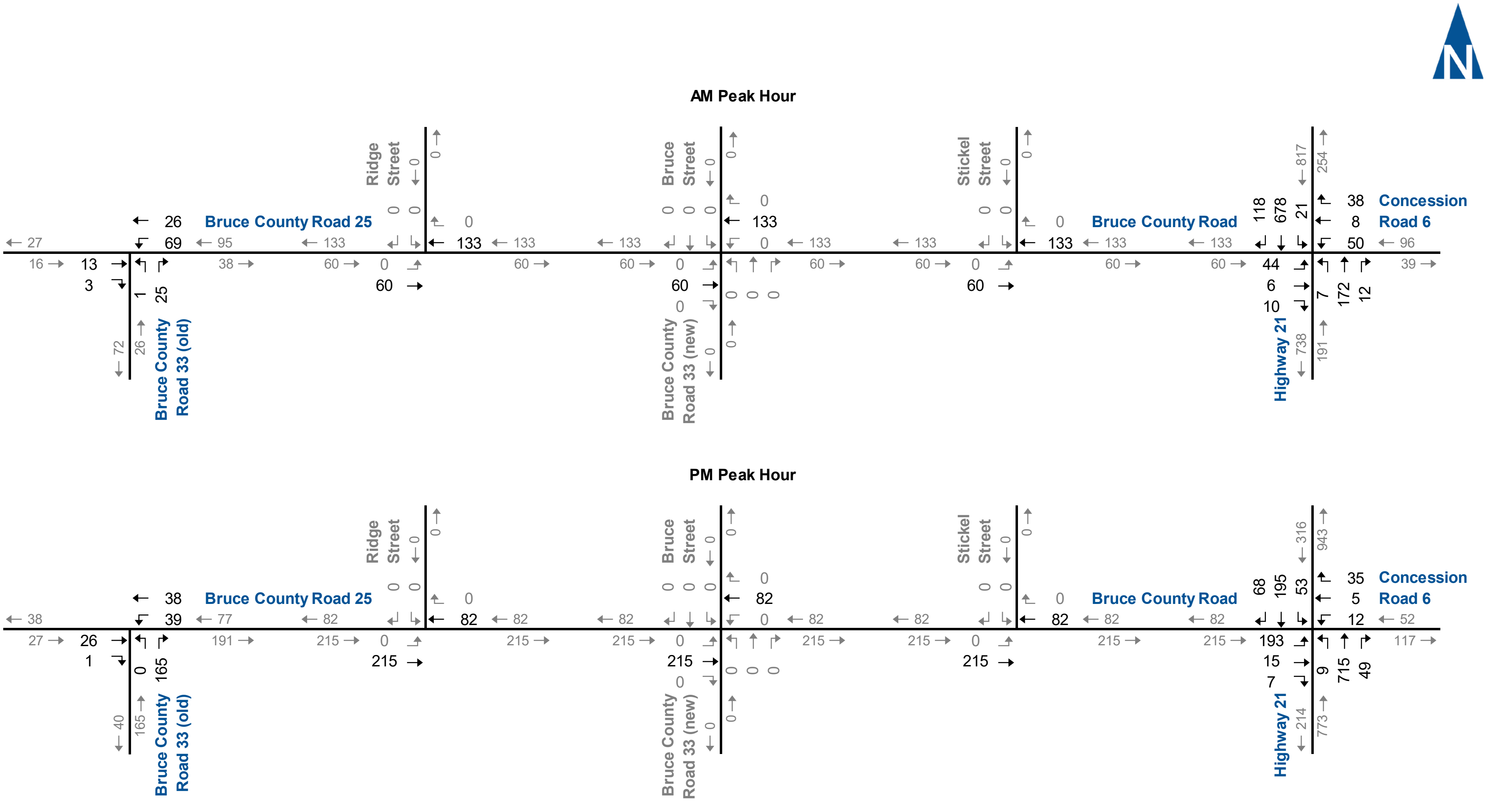
The Town of Saugeen Shores provided information on the potential developments expected to be constructed by 2040, in the area north of Bruce Road 25 and west of Goderich Street. The Town also provided the anticipated road network for this area. Peak hour traffic volumes anticipated to be generated by the developments were estimated based on data contained in the Institute of Transportation Engineers (ITE) *Trip Generation Manual* (ITE Manual). The following Land Use Codes (LUC) were selected as most representative of the expected developments.

The forecast trips generated by these developments were assigned to the adjacent and planned roadway network based on existing traffic patterns, logical routing to/from the site location and road classification.

**Figure 3.2** shows the forecast volumes for the proposed developments at the future intersections along Bruce Road 25. **Figure 3.3** shows the total forecast volumes along the study area for the future 2040 horizon.

## 3.4 Traffic Operations Analysis Approach and Methodology

The transportation need and justification assessment was based on traffic operations analysis conducted for the midblock sections and intersections within the study area. The analyses were conducted for both existing (2019) and future (2040) conditions during the weekday morning (AM) and afternoon (PM) peak hours to characterize operating conditions and identify locations requiring attention. The methodologies applied for the analyses are described as follows.



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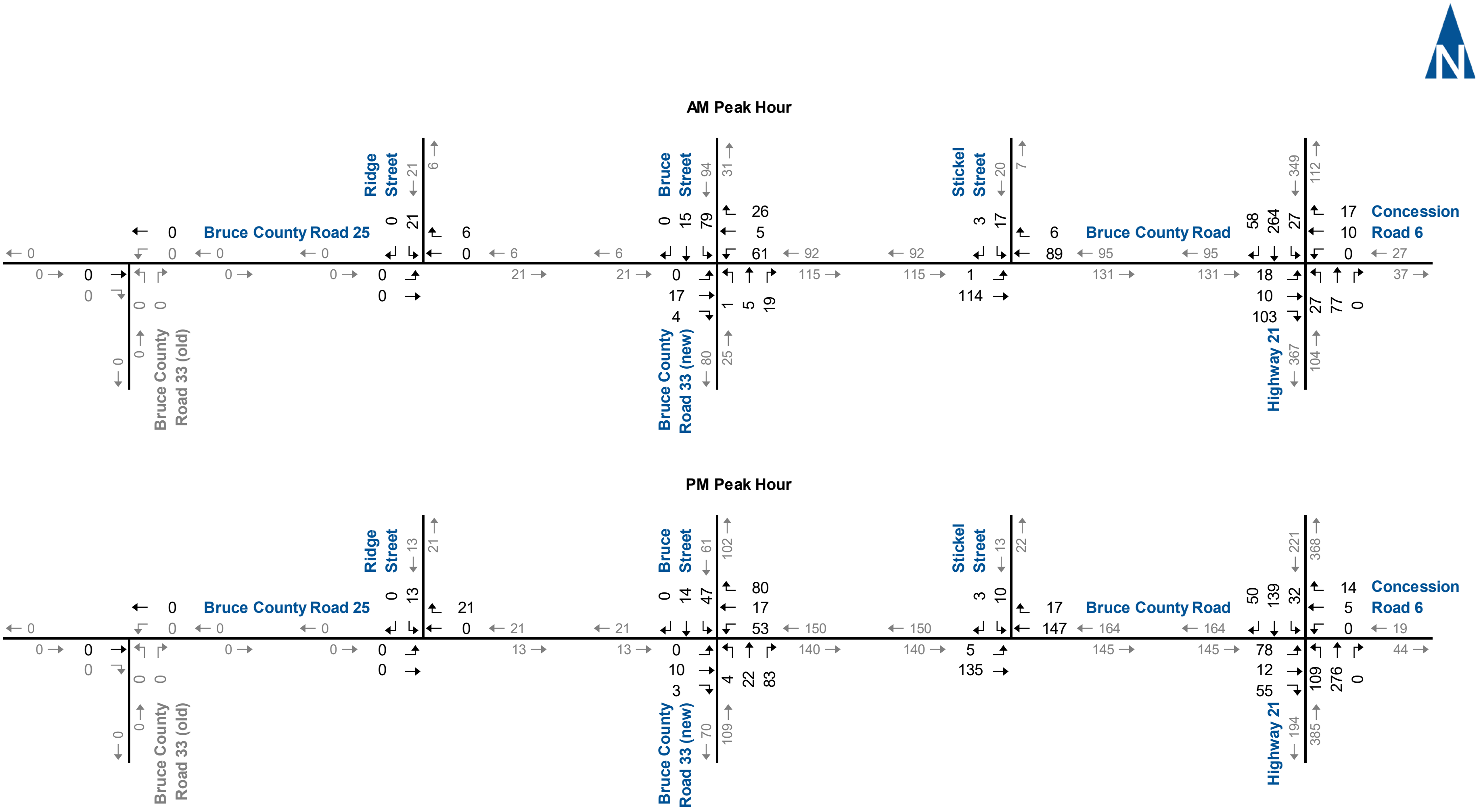
# 2019 Existing Volumes

Figure 3.1



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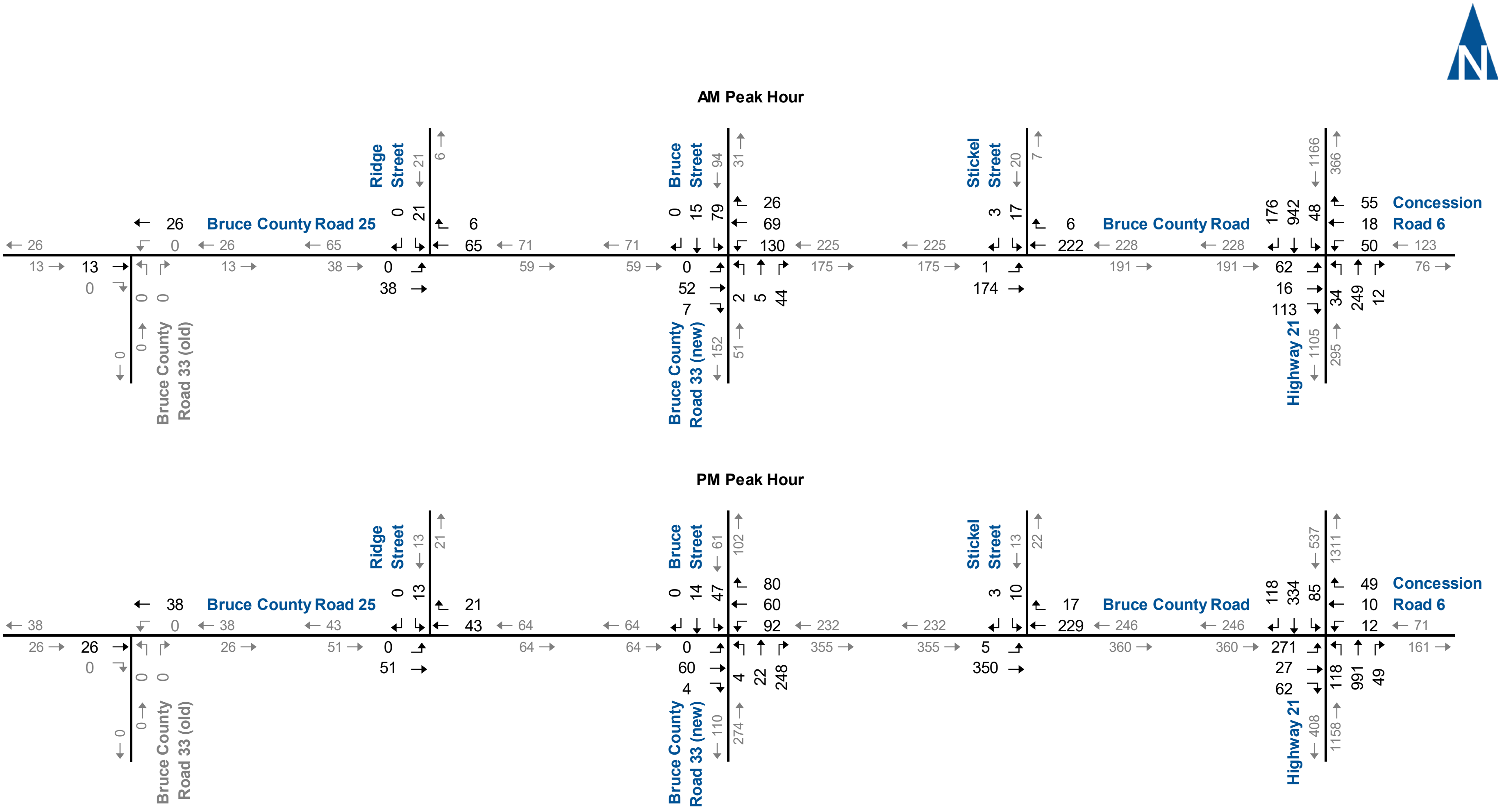
# Forecast Development Volumes

Figure 3.2



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# Total Volumes for the Future 2040 Horizon

Figure 3.3

### 3.4.1 Midblock Analysis

For midblock sections, operational performance was characterized based on the volume-to-capacity (v/c) ratio for the link. The v/c ratio provides a measure of traffic volume demand to available capacity, with an at-capacity condition represented by a v/c ratio of 1.00 (i.e. volume demand equals theoretical capacity). A v/c ratio of 0.90 or less is generally deemed acceptable operation for midblock locations, and road segments with volumes exceeding this threshold would typically be candidates for widening.

The midblock v/c ratios were calculated by dividing the traffic link volume (existing or forecasted) by the theoretical capacity for the subject link (i.e. the maximum hourly rate at which vehicles can be expected reasonably to traverse the section of roadway within a given time period, under prevailing roadway, traffic and control conditions). A theoretical capacity of 1,490 vehicles per hour per lane was assumed for Bruce Road 25 within the study area[8].

### 3.4.2 Intersection Analysis

Intersection Level of Service (LOS) is estimated based on average delay per vehicle and includes deceleration delay, queue move-up time, stopped delay, and final acceleration delay. LOS is a qualitative measure that describes the operating conditions within an intersection, and the perception of those conditions by road users. There are six levels of service defined. Each level has a letter identification from A to F with LOS A representing the best operating conditions and LOS F the worst. **Table 3.1** summarizes the LOS criteria for signalized, stop controlled, and roundabout intersections according to the 2000 and 2010 Highway Capacity Manual (HCM 2000 and HCM 2010).

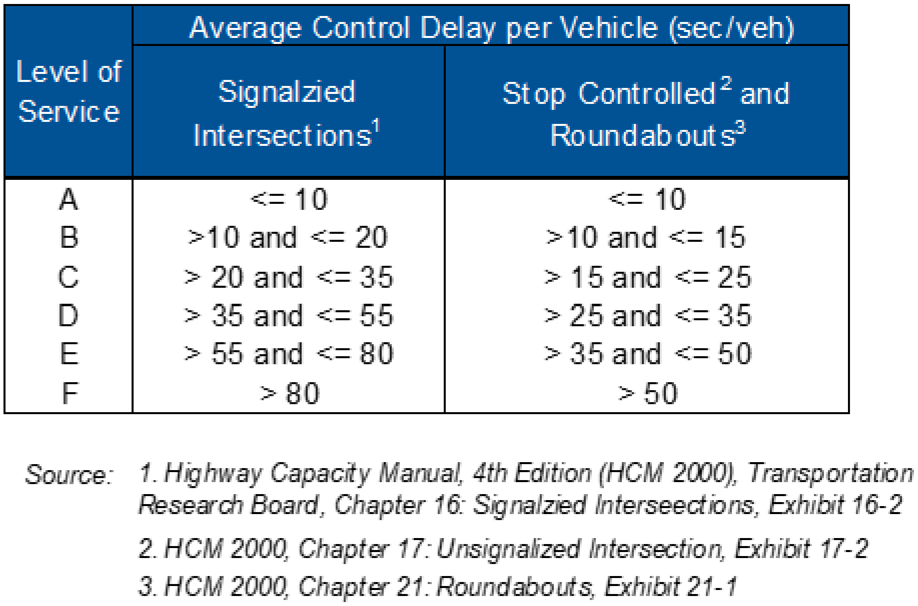
The operational analysis for the signalized and stop controlled intersections was conducted using Synchro Version 9.1, which implements the methods contained in HCM 2000 and HCM 2010. A Synchro network was developed specifically for this study and further refined through the analyses.

The operational performance of the signalized and stop controlled intersections within the study area was also assessed based on v/c ratios. Ratios were calculated at each intersection for individual movements and the entire intersection, with a v/c ratio of 0.85 or less considered acceptable operation.

---

[8] Transportation Research Board. 2016. *NCHRP Report 825 – Planning and Preliminary Engineering Applications Guide to the Highway Capacity Manual*. National Cooperative Highway Research Program, National Academy of Sciences.

**TABLE 3.1: INTERSECTION LEVEL OF SERVICE CRITERIA**



| Level of Service | Average Control Delay per Vehicle (sec/veh) | |
|---|---|---|
| | Signalzied Intersections[1] | Stop Controlled[2] and Roundabouts[3] |
| A | <= 10 | <= 10 |
| B | >10 and <= 20 | >10 and <= 15 |
| C | > 20 and <= 35 | > 15 and <= 25 |
| D | > 35 and <= 55 | > 25 and <= 35 |
| E | > 55 and <= 80 | > 35 and <= 50 |
| F | > 80 | > 50 |

Source: *1. Highway Capacity Manual, 4th Edition (HCM 2000), Transportation Research Board, Chapter 16: Signalzied Interseections, Exhibit 16-2*

*2. HCM 2000, Chapter 17: Unsignalized Intersection, Exhibit 17-2*

*3. HCM 2000, Chapter 21: Roundabouts, Exhibit 21-1*

## 3.5 Traffic Operations

Using the methodology presented above, the following intersections were analysed for the existing (2019) condition:

- Bruce Road 25 and Goderich Street; and
- Bruce Road 25 and existing Bruce Road 33.

For the future (2040) horizon, the following intersection were analysed:

- Bruce Road 25 and Goderich Street;
- Bruce Road 25 and Stickel Street;
- Bruce Road 25, realigned Bruce Road 33 and Bruce Street; and
- Bruce Road 25 and Ridge Street.

Existing conditions were analysed with the traffic data collected in June 2019. Future conditions utilized the existing counts and added forecast traffic generated by development planned within the next 21 years. A background growth rate was not applied to current traffic counts in forecasting future volumes, as directed by the County.

### 3.5.1 Midblock Analysis

**Table 3.2** shows existing 2019 midblock traffic operations.

**TABLE 3.2: 2019 MIDBLOCK TRAFFIC OPERATIONS**

| Peak Hour | Direction | Midblock v/c Ratio |
|---|---|---|
| AM | Eastbound | 0.04 |
| | Westbound | 0.09 |
| PM | Eastbound | 0.14 |
| | Westbound | 0.06 |

**Table 3.3** shows projected future 2040 midblock traffic operations with the existing two-lane configuration.

**TABLE 3.3: 2040 MIDBLOCK TRAFFIC OPERATIONS**

| Peak Hour | Direction | Midblock v/c Ratio |
|---|---|---|
| AM | Eastbound | 0.13 |
| | Westbound | 0.15 |
| PM | Eastbound | 0.24 |
| | Westbound | 0.17 |

The analysis of the 2019 and 2040 horizon years with the existing two-lane configuration indicates that a two-lane cross-section is and will be operating well within capacity.

### 3.5.2 Intersection Analysis

**Table 3.4** summarizes existing 2019 operating conditions, indicating LOS, average delays, v/c ratios, and 95th percentile queues experienced at intersections within the study area for the AM and PM peak hours. **Appendix A** provides the detailed Synchro analysis results.

The analysis of 2019 operating conditions indicates that all intersections and traffic movements are functioning at an acceptable level of service and well within capacity. The results are consistent with field observations.

**Table 3.5** summarizes future 2040 operating conditions, indicating LOS, average delays, v/c ratios, and 95th percentile queues experienced at intersections within the study area for the AM and PM peak hours. **Appendix B** provides the detailed Synchro analysis results.

The analysis of 2040 operating conditions indicates that all intersections and traffic movements are expected to operate at an acceptable level of service and within capacity.

# TABLE 3.4: 2019 INTERSECTION TRAFFIC OPERATIONS SUMMARY

| Analysis Period | Intersection | Control Type | MOE | Direction / Movement / Approach | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Eastbound | | | | Westbound | | | | Northbound | | | | Southbound | | | | |
| | | | | Left | Through | Right | **Approach** | Left | Through | Right | **Approach** | Left | Through | Right | **Approach** | Left | Through | Right | **Approach** | **Overall** |
| AM Peak Hour | Highway 21 & Bruce County Road 25/Concession Road 6 | TCS | LOS | C | C | > | **C** | C | C | > | **C** | A | A | > | **A** | A | A | A | **A** | **A** |
| | | | Delay | 25 | 23 | > | **24** | 24 | 23 | > | **24** | 5 | 5 | > | **5** | 5 | 6 | 5 | **6** | **8** |
| | | | V/C | 0.31 | 0.05 | > | | 0.28 | 0.07 | > | | 0.02 | 0.10 | > | | 0.03 | 0.35 | 0.08 | | **0.34** |
| | | | Q | 12 | 5 | > | | 13 | 8 | > | | 2 | 11 | > | | 5 | 39 | 7 | | |
| | | | Ex | 85 | - | > | | 50 | - | > | | 75 | - | > | | 65 | - | 70 | | |
| | | | Avail. | 73 | - | > | | 37 | - | > | | 73 | - | > | | 61 | - | 63 | | |
| | Bruce County Road 33 & Bruce County Road 25 | TWSC | LOS | | A | > | **A** | < | A | | **A** | < | | A | **A** | | | | | **A** |
| | | | Delay | | 0 | > | **0** | < | 5 | | **5** | < | | 9 | **9** | | | | | **5** |
| | | | V/C | | 0.01 | > | | < | 0.05 | | | < | | 0.03 | | | | | | |
| | | | Q | | 0 | > | | < | 1 | | | < | | 1 | | | | | | |
| | | | Ex | | - | > | | < | - | | | < | | - | | | | | | |
| | | | Avail. | | - | > | | < | - | | | < | | - | | | | | | |
| PM Peak Hour | Highway 21 & Bruce County Road 25/Concession Road 6 | TCS | LOS | C | B | > | **C** | B | B | > | **B** | A | B | > | **B** | B | A | A | **A** | **B** |
| | | | Delay | 25 | 17 | > | **24** | 17 | 17 | > | **17** | 9 | 12 | > | **12** | 11 | 10 | 9 | **10** | **14** |
| | | | V/C | 0.65 | 0.05 | > | | 0.03 | 0.04 | > | | 0.02 | 0.53 | > | | 0.22 | 0.13 | 0.05 | | **0.57** |
| | | | Q | 43 | 6 | > | | 5 | 6 | > | | 4 | 64 | > | | 14 | 16 | 7 | | |
| | | | Ex | 85 | - | > | | 50 | - | > | | 75 | - | > | | 65 | - | 70 | | |
| | | | Avail. | 42 | - | > | | 45 | - | > | | 72 | - | > | | 51 | - | 63 | | |
| | Bruce County Road 33 & Bruce County Road 25 | TWSC | LOS | | A | > | **A** | < | A | | **A** | < | | A | **A** | | | | | **A** |
| | | | Delay | | 0 | > | **0** | < | 4 | | **4** | < | | 9 | **9** | | | | | **7** |
| | | | V/C | | 0.02 | > | | < | 0.03 | | | < | | 0.17 | | | | | | |
| | | | Q | | 0 | > | | < | 1 | | | < | | 5 | | | | | | |
| | | | Ex | | - | > | | < | - | | | < | | - | | | | | | |
| | | | Avail. | | - | > | | < | - | | | < | | - | | | | | | |

*MOE - Measure of Effectiveness*
*LOS - Level of Service*
*Delay - Average Delay per Vehicle in Seconds*
*V/C - Volume to Capacity Ratio*
*Q - 95th Percentile Queue Length*
*TCS - Traffic Control Signal*
*TWSC - Two-Way Stop Control*
*Ex. - Existing Available Storage*
*Avail. - Available Storage*
*< - Shared Left-turn*
*> - Shared Right-turn*

# TABLE 3.5: 2040 INTERSECTION TRAFFIC OPERATIONS SUMMARY

| Analysis Period | Intersection | Control Type | MOE | Direction / Movement / Approach | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Eastbound | | | | Westbound | | | | Northbound | | | | Southbound | | | | Overall |
| | | | | Left | Through | Right | Approach | Left | Through | Right | Approach | Left | Through | Right | Approach | Left | Through | Right | Approach | |
| AM Peak Hour | Highway 21 & Bruce County Road 25/Concession Road 6 | TCS | LOS | C | C | > | C | C | C | > | C | A | A | > | A | A | A | A | A | B |
| | | | Delay | 22 | 24 | > | 23 | 21 | 21 | > | 21 | 8 | 7 | > | 7 | 7 | 9 | 7 | 9 | 11 |
| | | | V/C | 0.31 | 0.50 | > | | 0.22 | 0.10 | > | | 0.19 | 0.15 | > | | 0.09 | 0.53 | 0.12 | | 0.52 |
| | | | Q | 16 | 25 | > | | 13 | 11 | > | | 8 | 16 | > | | 9 | 62 | 9 | | |
| | | | Ex | 85 | - | > | | 50 | - | > | | 75 | - | > | | 65 | - | 70 | | |
| | | | Avail. | 69 | - | > | | 37 | - | > | | 67 | - | > | | 56 | - | 61 | | |
| | Bruce County Road 25 & Stickel Street | TWSC | LOS | < | A | | A | | A | > | A | | | | | < | | B | B | A |
| | | | Delay | < | 0 | | 0 | | 0 | > | 0 | | | | | < | | 11 | 11 | 1 |
| | | | V/C | < | 0.00 | | | | 0.15 | > | | | | | | < | | 0.03 | | |
| | | | Q | < | 0 | | | | 0 | > | | | | | | < | | 1 | | |
| | | | Ex | < | - | | | | - | > | | | | | | < | | - | | |
| | | | Avail. | < | - | | | | - | > | | | | | | < | | - | | |
| | Bruce County Road 33 & Bruce County Road 25 | TWSC | LOS | | A | > | A | < | A | | A | < | | A | A | < | | C | C | A |
| | | | Delay | | 0 | > | 0 | < | 5 | | 5 | < | | 9 | 9 | < | | 15 | 15 | 7 |
| | | | V/C | | 0.00 | > | | < | 0.09 | | | < | | 0.06 | | < | | 0.23 | | |
| | | | Q | | 0 | > | | < | 2 | | | < | | 2 | | < | | 7 | | |
| | | | Ex | | - | > | | < | - | | | < | | - | | < | | - | | |
| | | | Avail. | | - | > | | < | - | | | < | | - | | < | | - | | |
| | Bruce County Road 25 & Ridge Street | TWSC | LOS | < | A | | A | | A | > | A | | | | | < | | A | A | A |
| | | | Delay | < | 0 | | 0 | | 0 | > | 0 | | | | | < | | 9 | 9 | 2 |
| | | | V/C | < | 0.00 | | | | 0.05 | > | | | | | | < | | 0.03 | | |
| | | | Q | < | 0 | | | | 0 | > | | | | | | < | | 1 | | |
| | | | Ex | < | - | | | | - | > | | | | | | < | | - | | |
| | | | Avail. | < | - | | | | - | > | | | | | | < | | - | | |
| PM Peak Hour | Highway 21 & Bruce County Road 25/Concession Road 6 | TCS | LOS | C | B | > | C | B | B | > | B | B | B | > | B | D | B | B | B | B |
| | | | Delay | 32 | 16 | > | 28 | 16 | 16 | > | 16 | 14 | 19 | > | 19 | 36 | 12 | 11 | 16 | 19 |
| | | | V/C | 0.80 | 0.13 | > | | 0.03 | 0.09 | > | | 0.37 | 0.77 | > | | 0.74 | 0.23 | 0.08 | | 0.78 |
| | | | Q | 64 | 12 | > | | 5 | 11 | > | | 29 | 118 | > | | 40 | 29 | 10 | | |
| | | | Ex | 85 | - | > | | 50 | - | > | | 75 | - | > | | 65 | - | 70 | | |
| | | | Avail. | 21 | - | > | | 46 | - | > | | 46 | - | > | | 25 | - | 60 | | |
| | Bruce County Road 25 & Stickel Street | TWSC | LOS | < | A | | A | | A | > | A | | | | | < | | B | B | A |
| | | | Delay | < | 0 | | 0 | | 0 | > | 0 | | | | | < | | 13 | 13 | 0 |
| | | | V/C | < | 0.00 | | | | 0.16 | > | | | | | | < | | 0.03 | | |
| | | | Q | < | 0 | | | | 0 | > | | | | | | < | | 1 | | |
| | | | Ex | < | - | | | | - | > | | | | | | < | | - | | |
| | | | Avail. | < | - | | | | - | > | | | | | | < | | - | | |
| | Bruce County Road 33 & Bruce County Road 25 | TWSC | LOS | | A | > | A | < | A | | A | < | | B | B | < | | C | C | A |
| | | | Delay | | 0 | > | 0 | < | 3 | | 3 | < | | 11 | 11 | < | | 21 | 21 | 8 |
| | | | V/C | | 0.00 | > | | < | 0.06 | | | < | | 0.33 | | < | | 0.23 | | |
| | | | Q | | 0 | > | | < | 2 | | | < | | 11 | | < | | 7 | | |
| | | | Ex | | - | > | | < | - | | | < | | - | | < | | - | | |
| | | | Avail. | | - | > | | < | - | | | < | | - | | < | | - | | |
| | Bruce County Road 25 & Ridge Street | TWSC | LOS | < | A | | A | | A | > | A | | | | | < | | A | A | A |
| | | | Delay | < | 0 | | 0 | | 0 | > | 0 | | | | | < | | 9 | 9 | 1 |
| | | | V/C | < | 0.00 | | | | 0.04 | > | | | | | | < | | 0.02 | | |
| | | | Q | < | 0 | | | | 0 | > | | | | | | < | | 0 | | |
| | | | Ex | < | - | | | | - | > | | | | | | < | | - | | |
| | | | Avail. | < | - | | | | - | > | | | | | | < | | - | | |

*MOE - Measure of Effectiveness*

*LOS - Level of Service*

*Delay - Average Delay per Vehicle in Seconds*

*V/C - Volume to Capacity Ratio*

*Q - 95th Percentile Queue Length*

*TCS - Traffic Control Signal*

*TWSC - Two-Way Stop Control*

*Ex. - Existing Available Storage*

*Avail. - Available Storage*

*< - Shared Left-turn*

*> - Shared Right-turn*

## 3.6 Road Safety

### 3.6.1 Collision Analysis

The Saugeen Shores Police Service indicated five motor vehicle collisions have occurred over the past five years at the Bruce Road 25 and Goderich Street intersection. Details of the collisions were not provided.

### 3.6.2 Geometric Review

*Lane and Shoulder Widths*

According to the TAC *Geometric Design Guide for Canadian Roads* and the MTO *Design Supplement for the TAC Geometric Design Guide for Canadian Roads – June 2017*, lane widths should be a minimum of 3.0 metres for a design speed of 70 km/h (assuming 10 km/h over the posted speed limit) and an AADT above 1,000 vehicles per day. The current lane widths (3.6 metres) exceed the recommended minimum dimension. For a design speed of 70 km/h and an AADT between 2,000 and 3,000 vehicles per day, shoulder widths should be a minimum of 2.0 metres wide. The current shoulder widths (2.1 metres) exceed the recommended minimum dimension.

*Active Transportation*

Bruce Road 25 is considered an On-Road Trail Connector and is part of the Great Lakes Waterfront Trail. Pedestrians can use the shoulders, but cyclists are expected to share the travel lanes since the shoulder surface is gravel.

OTM Book 18[9] recommends considering designated cycling operating space for collector roads with moderate to high operating speeds (50 to 89 km/h) and volumes of 2,000 vehicles per day or higher. Designated cycling operating space can take the form of paved shoulders, exclusive bicycle lanes, separated bicycle lanes or cycle tracks.

*Roadside Safety*

The roadsides adjacent to Bruce Road 25 and Bruce Road 33 closer to Bruce Road 25 are relatively flat with drainage ditches on each side. Most larger trees and electrical poles are located behind the ditches.

Consideration should be given during design and construction to maintaining or enhancing the existing clear zones based on criteria set out in the TAC *Geometric Design Guide for Canadian Roads* and other applicable references.

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[9] Ontario Ministry of Transportation. *Ontario Traffic Manual, Book 18 – Cycling Facilities*. December 2013.

*Roadway Alignment*

Within the study area, Bruce Road 25 in a straight roadway with no horizontal curves. There is a vertical curve in the vicinity of Bruce Road 33, with a crest just east of the intersection. Bruce Road 33, approaching Bruce Road 25, is also mostly straight and flat, with a vertical curve approaching the intersection.

Bruce Road 33 intersects with Bruce Road 25 at a slightly skewed angle (approximately 15 degrees). This angle is acceptable for the intersection of an arterial road (Bruce Road 25) and a local road (Lake Range Road once Bruce Road 33 is realigned) per the TAC *Geometric Design Guide for Canadian Roads*.

Consideration should be given to aligning the intersection of realigned Bruce Road 33, Bruce Road 25 and new Bruce Street at a 90-degree angle to enhance safety.

*Illumination*

Lighting is provided at the intersections of Bruce Road 25 with Bruce Road 33 and Goderich Street. There is no other lighting provided along Bruce Road 25 within the study area.

*Pavement Condition*

The pavement surface along Bruce Road 25 and Bruce Road 33 within the study area is in a poor to fair condition. For large stretches of the roadways, the edge of pavement is deteriorating and collapsing into the gravel shoulder.

*Pavement Markings*

Pavement markings are generally in fair to good condition on roads in the study area.

*Signing*

Signs along Brue Road 25 were found to be visible and conspicuous. The following signs were noted:

- Eastbound, between Bruce Road 33 and Goderich Street:
    - No Parking (left and right arrow);
    - “Adopt a Highway”;
    - Maximum Speed, 60 km/h;
    - Traffic Signals Ahead warning sign;
    - Two Highway 21 Provincial Route Marker Crowns with cardinal direction and advanced arrow tab on each sign (left and right);
    - No Parking (left arrow);

  - Port Elgin sign, directional sign for Tiverton, Kincardine, Port Elgin and Southampton with Great Lakes Waterfront Trail sign with left arrow underneath; and
  - No parking (left and right arrow);
- Westbound, from Goderich Street to Bruce Road 33:
  - Bruce Road 25 County Road Marker with Great Lakes Waterfront Trail sign underneath;
  - Maximum Speed, 60 km/h with Begins tab;
  - No Parking (right arrow);
  - “Adopt a Highway”;
  - Intersection (controlled) warning sign;
  - Maximum Speed, 50 km/h with Begins tab;
  - No Parking (left arrow); and
  - “Resort Area Watch for Pedestrians” sign with Bruce Road 33 County Road Marker with “JCT” (Junction) tab and left turn arrow underneath.

*Speed Limit*

The posted speed limit on Bruce Road 25 is 60 km/h in the eastbound and westbound directions for most of the study area. Approximately 60 metres east of Bruce Road 33, the westbound speed limit changes to 50 km/h.

*Sight Distances*

Since the speed limit changes close to the intersection, the sight distances were evaluated based on a speed limit of 60 km/h, and therefore a design speed of 70 km/h. **Table 3.6** shows the observed and recommended sight distances at the intersection of Bruce Road 25 and Bruce Road 33.

## TABLE 3.6: SIGHT DISTANCES

| Type and Location | Observed Distance (m) | Recommended Distance (m) | Guideline Met? |
|---|---|---|---|
| **Bruce Road 25 Westbound, Approaching Intersection with Bruce Road 33** | | | |
| Decision sight distance<br>Stop on rural roadway | ~120 metres | 125 metres | ~* |
| **Bruce Road 33 Northbound, Approaching Intersection with Bruce Road 25** | | | |
| Decision sight distance<br>Stop on rural roadway | ~150 metres | 125 metres | √ |
| **Bruce Road 33 Northbound, Departure from Intersection with Bruce Road 25** | | | |
| Departure sight distance<br>Left turn from stop<br>Looking to the right | >300 metres | 130 metres | √ |
| Departure sight distance<br>Right turn from stop<br>Looking to the left | ~160 metres | 150 metres | √ |

Note: * Speed limit may be reduced west of Bruce Road 33 if realigned. If so, the sight distance guideline would be met.

# 4. Development and Assessment of Alternatives

## 4.1 Identified Concerns

The site visit, geometric review and traffic operations analysis identified the following concerns within the study area:

- **Active Transportation Facilities:** Bruce Road 25 is considered an On-Road Trail Connector and part of the Great Lakes Waterfront Trail, but currently does not have any dedicated pedestrian or cycling facilities;
- **Pavement Condition:** The pavement surface along Bruce Road 25 is in fair to poor condition, with sections of the edge deteriorating;
- **Sight Distances:** Although sight distances at the current intersection of Bruce Road 25 with Lake Range Road meet most guidelines, a vertical curve along Bruce Road 25 just east of the intersection reduces visibility; and
- **New Developments:** The lands north of the study area are planned for future developments, with three roadways to intersect with Bruce Road 25: Stickel Street, Bruce Street and Ridge Street.

Based on the analysis completed, Bruce Road 25 and its intersections within the study area currently operating at satisfactory levels of service. Operating conditions are expected to remain acceptable into the future.

## 4.2 Preliminary List of Alternatives

**Table 4.1** describes the preliminary list of alternatives, and variations thereof, to address identified concerns within the study area. The alternatives are intended to capture the range of realistic options available to the County to enable a fulsome consideration and assessment of potential improvements. The alternatives were generated considering that the proposed improvements must address, to some degree, the identified concerns of active transportation facilities, pavement condition, sight distances and new developments, and consider previous studies completed for this area.

TABLE 4.1: PRELIMINARY LIST OF ALTERNATIVES

| Alt. | Description |
|---|---|
| 1 | Do Nothing |
| 2 | Realign Bruce Road 33 to intersect Bruce Road 25 at the future Bruce Street intersection, consider various control operations and lane configurations |
| 3 | Future intersection of Bruce Road 25 and Stickel Street, consider various control operations and lane configurations |
| 4 | Future intersection of Bruce Road 25 and Ridge Street, consider various control operations and lane configurations |
| 5 | Existing intersection of Bruce Road 25 and Concession Road 6 with Goderich Street (Highway 21), signalized, consider various lane configurations |
| 6 | Four-lane cross-section on Bruce Road 25, between Goderich Street and Bruce Street |
| 7 | Four-lane cross-section on Bruce Road 25, between Bruce Street and the current intersection with Bruce Road 33 |
| 8 | Provide active transportation infrastructure |

## 4.3 Description of Alternatives

The following provides a description of the alternatives listed in **Table 4.1**, citing the potential advantages and disadvantages of each scenario in addition to their implementation considerations.

### 4.3.1 Alternative 1 – Do Nothing

With this alternative, the study area road network would remain as presently configured. This option would not affect the current operation of the intersections and would provide no improvement over existing conditions. It does not account for new roadways intersecting with Bruce Road 25 (Stickel Street, Bruce Street, Ridge Street).

### 4.3.2 Alternative 2 – Realign Bruce Road 33

With this alternative, Bruce Road 33 would be realigned to intersect Bruce Road 25 at the location of the future intersection with Bruce Street. **Table 4.2** shows the various sub-alternatives considered, including various types of intersection control and different lane configurations.

### 4.3.3 Alternative 3 – Future Intersection of Bruce Road 25 and Stickel Street

This alternative considers various types of intersection control and different lane configurations for the future intersection, as shown in **Table 4.3**.

### TABLE 4.2: LIST OF OPTIONS FOR ALTERNATIVE 2

| Opt. | Description |
|---|---|
| **A** | **Two-way stop control on realigned Bruce Road 33 and Bruce Street** |
| 1 | One lane per direction on each approach |
| 2 | Two lanes per direction on Bruce Road 25 and one lane per direction on realigned Bruce Road 33 and Bruce Street |
| **B** | **All-way stop control** |
| 1 | One lane per direction on each approach |
| 2 | Two lanes per direction on Bruce Road 25 and one lane per direction on realigned Bruce Road 33 and Bruce Street |
| **C** | **Signalized intersection** |
| 1 | One lane per direction on each approach |
| 2 | Two lanes per direction on Bruce Road 25 and one lane per direction on realigned Bruce Road 33 and Bruce Street |
| 3 | Same as C-2, with the addition of dedicated left-turn lanes for each approach |
| **D** | **Roundabout** |
| 1 | One lane per direction on each approach |
| 2 | Two lanes per direction on Bruce Road 25 and one lane per direction on realigned Bruce Road 33 and Bruce Street |

### TABLE 4.3: LIST OF OPTIONS FOR ALTERNATIVE 3

| Opt. | Description |
|---|---|
| **A** | **One-way stop control on Stickel Street** |
| 1 | Two-lane cross-section on Bruce Road 25, and two-lane cross section on Stickel Street |
| 2 | Four-lane cross-section on Bruce Road 25, and two-lane cross section on Stickel Street |
| **B** | **All-way stop control** |
| 1 | Two-lane cross-section on Bruce Road 25, and two-lane cross section on Stickel Street |
| 2 | Four-lane cross-section on Bruce Road 25, and two-lane cross section on Stickel Street |
| **C** | **Signalized intersection** |
| 1 | Two-lane cross-section on Bruce Road 25, and two-lane cross section on Stickel Street |
| 2 | Four-lane cross-section on Bruce Road 25, and two-lane cross section on Stickel Street |
| 3 | Two-lane cross-section on Bruce Road 25, and two-lane cross section on Stickel Street, plus dedicated southbound left turn lane on Stickel Street |
| 4 | Four-lane cross-section on Bruce Road 25, and two-lane cross section on Stickel Street, plus dedicated southbound left turn lane on Stickel Street |
| **D** | **Roundabout** |
| 1 | Two-lane cross-section on Bruce Road 25, and two-lane cross section on Stickel Street |
| 2 | Four-lane cross-section on Bruce Road 25, and two-lane cross section on Stickel Street |

### 4.3.4 Alternative 4 – Future Intersection of Bruce Road 25 and Ridge Street

This alternative considers various types of intersection control and different lane configurations for the future intersection, as shown in **Table 4.4**.

### 4.3.5 Alternative 5 – Existing Intersection of Bruce Road 25 and Concession Road 6 with Goderich Street (Highway 21)

This alternative considers various configuration improvements at the existing intersection. Improvements only consider changes to the cross-sections of Bruce Road 25 and Concession Road 6, with no changes to the Goderich Street (Highway 21) approaches. **Table 4.5** and **Figure 4.1** detail the various options.

### 4.3.6 Alternative 6 – Four-Lane Cross-Section on Bruce Road 25 between Goderich Street and Bruce Street

This alternative considers expanding the cross-section for Bruce Road 25, to include two lanes per direction of travel between the existing intersection with Goderich Street and the future intersection with Bruce Street. This alternative increases the capacity of this midblock section.

### 4.3.7 Alternative 7 – Four-Lane Cross-Section on Bruce Road 25 between Bruce Street and Existing Bruce Road 33

This alternative considers expanding the cross-section for Bruce Road 25, between the future intersection with Bruce Street and the current location of the intersection with Bruce Road 33. This alternative increases the capacity or this midblock section.

### 4.3.8 Alternative 8 – Provide Active Transportation Infrastructure

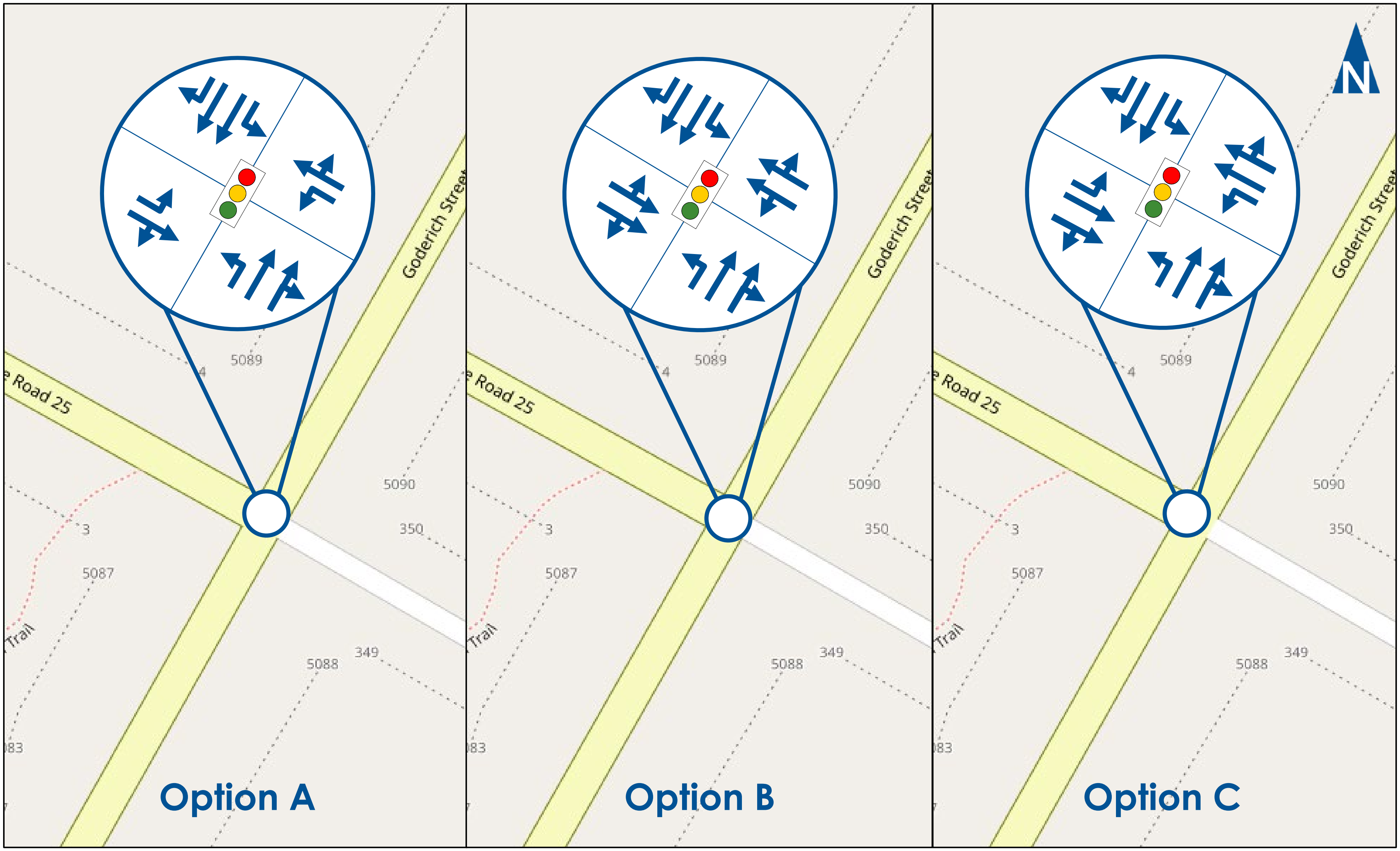
This alternative considers the addition of active transportation infrastructure along Bruce Road 25, between Goderich Street and the current location of the intersection with Bruce Road 33.

### TABLE 4.4: LIST OF OPTIONS FOR ALTERNATIVE 4

| Opt. | Description |
|---|---|
| **A** | **One-way stop control on Ridge Street** |
| 1 | Two-lane cross-section on Bruce Road 25, and two-lane cross section on Ridge Street |
| 2 | Four-lane cross-section on Bruce Road 25, and two-lane cross section on Ridge Street |
| **B** | **All-way stop control** |
| 1 | Two-lane cross-section on Bruce Road 25, and two-lane cross section on Ridge Street |
| 2 | Four-lane cross-section on Bruce Road 25, and two-lane cross section on Ridge Street |
| **C** | **Signalized intersection** |
| 1 | Two-lane cross-section on Bruce Road 25, and two-lane cross section on Ridge Street |
| 2 | Four-lane cross-section on Bruce Road 25, and two-lane cross section on Ridge Street |
| 3 | Two-lane cross-section on Bruce Road 25, and two-lane cross section on Ridge Street, plus dedicated southbound left turn lane on Ridge Street |
| 4 | Four-lane cross-section on Bruce Road 25, and two-lane cross section on Ridge Street, plus dedicated southbound left turn lane on Ridge Street |
| **D** | **Roundabout** |
| 1 | Two-lane cross-section on Bruce Road 25, and two-lane cross section on Ridge Street |
| 2 | Four-lane cross-section on Bruce Road 25, and two-lane cross section on Ridge Street |

### TABLE 4.5: LIST OF OPTIONS FOR ALTERNATIVE 5

| Opt. | Description |
|---|---|
| A | Existing configuration:<br>▶ Westbound – Shared right/through lane and left turn lane<br>▶ Eastbound – Shared right/through lane and left turn lane |
| B | Four-lane cross-sections on Bruce Road 25 and Concession Road 6:<br>Bruce Road 25:<br>▶ Westbound – Two receiving lanes, shared left/through lane and shared right/through lane<br>Concession Road 6:<br>▶ Eastbound – Two receiving lanes, shared left/through lane and shared right/through lane |
| C | Four-lane cross-section with dedicated left-turn lanes on Bruce Road 25 and Concession Road 6 |



# Optional Configurations for Bruce Road 25, Concession Road 6 and Goderich Street

Figure 4.1

## 4.4 Assessment of Alternatives

### 4.4.1 Alternative 1 – Do Nothing

As shown in Section 3.5, the intersections and midblock segments are expected to operate at acceptable levels of service and within capacity. The alternative does not, however, consider the new intersections of Stickel Street, Bruce Street and Ridge Street with Bruce Road 25.

### 4.4.2 Alternative 2 – Realign Bruce Road 33

With this alternative, Bruce Road 33 would be realigned to intersect Bruce Road 25 at the location of the future intersection with Bruce Street. The realignment could address the sight distance concerns at the existing intersection. The realignment would also combine the intersections of Bruce Road 25 with realigned Bruce Road 33 and Bruce Street, and would help accommodate the planned new developments north of Bruce Road 25. **Table 4.6** shows the traffic operation analysis results for the various options considered, for the weekday PM peak hour of the future 2040 horizon. **Appendix C** provides the detailed Synchro analysis results.

### 4.4.3 Alternative 3 – Future Intersection of Bruce Road 25 and Stickel Street

With this alternative, Stickel Street would intersect with Bruce Road 25 approximately 390 metres west of the intersection of Bruce Road 25 and Goderich Street. This alternative would help accommodate the planned new developments north of Bruce Road 25. **Table 4.7** shows the traffic operation analysis results for the various options considered, for the weekday PM peak hour of the future 2040 horizon. **Appendix C** provides the detailed Synchro analysis results.

### 4.4.4 Alternative 4 – Future Intersection of Bruce Road 25 and Ridge Street

With this alternative, Ridge Street would intersect with Bruce Road 25 approximately 950 metres west of the intersection of Bruce Road 25 and Goderich Street. This alternative would help accommodate the planned new developments north of Bruce Road 25. **Table 4.8** shows the traffic operation analysis results for the various options considered, for the weekday PM peak hour of the future 2040 horizon. **Appendix C** provides the detailed Synchro analysis results.

### 4.4.5 Alternative 5 – Existing Intersection of Bruce Road 25 and Concession Road 6 with Goderich Street (Highway 21)

With this alternative, improvements would be made to the eastbound and westbound lanes at the intersection of Bruce Road 25 and Goderich Street. **Table 4.9** shows the traffic operation analysis results for the various options considered, for the weekday PM peak hour of the future 2040 horizon. **Appendix C** provides the detailed Synchro analysis results.

## TABLE 4.6: TRAFFIC OPERATIONS ANALYSIS SUMMARY FOR ALTERNATIVE 2

| Opt. | Description | Performance Measures | Comments |
|---|---|---|---|
| **A** | **Two-way stop control on realigned Bruce Road 33 and Bruce Street** | | |
| 1 | One lane per direction on each approach | Intersection LOS: A<br>Max v/c ratio: 0.33 (NB)<br>Intersection Delay: 8.0 s | NB movement LOS B and 11 s delay<br>NB queue: 11 m (2 vehicles)<br>SB movement LOS C and 21 s delay |
| 2 | Two lanes per direction on Bruce Road 25 and one lane per direction on realigned Bruce Road 33 and Bruce Street | Intersection LOS: A<br>Max v/c ratio: 0.32 (NB)<br>Intersection Delay: 7.8 s | NB movement LOS B and 11 s delay<br>NB queue: 11 m (2 vehicles)<br>SB movement LOS C and 21 s delay |
| **B** | **All-way stop control** | | |
| 1 | One lane per direction on each approach | Intersection LOS: A<br>Max v/c ratio: 0.35 (NB)<br>Intersection Delay: 9.5 s | NB movement LOS A and 10 s delay<br>SB movement LOS A and 9 s delay |
| 2 | Two lanes per direction on Bruce Road 25 and one lane per direction on realigned Bruce Road 33 and Bruce Street | Intersection LOS: A<br>Max v/c ratio: 0.35 (NB)<br>Intersection Delay: 8.9 s | NB movement LOS A and 10 s delay<br>SB movement LOS A and 9 s delay |
| **C** | **Signalized intersection (60 second cycle – NB/SB 25 seconds, EB/WB 35 seconds)** | | |
| 1 | One lane per direction on each approach | Intersection LOS: A<br>Max v/c ratio: 0.61 (WB)<br>Intersection Delay: 9.5 s | NB movement LOS A and 3 s delay<br>SB movement LOS A and 8 s delay<br>EB movement LOS B and 12 s delay<br>WB movement LOS B and 17 s delay |
| 2 | Two lanes per direction on Bruce Road 25 and one lane per direction on realigned Bruce Road 33 and Bruce Street | Intersection LOS: A<br>Max v/c ratio: 0.42 (WB)<br>Intersection Delay: 6.9 s | NB movement LOS A and 2 s delay<br>SB movement LOS A and 6 s delay<br>EB movement LOS B and 12 s delay<br>WB movement LOS B and 11 s delay |
| 3 | Same as C-2, with the addition of dedicated left-turn lanes for each approach | Intersection LOS: A<br>Max v/c ratio: 0.36 (WB)<br>Intersection Delay: 7.0 s | NB movement LOS A and 2 s delay<br>SB movement LOS A and 6 s delay<br>EB movement LOS B and 12 s delay<br>WB movement LOS B and 11 s delay |
| **D** | **Roundabout** | | |
| 1 | One lane per direction on each approach | Intersection LOS: A<br>Max v/c ratio: 0.23 (NB)<br>Intersection Delay: 3.4 s | NB movement LOS A and 4 s delay<br>SB movement LOS A and 3 s delay<br>EB movement LOS A and 3 s delay<br>WB movement LOS A and 3 s delay |
| 2 | Two lanes per direction on Bruce Road 25 and one lane per direction on realigned Bruce Road 33 and Bruce Street | Intersection LOS: A<br>Max v/c ratio: 0.23 (NB)<br>Intersection Delay: 2.6 s | NB movement LOS A and 4 s delay<br>SB movement LOS A and 3 s delay<br>EB movement LOS A and 2 s delay<br>WB movement LOS A and 2 s delay |

## TABLE 4.7: TRAFFIC OPERATIONS ANALYSIS SUMMARY FOR ALTERNATIVE 3

| Opt. | Description | Performance Measures | Comments |
|---|---|---|---|
| **A** | **One-way stop control** | | |
| 1 | One lane per direction on each approach | Intersection LOS: A<br>Max v/c ratio: 0.16 (WB)<br>Intersection Delay: 0.3 s | SB movement LOS B and 13 s delay |
| 2 | Two lanes per direction on Bruce Road 25 and one lane per direction on Stickel Street | Intersection LOS: A<br>Max v/c ratio: 0.15 (EB)<br>Intersection Delay: 0.3 s | SB movement LOS B and 11 s delay |
| **B** | **All-way stop control** | | |
| 1 | One lane per direction on each approach | Intersection LOS: B<br>Max v/c ratio: 0.45 (EB)<br>Intersection Delay: 10.0 s | SB movement LOS A and 8 s delay<br>EB movement LOS B and 11 s delay<br>WB movement LOS A and 9 s delay |
| 2 | Two lanes per direction on Bruce Road 25 and one lane per direction on Stickel Street | Intersection LOS: A<br>Max v/c ratio: 0.33 (EB)<br>Intersection Delay: 8.1 s | SB movement LOS A and 8 s delay<br>EB movement LOS A and 8 s delay<br>WB movement LOS A and 8 s delay |
| **C** | **Signalized intersection** | | |
| 1 | One lane per direction on each approach | Intersection LOS: A<br>Max v/c ratio: 0.27 (EB)<br>Intersection Delay: 3.0 s | SB movement LOS A and 7 s delay<br>EB movement LOS A and 3 s delay<br>WB movement LOS A and 3 s delay |
| 2 | Two lanes per direction on Bruce Road 25 and one lane per direction on Stickel Street | Intersection LOS: B<br>Max v/c ratio: 0.47 (EB)<br>Intersection Delay: 14.1 s | SB movement LOS A and 6 s delay<br>EB movement LOS B and 15 s delay<br>WB movement LOS B and 13 s delay |
| 3 | One lane per direction on Bruce Road 25 and two lanes on Stickel Street | Intersection LOS: B<br>Max v/c ratio: 0.65 (EB)<br>Intersection Delay: 17.0 s | SB movement LOS A and 9 s delay<br>EB movement LOS B and 19 s delay<br>WB movement LOS B and 14 s delay |
| 4 | Two lanes per direction on Bruce Road 25 and two lanes on Stickel Street | Intersection LOS: B<br>Max v/c ratio: 0.47 (EB)<br>Intersection Delay: 14.1 s | SB movement LOS A and 6 s delay<br>EB movement LOS B and 15 s delay<br>WB movement LOS B and 13 s delay |
| **D** | **Roundabout** | | |
| 1 | One lane per direction on each approach | Intersection LOS: A<br>Max v/c ratio: 0.29 (EB)<br>Intersection Delay: 3.6 s | SB movement LOS A and 3 s delay<br>EB movement LOS A and 4 s delay<br>WB movement LOS A and 3 s delay |
| 2 | Two lanes per direction on Bruce Road 25 and one lane per direction on Stickel Street | Intersection LOS: A<br>Max v/c ratio: 0.16 (EB)<br>Intersection Delay: 1.8 s | SB movement LOS A and 3 s delay<br>EB movement LOS A and 2 s delay<br>WB movement LOS A and 2 s delay |

## TABLE 4.8: TRAFFIC OPERATIONS ANALYSIS SUMMARY FOR ALTERNATIVE 4

| Opt. | Description | Performance Measures | Comments |
|---|---|---|---|
| **A** | **One-way stop control** | | |
| 1 | One lane per direction on each approach | Intersection LOS: A<br>Max v/c ratio: 0.04 (WB)<br>Intersection Delay: 0.9 s | SB movement LOS A and 9 s delay<br>EB movement LOS A and 0 s delay<br>WB movement LOS A and 0 s delay |
| 2 | Two lanes per direction on Bruce Road 25 and one lane per direction on Ridge Street | Intersection LOS: A<br>Max v/c ratio: 0.02 (EB/WB/SB)<br>Intersection Delay: 0.9 s | SB movement LOS A and 9 s delay<br>EB movement LOS A and 0 s delay<br>WB movement LOS A and 0 s delay |
| **B** | **All-way stop control** | | |
| 1 | One lane per direction on each approach | Intersection LOS: A<br>Max v/c ratio: 0.07 (WB)<br>Intersection Delay: 7.2 s | SB movement LOS A and 7 s delay<br>EB movement LOS A and 7 s delay<br>WB movement LOS A and 7 s delay |
| 2 | Two lanes per direction on Bruce Road 25 and one lane per direction on Ridge Street | Intersection LOS: A<br>Max v/c ratio: 0.05 (EB)<br>Intersection Delay: 6.5 s | SB movement LOS A and 7 s delay<br>EB movement LOS A and 7 s delay<br>WB movement LOS A and 6 s delay |
| **C** | **Signalized intersection** | | |
| 1 | One lane per direction on each approach | Intersection LOS: B<br>Max v/c ratio: 0.22 (WB)<br>Intersection Delay: 12.0 s | SB movement LOS A and 5 s delay<br>EB movement LOS B and 15 s delay<br>WB movement LOS B and 12 s delay |
| 2 | Two lanes per direction on Bruce Road 25 and one lane per direction on Ridge Street | Intersection LOS: B<br>Max v/c ratio: 0.13 (WB)<br>Intersection Delay: 11.1 s | SB movement LOS A and 4 s delay<br>EB movement LOS B and 14 s delay<br>WB movement LOS B and 11 s delay |
| 3 | One lane per direction on Bruce Road 25 and two lanes on Ridge Street | Intersection LOS: B<br>Max v/c ratio: 0.22 (WB)<br>Intersection Delay: 12.0 s | SB movement LOS A and 5 s delay<br>EB movement LOS B and 15 s delay<br>WB movement LOS B and 12 s delay |
| 4 | Two lanes per direction on Bruce Road 25 and two lanes on Ridge Street | Intersection LOS: B<br>Max v/c ratio: 0.13 (WB)<br>Intersection Delay: 11.1 s | SB movement LOS A and 4 s delay<br>EB movement LOS B and 14 s delay<br>WB movement LOS B and 11 s delay |
| **D** | **Roundabout** | | |
| 1 | One lane per direction on each approach | Intersection LOS: A<br>Max v/c ratio: 0.05 (WB)<br>Intersection Delay: 2.8 s | SB movement LOS A and 3 s delay<br>EB movement LOS A and 3 s delay<br>WB movement LOS A and 3 s delay |
| 2 | Two lanes per direction on Bruce Road 25 and one lane per direction on Ridge Street | Intersection LOS: A<br>Max v/c ratio: 0.03 (WB)<br>Intersection Delay: 1.6 s | SB movement LOS A and 3 s delay<br>EB movement LOS A and 2 s delay<br>WB movement LOS A and 2 s delay |

## TABLE 4.9: TRAFFIC OPERATIONS ANALYSIS SUMMARY FOR ALTERNATIVE 5

| Opt. | Description | Performance Measures | Comments |
|---|---|---|---|
| **A** | **Existing configuration** | | |
| 1 | Eastbound and Westbound, each: one right/through lane, one left turn lane | Intersection LOS: C<br>Max v/c ratio: 0.80 (EBL)<br>Intersection Delay: 22.1 s | NBL LOS B and 19 s delay<br>NBTR LOS C, v/c 0.77 and 22 s delay<br>SBL LOS E, v/c 0.72 and 56 s delay<br>SBT LOS B and 14 s delay<br>SBR LOS A and 4 s delay<br>EBL LOS D, v/c 0.80 and 38 s delay<br>EBTR LOS A and 8 s delay<br>WBL LOS B and 15 s delay<br>WBTR LOS B and 11 s delay |
| **B** | **Two lanes per direction (eastbound and westbound)** | | |
| 1 | Eastbound and Westbound, each: one shared through/right lane and left turn | Intersection LOS: B<br>Max v/c ratio: 0.91 (EB)<br>Intersection Delay: 16.7 s | NBL LOS B and 14 s delay<br>NBTR LOS B, v/c 0.69 and 16 s delay<br>SBL LOS C, v/c 0.57 and 31 s delay<br>SBT LOS B and 11 s delay<br>SBR LOS A and 3 s delay<br>EB LOS C, v/c 0.91 and 26 s delay<br>WB LOS B and 12 s delay |
| **C** | **Two lanes per direction with dedicated left turn lane** | | |
| 1 | Eastbound and Westbound, each: one left-turn lane, one through lane, one shared right/through lane | Intersection LOS: C<br>Max v/c ratio: 0.81 (EBL)<br>Intersection Delay: 21.6 s | NBL LOS B and 18 s delay<br>NBTR LOS C, v/c 0.75 and 21 s delay<br>SBL LOS D, v/c 0.69 and 50 s delay<br>SBT LOS B and 14 s delay<br>SBR LOS A and 4 s delay<br>EBL LOS D, v/c 0.81 and 41 s delay<br>EBTR LOS A and 8 s delay<br>WBL LOS B and 16 s delay<br>WBTR LOS A and 9 s delay |

### 4.4.6 Alternative 6 – Four-Lane Cross-Section on Bruce Road 25 between Goderich Street and Bruce Street

Alternative 6 considers expanding the cross-section for Bruce Road 25, to include two lanes per direction of travel between the existing intersection with Goderich Street and the future intersection with Bruce Street. **Table 4.10** shows the expected midblock volume-to-capacity ratios for the PM peak hour of the future 2040 horizon.

TABLE 4.10: MIDBLOCK OPERATIONS ANALYSIS FOR ALTERNATIVE 6

| Peak Hour | Direction | Midblock v/c ratio |
|---|---|---|
| AM | Eastbound | 0.06 |
| | Westbound | 0.08 |
| PM | Eastbound | 0.12 |
| | Westbound | 0.08 |

### 4.4.7 Alternative 7 – Four-Lane Cross-Section on Bruce Road 25 between Bruce Street and Realigned Bruce Road 33

Alternative 7 considers expanding the cross-section for Bruce Road 25, to include two lanes per direction of travel between the future intersection with Bruce Street and existing intersection with Bruce Road 33. **Table 4.11** shows the expected midblock volume-to-capacity ratios for the PM peak hour of the future 2040 horizon.

TABLE 4.11: MIDBLOCK OPERATIONS ANALYSIS FOR ALTERNATIVE 7

| Peak Hour | Direction | Midblock v/c ratio |
|---|---|---|
| AM | Eastbound | 0.02 |
| | Westbound | 0.02 |
| PM | Eastbound | 0.02 |
| | Westbound | 0.02 |

### 4.4.8 Alternative 8 – Provide Active Transportation Infrastructure

As noted in Section 2.3.2, Bruce Road 25 is being considered for dedicated cycling facilities in the Town of Saugeen Shores Transportation Master Plan. The consultation materials identify two types of dedicated cycling facilities: reserved bike lanes and trails. **Figure 4.2** shows the details of the facilities.[10]

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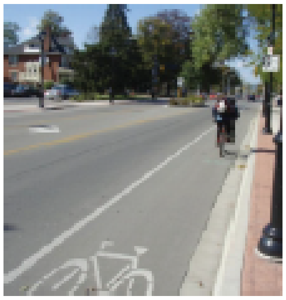
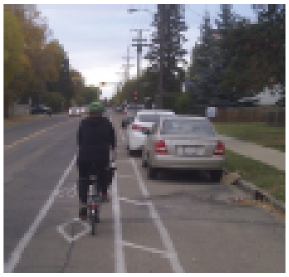
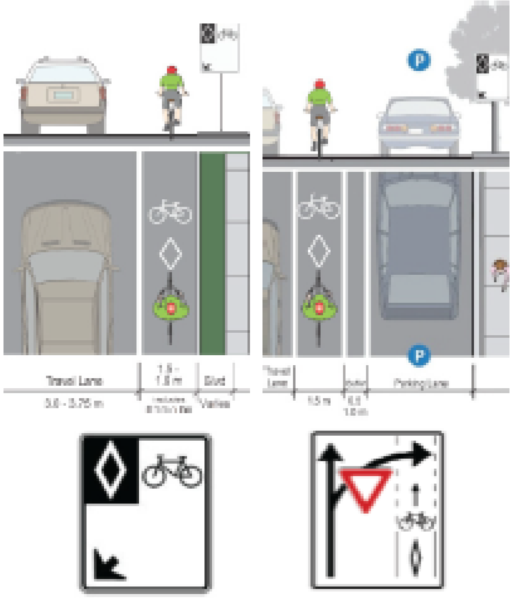
[10] Town of Saugeen Shores. *Town of Saugeen Shores Transportation Master Plan Public Information Centre Board*. 7 August 2019. https://www.saugeenshores.ca/en/living-in-our-community/transportation.aspx

## Reserved Bike Lanes



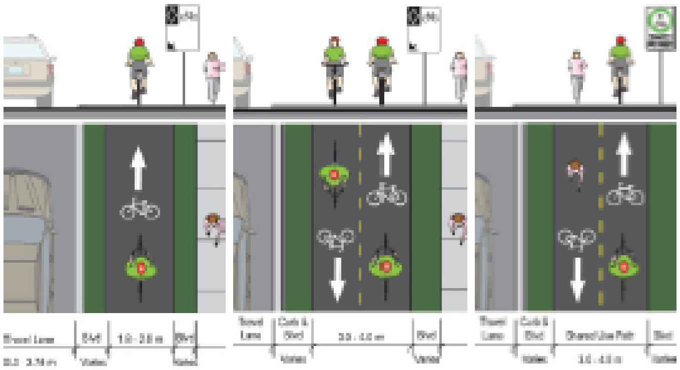




**Design:** Denoted with solid white line and reserved bike lane signs. Option to include added buffer between bike lane and parked and/or moving vehicles. Cyclists travel in bike lane.

**Application:** Urban arterial and collector roads. Higher traffic volumes and speeds.

## Trails



**Design:** Physically separated from vehicles. Trail may or may not be for exclusive cyclist use. Wayfinding signage provided along route.

**Application:** Near tourist destinations, parallel to high volumes, high speed roads, direct commuter route in corridors not served by on-road bike facilities.

Source: Town of Saugeen Shores. *Town of Saugeen Shores Transportation Master Plan Public Information Centre Board*. 7 August 2019.

## Dedicated Cycling Facility Options from Town of Saugeen Shores TMP

**Figure 4.2**

**Table 4.12** evaluates the characteristics of bicycle lanes and trails.

Although buffered bicycle lanes on both sides of Bruce Road 25 would be acceptable, a Multi-Use Trail on the north side of Bruce Road 25 would be preferred. The Multi-Use Trail would provide a dedicated facility for all modes of active transportation, accommodate differing ability levels, and would provide consistency with other trails in the area.

Where the trail crosses intersecting roadways (Stickel Street, Bruce Street and Ridge Street), appropriate treatment, such as a crossride, should be implemented. Consideration should also be given to providing a cross-ride at the intersection of Bruce Road 25 with Goderich Street, along with a connection to the Saugeen Rail Trail.

## 4.5 Summary of Alternatives Assessment

**Table 4.13** provides an assessment of the impacts of each alternative and option and identifies the recommended alternatives to carry forward for implementation, as discussed in the next section of this report.

## TABLE 4.12: EVALUATION OF BICYCLE LANES AND TRAILS FOR BRUCE ROAD 25

| Criteria | Bicycle Lanes | Trail |
|---|---|---|
| Accommodating Cyclists | Provides a dedicated facility for cyclists. | Accommodates cyclists. May have to share the facility with pedestrians. |
| Accommodating Pedestrians | Does not accommodate pedestrians. | Accommodates pedestrians. May have to share the facility with cyclists. |
| Continuity | Can provide a continuous dedicated facility through the study area. | Can provide a continuous dedicated facility through the study area. |
| Safety and Comfort | If buffered from the travel lanes, provides a safe and comfortable route for most cyclists.<br>Cyclists may need to cross Bruce Road 25 to connect to future bicycle network on Bruce Street and Ridge Street. | If buffered from the travel lanes, provides a safe and comfortable route for most cyclists and pedestrians.<br>Appropriate treatment needed at intersections, especially considering presence of cyclists in both directions on one side of Bruce Road 25. |
| Consistency | There are a few other on-road bicycle lanes (or paved shoulders) in the area. | There are several other trails (paved and unpaved) in the area. |
| Cost | Medium-level costs, if included in roadway reconstruction. | Medium-level costs, if included in roadway reconstruction. |

# TABLE 4.13: SUMMARY OF ALTERNATIVES ASSESSMENT

| Alternative | | | Issues | | | | | Recommendation for Implementation |
|---|---|---|---|---|---|---|---|---|
| | | | Traffic Operations | Active Transportation Facilities | Pavement Condition | Sight Distances | Accommodating New Developments | |
| **1** | | **Do Nothing** | | | | | | |
| | 1 | Do Nothing | ◕ | ○ | ○ | ○ | ○ | |
| **2** | | **Realign Bruce Road 33** | | | | | | |
| | A-1 | 2WSC, 1 lane/dir all approches | ● | ○ | N/A | ● | ● | ✓ |
| | A-2 | 2WSC, 2 lanes/dir CR25, 1 lane/dir CR33 & Bruce | ● | ○ | N/A | ● | ● | |
| | B-1 | AWSC, 1 lane/dir all approaches | ● | ○ | N/A | ● | ● | |
| | B-2 | AWSC, 2 lanes/dir CR25, 1 lane/dir CR33 & Bruce | ● | ○ | N/A | ● | ● | |
| | C-1 | Signalized, 1 lane/dir all approaches | ● | ○ | N/A | ● | ● | |
| | C-2 | Signalized, 2 lanes/dir CR25, 1 lane/dir CR33 & Bruce | ● | ○ | N/A | ● | ● | |
| | C-3 | Signalized, 2 lanes/dir + LTL CR25, 1 lane/dir + LTL CR33 & Bruce | ● | ○ | N/A | ● | ● | |
| | D-1 | Roundabout, 1 lane/dir all approches | ● | ○ | N/A | ● | ● | |
| | D-2 | Roundabout, 2 lanes/dir CR25, 1 lane/dir CR33 & Bruce | ● | ○ | N/A | ● | ● | |
| **3** | | **Future Intersection of County Road 25 and Stickel St** | | | | | | |
| | A-1 | 1WSC, 1 lane/dir all approches | ● | ○ | N/A | N/A | ● | ✓ |
| | A-2 | 1WSC, 2 lanes/dir CR25, 1 lane/dir Stickel St | ● | ○ | N/A | N/A | ● | |
| | B-1 | AWSC, 1 lane/dir all approches | ◕ | ○ | N/A | N/A | ● | |
| | B-2 | AWSC, 2 lanes/dir CR25, 1 lane/dir Stickel St | ● | ○ | N/A | N/A | ● | |
| | C-1 | Signalized, 1 lane/dir all approches | ● | ○ | N/A | N/A | ● | |
| | C-2 | Signalized, 2 lanes/dir CR25, 1 lane/dir Stickel St | ◕ | ○ | N/A | N/A | ● | |
| | C-3 | Signalized, 1 lane/dir CR 25, 1 lane/dir + LTL Stickel St | ◕ | ○ | N/A | N/A | ● | |
| | C-4 | Signalized, 2 lanes/dir CR25, 1 lane/dir + LTL Stickel St | ◕ | ○ | N/A | N/A | ● | |
| | D-1 | Roundabout, 1 lane/dir all approches | ● | ○ | N/A | N/A | ● | |
| | D-2 | Roundabout, 2 lanes/dir CR25, 1 lane/dir Stickel St | ● | ○ | N/A | N/A | ● | |

## TABLE 4.13: SUMMARY OF ALTERNATIVES ASSESSMENT (Cont'd)

| Alternative | | | Issues | | | | | Recommendation for Implementation |
|---|---|---|---|---|---|---|---|---|
| | | | Traffic Operations | Active Transportation Facilities | Pavement Condition | Sight Distances | Accommodating New Developments | |
| **4** | | **Future Intersection of County Road 25 and Ridge St** | | | | | | |
| | A-1 | 1WSC, 1 lane/dir all approches | ● | ○ | N/A | N/A | ● | ✓ |
| | A-2 | 1WSC, 2 lanes/dir CR25, 1 lane/dir Ridge St | ● | ○ | N/A | N/A | ● | |
| | B-1 | AWSC, 1 lane/dir all approches | ● | ○ | N/A | N/A | ● | |
| | B-2 | AWSC, 2 lanes/dir CR25, 1 lane/dir Ridge St | ● | ○ | N/A | N/A | ● | |
| | C-1 | Signalized, 1 lane/dir all approches | ◕ | ○ | N/A | N/A | ● | |
| | C-2 | Signalized, 2 lanes/dir CR25, 1 lane/dir Ridge St | ◕ | ○ | N/A | N/A | ● | |
| | C-3 | Signalized, 1 lane/dir CR 25, 1 lane/dir + LTL Ridge St | ◕ | ○ | N/A | N/A | ● | |
| | C-4 | Signalized, 2 lanes/dir CR25, 1 lane/dir + LTL Ridge St | ◕ | ○ | N/A | N/A | ● | |
| | D-1 | Roundabout, 1 lane/dir all approches | ● | ○ | N/A | N/A | ● | |
| | D-2 | Roundabout, 2 lanes/dir CR25, 1 lane/dir Ridge St | ● | ○ | N/A | N/A | ● | |
| **5** | | **Existing Intersection of County Road 25 and Concession Road 6 with Goderich Street (Highway 21)** | | | | | | |
| | A | Existing configuration | ◕ | ○ | N/A | N/A | N/A | |
| | B | Four-lane cross-section, shared R/T and L/T lanes (EB & WB) | ● | ○ | N/A | N/A | N/A | ✓ |
| | C | Four-lane cross-section + LTL (EB & WB) | ◕ | ○ | N/A | N/A | N/A | |
| **6** | | **Four-lane cross-section on County Road 25 between Goderich Street and Bruce Street** | | | | | | |
| | A | Two-lane cross-section | ● | ○ | ● | N/A | N/A | ✓ |
| | B | Four-lane cross-section | ● | ○ | ● | N/A | N/A | |
| **7** | | **Four-lane cross-section on County Road 25 between Bruce Street and current intersection with County Road 33** | | | | | | |
| | A | Two-lane cross-section | ● | ○ | ● | N/A | N/A | ✓ |
| | B | Four-lane cross-section | ● | ○ | ● | N/A | N/A | |
| **8** | | **Provide active transportation infrastructure** | | | | | | |
| | A | Buffered bicycle lane | N/A | ◕ | N/A | N/A | N/A | |
| | B | Buffered multi-use trail | N/A | ● | N/A | N/A | N/A | ✓ |

# 5 Conclusions and Recommendations

## 5.1 Conclusions

As noted in **Section 4.1**, the site visit, geometric review and traffic operations analysis identified concerns within the study area, including:

- **Active Transportation Facilities:** Bruce Road 25 is considered an On-Road Trail Connector and part of the Great Lakes Waterfront Trail, but currently does not have any dedicated pedestrian or cycling facilities;
- **Pavement Condition:** The pavement surface along Bruce Road 25 is in fair to poor condition, with sections of the edge deteriorating;
- **Sight Distances:** Although sight distances at the current intersection of Bruce Road 25 with Lake Range Road meet most guidelines, a vertical curve along Bruce Road 25 just east of the intersection reduces visibility; and
- **New Developments:** The lands north of the study area are planned for future developments, with three roadways to intersect with Bruce Road 25: Stickel Street, Bruce Street and Ridge Street.

Based on the analysis completed, Bruce Road 25 and its intersections within the study area currently operating at satisfactory levels of service. Operating conditions are expected to remain acceptable into the future.

The analysis illustrated that a four-lane cross-section was not necessary to serve traffic forecasts and expected traffic operations. Similarly, all intersections were found to operate at an acceptable level of service regardless of the intersection control, making all-way stop-control and signalization unnecessary for the intersections of Bruce Road 25 with Bruce Road 33/Bruce Street, Stickel Street and Ridge Street.

## 5.2 Recommendations

Based on the assessment of alternatives, the County should consider:

- Reconstructing or at a minimum resurfacing Bruce Road 25;
- For the future intersection of Bruce Road 25 with Bruce Road 33 and Bruce Street:
  - Realigning Bruce Road 33 to intersect Bruce Road 25 opposite of planned Bruce Street;
  - Installing stop controls on the north (Bruce Street) and south (realigned Bruce Road 33) legs;
  - Providing one lane per direction on the north (Bruce Street) and south (realigned Bruce Road 33) legs; and

  - Providing one lane per direction on the east and west legs (Bruce Road 25);
- For the future intersections of Bruce Road 25 with Stickel Street and Ridge Street:
  - Installing stop control on the north leg (Stickel Street and Ridge Street);
  - Providing one lane per direction on the north leg (Stickel Street and Ridge Street); and
  - Providing one lane per direction on the east and west legs (Bruce Road 25);
- Providing two-lanes per direction on Bruce Road 25 and Concession Road 6 at the intersection with Goderich Street, including one shared left/through lane and one shared through/right lane, with two receiving lanes for eastbound and westbound traffic;
- Maintaining a two-lane cross-section on Bruce Road 25 within the study area, with one lane per direction; and
- Providing a buffered multi-use trail along the north side of Bruce Road 25, with appropriate crossing treatments at the intersections.

It should be noted that the County may wish to consider any of the following alternatives, which are also expected to operate at acceptable levels of service:

- Providing a four-lane cross-section along Bruce Road 25 within the study area;
- Providing a roundabout at the intersection of Bruce Road 25 and realigned Bruce Road 33/Bruce Street;
- Providing a roundabout at the intersection of Bruce Road 25 and Stickel Street; or
- Providing a roundabout at the intersection of Bruce Road 25 and Ridge Street.

It should be noted, however, that these alternatives are not required from a traffic operations point of view. Should the County wish to implement roundabouts, careful consideration should be given to crossing treatments for the multi-use trail.

# Appendix A

## Detailed Synchro Analysis Results, 2019

| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | ↰ | ↱ |  | ↰ | ↱ |  | ↰ | ↑↱ |  | ↰ | ↑↑ | ↱ |
| Traffic Volume (vph) | 44 | 6 | 10 | 50 | 8 | 38 | 7 | 172 | 12 | 21 | 678 | 118 |
| Future Volume (vph) | 44 | 6 | 10 | 50 | 8 | 38 | 7 | 172 | 12 | 21 | 678 | 118 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Storage Length (m) | 85.0 |  | 0.0 | 50.0 |  | 0.0 | 75.0 |  | 0.0 | 65.0 |  | 70.0 |
| Storage Lanes | 1 |  | 0 | 1 |  | 0 | 1 |  | 0 | 1 |  | 1 |
| Taper Length (m) | 100.0 |  |  | 55.0 |  |  | 100.0 |  |  | 25.0 |  |  |
| Lane Util. Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.95 | 0.95 | 1.00 | 0.95 | 1.00 |
| Frt |  | 0.908 |  |  | 0.877 |  |  | 0.990 |  |  |  | 0.850 |
| Flt Protected | 0.950 |  |  | 0.950 |  |  | 0.950 |  |  | 0.950 |  |  |
| Satd. Flow (prot) | 1492 | 1257 | 0 | 1805 | 1601 | 0 | 1399 | 3325 | 0 | 1719 | 3539 | 1568 |
| Flt Permitted | 0.724 |  |  | 0.746 |  |  | 0.372 |  |  | 0.626 |  |  |
| Satd. Flow (perm) | 1137 | 1257 | 0 | 1417 | 1601 | 0 | 548 | 3325 | 0 | 1133 | 3539 | 1568 |
| Right Turn on Red |  |  | Yes |  |  | Yes |  |  | Yes |  |  | Yes |
| Satd. Flow (RTOR) |  | 11 |  |  | 41 |  |  | 11 |  |  |  | 128 |
| Link Speed (k/h) |  | 60 |  |  | 40 |  |  | 50 |  |  | 50 |  |
| Link Distance (m) |  | 389.9 |  |  | 411.3 |  |  | 289.8 |  |  | 306.8 |  |
| Travel Time (s) |  | 23.4 |  |  | 37.0 |  |  | 20.9 |  |  | 22.1 |  |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Heavy Vehicles (%) | 21% | 33% | 40% | 0% | 0% | 5% | 29% | 8% | 0% | 5% | 2% | 3% |
| Adj. Flow (vph) | 48 | 7 | 11 | 54 | 9 | 41 | 8 | 187 | 13 | 23 | 737 | 128 |
| Shared Lane Traffic (%) |  |  |  |  |  |  |  |  |  |  |  |  |
| Lane Group Flow (vph) | 48 | 18 | 0 | 54 | 50 | 0 | 8 | 200 | 0 | 23 | 737 | 128 |
| Enter Blocked Intersection | No | No | No | No | No | No | No | No | No | No | No | No |
| Lane Alignment | Left | Left | Right | Left | Left | Right | Left | Left | Right | Left | Left | Right |
| Median Width(m) |  | 3.6 |  |  | 3.6 |  |  | 3.6 |  |  | 3.6 |  |
| Link Offset(m) |  | 0.0 |  |  | 0.0 |  |  | 0.0 |  |  | 0.0 |  |
| Crosswalk Width(m) |  | 4.8 |  |  | 4.8 |  |  | 4.8 |  |  | 4.8 |  |
| Two way Left Turn Lane |  |  |  |  |  |  |  |  |  |  | Yes |  |
| Headway Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Turning Speed (k/h) | 25 |  | 15 | 25 |  | 15 | 25 |  | 15 | 25 |  | 15 |
| Number of Detectors | 1 | 2 |  | 1 | 2 |  | 1 | 2 |  | 1 | 2 | 1 |
| Detector Template | Left | Thru |  | Left | Thru |  | Left | Thru |  | Left | Thru | Right |
| Leading Detector (m) | 2.0 | 10.0 |  | 2.0 | 10.0 |  | 2.0 | 10.0 |  | 2.0 | 10.0 | 2.0 |
| Trailing Detector (m) | 0.0 | 0.0 |  | 0.0 | 0.0 |  | 0.0 | 0.0 |  | 0.0 | 0.0 | 0.0 |
| Detector 1 Position(m) | 0.0 | 0.0 |  | 0.0 | 0.0 |  | 0.0 | 0.0 |  | 0.0 | 0.0 | 0.0 |
| Detector 1 Size(m) | 2.0 | 0.6 |  | 2.0 | 0.6 |  | 2.0 | 0.6 |  | 2.0 | 0.6 | 2.0 |
| Detector 1 Type | Cl+Ex | Cl+Ex |  | Cl+Ex | Cl+Ex |  | Cl+Ex | Cl+Ex |  | Cl+Ex | Cl+Ex | Cl+Ex |
| Detector 1 Channel |  |  |  |  |  |  |  |  |  |  |  |  |
| Detector 1 Extend (s) | 0.0 | 0.0 |  | 0.0 | 0.0 |  | 0.0 | 0.0 |  | 0.0 | 0.0 | 0.0 |
| Detector 1 Queue (s) | 0.0 | 0.0 |  | 0.0 | 0.0 |  | 0.0 | 0.0 |  | 0.0 | 0.0 | 0.0 |
| Detector 1 Delay (s) | 0.0 | 0.0 |  | 0.0 | 0.0 |  | 0.0 | 0.0 |  | 0.0 | 0.0 | 0.0 |
| Detector 2 Position(m) |  | 9.4 |  |  | 9.4 |  |  | 9.4 |  |  | 9.4 |  |
| Detector 2 Size(m) |  | 0.6 |  |  | 0.6 |  |  | 0.6 |  |  | 0.6 |  |
| Detector 2 Type |  | Cl+Ex |  |  | Cl+Ex |  |  | Cl+Ex |  |  | Cl+Ex |  |
| Detector 2 Channel |  |  |  |  |  |  |  |  |  |  |  |  |
| Detector 2 Extend (s) |  | 0.0 |  |  | 0.0 |  |  | 0.0 |  |  | 0.0 |  |
| Turn Type | Perm | NA |  | Perm | NA |  | Perm | NA |  | Perm | NA | Perm |
| Protected Phases |  | 4 |  |  | 8 |  |  | 2 |  |  | 6 |  |

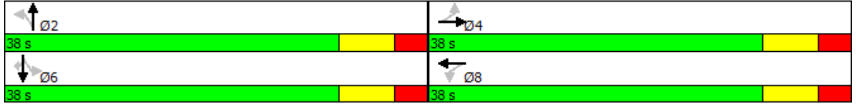
---

| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Permitted Phases | 4 |  |  | 8 |  |  | 2 |  |  | 6 |  | 6 |
| Detector Phase | 4 | 4 |  | 8 | 8 |  | 2 | 2 |  | 6 | 6 | 6 |
| Switch Phase |  |  |  |  |  |  |  |  |  |  |  |  |
| Minimum Initial (s) | 15.0 | 15.0 |  | 15.0 | 15.0 |  | 30.0 | 30.0 |  | 30.0 | 30.0 | 30.0 |
| Minimum Split (s) | 23.0 | 23.0 |  | 23.0 | 23.0 |  | 38.0 | 38.0 |  | 38.0 | 38.0 | 38.0 |
| Total Split (s) | 38.0 | 38.0 |  | 38.0 | 38.0 |  | 38.0 | 38.0 |  | 38.0 | 38.0 | 38.0 |
| Total Split (%) | 50.0% | 50.0% |  | 50.0% | 50.0% |  | 50.0% | 50.0% |  | 50.0% | 50.0% | 50.0% |
| Maximum Green (s) | 30.0 | 30.0 |  | 30.0 | 30.0 |  | 30.0 | 30.0 |  | 30.0 | 30.0 | 30.0 |
| Yellow Time (s) | 5.0 | 5.0 |  | 5.0 | 5.0 |  | 5.0 | 5.0 |  | 5.0 | 5.0 | 5.0 |
| All-Red Time (s) | 3.0 | 3.0 |  | 3.0 | 3.0 |  | 3.0 | 3.0 |  | 3.0 | 3.0 | 3.0 |
| Lost Time Adjust (s) | 0.0 | 0.0 |  | 0.0 | 0.0 |  | 0.0 | 0.0 |  | 0.0 | 0.0 | 0.0 |
| Total Lost Time (s) | 8.0 | 8.0 |  | 8.0 | 8.0 |  | 8.0 | 8.0 |  | 8.0 | 8.0 | 8.0 |
| Lead/Lag |  |  |  |  |  |  |  |  |  |  |  |  |
| Lead-Lag Optimize? |  |  |  |  |  |  |  |  |  |  |  |  |
| Vehicle Extension (s) | 3.0 | 3.0 |  | 3.0 | 3.0 |  | 3.0 | 3.0 |  | 3.0 | 3.0 | 3.0 |
| Recall Mode | None | None |  | None | None |  | Ped | Ped |  | Ped | Ped | Ped |
| Walk Time (s) | 20.0 | 20.0 |  | 20.0 | 20.0 |  | 20.0 | 20.0 |  | 20.0 | 20.0 | 20.0 |
| Flash Dont Walk (s) | 10.0 | 10.0 |  | 10.0 | 10.0 |  | 10.0 | 10.0 |  | 10.0 | 10.0 | 10.0 |
| Pedestrian Calls (#/hr) | 0 | 0 |  | 0 | 0 |  | 0 | 0 |  | 0 | 0 | 0 |
| Act Effct Green (s) | 15.1 | 15.1 |  | 15.1 | 15.1 |  | 39.8 | 39.8 |  | 39.8 | 39.8 | 39.8 |
| Actuated g/C Ratio | 0.26 | 0.26 |  | 0.26 | 0.26 |  | 0.70 | 0.70 |  | 0.70 | 0.70 | 0.70 |
| v/c Ratio | 0.16 | 0.05 |  | 0.14 | 0.11 |  | 0.02 | 0.09 |  | 0.03 | 0.30 | 0.11 |
| Control Delay | 19.5 | 12.9 |  | 19.0 | 9.0 |  | 8.4 | 6.7 |  | 8.2 | 7.7 | 2.3 |
| Queue Delay | 0.0 | 0.0 |  | 0.0 | 0.0 |  | 0.0 | 0.0 |  | 0.0 | 0.0 | 0.0 |
| Total Delay | 19.5 | 12.9 |  | 19.0 | 9.0 |  | 8.4 | 6.7 |  | 8.2 | 7.7 | 2.3 |
| LOS | B | B |  | B | A |  | A | A |  | A | A | A |
| Approach Delay |  | 17.7 |  |  | 14.2 |  |  | 6.8 |  |  | 7.0 |  |
| Approach LOS |  | B |  |  | B |  |  | A |  |  | A |  |

## Intersection Summary

Area Type: Other
Cycle Length: 76
Actuated Cycle Length: 57.2
Natural Cycle: 65
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.30
Intersection Signal Delay: 8.1 Intersection LOS: A
Intersection Capacity Utilization 82.5% ICU Level of Service E
Analysis Period (min) 15

Splits and Phases: 1: Goderich Street & Bruce County Road 25/Concession Road 6



## Queues

Existing Traffic: AM Peak Hour

1: Goderich Street & Bruce County Road 25/Concession Road 6

190077 - County of Bruce - BCR 25/33 EA

| Lane Group | EBL | EBT | WBL | WBT | NBL | NBT | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|
| Lane Group Flow (vph) | 48 | 18 | 54 | 50 | 8 | 200 | 23 | 737 | 128 |
| v/c Ratio | 0.16 | 0.05 | 0.14 | 0.11 | 0.02 | 0.09 | 0.03 | 0.30 | 0.11 |
| Control Delay | 19.5 | 12.9 | 19.0 | 9.0 | 8.4 | 6.7 | 8.2 | 7.7 | 2.3 |
| Queue Delay | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Delay | 19.5 | 12.9 | 19.0 | 9.0 | 8.4 | 6.7 | 8.2 | 7.7 | 2.3 |
| Queue Length 50th (m) | 4.5 | 0.6 | 5.0 | 0.8 | 0.5 | 5.8 | 1.3 | 27.2 | 0.0 |
| Queue Length 95th (m) | 12.2 | 5.0 | 13.0 | 7.9 | 2.4 | 10.7 | 4.5 | 39.1 | 7.0 |
| Internal Link Dist (m) |  | 365.9 |  | 387.3 |  | 265.8 |  | 282.8 |  |
| Turn Bay Length (m) | 85.0 |  | 50.0 |  | 75.0 |  | 65.0 |  | 70.0 |
| Base Capacity (vph) | 601 | 669 | 749 | 866 | 381 | 2314 | 787 | 2460 | 1129 |
| Starvation Cap Reductn | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Spillback Cap Reductn | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Storage Cap Reductn | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Reduced v/c Ratio | 0.08 | 0.03 | 0.07 | 0.06 | 0.02 | 0.09 | 0.03 | 0.30 | 0.11 |

Intersection Summary

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## HCM Signalized Intersection Capacity Analysis

Existing Traffic: AM Peak Hour

1: Goderich Street & Bruce County Road 25/Concession Road 6

190077 - County of Bruce - BCR 25/33 EA

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | ↰ | ↱ |  | ↰ | ↱ |  | ↰ | ↑↱ |  | ↰ | ↑↑ | ↱ |
| Traffic Volume (vph) | 44 | 6 | 10 | 50 | 8 | 38 | 7 | 172 | 12 | 21 | 678 | 118 |
| Future Volume (vph) | 44 | 6 | 10 | 50 | 8 | 38 | 7 | 172 | 12 | 21 | 678 | 118 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | 8.0 | 8.0 |  | 8.0 | 8.0 |  | 8.0 | 8.0 |  | 8.0 | 8.0 | 8.0 |
| Lane Util. Factor | 1.00 | 1.00 |  | 1.00 | 1.00 |  | 1.00 | 0.95 |  | 1.00 | 0.95 | 1.00 |
| Frt | 1.00 | 0.91 |  | 1.00 | 0.88 |  | 1.00 | 0.99 |  | 1.00 | 1.00 | 0.85 |
| Flt Protected | 0.95 | 1.00 |  | 0.95 | 1.00 |  | 0.95 | 1.00 |  | 0.95 | 1.00 | 1.00 |
| Satd. Flow (prot) | 1492 | 1257 |  | 1805 | 1601 |  | 1399 | 3326 |  | 1719 | 3539 | 1568 |
| Flt Permitted | 0.72 | 1.00 |  | 0.75 | 1.00 |  | 0.37 | 1.00 |  | 0.63 | 1.00 | 1.00 |
| Satd. Flow (perm) | 1138 | 1257 |  | 1417 | 1601 |  | 547 | 3326 |  | 1133 | 3539 | 1568 |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 48 | 7 | 11 | 54 | 9 | 41 | 8 | 187 | 13 | 23 | 737 | 128 |
| RTOR Reduction (vph) | 0 | 9 | 0 | 0 | 35 | 0 | 0 | 4 | 0 | 0 | 0 | 52 |
| Lane Group Flow (vph) | 48 | 9 | 0 | 54 | 15 | 0 | 8 | 196 | 0 | 23 | 737 | 76 |
| Heavy Vehicles (%) | 21% | 33% | 40% | 0% | 0% | 5% | 29% | 8% | 0% | 5% | 2% | 3% |
| Turn Type | Perm | NA |  | Perm | NA |  | Perm | NA |  | Perm | NA | Perm |
| Protected Phases |  | 4 |  |  | 8 |  |  | 2 |  |  | 6 |  |
| Permitted Phases | 4 |  |  | 8 |  |  | 2 |  |  | 6 |  | 6 |
| Actuated Green, G (s) | 8.4 | 8.4 |  | 8.4 | 8.4 |  | 36.2 | 36.2 |  | 36.2 | 36.2 | 36.2 |
| Effective Green, g (s) | 8.4 | 8.4 |  | 8.4 | 8.4 |  | 36.2 | 36.2 |  | 36.2 | 36.2 | 36.2 |
| Actuated g/C Ratio | 0.14 | 0.14 |  | 0.14 | 0.14 |  | 0.60 | 0.60 |  | 0.60 | 0.60 | 0.60 |
| Clearance Time (s) | 8.0 | 8.0 |  | 8.0 | 8.0 |  | 8.0 | 8.0 |  | 8.0 | 8.0 | 8.0 |
| Vehicle Extension (s) | 3.0 | 3.0 |  | 3.0 | 3.0 |  | 3.0 | 3.0 |  | 3.0 | 3.0 | 3.0 |
| Lane Grp Cap (vph) | 157 | 174 |  | 196 | 221 |  | 326 | 1986 |  | 676 | 2114 | 936 |
| v/s Ratio Prot |  | 0.01 |  |  | 0.01 |  |  | 0.06 |  |  | c0.21 |  |
| v/s Ratio Perm | c0.04 |  |  | 0.04 |  |  | 0.01 |  |  | 0.02 |  | 0.05 |
| v/c Ratio | 0.31 | 0.05 |  | 0.28 | 0.07 |  | 0.02 | 0.10 |  | 0.03 | 0.35 | 0.08 |
| Uniform Delay, d1 | 23.5 | 22.6 |  | 23.4 | 22.7 |  | 5.0 | 5.2 |  | 5.0 | 6.2 | 5.2 |
| Progression Factor | 1.00 | 1.00 |  | 1.00 | 1.00 |  | 1.00 | 1.00 |  | 1.00 | 1.00 | 1.00 |
| Incremental Delay, d2 | 1.1 | 0.1 |  | 0.8 | 0.1 |  | 0.0 | 0.0 |  | 0.0 | 0.1 | 0.0 |
| Delay (s) | 24.6 | 22.8 |  | 24.1 | 22.8 |  | 5.0 | 5.2 |  | 5.0 | 6.3 | 5.2 |
| Level of Service | C | C |  | C | C |  | A | A |  | A | A | A |
| Approach Delay (s) |  | 24.1 |  |  | 23.5 |  |  | 5.2 |  |  | 6.1 |  |
| Approach LOS |  | C |  |  | C |  |  | A |  |  | A |  |

| Intersection Summary |  |  |  |
|---|---|---|---|
| HCM 2000 Control Delay | 8.3 | HCM 2000 Level of Service | A |
| HCM 2000 Volume to Capacity ratio | 0.34 |  |  |
| Actuated Cycle Length (s) | 60.6 | Sum of lost time (s) | 16.0 |
| Intersection Capacity Utilization | 82.5% | ICU Level of Service | E |
| Analysis Period (min) | 15 |  |  |
| c Critical Lane Group |  |  |  |

| | → | ↘ | ↙ | ← | ↖ | ↗ |
|---|---|---|---|---|---|---|
| Lane Group | EBT | EBR | WBL | WBT | NBL | NBR |
| Lane Configurations | ↱ | | | ↰ | Y | |
| Traffic Volume (vph) | 13 | 3 | 69 | 26 | 1 | 25 |
| Future Volume (vph) | 13 | 3 | 69 | 26 | 1 | 25 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Lane Util. Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Frt | 0.976 | | | | 0.870 | |
| Flt Protected | | | | 0.965 | 0.998 | |
| Satd. Flow (prot) | 1854 | 0 | 0 | 1801 | 1588 | 0 |
| Flt Permitted | | | | 0.965 | 0.998 | |
| Satd. Flow (perm) | 1854 | 0 | 0 | 1801 | 1588 | 0 |
| Link Speed (k/h) | 60 | | | 60 | 50 | |
| Link Distance (m) | 264.4 | | | 205.2 | 284.2 | |
| Travel Time (s) | 15.9 | | | 12.3 | 20.5 | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Heavy Vehicles (%) | 0% | 0% | 1% | 4% | 0% | 4% |
| Adj. Flow (vph) | 14 | 3 | 75 | 28 | 1 | 27 |
| Shared Lane Traffic (%) | | | | | | |
| Lane Group Flow (vph) | 17 | 0 | 0 | 103 | 28 | 0 |
| Enter Blocked Intersection | No | No | No | No | No | No |
| Lane Alignment | Left | Right | Left | Left | Left | Right |
| Median Width(m) | 0.0 | | | 0.0 | 3.6 | |
| Link Offset(m) | 0.0 | | | 0.0 | 0.0 | |
| Crosswalk Width(m) | 4.8 | | | 4.8 | 4.8 | |
| Two way Left Turn Lane | | | | | | |
| Headway Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Turning Speed (k/h) | | 15 | 25 | | 25 | 15 |
| Sign Control | Free | | | Free | Stop | |

**Intersection Summary**

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 21.9% ICU Level of Service A

Analysis Period (min) 15

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| | → | ↘ | ↙ | ← | ↖ | ↗ |
|---|---|---|---|---|---|---|
| Movement | EBT | EBR | WBL | WBT | NBL | NBR |
| Lane Configurations | ↱ | | | ↰ | Y | |
| Traffic Volume (veh/h) | 13 | 3 | 69 | 26 | 1 | 25 |
| Future Volume (Veh/h) | 13 | 3 | 69 | 26 | 1 | 25 |
| Sign Control | Free | | | Free | Stop | |
| Grade | 0% | | | 0% | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 14 | 3 | 75 | 28 | 1 | 27 |
| Pedestrians | | | | | | |
| Lane Width (m) | | | | | | |
| Walking Speed (m/s) | | | | | | |
| Percent Blockage | | | | | | |
| Right turn flare (veh) | | | | | | |
| Median type | None | | | None | | |
| Median storage veh) | | | | | | |
| Upstream signal (m) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | | | 17 | | 194 | 16 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | | | 17 | | 194 | 16 |
| tC, single (s) | | | 4.1 | | 6.4 | 6.2 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | | | 2.2 | | 3.5 | 3.3 |
| p0 queue free % | | | 95 | | 100 | 97 |
| cM capacity (veh/h) | | | 1607 | | 763 | 1058 |

| Direction, Lane # | EB 1 | WB 1 | NB 1 |
|---|---|---|---|
| Volume Total | 17 | 103 | 28 |
| Volume Left | 0 | 75 | 1 |
| Volume Right | 3 | 0 | 27 |
| cSH | 1700 | 1607 | 1044 |
| Volume to Capacity | 0.01 | 0.05 | 0.03 |
| Queue Length 95th (m) | 0.0 | 1.2 | 0.7 |
| Control Delay (s) | 0.0 | 5.4 | 8.5 |
| Lane LOS | | A | A |
| Approach Delay (s) | 0.0 | 5.4 | 8.5 |
| Approach LOS | | | A |

| Intersection Summary | | | |
|---|---|---|---|
| Average Delay | 5.4 | | |
| Intersection Capacity Utilization | 21.9% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |

| | ↗ | → | ↘ | ↙ | ← | ↖ | ↖ | ↑ | ↗ | ↘ | ↓ | ↙ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations | ↰ | ↱ | | ↰ | ↱ | | ↰ | ↑↱ | | ↰ | ↑↑ | ↱ |
| Traffic Volume (vph) | 193 | 15 | 7 | 12 | 5 | 35 | 9 | 715 | 49 | 53 | 195 | 68 |
| Future Volume (vph) | 193 | 15 | 7 | 12 | 5 | 35 | 9 | 715 | 49 | 53 | 195 | 68 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Storage Length (m) | 85.0 | | 0.0 | 50.0 | | 0.0 | 75.0 | | 0.0 | 65.0 | | 70.0 |
| Storage Lanes | 1 | | 0 | 1 | | 0 | 1 | | 0 | 1 | | 1 |
| Taper Length (m) | 100.0 | | | 55.0 | | | 100.0 | | | 25.0 | | |
| Lane Util. Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.95 | 0.95 | 1.00 | 0.95 | 1.00 |
| Frt | | 0.950 | | | 0.867 | | | 0.990 | | | | 0.850 |
| Flt Protected | 0.950 | | | 0.950 | | | 0.950 | | | 0.950 | | |
| Satd. Flow (prot) | 1492 | 1334 | 0 | 1805 | 1578 | 0 | 1399 | 3325 | 0 | 1719 | 3539 | 1568 |
| Flt Permitted | 0.729 | | | 0.742 | | | 0.619 | | | 0.306 | | |
| Satd. Flow (perm) | 1145 | 1334 | 0 | 1410 | 1578 | 0 | 912 | 3325 | 0 | 554 | 3539 | 1568 |
| Right Turn on Red | | | Yes | | | Yes | | | Yes | | | Yes |
| Satd. Flow (RTOR) | | 8 | | | 38 | | | 11 | | | | 74 |
| Link Speed (k/h) | | 60 | | | 40 | | | 50 | | | 50 | |
| Link Distance (m) | | 389.9 | | | 411.3 | | | 289.8 | | | 306.8 | |
| Travel Time (s) | | 23.4 | | | 37.0 | | | 20.9 | | | 22.1 | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Heavy Vehicles (%) | 21% | 33% | 40% | 0% | 0% | 5% | 29% | 8% | 0% | 5% | 2% | 3% |
| Adj. Flow (vph) | 210 | 16 | 8 | 13 | 5 | 38 | 10 | 777 | 53 | 58 | 212 | 74 |
| Shared Lane Traffic (%) | | | | | | | | | | | | |
| Lane Group Flow (vph) | 210 | 24 | 0 | 13 | 43 | 0 | 10 | 830 | 0 | 58 | 212 | 74 |
| Enter Blocked Intersection | No | No | No | No | No | No | No | No | No | No | No | No |
| Lane Alignment | Left | Left | Right | Left | Left | Right | Left | Left | Right | Left | Left | Right |
| Median Width(m) | | 3.6 | | | 3.6 | | | 3.6 | | | 3.6 | |
| Link Offset(m) | | 0.0 | | | 0.0 | | | 0.0 | | | 0.0 | |
| Crosswalk Width(m) | | 4.8 | | | 4.8 | | | 4.8 | | | 4.8 | |
| Two way Left Turn Lane | | | | | | | | | | | Yes | |
| Headway Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Turning Speed (k/h) | 25 | | 15 | 25 | | 15 | 25 | | 15 | 25 | | 15 |
| Number of Detectors | 1 | 2 | | 1 | 2 | | 1 | 2 | | 1 | 2 | 1 |
| Detector Template | Left | Thru | | Left | Thru | | Left | Thru | | Left | Thru | Right |
| Leading Detector (m) | 2.0 | 10.0 | | 2.0 | 10.0 | | 2.0 | 10.0 | | 2.0 | 10.0 | 2.0 |
| Trailing Detector (m) | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 |
| Detector 1 Position(m) | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 |
| Detector 1 Size(m) | 2.0 | 0.6 | | 2.0 | 0.6 | | 2.0 | 0.6 | | 2.0 | 0.6 | 2.0 |
| Detector 1 Type | Cl+Ex | Cl+Ex | | Cl+Ex | Cl+Ex | | Cl+Ex | Cl+Ex | | Cl+Ex | Cl+Ex | Cl+Ex |
| Detector 1 Channel | | | | | | | | | | | | |
| Detector 1 Extend (s) | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 |
| Detector 1 Queue (s) | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 |
| Detector 1 Delay (s) | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 |
| Detector 2 Position(m) | | 9.4 | | | 9.4 | | | 9.4 | | | 9.4 | |
| Detector 2 Size(m) | | 0.6 | | | 0.6 | | | 0.6 | | | 0.6 | |
| Detector 2 Type | | Cl+Ex | | | Cl+Ex | | | Cl+Ex | | | Cl+Ex | |
| Detector 2 Channel | | | | | | | | | | | | |
| Detector 2 Extend (s) | | 0.0 | | | 0.0 | | | 0.0 | | | 0.0 | |
| Turn Type | Perm | NA | | Perm | NA | | Perm | NA | | Perm | NA | Perm |
| Protected Phases | | 4 | | | 8 | | | 2 | | | 6 | |

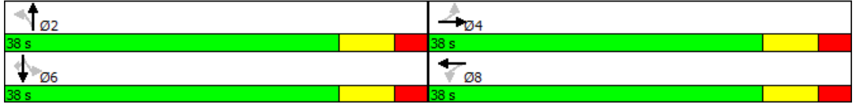
---

| | ↗ | → | ↘ | ↙ | ← | ↖ | ↖ | ↑ | ↗ | ↘ | ↓ | ↙ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Permitted Phases | 4 | | | 8 | | | 2 | | | 6 | | 6 |
| Detector Phase | 4 | 4 | | 8 | 8 | | 2 | 2 | | 6 | 6 | 6 |
| Switch Phase | | | | | | | | | | | | |
| Minimum Initial (s) | 15.0 | 15.0 | | 15.0 | 15.0 | | 30.0 | 30.0 | | 30.0 | 30.0 | 30.0 |
| Minimum Split (s) | 23.0 | 23.0 | | 23.0 | 23.0 | | 38.0 | 38.0 | | 38.0 | 38.0 | 38.0 |
| Total Split (s) | 38.0 | 38.0 | | 38.0 | 38.0 | | 38.0 | 38.0 | | 38.0 | 38.0 | 38.0 |
| Total Split (%) | 50.0% | 50.0% | | 50.0% | 50.0% | | 50.0% | 50.0% | | 50.0% | 50.0% | 50.0% |
| Maximum Green (s) | 30.0 | 30.0 | | 30.0 | 30.0 | | 30.0 | 30.0 | | 30.0 | 30.0 | 30.0 |
| Yellow Time (s) | 5.0 | 5.0 | | 5.0 | 5.0 | | 5.0 | 5.0 | | 5.0 | 5.0 | 5.0 |
| All-Red Time (s) | 3.0 | 3.0 | | 3.0 | 3.0 | | 3.0 | 3.0 | | 3.0 | 3.0 | 3.0 |
| Lost Time Adjust (s) | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 |
| Total Lost Time (s) | 8.0 | 8.0 | | 8.0 | 8.0 | | 8.0 | 8.0 | | 8.0 | 8.0 | 8.0 |
| Lead/Lag | | | | | | | | | | | | |
| Lead-Lag Optimize? | | | | | | | | | | | | |
| Vehicle Extension (s) | 3.0 | 3.0 | | 3.0 | 3.0 | | 3.0 | 3.0 | | 3.0 | 3.0 | 3.0 |
| Recall Mode | None | None | | None | None | | Ped | Ped | | Ped | Ped | Ped |
| Walk Time (s) | 20.0 | 20.0 | | 20.0 | 20.0 | | 20.0 | 20.0 | | 20.0 | 20.0 | 20.0 |
| Flash Dont Walk (s) | 10.0 | 10.0 | | 10.0 | 10.0 | | 10.0 | 10.0 | | 10.0 | 10.0 | 10.0 |
| Pedestrian Calls (#/hr) | 0 | 0 | | 0 | 0 | | 0 | 0 | | 0 | 0 | 0 |
| Act Effct Green (s) | 18.2 | 18.2 | | 18.2 | 18.2 | | 30.5 | 30.5 | | 30.5 | 30.5 | 30.5 |
| Actuated g/C Ratio | 0.28 | 0.28 | | 0.28 | 0.28 | | 0.47 | 0.47 | | 0.47 | 0.47 | 0.47 |
| v/c Ratio | 0.65 | 0.06 | | 0.03 | 0.09 | | 0.02 | 0.53 | | 0.22 | 0.13 | 0.10 |
| Control Delay | 30.6 | 13.1 | | 16.0 | 7.2 | | 11.3 | 14.1 | | 14.6 | 10.8 | 3.8 |
| Queue Delay | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 |
| Total Delay | 30.6 | 13.1 | | 16.0 | 7.2 | | 11.3 | 14.1 | | 14.6 | 10.8 | 3.8 |
| LOS | C | B | | B | A | | B | B | | B | B | A |
| Approach Delay | | 28.8 | | | 9.2 | | | 14.1 | | | 9.9 | |
| Approach LOS | | C | | | A | | | B | | | A | |

**Intersection Summary**

Area Type: Other
Cycle Length: 76
Actuated Cycle Length: 64.8
Natural Cycle: 65
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.65
Intersection Signal Delay: 15.3 Intersection LOS: B
Intersection Capacity Utilization 82.5% ICU Level of Service E
Analysis Period (min) 15

Splits and Phases: 1: Goderich Street & Bruce County Road 25/Concession Road 6



# Queues

## 1: Goderich Street & Bruce County Road 25/Concession Road 6

| | ↗ | → | ↙ | ← | ↖ | ↑ | ↘ | ↓ | ↙ |
|---|---|---|---|---|---|---|---|---|---|
| Lane Group | EBL | EBT | WBL | WBT | NBL | NBT | SBL | SBT | SBR |
| Lane Group Flow (vph) | 210 | 24 | 13 | 43 | 10 | 830 | 58 | 212 | 74 |
| v/c Ratio | 0.65 | 0.06 | 0.03 | 0.09 | 0.02 | 0.53 | 0.22 | 0.13 | 0.10 |
| Control Delay | 30.6 | 13.1 | 16.0 | 7.2 | 11.3 | 14.1 | 14.6 | 10.8 | 3.8 |
| Queue Delay | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Delay | 30.6 | 13.1 | 16.0 | 7.2 | 11.3 | 14.1 | 14.6 | 10.8 | 3.8 |
| Queue Length 50th (m) | 22.9 | 1.4 | 1.2 | 0.5 | 0.6 | 33.5 | 3.8 | 6.9 | 0.0 |
| Queue Length 95th (m) | 43.2 | 6.1 | 4.6 | 6.4 | 3.5 | 63.4 | 13.8 | 16.0 | 7.0 |
| Internal Link Dist (m) | | 365.9 | | 387.3 | | 265.8 | | 282.8 | |
| Turn Bay Length (m) | 85.0 | | 50.0 | | 75.0 | | 65.0 | | 70.0 |
| Base Capacity (vph) | 532 | 624 | 654 | 753 | 429 | 1572 | 260 | 1667 | 778 |
| Starvation Cap Reductn | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Spillback Cap Reductn | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Storage Cap Reductn | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Reduced v/c Ratio | 0.39 | 0.04 | 0.02 | 0.06 | 0.02 | 0.53 | 0.22 | 0.13 | 0.10 |

Intersection Summary

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# HCM Signalized Intersection Capacity Analysis

## 1: Goderich Street & Bruce County Road 25/Concession Road 6

| | ↗ | → | ↘ | ↙ | ← | ↖ | ↖ | ↑ | ↗ | ↘ | ↓ | ↙ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations | ↰ | ↱ | | ↰ | ↱ | | ↰ | ↑↱ | | ↰ | ↑↑ | ↱ |
| Traffic Volume (vph) | 193 | 15 | 7 | 12 | 5 | 35 | 9 | 715 | 49 | 53 | 195 | 68 |
| Future Volume (vph) | 193 | 15 | 7 | 12 | 5 | 35 | 9 | 715 | 49 | 53 | 195 | 68 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | 8.0 | 8.0 | | 8.0 | 8.0 | | 8.0 | 8.0 | | 8.0 | 8.0 | 8.0 |
| Lane Util. Factor | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 | 0.95 | | 1.00 | 0.95 | 1.00 |
| Frt | 1.00 | 0.95 | | 1.00 | 0.87 | | 1.00 | 0.99 | | 1.00 | 1.00 | 0.85 |
| Flt Protected | 0.95 | 1.00 | | 0.95 | 1.00 | | 0.95 | 1.00 | | 0.95 | 1.00 | 1.00 |
| Satd. Flow (prot) | 1492 | 1334 | | 1805 | 1578 | | 1399 | 3326 | | 1719 | 3539 | 1568 |
| Flt Permitted | 0.73 | 1.00 | | 0.74 | 1.00 | | 0.62 | 1.00 | | 0.31 | 1.00 | 1.00 |
| Satd. Flow (perm) | 1145 | 1334 | | 1409 | 1578 | | 912 | 3326 | | 554 | 3539 | 1568 |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 210 | 16 | 8 | 13 | 5 | 38 | 10 | 777 | 53 | 58 | 212 | 74 |
| RTOR Reduction (vph) | 0 | 6 | 0 | 0 | 27 | 0 | 0 | 6 | 0 | 0 | 0 | 39 |
| Lane Group Flow (vph) | 210 | 18 | 0 | 13 | 16 | 0 | 10 | 824 | 0 | 58 | 212 | 35 |
| Heavy Vehicles (%) | 21% | 33% | 40% | 0% | 0% | 5% | 29% | 8% | 0% | 5% | 2% | 3% |
| Turn Type | Perm | NA | | Perm | NA | | Perm | NA | | Perm | NA | Perm |
| Protected Phases | | 4 | | | 8 | | | 2 | | | 6 | |
| Permitted Phases | 4 | | | 8 | | | 2 | | | 6 | | 6 |
| Actuated Green, G (s) | 18.2 | 18.2 | | 18.2 | 18.2 | | 30.5 | 30.5 | | 30.5 | 30.5 | 30.5 |
| Effective Green, g (s) | 18.2 | 18.2 | | 18.2 | 18.2 | | 30.5 | 30.5 | | 30.5 | 30.5 | 30.5 |
| Actuated g/C Ratio | 0.28 | 0.28 | | 0.28 | 0.28 | | 0.47 | 0.47 | | 0.47 | 0.47 | 0.47 |
| Clearance Time (s) | 8.0 | 8.0 | | 8.0 | 8.0 | | 8.0 | 8.0 | | 8.0 | 8.0 | 8.0 |
| Vehicle Extension (s) | 3.0 | 3.0 | | 3.0 | 3.0 | | 3.0 | 3.0 | | 3.0 | 3.0 | 3.0 |
| Lane Grp Cap (vph) | 322 | 375 | | 396 | 443 | | 429 | 1567 | | 261 | 1668 | 739 |
| v/s Ratio Prot | | 0.01 | | | 0.01 | | | c0.25 | | | 0.06 | |
| v/s Ratio Perm | c0.18 | | | 0.01 | | | 0.01 | | | 0.10 | | 0.02 |
| v/c Ratio | 0.65 | 0.05 | | 0.03 | 0.04 | | 0.02 | 0.53 | | 0.22 | 0.13 | 0.05 |
| Uniform Delay, d1 | 20.5 | 16.9 | | 16.9 | 16.9 | | 9.1 | 12.0 | | 10.1 | 9.6 | 9.2 |
| Progression Factor | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | 1.00 |
| Incremental Delay, d2 | 4.7 | 0.1 | | 0.0 | 0.0 | | 0.0 | 0.3 | | 0.4 | 0.0 | 0.0 |
| Delay (s) | 25.1 | 17.0 | | 16.9 | 16.9 | | 9.2 | 12.3 | | 10.5 | 9.6 | 9.3 |
| Level of Service | C | B | | B | B | | A | B | | B | A | A |
| Approach Delay (s) | | 24.3 | | | 16.9 | | | 12.3 | | | 9.7 | |
| Approach LOS | | C | | | B | | | B | | | A | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM 2000 Control Delay | 13.8 | HCM 2000 Level of Service | B |
| HCM 2000 Volume to Capacity ratio | 0.57 | | |
| Actuated Cycle Length (s) | 64.7 | Sum of lost time (s) | 16.0 |
| Intersection Capacity Utilization | 82.5% | ICU Level of Service | E |
| Analysis Period (min) | 15 | | |
| c Critical Lane Group | | | |

## Lanes, Volumes, Timings
## 5: Bruce County Road 33 & Bruce County Road 25

Existing Traffic: PM Peak Hour
190077 - County of Bruce - BCR 25/33 EA

| | → | ↘ | ↙ | ← | ↖ | ↗ |
|---|---|---|---|---|---|---|
| Lane Group | EBT | EBR | WBL | WBT | NBL | NBR |
| Lane Configurations | ↱ | | | ↰ | ↰↱ | |
| Traffic Volume (vph) | 26 | 1 | 39 | 38 | 0 | 165 |
| Future Volume (vph) | 26 | 1 | 39 | 38 | 0 | 165 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Lane Util. Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Frt | 0.995 | | | | 0.865 | |
| Flt Protected | | | | 0.975 | | |
| Satd. Flow (prot) | 1890 | 0 | 0 | 1808 | 1580 | 0 |
| Flt Permitted | | | | 0.975 | | |
| Satd. Flow (perm) | 1890 | 0 | 0 | 1808 | 1580 | 0 |
| Link Speed (k/h) | 60 | | | 60 | 50 | |
| Link Distance (m) | 264.4 | | | 205.2 | 284.2 | |
| Travel Time (s) | 15.9 | | | 12.3 | 20.5 | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Heavy Vehicles (%) | 0% | 0% | 1% | 4% | 0% | 4% |
| Adj. Flow (vph) | 28 | 1 | 42 | 41 | 0 | 179 |
| Shared Lane Traffic (%) | | | | | | |
| Lane Group Flow (vph) | 29 | 0 | 0 | 83 | 179 | 0 |
| Enter Blocked Intersection | No | No | No | No | No | No |
| Lane Alignment | Left | Right | Left | Left | Left | Right |
| Median Width(m) | 0.0 | | | 0.0 | 3.6 | |
| Link Offset(m) | 0.0 | | | 0.0 | 0.0 | |
| Crosswalk Width(m) | 4.8 | | | 4.8 | 4.8 | |
| Two way Left Turn Lane | | | | | | |
| Headway Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Turning Speed (k/h) | | 15 | 25 | | 25 | 15 |
| Sign Control | Free | | | Free | Stop | |

Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 27.7% ICU Level of Service A
Analysis Period (min) 15

---

## HCM Unsignalized Intersection Capacity Analysis
## 5: Bruce County Road 33 & Bruce County Road 25

Existing Traffic: PM Peak Hour
190077 - County of Bruce - BCR 25/33 EA

| | → | ↘ | ↙ | ← | ↖ | ↗ |
|---|---|---|---|---|---|---|
| Movement | EBT | EBR | WBL | WBT | NBL | NBR |
| Lane Configurations | ↱ | | | ↰ | ↰↱ | |
| Traffic Volume (veh/h) | 26 | 1 | 39 | 38 | 0 | 165 |
| Future Volume (Veh/h) | 26 | 1 | 39 | 38 | 0 | 165 |
| Sign Control | Free | | | Free | Stop | |
| Grade | 0% | | | 0% | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 28 | 1 | 42 | 41 | 0 | 179 |
| Pedestrians | | | | | | |
| Lane Width (m) | | | | | | |
| Walking Speed (m/s) | | | | | | |
| Percent Blockage | | | | | | |
| Right turn flare (veh) | | | | | | |
| Median type | None | | | None | | |
| Median storage veh) | | | | | | |
| Upstream signal (m) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | | | 29 | | 154 | 28 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | | | 29 | | 154 | 28 |
| tC, single (s) | | | 4.1 | | 6.4 | 6.2 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | | | 2.2 | | 3.5 | 3.3 |
| p0 queue free % | | | 97 | | 100 | 83 |
| cM capacity (veh/h) | | | 1591 | | 821 | 1041 |

| Direction, Lane # | EB 1 | WB 1 | NB 1 |
|---|---|---|---|
| Volume Total | 29 | 83 | 179 |
| Volume Left | 0 | 42 | 0 |
| Volume Right | 1 | 0 | 179 |
| cSH | 1700 | 1591 | 1041 |
| Volume to Capacity | 0.02 | 0.03 | 0.17 |
| Queue Length 95th (m) | 0.0 | 0.7 | 5.0 |
| Control Delay (s) | 0.0 | 3.8 | 9.2 |
| Lane LOS | | A | A |
| Approach Delay (s) | 0.0 | 3.8 | 9.2 |
| Approach LOS | | | A |

Intersection Summary

| | | | |
|---|---|---|---|
| Average Delay | 6.7 | | |
| Intersection Capacity Utilization | 27.7% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |

# Appendix B

## Detailed Synchro Analysis Results, 2040

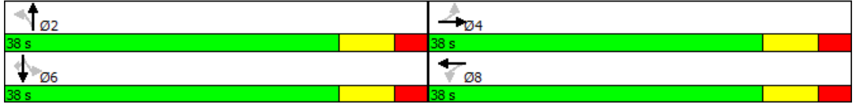
| | ↗ | → | ↘ | ↙ | ← | ↖ | ↖ | ↑ | ↗ | ↘ | ↓ | ↙ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations | ↰ | ↱ | | ↰ | ↱ | | ↰ | ↑↱ | | ↰ | ↑↑ | ↱ |
| Traffic Volume (vph) | 62 | 16 | 113 | 50 | 18 | 55 | 34 | 249 | 12 | 48 | 942 | 176 |
| Future Volume (vph) | 62 | 16 | 113 | 50 | 18 | 55 | 34 | 249 | 12 | 48 | 942 | 176 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Storage Length (m) | 85.0 | | 0.0 | 50.0 | | 0.0 | 75.0 | | 0.0 | 65.0 | | 70.0 |
| Storage Lanes | 1 | | 0 | 1 | | 0 | 1 | | 0 | 1 | | 1 |
| Taper Length (m) | 100.0 | | | 55.0 | | | 100.0 | | | 25.0 | | |
| Lane Util. Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.95 | 0.95 | 1.00 | 0.95 | 1.00 |
| Frt | | 0.868 | | | 0.887 | | | 0.993 | | | | 0.850 |
| Flt Protected | 0.950 | | | 0.950 | | | 0.950 | | | 0.950 | | |
| Satd. Flow (prot) | 1492 | 1185 | 0 | 1805 | 1624 | 0 | 1399 | 3330 | 0 | 1719 | 3539 | 1568 |
| Flt Permitted | 0.705 | | | 0.668 | | | 0.247 | | | 0.578 | | |
| Satd. Flow (perm) | 1107 | 1185 | 0 | 1269 | 1624 | 0 | 364 | 3330 | 0 | 1046 | 3539 | 1568 |
| Right Turn on Red | | | Yes | | | Yes | | | Yes | | | Yes |
| Satd. Flow (RTOR) | | 33 | | | 60 | | | 7 | | | | 191 |
| Link Speed (k/h) | | 60 | | | 40 | | | 50 | | | 50 | |
| Link Distance (m) | | 389.9 | | | 411.3 | | | 289.8 | | | 306.8 | |
| Travel Time (s) | | 23.4 | | | 37.0 | | | 20.9 | | | 22.1 | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Heavy Vehicles (%) | 21% | 33% | 40% | 0% | 0% | 5% | 29% | 8% | 0% | 5% | 2% | 3% |
| Adj. Flow (vph) | 67 | 17 | 123 | 54 | 20 | 60 | 37 | 271 | 13 | 52 | 1024 | 191 |
| Shared Lane Traffic (%) | | | | | | | | | | | | |
| Lane Group Flow (vph) | 67 | 140 | 0 | 54 | 80 | 0 | 37 | 284 | 0 | 52 | 1024 | 191 |
| Enter Blocked Intersection | No | No | No | No | No | No | No | No | No | No | No | No |
| Lane Alignment | Left | Left | Right | Left | Left | Right | Left | Left | Right | Left | Left | Right |
| Median Width(m) | | 3.6 | | | 3.6 | | | 3.6 | | | 3.6 | |
| Link Offset(m) | | 0.0 | | | 0.0 | | | 0.0 | | | 0.0 | |
| Crosswalk Width(m) | | 4.8 | | | 4.8 | | | 4.8 | | | 4.8 | |
| Two way Left Turn Lane | | | | | | | | | | | Yes | |
| Headway Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Turning Speed (k/h) | 25 | | 15 | 25 | | 15 | 25 | | 15 | 25 | | 15 |
| Number of Detectors | 1 | 2 | | 1 | 2 | | 1 | 2 | | 1 | 2 | 1 |
| Detector Template | Left | Thru | | Left | Thru | | Left | Thru | | Left | Thru | Right |
| Leading Detector (m) | 2.0 | 10.0 | | 2.0 | 10.0 | | 2.0 | 10.0 | | 2.0 | 10.0 | 2.0 |
| Trailing Detector (m) | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 |
| Detector 1 Position(m) | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 |
| Detector 1 Size(m) | 2.0 | 0.6 | | 2.0 | 0.6 | | 2.0 | 0.6 | | 2.0 | 0.6 | 2.0 |
| Detector 1 Type | Cl+Ex | Cl+Ex | | Cl+Ex | Cl+Ex | | Cl+Ex | Cl+Ex | | Cl+Ex | Cl+Ex | Cl+Ex |
| Detector 1 Channel | | | | | | | | | | | | |
| Detector 1 Extend (s) | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 |
| Detector 1 Queue (s) | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 |
| Detector 1 Delay (s) | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 |
| Detector 2 Position(m) | | 9.4 | | | 9.4 | | | 9.4 | | | 9.4 | |
| Detector 2 Size(m) | | 0.6 | | | 0.6 | | | 0.6 | | | 0.6 | |
| Detector 2 Type | | Cl+Ex | | | Cl+Ex | | | Cl+Ex | | | Cl+Ex | |
| Detector 2 Channel | | | | | | | | | | | | |
| Detector 2 Extend (s) | | 0.0 | | | 0.0 | | | 0.0 | | | 0.0 | |
| Turn Type | Perm | NA | | Perm | NA | | Perm | NA | | Perm | NA | Perm |
| Protected Phases | | 4 | | | 8 | | | 2 | | | 6 | |

---

| | ↗ | → | ↘ | ↙ | ← | ↖ | ↖ | ↑ | ↗ | ↘ | ↓ | ↙ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Permitted Phases | 4 | | | 8 | | | 2 | | | 6 | | 6 |
| Detector Phase | 4 | 4 | | 8 | 8 | | 2 | 2 | | 6 | 6 | 6 |
| Switch Phase | | | | | | | | | | | | |
| Minimum Initial (s) | 15.0 | 15.0 | | 15.0 | 15.0 | | 30.0 | 30.0 | | 30.0 | 30.0 | 30.0 |
| Minimum Split (s) | 23.0 | 23.0 | | 23.0 | 23.0 | | 38.0 | 38.0 | | 38.0 | 38.0 | 38.0 |
| Total Split (s) | 38.0 | 38.0 | | 38.0 | 38.0 | | 38.0 | 38.0 | | 38.0 | 38.0 | 38.0 |
| Total Split (%) | 50.0% | 50.0% | | 50.0% | 50.0% | | 50.0% | 50.0% | | 50.0% | 50.0% | 50.0% |
| Maximum Green (s) | 30.0 | 30.0 | | 30.0 | 30.0 | | 30.0 | 30.0 | | 30.0 | 30.0 | 30.0 |
| Yellow Time (s) | 5.0 | 5.0 | | 5.0 | 5.0 | | 5.0 | 5.0 | | 5.0 | 5.0 | 5.0 |
| All-Red Time (s) | 3.0 | 3.0 | | 3.0 | 3.0 | | 3.0 | 3.0 | | 3.0 | 3.0 | 3.0 |
| Lost Time Adjust (s) | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 |
| Total Lost Time (s) | 8.0 | 8.0 | | 8.0 | 8.0 | | 8.0 | 8.0 | | 8.0 | 8.0 | 8.0 |
| Lead/Lag | | | | | | | | | | | | |
| Lead-Lag Optimize? | | | | | | | | | | | | |
| Vehicle Extension (s) | 3.0 | 3.0 | | 3.0 | 3.0 | | 3.0 | 3.0 | | 3.0 | 3.0 | 3.0 |
| Recall Mode | None | None | | None | None | | Ped | Ped | | Ped | Ped | Ped |
| Walk Time (s) | 20.0 | 20.0 | | 20.0 | 20.0 | | 20.0 | 20.0 | | 20.0 | 20.0 | 20.0 |
| Flash Dont Walk (s) | 10.0 | 10.0 | | 10.0 | 10.0 | | 10.0 | 10.0 | | 10.0 | 10.0 | 10.0 |
| Pedestrian Calls (#/hr) | 0 | 0 | | 0 | 0 | | 0 | 0 | | 0 | 0 | 0 |
| Act Effct Green (s) | 15.3 | 15.3 | | 15.3 | 15.3 | | 35.3 | 35.3 | | 35.3 | 35.3 | 35.3 |
| Actuated g/C Ratio | 0.26 | 0.26 | | 0.26 | 0.26 | | 0.59 | 0.59 | | 0.59 | 0.59 | 0.59 |
| v/c Ratio | 0.24 | 0.43 | | 0.17 | 0.17 | | 0.17 | 0.14 | | 0.08 | 0.49 | 0.19 |
| Control Delay | 21.0 | 19.8 | | 19.6 | 8.9 | | 11.9 | 8.3 | | 9.1 | 11.1 | 2.2 |
| Queue Delay | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 |
| Total Delay | 21.0 | 19.8 | | 19.6 | 8.9 | | 11.9 | 8.3 | | 9.1 | 11.1 | 2.2 |
| LOS | C | B | | B | A | | B | A | | A | B | A |
| Approach Delay | | 20.2 | | | 13.2 | | | 8.7 | | | 9.6 | |
| Approach LOS | | C | | | B | | | A | | | A | |

| Intersection Summary | |
|---|---|
| Area Type: Other | |
| Cycle Length: 76 | |
| Actuated Cycle Length: 59.7 | |
| Natural Cycle: 65 | |
| Control Type: Actuated-Uncoordinated | |
| Maximum v/c Ratio: 0.49 | |
| Intersection Signal Delay: 10.9 | Intersection LOS: B |
| Intersection Capacity Utilization 84.9% | ICU Level of Service E |
| Analysis Period (min) 15 | |

Splits and Phases: 1: Goderich Street & Bruce County Road 25/Concession Road 6



# Queues

## 1: Goderich Street & Bruce County Road 25/Concession Road 6

| | ↗ | → | ↙ | ← | ↖ | ↑ | ↘ | ↓ | ↙ |
|---|---|---|---|---|---|---|---|---|---|
| Lane Group | EBL | EBT | WBL | WBT | NBL | NBT | SBL | SBT | SBR |
| Lane Group Flow (vph) | 67 | 140 | 54 | 80 | 37 | 284 | 52 | 1024 | 191 |
| v/c Ratio | 0.24 | 0.43 | 0.17 | 0.17 | 0.17 | 0.14 | 0.08 | 0.49 | 0.19 |
| Control Delay | 21.0 | 19.8 | 19.6 | 8.9 | 11.9 | 8.3 | 9.1 | 11.1 | 2.2 |
| Queue Delay | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Delay | 21.0 | 19.8 | 19.6 | 8.9 | 11.9 | 8.3 | 9.1 | 11.1 | 2.2 |
| Queue Length 50th (m) | 6.3 | 10.5 | 5.0 | 1.8 | 2.3 | 8.8 | 3.1 | 42.2 | 0.0 |
| Queue Length 95th (m) | 15.7 | 25.1 | 13.0 | 10.8 | 8.3 | 15.5 | 8.6 | 61.8 | 8.8 |
| Internal Link Dist (m) | | 365.9 | | 387.3 | | 265.8 | | 282.8 | |
| Turn Bay Length (m) | 85.0 | | 50.0 | | 75.0 | | 65.0 | | 70.0 |
| Base Capacity (vph) | 558 | 614 | 640 | 849 | 215 | 1972 | 618 | 2093 | 1005 |
| Starvation Cap Reductn | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Spillback Cap Reductn | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Storage Cap Reductn | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Reduced v/c Ratio | 0.12 | 0.23 | 0.08 | 0.09 | 0.17 | 0.14 | 0.08 | 0.49 | 0.19 |

Intersection Summary

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# HCM Signalized Intersection Capacity Analysis

## 1: Goderich Street & Bruce County Road 25/Concession Road 6

| | ↗ | → | ↘ | ↙ | ← | ↖ | ↖ | ↑ | ↗ | ↘ | ↓ | ↙ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations | ↰ | ↱ | | ↰ | ↱ | | ↰ | ↑↱ | | ↰ | ↑↑ | ↱ |
| Traffic Volume (vph) | 62 | 16 | 113 | 50 | 18 | 55 | 34 | 249 | 12 | 48 | 942 | 176 |
| Future Volume (vph) | 62 | 16 | 113 | 50 | 18 | 55 | 34 | 249 | 12 | 48 | 942 | 176 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | 8.0 | 8.0 | | 8.0 | 8.0 | | 8.0 | 8.0 | | 8.0 | 8.0 | 8.0 |
| Lane Util. Factor | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 | 0.95 | | 1.00 | 0.95 | 1.00 |
| Frt | 1.00 | 0.87 | | 1.00 | 0.89 | | 1.00 | 0.99 | | 1.00 | 1.00 | 0.85 |
| Flt Protected | 0.95 | 1.00 | | 0.95 | 1.00 | | 0.95 | 1.00 | | 0.95 | 1.00 | 1.00 |
| Satd. Flow (prot) | 1492 | 1185 | | 1805 | 1625 | | 1399 | 3331 | | 1719 | 3539 | 1568 |
| Flt Permitted | 0.70 | 1.00 | | 0.67 | 1.00 | | 0.25 | 1.00 | | 0.58 | 1.00 | 1.00 |
| Satd. Flow (perm) | 1107 | 1185 | | 1269 | 1625 | | 364 | 3331 | | 1045 | 3539 | 1568 |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 67 | 17 | 123 | 54 | 20 | 60 | 37 | 271 | 13 | 52 | 1024 | 191 |
| RTOR Reduction (vph) | 0 | 27 | 0 | 0 | 48 | 0 | 0 | 3 | 0 | 0 | 0 | 87 |
| Lane Group Flow (vph) | 67 | 113 | 0 | 54 | 32 | 0 | 37 | 281 | 0 | 52 | 1024 | 104 |
| Heavy Vehicles (%) | 21% | 33% | 40% | 0% | 0% | 5% | 29% | 8% | 0% | 5% | 2% | 3% |
| Turn Type | Perm | NA | | Perm | NA | | Perm | NA | | Perm | NA | Perm |
| Protected Phases | | 4 | | | 8 | | | 2 | | | 6 | |
| Permitted Phases | 4 | | | 8 | | | 2 | | | 6 | | 6 |
| Actuated Green, G (s) | 11.9 | 11.9 | | 11.9 | 11.9 | | 33.5 | 33.5 | | 33.5 | 33.5 | 33.5 |
| Effective Green, g (s) | 11.9 | 11.9 | | 11.9 | 11.9 | | 33.5 | 33.5 | | 33.5 | 33.5 | 33.5 |
| Actuated g/C Ratio | 0.19 | 0.19 | | 0.19 | 0.19 | | 0.55 | 0.55 | | 0.55 | 0.55 | 0.55 |
| Clearance Time (s) | 8.0 | 8.0 | | 8.0 | 8.0 | | 8.0 | 8.0 | | 8.0 | 8.0 | 8.0 |
| Vehicle Extension (s) | 3.0 | 3.0 | | 3.0 | 3.0 | | 3.0 | 3.0 | | 3.0 | 3.0 | 3.0 |
| Lane Grp Cap (vph) | 214 | 229 | | 245 | 314 | | 198 | 1817 | | 570 | 1930 | 855 |
| v/s Ratio Prot | | c0.10 | | | 0.02 | | | 0.08 | | | c0.29 | |
| v/s Ratio Perm | 0.06 | | | 0.04 | | | 0.10 | | | 0.05 | | 0.07 |
| v/c Ratio | 0.31 | 0.50 | | 0.22 | 0.10 | | 0.19 | 0.15 | | 0.09 | 0.53 | 0.12 |
| Uniform Delay, d1 | 21.2 | 22.1 | | 20.8 | 20.4 | | 7.1 | 6.9 | | 6.7 | 8.9 | 6.8 |
| Progression Factor | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | 1.00 |
| Incremental Delay, d2 | 0.8 | 1.7 | | 0.5 | 0.1 | | 0.5 | 0.0 | | 0.1 | 0.3 | 0.1 |
| Delay (s) | 22.1 | 23.8 | | 21.3 | 20.5 | | 7.5 | 7.0 | | 6.7 | 9.2 | 6.9 |
| Level of Service | C | C | | C | C | | A | A | | A | A | A |
| Approach Delay (s) | | 23.2 | | | 20.8 | | | 7.0 | | | 8.7 | |
| Approach LOS | | C | | | C | | | A | | | A | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM 2000 Control Delay | 10.9 | HCM 2000 Level of Service | B |
| HCM 2000 Volume to Capacity ratio | 0.52 | | |
| Actuated Cycle Length (s) | 61.4 | Sum of lost time (s) | 16.0 |
| Intersection Capacity Utilization | 84.9% | ICU Level of Service | E |
| Analysis Period (min) | 15 | | |

c Critical Lane Group

| | ↗ | → | ← | ↖ | ↘ | ↙ |
|---|---|---|---|---|---|---|
| Lane Group | EBL | EBT | WBT | WBR | SBL | SBR |
| Lane Configurations | | ↰ | ↱ | | ⅄ | |
| Traffic Volume (vph) | 1 | 174 | 222 | 6 | 17 | 3 |
| Future Volume (vph) | 1 | 174 | 222 | 6 | 17 | 3 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Lane Util. Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Frt | | | 0.996 | | 0.981 | |
| Flt Protected | | | | | 0.959 | |
| Satd. Flow (prot) | 0 | 1900 | 1892 | 0 | 1787 | 0 |
| Flt Permitted | | | | | 0.959 | |
| Satd. Flow (perm) | 0 | 1900 | 1892 | 0 | 1787 | 0 |
| Link Speed (k/h) | | 60 | 60 | | 50 | |
| Link Distance (m) | | 182.0 | 389.9 | | 269.3 | |
| Travel Time (s) | | 10.9 | 23.4 | | 19.4 | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 1 | 189 | 241 | 7 | 18 | 3 |
| Shared Lane Traffic (%) | | | | | | |
| Lane Group Flow (vph) | 0 | 190 | 248 | 0 | 21 | 0 |
| Enter Blocked Intersection | No | No | No | No | No | No |
| Lane Alignment | Left | Left | Left | Right | Left | Right |
| Median Width(m) | | 3.6 | 3.6 | | 3.6 | |
| Link Offset(m) | | 0.0 | 0.0 | | 0.0 | |
| Crosswalk Width(m) | | 4.8 | 4.8 | | 4.8 | |
| Two way Left Turn Lane | | | | | | |
| Headway Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Turning Speed (k/h) | 25 | | | 15 | 25 | 15 |
| Sign Control | | Free | Free | | Stop | |

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 22.0% ICU Level of Service A

Analysis Period (min) 15

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| | ↗ | → | ← | ↖ | ↘ | ↙ |
|---|---|---|---|---|---|---|
| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
| Lane Configurations | | ↰ | ↱ | | ⅄ | |
| Traffic Volume (veh/h) | 1 | 174 | 222 | 6 | 17 | 3 |
| Future Volume (Veh/h) | 1 | 174 | 222 | 6 | 17 | 3 |
| Sign Control | | Free | Free | | Stop | |
| Grade | | 0% | 0% | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 1 | 189 | 241 | 7 | 18 | 3 |
| Pedestrians | | | | | | |
| Lane Width (m) | | | | | | |
| Walking Speed (m/s) | | | | | | |
| Percent Blockage | | | | | | |
| Right turn flare (veh) | | | | | | |
| Median type | | None | None | | | |
| Median storage veh) | | | | | | |
| Upstream signal (m) | | | 390 | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 248 | | | | 436 | 244 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 248 | | | | 436 | 244 |
| tC, single (s) | 4.1 | | | | 6.4 | 6.2 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 2.2 | | | | 3.5 | 3.3 |
| p0 queue free % | 100 | | | | 97 | 100 |
| cM capacity (veh/h) | 1330 | | | | 581 | 799 |

| Direction, Lane # | EB 1 | WB 1 | SB 1 |
|---|---|---|---|
| Volume Total | 190 | 248 | 21 |
| Volume Left | 1 | 0 | 18 |
| Volume Right | 0 | 7 | 3 |
| cSH | 1330 | 1700 | 605 |
| Volume to Capacity | 0.00 | 0.15 | 0.03 |
| Queue Length 95th (m) | 0.0 | 0.0 | 0.9 |
| Control Delay (s) | 0.0 | 0.0 | 11.2 |
| Lane LOS | A | | B |
| Approach Delay (s) | 0.0 | 0.0 | 11.2 |
| Approach LOS | | | B |

| Intersection Summary | | | |
|---|---|---|---|
| Average Delay | 0.5 | | |
| Intersection Capacity Utilization | 22.0% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |

| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations |  | ✣ |  |  | ✣ |  |  | ✣ |  |  | ✣ |  |
| Traffic Volume (vph) | 0 | 52 | 7 | 127 | 69 | 26 | 2 | 5 | 44 | 79 | 15 | 0 |
| Future Volume (vph) | 0 | 52 | 7 | 127 | 69 | 26 | 2 | 5 | 44 | 79 | 15 | 0 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Lane Util. Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Frt |  | 0.983 |  |  | 0.984 |  |  | 0.882 |  |  |  |  |
| Flt Protected |  |  |  |  | 0.972 |  |  | 0.998 |  |  | 0.960 |  |
| Satd. Flow (prot) | 0 | 1868 | 0 | 0 | 1817 | 0 | 0 | 1672 | 0 | 0 | 1824 | 0 |
| Flt Permitted |  |  |  |  | 0.972 |  |  | 0.998 |  |  | 0.960 |  |
| Satd. Flow (perm) | 0 | 1868 | 0 | 0 | 1817 | 0 | 0 | 1672 | 0 | 0 | 1824 | 0 |
| Link Speed (k/h) |  | 60 |  |  | 60 |  |  | 50 |  |  | 50 |  |
| Link Distance (m) |  | 324.2 |  |  | 182.0 |  |  | 154.6 |  |  | 254.8 |  |
| Travel Time (s) |  | 19.5 |  |  | 10.9 |  |  | 11.1 |  |  | 18.3 |  |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 0 | 57 | 8 | 138 | 75 | 28 | 2 | 5 | 48 | 86 | 16 | 0 |
| Shared Lane Traffic (%) |  |  |  |  |  |  |  |  |  |  |  |  |
| Lane Group Flow (vph) | 0 | 65 | 0 | 0 | 241 | 0 | 0 | 55 | 0 | 0 | 102 | 0 |
| Enter Blocked Intersection | No | No | No | No | No | No | No | No | No | No | No | No |
| Lane Alignment | Left | Left | Right | Left | Left | Right | Left | Left | Right | Left | Left | Right |
| Median Width(m) |  | 0.0 |  |  | 0.0 |  |  | 0.0 |  |  | 0.0 |  |
| Link Offset(m) |  | 0.0 |  |  | 0.0 |  |  | 0.0 |  |  | 0.0 |  |
| Crosswalk Width(m) |  | 4.8 |  |  | 4.8 |  |  | 4.8 |  |  | 4.8 |  |
| Two way Left Turn Lane |  |  |  |  |  |  |  |  |  |  |  |  |
| Headway Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Turning Speed (k/h) | 25 |  | 15 | 25 |  | 15 | 25 |  | 15 | 25 |  | 15 |
| Sign Control |  | Free |  |  | Free |  |  | Stop |  |  | Stop |  |

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 37.4% ICU Level of Service A

Analysis Period (min) 15

---

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations |  | ✣ |  |  | ✣ |  |  | ✣ |  |  | ✣ |  |
| Traffic Volume (veh/h) | 0 | 52 | 7 | 127 | 69 | 26 | 2 | 5 | 44 | 79 | 15 | 0 |
| Future Volume (Veh/h) | 0 | 52 | 7 | 127 | 69 | 26 | 2 | 5 | 44 | 79 | 15 | 0 |
| Sign Control |  | Free |  |  | Free |  |  | Stop |  |  | Stop |  |
| Grade |  | 0% |  |  | 0% |  |  | 0% |  |  | 0% |  |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 0 | 57 | 8 | 138 | 75 | 28 | 2 | 5 | 48 | 86 | 16 | 0 |
| Pedestrians |  |  |  |  |  |  |  |  |  |  |  |  |
| Lane Width (m) |  |  |  |  |  |  |  |  |  |  |  |  |
| Walking Speed (m/s) |  |  |  |  |  |  |  |  |  |  |  |  |
| Percent Blockage |  |  |  |  |  |  |  |  |  |  |  |  |
| Right turn flare (veh) |  |  |  |  |  |  |  |  |  |  |  |  |
| Median type |  | None |  |  | None |  |  |  |  |  |  |  |
| Median storage veh) |  |  |  |  |  |  |  |  |  |  |  |  |
| Upstream signal (m) |  |  |  |  |  |  |  |  |  |  |  |  |
| pX, platoon unblocked |  |  |  |  |  |  |  |  |  |  |  |  |
| vC, conflicting volume | 103 |  |  | 65 |  |  | 434 | 440 | 61 | 476 | 430 | 89 |
| vC1, stage 1 conf vol |  |  |  |  |  |  |  |  |  |  |  |  |
| vC2, stage 2 conf vol |  |  |  |  |  |  |  |  |  |  |  |  |
| vCu, unblocked vol | 103 |  |  | 65 |  |  | 434 | 440 | 61 | 476 | 430 | 89 |
| tC, single (s) | 4.1 |  |  | 4.1 |  |  | 7.1 | 6.5 | 6.2 | 7.1 | 6.5 | 6.2 |
| tC, 2 stage (s) |  |  |  |  |  |  |  |  |  |  |  |  |
| tF (s) | 2.2 |  |  | 2.2 |  |  | 3.5 | 4.0 | 3.3 | 3.5 | 4.0 | 3.3 |
| p0 queue free % | 100 |  |  | 91 |  |  | 100 | 99 | 95 | 81 | 97 | 100 |
| cM capacity (veh/h) | 1502 |  |  | 1550 |  |  | 487 | 468 | 1010 | 442 | 474 | 975 |

| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 |
|---|---|---|---|---|
| Volume Total | 65 | 241 | 55 | 102 |
| Volume Left | 0 | 138 | 2 | 86 |
| Volume Right | 8 | 28 | 48 | 0 |
| cSH | 1502 | 1550 | 883 | 447 |
| Volume to Capacity | 0.00 | 0.09 | 0.06 | 0.23 |
| Queue Length 95th (m) | 0.0 | 2.3 | 1.6 | 7.0 |
| Control Delay (s) | 0.0 | 4.6 | 9.4 | 15.4 |
| Lane LOS |  | A | A | C |
| Approach Delay (s) | 0.0 | 4.6 | 9.4 | 15.4 |
| Approach LOS |  |  | A | C |

| Intersection Summary |  |  |  |
|---|---|---|---|
| Average Delay | 6.9 |  |  |
| Intersection Capacity Utilization | 37.4% | ICU Level of Service | A |
| Analysis Period (min) | 15 |  |  |

## Lanes, Volumes, Timings
## 4: Bruce County Road 25 & Ridge Street

| Lane Group | EBL | EBT | WBT | WBR | SBL | SBR |
|---|---|---|---|---|---|---|
| Lane Configurations | | ↰ | ↱ | | ⇆ | |
| Traffic Volume (vph) | 0 | 38 | 65 | 6 | 21 | 0 |
| Future Volume (vph) | 0 | 38 | 65 | 6 | 21 | 0 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Lane Util. Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Frt | | | 0.988 | | | |
| Flt Protected | | | | | 0.950 | |
| Satd. Flow (prot) | 0 | 1900 | 1877 | 0 | 1805 | 0 |
| Flt Permitted | | | | | 0.950 | |
| Satd. Flow (perm) | 0 | 1900 | 1877 | 0 | 1805 | 0 |
| Link Speed (k/h) | | 60 | 60 | | 50 | |
| Link Distance (m) | | 205.2 | 324.2 | | 219.6 | |
| Travel Time (s) | | 12.3 | 19.5 | | 15.8 | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 0 | 41 | 71 | 7 | 23 | 0 |
| Shared Lane Traffic (%) | | | | | | |
| Lane Group Flow (vph) | 0 | 41 | 78 | 0 | 23 | 0 |
| Enter Blocked Intersection | No | No | No | No | No | No |
| Lane Alignment | Left | Left | Left | Right | Left | Right |
| Median Width(m) | | 0.0 | 0.0 | | 3.6 | |
| Link Offset(m) | | 0.0 | 0.0 | | 0.0 | |
| Crosswalk Width(m) | | 4.8 | 4.8 | | 4.8 | |
| Two way Left Turn Lane | | | | | | |
| Headway Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Turning Speed (k/h) | 25 | | | 15 | 25 | 15 |
| Sign Control | | Free | Free | | Stop | |

Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 13.8% ICU Level of Service A
Analysis Period (min) 15

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## HCM Unsignalized Intersection Capacity Analysis
## 4: Bruce County Road 25 & Ridge Street

| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|---|---|---|---|---|---|---|
| Lane Configurations | | ↰ | ↱ | | ⇆ | |
| Traffic Volume (veh/h) | 0 | 38 | 65 | 6 | 21 | 0 |
| Future Volume (Veh/h) | 0 | 38 | 65 | 6 | 21 | 0 |
| Sign Control | | Free | Free | | Stop | |
| Grade | | 0% | 0% | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 0 | 41 | 71 | 7 | 23 | 0 |
| Pedestrians | | | | | | |
| Lane Width (m) | | | | | | |
| Walking Speed (m/s) | | | | | | |
| Percent Blockage | | | | | | |
| Right turn flare (veh) | | | | | | |
| Median type | | None | None | | | |
| Median storage veh) | | | | | | |
| Upstream signal (m) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 78 | | | | 116 | 74 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 78 | | | | 116 | 74 |
| tC, single (s) | 4.1 | | | | 6.4 | 6.2 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 2.2 | | | | 3.5 | 3.3 |
| p0 queue free % | 100 | | | | 97 | 100 |
| cM capacity (veh/h) | 1533 | | | | 886 | 993 |

| Direction, Lane # | EB 1 | WB 1 | SB 1 |
|---|---|---|---|
| Volume Total | 41 | 78 | 23 |
| Volume Left | 0 | 0 | 23 |
| Volume Right | 0 | 7 | 0 |
| cSH | 1533 | 1700 | 886 |
| Volume to Capacity | 0.00 | 0.05 | 0.03 |
| Queue Length 95th (m) | 0.0 | 0.0 | 0.6 |
| Control Delay (s) | 0.0 | 0.0 | 9.2 |
| Lane LOS | | | A |
| Approach Delay (s) | 0.0 | 0.0 | 9.2 |
| Approach LOS | | | A |

| Intersection Summary | | | |
|---|---|---|---|
| Average Delay | 1.5 | | |
| Intersection Capacity Utilization | 13.8% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |

| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | ↰ | ↱ | | ↰ | ↱ | | ↰ | ↑↱ | | ↰ | ↑↑ | ↱ |
| Traffic Volume (vph) | 271 | 27 | 62 | 12 | 10 | 49 | 118 | 991 | 49 | 85 | 334 | 118 |
| Future Volume (vph) | 271 | 27 | 62 | 12 | 10 | 49 | 118 | 991 | 49 | 85 | 334 | 118 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Storage Length (m) | 85.0 | | 0.0 | 50.0 | | 0.0 | 75.0 | | 0.0 | 65.0 | | 70.0 |
| Storage Lanes | 1 | | 0 | 1 | | 0 | 1 | | 0 | 1 | | 1 |
| Taper Length (m) | 100.0 | | | 55.0 | | | 100.0 | | | 25.0 | | |
| Lane Util. Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.95 | 0.95 | 1.00 | 0.95 | 1.00 |
| Frt | | 0.895 | | | 0.876 | | | 0.993 | | | | 0.850 |
| Flt Protected | 0.950 | | | 0.950 | | | 0.950 | | | 0.950 | | |
| Satd. Flow (prot) | 1492 | 1233 | 0 | 1805 | 1598 | 0 | 1399 | 3331 | 0 | 1719 | 3539 | 1568 |
| Flt Permitted | 0.715 | | | 0.695 | | | 0.535 | | | 0.160 | | |
| Satd. Flow (perm) | 1123 | 1233 | 0 | 1320 | 1598 | 0 | 788 | 3331 | 0 | 290 | 3539 | 1568 |
| Right Turn on Red | | | Yes | | | Yes | | | Yes | | | Yes |
| Satd. Flow (RTOR) | | 67 | | | 27 | | | 8 | | | | 128 |
| Link Speed (k/h) | | 60 | | | 40 | | | 50 | | | 50 | |
| Link Distance (m) | | 389.9 | | | 411.3 | | | 289.8 | | | 306.8 | |
| Travel Time (s) | | 23.4 | | | 37.0 | | | 20.9 | | | 22.1 | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Heavy Vehicles (%) | 21% | 33% | 40% | 0% | 0% | 5% | 29% | 8% | 0% | 5% | 2% | 3% |
| Adj. Flow (vph) | 295 | 29 | 67 | 13 | 11 | 53 | 128 | 1077 | 53 | 92 | 363 | 128 |
| Shared Lane Traffic (%) | | | | | | | | | | | | |
| Lane Group Flow (vph) | 295 | 96 | 0 | 13 | 64 | 0 | 128 | 1130 | 0 | 92 | 363 | 128 |
| Enter Blocked Intersection | No | No | No | No | No | No | No | No | No | No | No | No |
| Lane Alignment | Left | Left | Right | Left | Left | Right | Left | Left | Right | Left | Left | Right |
| Median Width(m) | | 3.6 | | | 3.6 | | | 3.6 | | | 3.6 | |
| Link Offset(m) | | 0.0 | | | 0.0 | | | 0.0 | | | 0.0 | |
| Crosswalk Width(m) | | 4.8 | | | 4.8 | | | 4.8 | | | 4.8 | |
| Two way Left Turn Lane | | | | | | | | | | | Yes | |
| Headway Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Turning Speed (k/h) | 25 | | 15 | 25 | | 15 | 25 | | 15 | 25 | | 15 |
| Number of Detectors | 1 | 2 | | 1 | 2 | | 1 | 2 | | 1 | 2 | 1 |
| Detector Template | Left | Thru | | Left | Thru | | Left | Thru | | Left | Thru | Right |
| Leading Detector (m) | 2.0 | 10.0 | | 2.0 | 10.0 | | 2.0 | 10.0 | | 2.0 | 10.0 | 2.0 |
| Trailing Detector (m) | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 |
| Detector 1 Position(m) | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 |
| Detector 1 Size(m) | 2.0 | 0.6 | | 2.0 | 0.6 | | 2.0 | 0.6 | | 2.0 | 0.6 | 2.0 |
| Detector 1 Type | Cl+Ex | Cl+Ex | | Cl+Ex | Cl+Ex | | Cl+Ex | Cl+Ex | | Cl+Ex | Cl+Ex | Cl+Ex |
| Detector 1 Channel | | | | | | | | | | | | |
| Detector 1 Extend (s) | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 |
| Detector 1 Queue (s) | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 |
| Detector 1 Delay (s) | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 |
| Detector 2 Position(m) | | 9.4 | | | 9.4 | | | 9.4 | | | 9.4 | |
| Detector 2 Size(m) | | 0.6 | | | 0.6 | | | 0.6 | | | 0.6 | |
| Detector 2 Type | | Cl+Ex | | | Cl+Ex | | | Cl+Ex | | | Cl+Ex | |
| Detector 2 Channel | | | | | | | | | | | | |
| Detector 2 Extend (s) | | 0.0 | | | 0.0 | | | 0.0 | | | 0.0 | |
| Turn Type | Perm | NA | | Perm | NA | | Perm | NA | | Perm | NA | Perm |
| Protected Phases | | 4 | | | 8 | | | 2 | | | 6 | |

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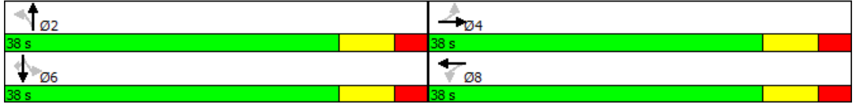
| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Permitted Phases | 4 | | | 8 | | | 2 | | | 6 | | 6 |
| Detector Phase | 4 | 4 | | 8 | 8 | | 2 | 2 | | 6 | 6 | 6 |
| Switch Phase | | | | | | | | | | | | |
| Minimum Initial (s) | 15.0 | 15.0 | | 15.0 | 15.0 | | 30.0 | 30.0 | | 30.0 | 30.0 | 30.0 |
| Minimum Split (s) | 23.0 | 23.0 | | 23.0 | 23.0 | | 38.0 | 38.0 | | 38.0 | 38.0 | 38.0 |
| Total Split (s) | 38.0 | 38.0 | | 38.0 | 38.0 | | 38.0 | 38.0 | | 38.0 | 38.0 | 38.0 |
| Total Split (%) | 50.0% | 50.0% | | 50.0% | 50.0% | | 50.0% | 50.0% | | 50.0% | 50.0% | 50.0% |
| Maximum Green (s) | 30.0 | 30.0 | | 30.0 | 30.0 | | 30.0 | 30.0 | | 30.0 | 30.0 | 30.0 |
| Yellow Time (s) | 5.0 | 5.0 | | 5.0 | 5.0 | | 5.0 | 5.0 | | 5.0 | 5.0 | 5.0 |
| All-Red Time (s) | 3.0 | 3.0 | | 3.0 | 3.0 | | 3.0 | 3.0 | | 3.0 | 3.0 | 3.0 |
| Lost Time Adjust (s) | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 |
| Total Lost Time (s) | 8.0 | 8.0 | | 8.0 | 8.0 | | 8.0 | 8.0 | | 8.0 | 8.0 | 8.0 |
| Lead/Lag | | | | | | | | | | | | |
| Lead-Lag Optimize? | | | | | | | | | | | | |
| Vehicle Extension (s) | 3.0 | 3.0 | | 3.0 | 3.0 | | 3.0 | 3.0 | | 3.0 | 3.0 | 3.0 |
| Recall Mode | None | None | | None | None | | Ped | Ped | | Ped | Ped | Ped |
| Walk Time (s) | 20.0 | 20.0 | | 20.0 | 20.0 | | 20.0 | 20.0 | | 20.0 | 20.0 | 20.0 |
| Flash Dont Walk (s) | 10.0 | 10.0 | | 10.0 | 10.0 | | 10.0 | 10.0 | | 10.0 | 10.0 | 10.0 |
| Pedestrian Calls (#/hr) | 0 | 0 | | 0 | 0 | | 0 | 0 | | 0 | 0 | 0 |
| Act Effct Green (s) | 22.5 | 22.5 | | 22.5 | 22.5 | | 30.2 | 30.2 | | 30.2 | 30.2 | 30.2 |
| Actuated g/C Ratio | 0.33 | 0.33 | | 0.33 | 0.33 | | 0.44 | 0.44 | | 0.44 | 0.44 | 0.44 |
| v/c Ratio | 0.80 | 0.21 | | 0.03 | 0.12 | | 0.37 | 0.77 | | 0.72 | 0.23 | 0.17 |
| Control Delay | 38.3 | 8.0 | | 14.8 | 10.5 | | 18.9 | 22.2 | | 56.0 | 13.7 | 3.8 |
| Queue Delay | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 |
| Total Delay | 38.3 | 8.0 | | 14.8 | 10.5 | | 18.9 | 22.2 | | 56.0 | 13.7 | 3.8 |
| LOS | D | A | | B | B | | B | C | | E | B | A |
| Approach Delay | | 30.9 | | | 11.2 | | | 21.9 | | | 18.2 | |
| Approach LOS | | C | | | B | | | C | | | B | |

**Intersection Summary**

Area Type: Other
Cycle Length: 76
Actuated Cycle Length: 68.8
Natural Cycle: 70
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.80
Intersection Signal Delay: 22.1 Intersection LOS: C
Intersection Capacity Utilization 95.6% ICU Level of Service F
Analysis Period (min) 15

Splits and Phases: 1: Goderich Street & Bruce County Road 25/Concession Road 6



# Queues

## 1: Goderich Street & Bruce County Road 25/Concession Road 6

| Lane Group | EBL | EBT | WBL | WBT | NBL | NBT | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|
| Lane Group Flow (vph) | 295 | 96 | 13 | 64 | 128 | 1130 | 92 | 363 | 128 |
| v/c Ratio | 0.80 | 0.21 | 0.03 | 0.12 | 0.37 | 0.77 | 0.72 | 0.23 | 0.17 |
| Control Delay | 38.3 | 8.0 | 14.8 | 10.5 | 18.9 | 22.2 | 56.0 | 13.7 | 3.8 |
| Queue Delay | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Delay | 38.3 | 8.0 | 14.8 | 10.5 | 18.9 | 22.2 | 56.0 | 13.7 | 3.8 |
| Queue Length 50th (m) | 35.6 | 2.6 | 1.2 | 3.4 | 11.1 | 65.0 | 9.8 | 15.5 | 0.0 |
| Queue Length 95th (m) | 64.4 | 11.7 | 4.5 | 10.8 | 28.9 | #117.7 | #39.6 | 28.6 | 9.7 |
| Internal Link Dist (m) |  | 365.9 |  | 387.3 |  | 265.8 |  | 282.8 |  |
| Turn Bay Length (m) | 85.0 |  | 50.0 |  | 75.0 |  | 65.0 |  | 70.0 |
| Base Capacity (vph) | 492 | 578 | 579 | 716 | 345 | 1466 | 127 | 1552 | 759 |
| Starvation Cap Reductn | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Spillback Cap Reductn | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Storage Cap Reductn | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Reduced v/c Ratio | 0.60 | 0.17 | 0.02 | 0.09 | 0.37 | 0.77 | 0.72 | 0.23 | 0.17 |

Intersection Summary

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

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# HCM Signalized Intersection Capacity Analysis

## 1: Goderich Street & Bruce County Road 25/Concession Road 6

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | ↰ | ↱ |  | ↰ | ↱ |  | ↰ | ↑↱ |  | ↰ | ↑↑ | ↱ |
| Traffic Volume (vph) | 271 | 27 | 62 | 12 | 10 | 49 | 118 | 991 | 49 | 85 | 334 | 118 |
| Future Volume (vph) | 271 | 27 | 62 | 12 | 10 | 49 | 118 | 991 | 49 | 85 | 334 | 118 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | 8.0 | 8.0 |  | 8.0 | 8.0 |  | 8.0 | 8.0 |  | 8.0 | 8.0 | 8.0 |
| Lane Util. Factor | 1.00 | 1.00 |  | 1.00 | 1.00 |  | 1.00 | 0.95 |  | 1.00 | 0.95 | 1.00 |
| Frt | 1.00 | 0.90 |  | 1.00 | 0.88 |  | 1.00 | 0.99 |  | 1.00 | 1.00 | 0.85 |
| Flt Protected | 0.95 | 1.00 |  | 0.95 | 1.00 |  | 0.95 | 1.00 |  | 0.95 | 1.00 | 1.00 |
| Satd. Flow (prot) | 1492 | 1234 |  | 1805 | 1598 |  | 1399 | 3331 |  | 1719 | 3539 | 1568 |
| Flt Permitted | 0.72 | 1.00 |  | 0.69 | 1.00 |  | 0.54 | 1.00 |  | 0.16 | 1.00 | 1.00 |
| Satd. Flow (perm) | 1123 | 1234 |  | 1320 | 1598 |  | 788 | 3331 |  | 290 | 3539 | 1568 |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 295 | 29 | 67 | 13 | 11 | 53 | 128 | 1077 | 53 | 92 | 363 | 128 |
| RTOR Reduction (vph) | 0 | 45 | 0 | 0 | 18 | 0 | 0 | 4 | 0 | 0 | 0 | 72 |
| Lane Group Flow (vph) | 295 | 51 | 0 | 13 | 46 | 0 | 128 | 1126 | 0 | 92 | 363 | 56 |
| Heavy Vehicles (%) | 21% | 33% | 40% | 0% | 0% | 5% | 29% | 8% | 0% | 5% | 2% | 3% |
| Turn Type | Perm | NA |  | Perm | NA |  | Perm | NA |  | Perm | NA | Perm |
| Protected Phases |  | 4 |  |  | 8 |  |  | 2 |  |  | 6 |  |
| Permitted Phases | 4 |  |  | 8 |  |  | 2 |  |  | 6 |  | 6 |
| Actuated Green, G (s) | 22.5 | 22.5 |  | 22.5 | 22.5 |  | 30.2 | 30.2 |  | 30.2 | 30.2 | 30.2 |
| Effective Green, g (s) | 22.5 | 22.5 |  | 22.5 | 22.5 |  | 30.2 | 30.2 |  | 30.2 | 30.2 | 30.2 |
| Actuated g/C Ratio | 0.33 | 0.33 |  | 0.33 | 0.33 |  | 0.44 | 0.44 |  | 0.44 | 0.44 | 0.44 |
| Clearance Time (s) | 8.0 | 8.0 |  | 8.0 | 8.0 |  | 8.0 | 8.0 |  | 8.0 | 8.0 | 8.0 |
| Vehicle Extension (s) | 3.0 | 3.0 |  | 3.0 | 3.0 |  | 3.0 | 3.0 |  | 3.0 | 3.0 | 3.0 |
| Lane Grp Cap (vph) | 367 | 404 |  | 432 | 523 |  | 346 | 1464 |  | 127 | 1555 | 689 |
| v/s Ratio Prot |  | 0.04 |  |  | 0.03 |  |  | c0.34 |  |  | 0.10 |  |
| v/s Ratio Perm | c0.26 |  |  | 0.01 |  |  | 0.16 |  |  | 0.32 |  | 0.04 |
| v/c Ratio | 0.80 | 0.13 |  | 0.03 | 0.09 |  | 0.37 | 0.77 |  | 0.72 | 0.23 | 0.08 |
| Uniform Delay, d1 | 21.1 | 16.2 |  | 15.7 | 16.0 |  | 12.9 | 16.3 |  | 15.8 | 12.0 | 11.2 |
| Progression Factor | 1.00 | 1.00 |  | 1.00 | 1.00 |  | 1.00 | 1.00 |  | 1.00 | 1.00 | 1.00 |
| Incremental Delay, d2 | 12.0 | 0.1 |  | 0.0 | 0.1 |  | 0.7 | 2.5 |  | 18.4 | 0.1 | 0.1 |
| Delay (s) | 33.1 | 16.3 |  | 15.7 | 16.1 |  | 13.6 | 18.8 |  | 34.3 | 12.1 | 11.2 |
| Level of Service | C | B |  | B | B |  | B | B |  | C | B | B |
| Approach Delay (s) |  | 29.0 |  |  | 16.0 |  |  | 18.3 |  |  | 15.4 |  |
| Approach LOS |  | C |  |  | B |  |  | B |  |  | B |  |

| Intersection Summary |  |  |  |
|---|---|---|---|
| HCM 2000 Control Delay | 19.3 | HCM 2000 Level of Service | B |
| HCM 2000 Volume to Capacity ratio | 0.78 |  |  |
| Actuated Cycle Length (s) | 68.7 | Sum of lost time (s) | 16.0 |
| Intersection Capacity Utilization | 95.6% | ICU Level of Service | F |
| Analysis Period (min) | 15 |  |  |

c Critical Lane Group

## Lanes, Volumes, Timings
## 2: Bruce County Road 25 & Stickel Street

| | ↗ | → | ← | ↖ | ↘ | ↙ |
|---|---|---|---|---|---|---|
| Lane Group | EBL | EBT | WBT | WBR | SBL | SBR |
| Lane Configurations | | ↰ | ↱ | | Y | |
| Traffic Volume (vph) | 5 | 350 | 229 | 17 | 10 | 3 |
| Future Volume (vph) | 5 | 350 | 229 | 17 | 10 | 3 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Lane Util. Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Frt | | | 0.991 | | 0.971 | |
| Flt Protected | | 0.999 | | | 0.962 | |
| Satd. Flow (prot) | 0 | 1898 | 1883 | 0 | 1775 | 0 |
| Flt Permitted | | 0.999 | | | 0.962 | |
| Satd. Flow (perm) | 0 | 1898 | 1883 | 0 | 1775 | 0 |
| Link Speed (k/h) | | 60 | 60 | | 50 | |
| Link Distance (m) | | 182.0 | 389.9 | | 269.3 | |
| Travel Time (s) | | 10.9 | 23.4 | | 19.4 | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 5 | 380 | 249 | 18 | 11 | 3 |
| Shared Lane Traffic (%) | | | | | | |
| Lane Group Flow (vph) | 0 | 385 | 267 | 0 | 14 | 0 |
| Enter Blocked Intersection | No | No | No | No | No | No |
| Lane Alignment | Left | Left | Left | Right | Left | Right |
| Median Width(m) | | 3.6 | 3.6 | | 3.6 | |
| Link Offset(m) | | 0.0 | 0.0 | | 0.0 | |
| Crosswalk Width(m) | | 4.8 | 4.8 | | 4.8 | |
| Two way Left Turn Lane | | | | | | |
| Headway Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Turning Speed (k/h) | 25 | | | 15 | 25 | 15 |
| Sign Control | | Free | Free | | Stop | |

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 32.4% ICU Level of Service A

Analysis Period (min) 15

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## HCM Unsignalized Intersection Capacity Analysis
## 2: Bruce County Road 25 & Stickel Street

| | ↗ | → | ← | ↖ | ↘ | ↙ |
|---|---|---|---|---|---|---|
| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
| Lane Configurations | | ↰ | ↱ | | Y | |
| Traffic Volume (veh/h) | 5 | 350 | 229 | 17 | 10 | 3 |
| Future Volume (Veh/h) | 5 | 350 | 229 | 17 | 10 | 3 |
| Sign Control | | Free | Free | | Stop | |
| Grade | | 0% | 0% | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 5 | 380 | 249 | 18 | 11 | 3 |
| Pedestrians | | | | | | |
| Lane Width (m) | | | | | | |
| Walking Speed (m/s) | | | | | | |
| Percent Blockage | | | | | | |
| Right turn flare (veh) | | | | | | |
| Median type | | None | None | | | |
| Median storage veh) | | | | | | |
| Upstream signal (m) | | | 390 | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 267 | | | | 648 | 258 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 267 | | | | 648 | 258 |
| tC, single (s) | 4.1 | | | | 6.4 | 6.2 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 2.2 | | | | 3.5 | 3.3 |
| p0 queue free % | 100 | | | | 97 | 100 |
| cM capacity (veh/h) | 1308 | | | | 436 | 786 |

| Direction, Lane # | EB 1 | WB 1 | SB 1 |
|---|---|---|---|
| Volume Total | 385 | 267 | 14 |
| Volume Left | 5 | 0 | 11 |
| Volume Right | 0 | 18 | 3 |
| cSH | 1308 | 1700 | 482 |
| Volume to Capacity | 0.00 | 0.16 | 0.03 |
| Queue Length 95th (m) | 0.1 | 0.0 | 0.7 |
| Control Delay (s) | 0.1 | 0.0 | 12.7 |
| Lane LOS | A | | B |
| Approach Delay (s) | 0.1 | 0.0 | 12.7 |
| Approach LOS | | | B |

| Intersection Summary | | | |
|---|---|---|---|
| Average Delay | 0.3 | | |
| Intersection Capacity Utilization | 32.4% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |

| | ↗ | → | ↘ | ↙ | ← | ↖ | ↖ | ↑ | ↗ | ↘ | ↓ | ↙ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations | | ✣ | | | ✣ | | | ✣ | | | ✣ | |
| Traffic Volume (vph) | 0 | 60 | 4 | 92 | 60 | 80 | 4 | 22 | 248 | 47 | 14 | 0 |
| Future Volume (vph) | 0 | 60 | 4 | 92 | 60 | 80 | 4 | 22 | 248 | 47 | 14 | 0 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Lane Util. Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Frt | | 0.992 | | | 0.953 | | | 0.878 | | | | |
| Flt Protected | | | | | 0.981 | | | 0.999 | | | 0.963 | |
| Satd. Flow (prot) | 0 | 1885 | 0 | 0 | 1776 | 0 | 0 | 1667 | 0 | 0 | 1830 | 0 |
| Flt Permitted | | | | | 0.981 | | | 0.999 | | | 0.963 | |
| Satd. Flow (perm) | 0 | 1885 | 0 | 0 | 1776 | 0 | 0 | 1667 | 0 | 0 | 1830 | 0 |
| Link Speed (k/h) | | 60 | | | 60 | | | 50 | | | 50 | |
| Link Distance (m) | | 324.2 | | | 182.0 | | | 154.6 | | | 254.8 | |
| Travel Time (s) | | 19.5 | | | 10.9 | | | 11.1 | | | 18.3 | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 0 | 65 | 4 | 100 | 65 | 87 | 4 | 24 | 270 | 51 | 15 | 0 |
| Shared Lane Traffic (%) | | | | | | | | | | | | |
| Lane Group Flow (vph) | 0 | 69 | 0 | 0 | 252 | 0 | 0 | 298 | 0 | 0 | 66 | 0 |
| Enter Blocked Intersection | No | No | No | No | No | No | No | No | No | No | No | No |
| Lane Alignment | Left | Left | Right | Left | Left | Right | Left | Left | Right | Left | Left | Right |
| Median Width(m) | | 0.0 | | | 0.0 | | | 0.0 | | | 0.0 | |
| Link Offset(m) | | 0.0 | | | 0.0 | | | 0.0 | | | 0.0 | |
| Crosswalk Width(m) | | 4.8 | | | 4.8 | | | 4.8 | | | 4.8 | |
| Two way Left Turn Lane | | | | | | | | | | | | |
| Headway Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Turning Speed (k/h) | 25 | | 15 | 25 | | 15 | 25 | | 15 | 25 | | 15 |
| Sign Control | | Free | | | Free | | | Stop | | | Stop | |

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 49.8% ICU Level of Service A

Analysis Period (min) 15

---

| | ↗ | → | ↘ | ↙ | ← | ↖ | ↖ | ↑ | ↗ | ↘ | ↓ | ↙ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations | | ✣ | | | ✣ | | | ✣ | | | ✣ | |
| Traffic Volume (veh/h) | 0 | 60 | 4 | 92 | 60 | 80 | 4 | 22 | 248 | 47 | 14 | 0 |
| Future Volume (Veh/h) | 0 | 60 | 4 | 92 | 60 | 80 | 4 | 22 | 248 | 47 | 14 | 0 |
| Sign Control | | Free | | | Free | | | Stop | | | Stop | |
| Grade | | 0% | | | 0% | | | 0% | | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 0 | 65 | 4 | 100 | 65 | 87 | 4 | 24 | 270 | 51 | 15 | 0 |
| Pedestrians | | | | | | | | | | | | |
| Lane Width (m) | | | | | | | | | | | | |
| Walking Speed (m/s) | | | | | | | | | | | | |
| Percent Blockage | | | | | | | | | | | | |
| Right turn flare (veh) | | | | | | | | | | | | |
| Median type | | None | | | None | | | | | | | |
| Median storage veh) | | | | | | | | | | | | |
| Upstream signal (m) | | | | | | | | | | | | |
| pX, platoon unblocked | | | | | | | | | | | | |
| vC, conflicting volume | 152 | | | 69 | | | 383 | 419 | 67 | 658 | 378 | 108 |
| vC1, stage 1 conf vol | | | | | | | | | | | | |
| vC2, stage 2 conf vol | | | | | | | | | | | | |
| vCu, unblocked vol | 152 | | | 69 | | | 383 | 419 | 67 | 658 | 378 | 108 |
| tC, single (s) | 4.1 | | | 4.1 | | | 7.1 | 6.5 | 6.2 | 7.1 | 6.5 | 6.2 |
| tC, 2 stage (s) | | | | | | | | | | | | |
| tF (s) | 2.2 | | | 2.2 | | | 3.5 | 4.0 | 3.3 | 3.5 | 4.0 | 3.3 |
| p0 queue free % | 100 | | | 94 | | | 99 | 95 | 73 | 80 | 97 | 100 |
| cM capacity (veh/h) | 1441 | | | 1545 | | | 538 | 494 | 1002 | 255 | 521 | 951 |

| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 |
|---|---|---|---|---|
| Volume Total | 69 | 252 | 298 | 66 |
| Volume Left | 0 | 100 | 4 | 51 |
| Volume Right | 4 | 87 | 270 | 0 |
| cSH | 1441 | 1545 | 916 | 288 |
| Volume to Capacity | 0.00 | 0.06 | 0.33 | 0.23 |
| Queue Length 95th (m) | 0.0 | 1.7 | 11.4 | 6.9 |
| Control Delay (s) | 0.0 | 3.3 | 10.8 | 21.2 |
| Lane LOS | | A | B | C |
| Approach Delay (s) | 0.0 | 3.3 | 10.8 | 21.2 |
| Approach LOS | | | B | C |

| Intersection Summary | | | |
|---|---|---|---|
| Average Delay | 8.0 | | |
| Intersection Capacity Utilization | 49.8% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |

## Lanes, Volumes, Timings
## 4: Bruce County Road 25 & Ridge Street

| | ↗ | → | ← | ↖ | ↘ | ↙ |
|---|---|---|---|---|---|---|
| Lane Group | EBL | EBT | WBT | WBR | SBL | SBR |
| Lane Configurations | | ↰ | ↱ | | ↙↘ | |
| Traffic Volume (vph) | 0 | 51 | 43 | 21 | 13 | 0 |
| Future Volume (vph) | 0 | 51 | 43 | 21 | 13 | 0 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Lane Util. Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Frt | | | 0.956 | | | |
| Flt Protected | | | | | 0.950 | |
| Satd. Flow (prot) | 0 | 1900 | 1816 | 0 | 1805 | 0 |
| Flt Permitted | | | | | 0.950 | |
| Satd. Flow (perm) | 0 | 1900 | 1816 | 0 | 1805 | 0 |
| Link Speed (k/h) | | 60 | 60 | | 50 | |
| Link Distance (m) | | 205.2 | 324.2 | | 219.6 | |
| Travel Time (s) | | 12.3 | 19.5 | | 15.8 | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 0 | 55 | 47 | 23 | 14 | 0 |
| Shared Lane Traffic (%) | | | | | | |
| Lane Group Flow (vph) | 0 | 55 | 70 | 0 | 14 | 0 |
| Enter Blocked Intersection | No | No | No | No | No | No |
| Lane Alignment | Left | Left | Left | Right | Left | Right |
| Median Width(m) | | 0.0 | 0.0 | | 3.6 | |
| Link Offset(m) | | 0.0 | 0.0 | | 0.0 | |
| Crosswalk Width(m) | | 4.8 | 4.8 | | 4.8 | |
| Two way Left Turn Lane | | | | | | |
| Headway Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Turning Speed (k/h) | 25 | | | 15 | 25 | 15 |
| Sign Control | | Free | Free | | Stop | |

Intersection Summary

Area Type: Other

Control Type: Unsignalized

Intersection Capacity Utilization 13.5% ICU Level of Service A

Analysis Period (min) 15

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## HCM Unsignalized Intersection Capacity Analysis
## 4: Bruce County Road 25 & Ridge Street

| | ↗ | → | ← | ↖ | ↘ | ↙ |
|---|---|---|---|---|---|---|
| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
| Lane Configurations | | ↰ | ↱ | | ↙↘ | |
| Traffic Volume (veh/h) | 0 | 51 | 43 | 21 | 13 | 0 |
| Future Volume (Veh/h) | 0 | 51 | 43 | 21 | 13 | 0 |
| Sign Control | | Free | Free | | Stop | |
| Grade | | 0% | 0% | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 0 | 55 | 47 | 23 | 14 | 0 |
| Pedestrians | | | | | | |
| Lane Width (m) | | | | | | |
| Walking Speed (m/s) | | | | | | |
| Percent Blockage | | | | | | |
| Right turn flare (veh) | | | | | | |
| Median type | | None | None | | | |
| Median storage veh) | | | | | | |
| Upstream signal (m) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 70 | | | | 114 | 58 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 70 | | | | 114 | 58 |
| tC, single (s) | 4.1 | | | | 6.4 | 6.2 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 2.2 | | | | 3.5 | 3.3 |
| p0 queue free % | 100 | | | | 98 | 100 |
| cM capacity (veh/h) | 1544 | | | | 888 | 1013 |

| Direction, Lane # | EB 1 | WB 1 | SB 1 |
|---|---|---|---|
| Volume Total | 55 | 70 | 14 |
| Volume Left | 0 | 0 | 14 |
| Volume Right | 0 | 23 | 0 |
| cSH | 1544 | 1700 | 888 |
| Volume to Capacity | 0.00 | 0.04 | 0.02 |
| Queue Length 95th (m) | 0.0 | 0.0 | 0.4 |
| Control Delay (s) | 0.0 | 0.0 | 9.1 |
| Lane LOS | | | A |
| Approach Delay (s) | 0.0 | 0.0 | 9.1 |
| Approach LOS | | | A |

| Intersection Summary | | | |
|---|---|---|---|
| Average Delay | 0.9 | | |
| Intersection Capacity Utilization | 13.5% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |

# Appendix C

## Detailed Synchro Analysis Results, Proposed Alternatives, 2040

# Alternative 1

# Do Nothing

| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | ↰ | ↱ | | ↰ | ↱ | | ↰ | ↑↱ | | ↰ | ↑↑ | ↱ |
| Traffic Volume (vph) | 193 | 15 | 7 | 12 | 5 | 35 | 9 | 715 | 49 | 53 | 195 | 68 |
| Future Volume (vph) | 193 | 15 | 7 | 12 | 5 | 35 | 9 | 715 | 49 | 53 | 195 | 68 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Storage Length (m) | 85.0 | | 0.0 | 50.0 | | 0.0 | 75.0 | | 0.0 | 65.0 | | 70.0 |
| Storage Lanes | 1 | | 0 | 1 | | 0 | 1 | | 0 | 1 | | 1 |
| Taper Length (m) | 100.0 | | | 55.0 | | | 100.0 | | | 25.0 | | |
| Lane Util. Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.95 | 0.95 | 1.00 | 0.95 | 1.00 |
| Frt | | 0.950 | | | 0.867 | | | 0.990 | | | | 0.850 |
| Flt Protected | 0.950 | | | 0.950 | | | 0.950 | | | 0.950 | | |
| Satd. Flow (prot) | 1492 | 1334 | 0 | 1805 | 1578 | 0 | 1399 | 3325 | 0 | 1719 | 3539 | 1568 |
| Flt Permitted | 0.729 | | | 0.742 | | | 0.619 | | | 0.306 | | |
| Satd. Flow (perm) | 1145 | 1334 | 0 | 1410 | 1578 | 0 | 912 | 3325 | 0 | 554 | 3539 | 1568 |
| Right Turn on Red | | | Yes | | | Yes | | | Yes | | | Yes |
| Satd. Flow (RTOR) | | 8 | | | 38 | | | 11 | | | | 74 |
| Link Speed (k/h) | | 60 | | | 40 | | | 50 | | | 50 | |
| Link Distance (m) | | 389.9 | | | 411.3 | | | 289.8 | | | 306.8 | |
| Travel Time (s) | | 23.4 | | | 37.0 | | | 20.9 | | | 22.1 | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Heavy Vehicles (%) | 21% | 33% | 40% | 0% | 0% | 5% | 29% | 8% | 0% | 5% | 2% | 3% |
| Adj. Flow (vph) | 210 | 16 | 8 | 13 | 5 | 38 | 10 | 777 | 53 | 58 | 212 | 74 |
| Shared Lane Traffic (%) | | | | | | | | | | | | |
| Lane Group Flow (vph) | 210 | 24 | 0 | 13 | 43 | 0 | 10 | 830 | 0 | 58 | 212 | 74 |
| Enter Blocked Intersection | No | No | No | No | No | No | No | No | No | No | No | No |
| Lane Alignment | Left | Left | Right | Left | Left | Right | Left | Left | Right | Left | Left | Right |
| Median Width(m) | | 3.6 | | | 3.6 | | | 3.6 | | | 3.6 | |
| Link Offset(m) | | 0.0 | | | 0.0 | | | 0.0 | | | 0.0 | |
| Crosswalk Width(m) | | 4.8 | | | 4.8 | | | 4.8 | | | 4.8 | |
| Two way Left Turn Lane | | | | | | | | | | | Yes | |
| Headway Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Turning Speed (k/h) | 25 | | 15 | 25 | | 15 | 25 | | 15 | 25 | | 15 |
| Number of Detectors | 1 | 2 | | 1 | 2 | | 1 | 2 | | 1 | 2 | 1 |
| Detector Template | Left | Thru | | Left | Thru | | Left | Thru | | Left | Thru | Right |
| Leading Detector (m) | 2.0 | 10.0 | | 2.0 | 10.0 | | 2.0 | 10.0 | | 2.0 | 10.0 | 2.0 |
| Trailing Detector (m) | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 |
| Detector 1 Position(m) | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 |
| Detector 1 Size(m) | 2.0 | 0.6 | | 2.0 | 0.6 | | 2.0 | 0.6 | | 2.0 | 0.6 | 2.0 |
| Detector 1 Type | Cl+Ex | Cl+Ex | | Cl+Ex | Cl+Ex | | Cl+Ex | Cl+Ex | | Cl+Ex | Cl+Ex | Cl+Ex |
| Detector 1 Channel | | | | | | | | | | | | |
| Detector 1 Extend (s) | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 |
| Detector 1 Queue (s) | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 |
| Detector 1 Delay (s) | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 |
| Detector 2 Position(m) | | 9.4 | | | 9.4 | | | 9.4 | | | 9.4 | |
| Detector 2 Size(m) | | 0.6 | | | 0.6 | | | 0.6 | | | 0.6 | |
| Detector 2 Type | | Cl+Ex | | | Cl+Ex | | | Cl+Ex | | | Cl+Ex | |
| Detector 2 Channel | | | | | | | | | | | | |
| Detector 2 Extend (s) | | 0.0 | | | 0.0 | | | 0.0 | | | 0.0 | |
| Turn Type | Perm | NA | | Perm | NA | | Perm | NA | | Perm | NA | Perm |
| Protected Phases | | 4 | | | 8 | | | 2 | | | 6 | |

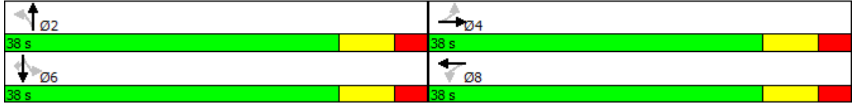
---

| Lane Group | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Permitted Phases | 4 | | | 8 | | | 2 | | | 6 | | 6 |
| Detector Phase | 4 | 4 | | 8 | 8 | | 2 | 2 | | 6 | 6 | 6 |
| Switch Phase | | | | | | | | | | | | |
| Minimum Initial (s) | 15.0 | 15.0 | | 15.0 | 15.0 | | 30.0 | 30.0 | | 30.0 | 30.0 | 30.0 |
| Minimum Split (s) | 23.0 | 23.0 | | 23.0 | 23.0 | | 38.0 | 38.0 | | 38.0 | 38.0 | 38.0 |
| Total Split (s) | 38.0 | 38.0 | | 38.0 | 38.0 | | 38.0 | 38.0 | | 38.0 | 38.0 | 38.0 |
| Total Split (%) | 50.0% | 50.0% | | 50.0% | 50.0% | | 50.0% | 50.0% | | 50.0% | 50.0% | 50.0% |
| Maximum Green (s) | 30.0 | 30.0 | | 30.0 | 30.0 | | 30.0 | 30.0 | | 30.0 | 30.0 | 30.0 |
| Yellow Time (s) | 5.0 | 5.0 | | 5.0 | 5.0 | | 5.0 | 5.0 | | 5.0 | 5.0 | 5.0 |
| All-Red Time (s) | 3.0 | 3.0 | | 3.0 | 3.0 | | 3.0 | 3.0 | | 3.0 | 3.0 | 3.0 |
| Lost Time Adjust (s) | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 |
| Total Lost Time (s) | 8.0 | 8.0 | | 8.0 | 8.0 | | 8.0 | 8.0 | | 8.0 | 8.0 | 8.0 |
| Lead/Lag | | | | | | | | | | | | |
| Lead-Lag Optimize? | | | | | | | | | | | | |
| Vehicle Extension (s) | 3.0 | 3.0 | | 3.0 | 3.0 | | 3.0 | 3.0 | | 3.0 | 3.0 | 3.0 |
| Recall Mode | None | None | | None | None | | Ped | Ped | | Ped | Ped | Ped |
| Walk Time (s) | 20.0 | 20.0 | | 20.0 | 20.0 | | 20.0 | 20.0 | | 20.0 | 20.0 | 20.0 |
| Flash Dont Walk (s) | 10.0 | 10.0 | | 10.0 | 10.0 | | 10.0 | 10.0 | | 10.0 | 10.0 | 10.0 |
| Pedestrian Calls (#/hr) | 0 | 0 | | 0 | 0 | | 0 | 0 | | 0 | 0 | 0 |
| Act Effct Green (s) | 18.2 | 18.2 | | 18.2 | 18.2 | | 30.5 | 30.5 | | 30.5 | 30.5 | 30.5 |
| Actuated g/C Ratio | 0.28 | 0.28 | | 0.28 | 0.28 | | 0.47 | 0.47 | | 0.47 | 0.47 | 0.47 |
| v/c Ratio | 0.65 | 0.06 | | 0.03 | 0.09 | | 0.02 | 0.53 | | 0.22 | 0.13 | 0.10 |
| Control Delay | 30.6 | 13.1 | | 16.0 | 7.2 | | 11.3 | 14.1 | | 14.6 | 10.8 | 3.8 |
| Queue Delay | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 |
| Total Delay | 30.6 | 13.1 | | 16.0 | 7.2 | | 11.3 | 14.1 | | 14.6 | 10.8 | 3.8 |
| LOS | C | B | | B | A | | B | B | | B | B | A |
| Approach Delay | | 28.8 | | | 9.2 | | | 14.1 | | | 9.9 | |
| Approach LOS | | C | | | A | | | B | | | A | |

**Intersection Summary**

Area Type: Other
Cycle Length: 76
Actuated Cycle Length: 64.8
Natural Cycle: 65
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 0.65
Intersection Signal Delay: 15.3 Intersection LOS: B
Intersection Capacity Utilization 82.5% ICU Level of Service E
Analysis Period (min) 15

Splits and Phases: 1: Goderich Street & Bruce County Road 25/Concession Road 6



| Lane Group | EBL | EBT | WBL | WBT | NBL | NBT | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|
| Lane Group Flow (vph) | 210 | 24 | 13 | 43 | 10 | 830 | 58 | 212 | 74 |
| v/c Ratio | 0.65 | 0.06 | 0.03 | 0.09 | 0.02 | 0.53 | 0.22 | 0.13 | 0.10 |
| Control Delay | 30.6 | 13.1 | 16.0 | 7.2 | 11.3 | 14.1 | 14.6 | 10.8 | 3.8 |
| Queue Delay | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Delay | 30.6 | 13.1 | 16.0 | 7.2 | 11.3 | 14.1 | 14.6 | 10.8 | 3.8 |
| Queue Length 50th (m) | 22.9 | 1.4 | 1.2 | 0.5 | 0.6 | 33.5 | 3.8 | 6.9 | 0.0 |
| Queue Length 95th (m) | 43.2 | 6.1 | 4.6 | 6.4 | 3.5 | 63.4 | 13.8 | 16.0 | 7.0 |
| Internal Link Dist (m) |  | 365.9 |  | 387.3 |  | 265.8 |  | 282.8 |  |
| Turn Bay Length (m) | 85.0 |  | 50.0 |  | 75.0 |  | 65.0 |  | 70.0 |
| Base Capacity (vph) | 532 | 624 | 654 | 753 | 429 | 1572 | 260 | 1667 | 778 |
| Starvation Cap Reductn | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Spillback Cap Reductn | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Storage Cap Reductn | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Reduced v/c Ratio | 0.39 | 0.04 | 0.02 | 0.06 | 0.02 | 0.53 | 0.22 | 0.13 | 0.10 |

Intersection Summary

---

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | ↰ | ↱ |  | ↰ | ↱ |  | ↰ | ↑↱ |  | ↰ | ↑↑ | ↱ |
| Traffic Volume (vph) | 193 | 15 | 7 | 12 | 5 | 35 | 9 | 715 | 49 | 53 | 195 | 68 |
| Future Volume (vph) | 193 | 15 | 7 | 12 | 5 | 35 | 9 | 715 | 49 | 53 | 195 | 68 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | 8.0 | 8.0 |  | 8.0 | 8.0 |  | 8.0 | 8.0 |  | 8.0 | 8.0 | 8.0 |
| Lane Util. Factor | 1.00 | 1.00 |  | 1.00 | 1.00 |  | 1.00 | 0.95 |  | 1.00 | 0.95 | 1.00 |
| Frt | 1.00 | 0.95 |  | 1.00 | 0.87 |  | 1.00 | 0.99 |  | 1.00 | 1.00 | 0.85 |
| Flt Protected | 0.95 | 1.00 |  | 0.95 | 1.00 |  | 0.95 | 1.00 |  | 0.95 | 1.00 | 1.00 |
| Satd. Flow (prot) | 1492 | 1334 |  | 1805 | 1578 |  | 1399 | 3326 |  | 1719 | 3539 | 1568 |
| Flt Permitted | 0.73 | 1.00 |  | 0.74 | 1.00 |  | 0.62 | 1.00 |  | 0.31 | 1.00 | 1.00 |
| Satd. Flow (perm) | 1145 | 1334 |  | 1409 | 1578 |  | 912 | 3326 |  | 554 | 3539 | 1568 |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 210 | 16 | 8 | 13 | 5 | 38 | 10 | 777 | 53 | 58 | 212 | 74 |
| RTOR Reduction (vph) | 0 | 6 | 0 | 0 | 27 | 0 | 0 | 6 | 0 | 0 | 0 | 39 |
| Lane Group Flow (vph) | 210 | 18 | 0 | 13 | 16 | 0 | 10 | 824 | 0 | 58 | 212 | 35 |
| Heavy Vehicles (%) | 21% | 33% | 40% | 0% | 0% | 5% | 29% | 8% | 0% | 5% | 2% | 3% |
| Turn Type | Perm | NA |  | Perm | NA |  | Perm | NA |  | Perm | NA | Perm |
| Protected Phases |  | 4 |  |  | 8 |  |  | 2 |  |  | 6 |  |
| Permitted Phases | 4 |  |  | 8 |  |  | 2 |  |  | 6 |  | 6 |
| Actuated Green, G (s) | 18.2 | 18.2 |  | 18.2 | 18.2 |  | 30.5 | 30.5 |  | 30.5 | 30.5 | 30.5 |
| Effective Green, g (s) | 18.2 | 18.2 |  | 18.2 | 18.2 |  | 30.5 | 30.5 |  | 30.5 | 30.5 | 30.5 |
| Actuated g/C Ratio | 0.28 | 0.28 |  | 0.28 | 0.28 |  | 0.47 | 0.47 |  | 0.47 | 0.47 | 0.47 |
| Clearance Time (s) | 8.0 | 8.0 |  | 8.0 | 8.0 |  | 8.0 | 8.0 |  | 8.0 | 8.0 | 8.0 |
| Vehicle Extension (s) | 3.0 | 3.0 |  | 3.0 | 3.0 |  | 3.0 | 3.0 |  | 3.0 | 3.0 | 3.0 |
| Lane Grp Cap (vph) | 322 | 375 |  | 396 | 443 |  | 429 | 1567 |  | 261 | 1668 | 739 |
| v/s Ratio Prot |  | 0.01 |  |  | 0.01 |  |  | c0.25 |  |  | 0.06 |  |
| v/s Ratio Perm | c0.18 |  |  | 0.01 |  |  | 0.01 |  |  | 0.10 |  | 0.02 |
| v/c Ratio | 0.65 | 0.05 |  | 0.03 | 0.04 |  | 0.02 | 0.53 |  | 0.22 | 0.13 | 0.05 |
| Uniform Delay, d1 | 20.5 | 16.9 |  | 16.9 | 16.9 |  | 9.1 | 12.0 |  | 10.1 | 9.6 | 9.2 |
| Progression Factor | 1.00 | 1.00 |  | 1.00 | 1.00 |  | 1.00 | 1.00 |  | 1.00 | 1.00 | 1.00 |
| Incremental Delay, d2 | 4.7 | 0.1 |  | 0.0 | 0.0 |  | 0.0 | 0.3 |  | 0.4 | 0.0 | 0.0 |
| Delay (s) | 25.1 | 17.0 |  | 16.9 | 16.9 |  | 9.2 | 12.3 |  | 10.5 | 9.6 | 9.3 |
| Level of Service | C | B |  | B | B |  | A | B |  | B | A | A |
| Approach Delay (s) |  | 24.3 |  |  | 16.9 |  |  | 12.3 |  |  | 9.7 |  |
| Approach LOS |  | C |  |  | B |  |  | B |  |  | A |  |

Intersection Summary

|  |  |  |  |
|---|---|---|---|
| HCM 2000 Control Delay | 13.8 | HCM 2000 Level of Service | B |
| HCM 2000 Volume to Capacity ratio | 0.57 |  |  |
| Actuated Cycle Length (s) | 64.7 | Sum of lost time (s) | 16.0 |
| Intersection Capacity Utilization | 82.5% | ICU Level of Service | E |
| Analysis Period (min) | 15 |  |  |

c Critical Lane Group

| Lane Group | EBT | EBR | WBL | WBT | NBL | NBR |
|---|---|---|---|---|---|---|
| Lane Configurations | ↱ |  |  | ↰ | ↰↱ |  |
| Traffic Volume (vph) | 26 | 1 | 39 | 38 | 0 | 165 |
| Future Volume (vph) | 26 | 1 | 39 | 38 | 0 | 165 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Lane Util. Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Frt | 0.995 |  |  |  | 0.865 |  |
| Flt Protected |  |  |  | 0.975 |  |  |
| Satd. Flow (prot) | 1890 | 0 | 0 | 1808 | 1580 | 0 |
| Flt Permitted |  |  |  | 0.975 |  |  |
| Satd. Flow (perm) | 1890 | 0 | 0 | 1808 | 1580 | 0 |
| Link Speed (k/h) | 60 |  |  | 60 | 50 |  |
| Link Distance (m) | 264.4 |  |  | 205.2 | 284.2 |  |
| Travel Time (s) | 15.9 |  |  | 12.3 | 20.5 |  |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Heavy Vehicles (%) | 0% | 0% | 1% | 4% | 0% | 4% |
| Adj. Flow (vph) | 28 | 1 | 42 | 41 | 0 | 179 |
| Shared Lane Traffic (%) |  |  |  |  |  |  |
| Lane Group Flow (vph) | 29 | 0 | 0 | 83 | 179 | 0 |
| Enter Blocked Intersection | No | No | No | No | No | No |
| Lane Alignment | Left | Right | Left | Left | Left | Right |
| Median Width(m) | 0.0 |  |  | 0.0 | 3.6 |  |
| Link Offset(m) | 0.0 |  |  | 0.0 | 0.0 |  |
| Crosswalk Width(m) | 4.8 |  |  | 4.8 | 4.8 |  |
| Two way Left Turn Lane |  |  |  |  |  |  |
| Headway Factor | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Turning Speed (k/h) |  | 15 | 25 |  | 25 | 15 |
| Sign Control | Free |  |  | Free | Stop |  |

Intersection Summary

Area Type: Other
Control Type: Unsignalized
Intersection Capacity Utilization 27.7% ICU Level of Service A
Analysis Period (min) 15

---

| Movement | EBT | EBR | WBL | WBT | NBL | NBR |
|---|---|---|---|---|---|---|
| Lane Configurations | ↱ |  |  | ↰ | ↰↱ |  |
| Traffic Volume (veh/h) | 26 | 1 | 39 | 38 | 0 | 165 |
| Future Volume (Veh/h) | 26 | 1 | 39 | 38 | 0 | 165 |
| Sign Control | Free |  |  | Free | Stop |  |
| Grade | 0% |  |  | 0% | 0% |  |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 28 | 1 | 42 | 41 | 0 | 179 |
| Pedestrians |  |  |  |  |  |  |
| Lane Width (m) |  |  |  |  |  |  |
| Walking Speed (m/s) |  |  |  |  |  |  |
| Percent Blockage |  |  |  |  |  |  |
| Right turn flare (veh) |  |  |  |  |  |  |
| Median type | None |  |  | None |  |  |
| Median storage veh) |  |  |  |  |  |  |
| Upstream signal (m) |  |  |  |  |  |  |
| pX, platoon unblocked |  |  |  |  |  |  |
| vC, conflicting volume |  |  | 29 |  | 154 | 28 |
| vC1, stage 1 conf vol |  |  |  |  |  |  |
| vC2, stage 2 conf vol |  |  |  |  |  |  |
| vCu, unblocked vol |  |  | 29 |  | 154 | 28 |
| tC, single (s) |  |  | 4.1 |  | 6.4 | 6.2 |
| tC, 2 stage (s) |  |  |  |  |  |  |
| tF (s) |  |  | 2.2 |  | 3.5 | 3.3 |
| p0 queue free % |  |  | 97 |  | 100 | 83 |
| cM capacity (veh/h) |  |  | 1591 |  | 821 | 1041 |

| Direction, Lane # | EB 1 | WB 1 | NB 1 |
|---|---|---|---|
| Volume Total | 29 | 83 | 179 |
| Volume Left | 0 | 42 | 0 |
| Volume Right | 1 | 0 | 179 |
| cSH | 1700 | 1591 | 1041 |
| Volume to Capacity | 0.02 | 0.03 | 0.17 |
| Queue Length 95th (m) | 0.0 | 0.7 | 5.0 |
| Control Delay (s) | 0.0 | 3.8 | 9.2 |
| Lane LOS |  | A | A |
| Approach Delay (s) | 0.0 | 3.8 | 9.2 |
| Approach LOS |  |  | A |

Intersection Summary

Average Delay 6.7
Intersection Capacity Utilization 27.7% ICU Level of Service A
Analysis Period (min) 15

# Alternative 2

# Realign Bruce Road 33

| | ↗ | → | ↘ | ↙ | ← | ↖ | ↖ | ↑ | ↗ | ↘ | ↓ | ↙ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations | | ✣ | | | ✣ | | | ✣ | | | ✣ | |
| Traffic Volume (veh/h) | 0 | 60 | 4 | 92 | 60 | 80 | 4 | 22 | 248 | 47 | 14 | 0 |
| Future Volume (Veh/h) | 0 | 60 | 4 | 92 | 60 | 80 | 4 | 22 | 248 | 47 | 14 | 0 |
| Sign Control | | Free | | | Free | | | Stop | | | Stop | |
| Grade | | 0% | | | 0% | | | 0% | | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 0 | 65 | 4 | 100 | 65 | 87 | 4 | 24 | 270 | 51 | 15 | 0 |
| Pedestrians | | | | | | | | | | | | |
| Lane Width (m) | | | | | | | | | | | | |
| Walking Speed (m/s) | | | | | | | | | | | | |
| Percent Blockage | | | | | | | | | | | | |
| Right turn flare (veh) | | | | | | | | | | | | |
| Median type | | None | | | None | | | | | | | |
| Median storage veh) | | | | | | | | | | | | |
| Upstream signal (m) | | | | | | | | | | | | |
| pX, platoon unblocked | | | | | | | | | | | | |
| vC, conflicting volume | 152 | | | 69 | | | 383 | 419 | 67 | 658 | 378 | 108 |
| vC1, stage 1 conf vol | | | | | | | | | | | | |
| vC2, stage 2 conf vol | | | | | | | | | | | | |
| vCu, unblocked vol | 152 | | | 69 | | | 383 | 419 | 67 | 658 | 378 | 108 |
| tC, single (s) | 4.1 | | | 4.1 | | | 7.1 | 6.5 | 6.2 | 7.1 | 6.5 | 6.2 |
| tC, 2 stage (s) | | | | | | | | | | | | |
| tF (s) | 2.2 | | | 2.2 | | | 3.5 | 4.0 | 3.3 | 3.5 | 4.0 | 3.3 |
| p0 queue free % | 100 | | | 94 | | | 99 | 95 | 73 | 80 | 97 | 100 |
| cM capacity (veh/h) | 1441 | | | 1545 | | | 538 | 494 | 1002 | 255 | 521 | 951 |

| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 |
|---|---|---|---|---|
| Volume Total | 69 | 252 | 298 | 66 |
| Volume Left | 0 | 100 | 4 | 51 |
| Volume Right | 4 | 87 | 270 | 0 |
| cSH | 1441 | 1545 | 916 | 288 |
| Volume to Capacity | 0.00 | 0.06 | 0.33 | 0.23 |
| Queue Length 95th (m) | 0.0 | 1.7 | 11.4 | 6.9 |
| Control Delay (s) | 0.0 | 3.3 | 10.8 | 21.2 |
| Lane LOS | | A | B | C |
| Approach Delay (s) | 0.0 | 3.3 | 10.8 | 21.2 |
| Approach LOS | | | B | C |

| Intersection Summary | | | |
|---|---|---|---|
| Average Delay | 8.0 | | |
| Intersection Capacity Utilization | 49.8% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | ↰↑↱ | | | ↰↑↱ | | | ✥ | | | ✥ | |
| Traffic Volume (veh/h) | 0 | 60 | 4 | 92 | 60 | 80 | 4 | 22 | 248 | 47 | 14 | 0 |
| Future Volume (Veh/h) | 0 | 60 | 4 | 92 | 60 | 80 | 4 | 22 | 248 | 47 | 14 | 0 |
| Sign Control | | Free | | | Free | | | Stop | | | Stop | |
| Grade | | 0% | | | 0% | | | 0% | | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 0 | 65 | 4 | 100 | 65 | 87 | 4 | 24 | 270 | 51 | 15 | 0 |
| Pedestrians | | | | | | | | | | | | |
| Lane Width (m) | | | | | | | | | | | | |
| Walking Speed (m/s) | | | | | | | | | | | | |
| Percent Blockage | | | | | | | | | | | | |
| Right turn flare (veh) | | | | | | | | | | | | |
| Median type | | None | | | None | | | | | | | |
| Median storage veh) | | | | | | | | | | | | |
| Upstream signal (m) | | | | | | | | | | | | |
| pX, platoon unblocked | | | | | | | | | | | | |
| vC, conflicting volume | 152 | | | 69 | | | 307 | 419 | 34 | 623 | 378 | 76 |
| vC1, stage 1 conf vol | | | | | | | | | | | | |
| vC2, stage 2 conf vol | | | | | | | | | | | | |
| vCu, unblocked vol | 152 | | | 69 | | | 307 | 419 | 34 | 623 | 378 | 76 |
| tC, single (s) | 4.1 | | | 4.1 | | | 7.5 | 6.5 | 6.9 | 7.5 | 6.5 | 6.9 |
| tC, 2 stage (s) | | | | | | | | | | | | |
| tF (s) | 2.2 | | | 2.2 | | | 3.5 | 4.0 | 3.3 | 3.5 | 4.0 | 3.3 |
| p0 queue free % | 100 | | | 94 | | | 99 | 95 | 74 | 80 | 97 | 100 |
| cM capacity (veh/h) | 1441 | | | 1545 | | | 584 | 494 | 1037 | 254 | 521 | 976 |

| Direction, Lane # | EB 1 | EB 2 | WB 1 | WB 2 | NB 1 | SB 1 |
|---|---|---|---|---|---|---|
| Volume Total | 32 | 36 | 132 | 120 | 298 | 66 |
| Volume Left | 0 | 0 | 100 | 0 | 4 | 51 |
| Volume Right | 0 | 4 | 0 | 87 | 270 | 0 |
| cSH | 1441 | 1700 | 1545 | 1700 | 944 | 287 |
| Volume to Capacity | 0.00 | 0.02 | 0.06 | 0.07 | 0.32 | 0.23 |
| Queue Length 95th (m) | 0.0 | 0.0 | 1.7 | 0.0 | 10.9 | 6.9 |
| Control Delay (s) | 0.0 | 0.0 | 5.8 | 0.0 | 10.6 | 21.2 |
| Lane LOS | | | A | | B | C |
| Approach Delay (s) | 0.0 | | 3.0 | | 10.6 | 21.2 |
| Approach LOS | | | | | B | C |

| Intersection Summary | | | |
|---|---|---|---|
| Average Delay | 7.8 | | |
| Intersection Capacity Utilization | 41.8% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |

| | ↗ | → | ↘ | ↙ | ← | ↖ | ↖ | ↑ | ↗ | ↘ | ↓ | ↙ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations | ↰ | ↑↱ | | ↰ | ↑↱ | | ↰ | ↱ | | ↰ | ↱ | |
| Traffic Volume (veh/h) | 0 | 60 | 4 | 92 | 60 | 80 | 4 | 22 | 248 | 47 | 14 | 0 |
| Future Volume (Veh/h) | 0 | 60 | 4 | 92 | 60 | 80 | 4 | 22 | 248 | 47 | 14 | 0 |
| Sign Control | | Free | | | Free | | | Stop | | | Stop | |
| Grade | | 0% | | | 0% | | | 0% | | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 0 | 65 | 4 | 100 | 65 | 87 | 4 | 24 | 270 | 51 | 15 | 0 |
| Pedestrians | | | | | | | | | | | | |
| Lane Width (m) | | | | | | | | | | | | |
| Walking Speed (m/s) | | | | | | | | | | | | |
| Percent Blockage | | | | | | | | | | | | |
| Right turn flare (veh) | | | | | | | | | | | | |
| Median type | | None | | | None | | | | | | | |
| Median storage veh) | | | | | | | | | | | | |
| Upstream signal (m) | | | | | | | | | | | | |
| pX, platoon unblocked | | | | | | | | | | | | |
| vC, conflicting volume | 152 | | | 69 | | | 307 | 419 | 34 | 623 | 378 | 76 |
| vC1, stage 1 conf vol | | | | | | | | | | | | |
| vC2, stage 2 conf vol | | | | | | | | | | | | |
| vCu, unblocked vol | 152 | | | 69 | | | 307 | 419 | 34 | 623 | 378 | 76 |
| tC, single (s) | 4.1 | | | 4.1 | | | 7.5 | 6.5 | 6.9 | 7.5 | 6.5 | 6.9 |
| tC, 2 stage (s) | | | | | | | | | | | | |
| tF (s) | 2.2 | | | 2.2 | | | 3.5 | 4.0 | 3.3 | 3.5 | 4.0 | 3.3 |
| p0 queue free % | 100 | | | 94 | | | 99 | 95 | 74 | 80 | 97 | 100 |
| cM capacity (veh/h) | 1441 | | | 1545 | | | 584 | 494 | 1037 | 254 | 521 | 976 |

| Direction, Lane # | EB 1 | EB 2 | EB 3 | WB 1 | WB 2 | WB 3 | NB 1 | NB 2 | SB 1 | SB 2 |
|---|---|---|---|---|---|---|---|---|---|---|
| Volume Total | 0 | 43 | 26 | 100 | 43 | 109 | 4 | 294 | 51 | 15 |
| Volume Left | 0 | 0 | 0 | 100 | 0 | 0 | 4 | 0 | 51 | 0 |
| Volume Right | 0 | 0 | 4 | 0 | 0 | 87 | 0 | 270 | 0 | 0 |
| cSH | 1700 | 1700 | 1700 | 1545 | 1700 | 1700 | 584 | 952 | 254 | 521 |
| Volume to Capacity | 0.00 | 0.03 | 0.02 | 0.06 | 0.03 | 0.06 | 0.01 | 0.31 | 0.20 | 0.03 |
| Queue Length 95th (m) | 0.0 | 0.0 | 0.0 | 1.7 | 0.0 | 0.0 | 0.2 | 10.6 | 5.9 | 0.7 |
| Control Delay (s) | 0.0 | 0.0 | 0.0 | 7.5 | 0.0 | 0.0 | 11.2 | 10.5 | 22.7 | 12.1 |
| Lane LOS | | | | A | | | B | B | C | B |
| Approach Delay (s) | 0.0 | | | 3.0 | | | 10.5 | | 20.3 | |
| Approach LOS | | | | | | | B | | C | |

| Intersection Summary | | | |
|---|---|---|---|
| Average Delay | 7.6 | | |
| Intersection Capacity Utilization | 41.6% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | ✣ | | | ✣ | | | ✣ | | | ✣ | |
| Sign Control | | Stop | | | Stop | | | Stop | | | Stop | |
| Traffic Volume (vph) | 0 | 60 | 4 | 92 | 60 | 80 | 4 | 22 | 248 | 47 | 14 | 0 |
| Future Volume (vph) | 0 | 60 | 4 | 92 | 60 | 80 | 4 | 22 | 248 | 47 | 14 | 0 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 0 | 65 | 4 | 100 | 65 | 87 | 4 | 24 | 270 | 51 | 15 | 0 |

| Direction, Lane # | EB 1 | WB 1 | NB 1 | SB 1 |
|---|---|---|---|---|
| Volume Total (vph) | 69 | 252 | 298 | 66 |
| Volume Left (vph) | 0 | 100 | 4 | 51 |
| Volume Right (vph) | 4 | 87 | 270 | 0 |
| Hadj (s) | -0.03 | -0.13 | -0.54 | 0.15 |
| Departure Headway (s) | 5.0 | 4.7 | 4.2 | 5.2 |
| Degree Utilization, x | 0.10 | 0.33 | 0.35 | 0.10 |
| Capacity (veh/h) | 641 | 714 | 798 | 627 |
| Control Delay (s) | 8.6 | 10.0 | 9.5 | 8.8 |
| Approach Delay (s) | 8.6 | 10.0 | 9.5 | 8.8 |
| Approach LOS | A | B | A | A |

| Intersection Summary | | | |
|---|---|---|---|
| Delay | 9.5 | | |
| Level of Service | A | | |
| Intersection Capacity Utilization | 49.8% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |

# HCM Unsignalized Intersection Capacity Analysis
## 1: Bruce County Road 33/Bruce Street & Bruce County Road 25

Alternative 2 - Option B - No. 2
190077 - County of Bruce - BCR 25 EA

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | ↰↑ ↑↱ | | | ↰↑ ↑↱ | | | ✥ | | | ✥ | |
| Sign Control | | Stop | | | Stop | | | Stop | | | Stop | |
| Traffic Volume (vph) | 0 | 60 | 4 | 92 | 60 | 80 | 4 | 22 | 248 | 47 | 14 | 0 |
| Future Volume (vph) | 0 | 60 | 4 | 92 | 60 | 80 | 4 | 22 | 248 | 47 | 14 | 0 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 0 | 65 | 4 | 100 | 65 | 87 | 4 | 24 | 270 | 51 | 15 | 0 |

| Direction, Lane # | EB 1 | EB 2 | WB 1 | WB 2 | NB 1 | SB 1 |
|---|---|---|---|---|---|---|
| Volume Total (vph) | 33 | 37 | 133 | 120 | 298 | 66 |
| Volume Left (vph) | 0 | 0 | 100 | 0 | 4 | 51 |
| Volume Right (vph) | 0 | 4 | 0 | 87 | 270 | 0 |
| Hadj (s) | 0.00 | -0.08 | 0.38 | -0.51 | -0.54 | 0.15 |
| Departure Headway (s) | 5.7 | 5.6 | 5.8 | 4.9 | 4.2 | 5.2 |
| Degree Utilization, x | 0.05 | 0.06 | 0.21 | 0.16 | 0.35 | 0.10 |
| Capacity (veh/h) | 580 | 591 | 583 | 687 | 806 | 637 |
| Control Delay (s) | 7.8 | 7.7 | 9.2 | 7.7 | 9.5 | 8.8 |
| Approach Delay (s) | 7.7 | | 8.5 | | 9.5 | 8.8 |
| Approach LOS | A | | A | | A | A |

| Intersection Summary | | | |
|---|---|---|---|
| Delay | 8.9 | | |
| Level of Service | A | | |
| Intersection Capacity Utilization | 41.8% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |

# Queues

## 1: Bruce County Road 33/Bruce Street & Bruce County Road 25

| | → | ← | ↑ | ↓ |
|---|---|---|---|---|
| Lane Group | EBT | WBT | NBT | SBT |
| Lane Group Flow (vph) | 69 | 252 | 298 | 66 |
| v/c Ratio | 0.15 | 0.61 | 0.32 | 0.10 |
| Control Delay | 11.8 | 16.8 | 3.0 | 8.2 |
| Queue Delay | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Delay | 11.8 | 16.8 | 3.0 | 8.2 |
| Queue Length 50th (m) | 3.8 | 12.2 | 1.1 | 2.5 |
| Queue Length 95th (m) | 10.1 | 27.7 | 12.4 | 9.1 |
| Internal Link Dist (m) | 138.1 | 261.9 | 130.6 | 230.8 |
| Turn Bay Length (m) | | | | |
| Base Capacity (vph) | 1245 | 1024 | 943 | 638 |
| Starvation Cap Reductn | 0 | 0 | 0 | 0 |
| Spillback Cap Reductn | 0 | 0 | 0 | 0 |
| Storage Cap Reductn | 0 | 0 | 0 | 0 |
| Reduced v/c Ratio | 0.06 | 0.25 | 0.32 | 0.10 |

Intersection Summary

| | ↗ | → | ↘ | ↙ | ← | ↖ | ↖ | ↑ | ↗ | ↘ | ↓ | ↙ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations | | ✥ | | | ✥ | | | ✥ | | | ✥ | |
| Traffic Volume (vph) | 0 | 60 | 4 | 92 | 60 | 80 | 4 | 22 | 248 | 47 | 14 | 0 |
| Future Volume (vph) | 0 | 60 | 4 | 92 | 60 | 80 | 4 | 22 | 248 | 47 | 14 | 0 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | | 6.0 | | | 6.0 | | | 6.0 | | | 6.0 | |
| Lane Util. Factor | | 1.00 | | | 1.00 | | | 1.00 | | | 1.00 | |
| Frt | | 0.99 | | | 0.95 | | | 0.88 | | | 1.00 | |
| Flt Protected | | 1.00 | | | 0.98 | | | 1.00 | | | 0.96 | |
| Satd. Flow (prot) | | 1885 | | | 1776 | | | 1666 | | | 1829 | |
| Flt Permitted | | 1.00 | | | 0.84 | | | 1.00 | | | 0.70 | |
| Satd. Flow (perm) | | 1885 | | | 1521 | | | 1663 | | | 1321 | |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 0 | 65 | 4 | 100 | 65 | 87 | 4 | 24 | 270 | 51 | 15 | 0 |
| RTOR Reduction (vph) | 0 | 3 | 0 | 0 | 46 | 0 | 0 | 139 | 0 | 0 | 0 | 0 |
| Lane Group Flow (vph) | 0 | 66 | 0 | 0 | 206 | 0 | 0 | 159 | 0 | 0 | 66 | 0 |
| Turn Type | | NA | | Perm | NA | | Perm | NA | | Perm | NA | |
| Protected Phases | | 4 | | | 8 | | | 2 | | | 6 | |
| Permitted Phases | 4 | | | 8 | | | 2 | | | 6 | | |
| Actuated Green, G (s) | | 10.8 | | | 10.8 | | | 21.4 | | | 21.4 | |
| Effective Green, g (s) | | 10.8 | | | 10.8 | | | 21.4 | | | 21.4 | |
| Actuated g/C Ratio | | 0.24 | | | 0.24 | | | 0.48 | | | 0.48 | |
| Clearance Time (s) | | 6.0 | | | 6.0 | | | 6.0 | | | 6.0 | |
| Vehicle Extension (s) | | 3.0 | | | 3.0 | | | 3.0 | | | 3.0 | |
| Lane Grp Cap (vph) | | 460 | | | 371 | | | 805 | | | 639 | |
| v/s Ratio Prot | | 0.03 | | | | | | | | | | |
| v/s Ratio Perm | | | | | c0.14 | | | c0.10 | | | 0.05 | |
| v/c Ratio | | 0.14 | | | 0.55 | | | 0.20 | | | 0.10 | |
| Uniform Delay, d1 | | 13.1 | | | 14.6 | | | 6.5 | | | 6.2 | |
| Progression Factor | | 1.00 | | | 1.00 | | | 1.00 | | | 1.00 | |
| Incremental Delay, d2 | | 0.1 | | | 1.8 | | | 0.5 | | | 0.3 | |
| Delay (s) | | 13.2 | | | 16.4 | | | 7.0 | | | 6.5 | |
| Level of Service | | B | | | B | | | A | | | A | |
| Approach Delay (s) | | 13.2 | | | 16.4 | | | 7.0 | | | 6.5 | |
| Approach LOS | | B | | | B | | | A | | | A | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM 2000 Control Delay | 11.1 | HCM 2000 Level of Service | B |
| HCM 2000 Volume to Capacity ratio | 0.32 | | |
| Actuated Cycle Length (s) | 44.2 | Sum of lost time (s) | 12.0 |
| Intersection Capacity Utilization | 55.7% | ICU Level of Service | B |
| Analysis Period (min) | 15 | | |

c Critical Lane Group

# Queues

## 1: Bruce County Road 33/Bruce Street & Bruce County Road 25

|  | → | ← | ↑ | ↓ |
|---|---|---|---|---|
| Lane Group | EBT | WBT | NBT | SBT |
| Lane Group Flow (vph) | 69 | 252 | 298 | 66 |
| v/c Ratio | 0.10 | 0.42 | 0.30 | 0.10 |
| Control Delay | 12.2 | 11.0 | 2.4 | 6.3 |
| Queue Delay | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Delay | 12.2 | 11.0 | 2.4 | 6.3 |
| Queue Length 50th (m) | 1.9 | 5.1 | 0.9 | 2.1 |
| Queue Length 95th (m) | 5.3 | 12.0 | 9.9 | 7.0 |
| Internal Link Dist (m) | 138.1 | 261.9 | 130.6 | 230.8 |
| Turn Bay Length (m) |  |  |  |  |
| Base Capacity (vph) | 2539 | 2028 | 989 | 688 |
| Starvation Cap Reductn | 0 | 0 | 0 | 0 |
| Spillback Cap Reductn | 0 | 0 | 0 | 0 |
| Storage Cap Reductn | 0 | 0 | 0 | 0 |
| Reduced v/c Ratio | 0.03 | 0.12 | 0.30 | 0.10 |
| Intersection Summary |  |  |  |  |

| | ↗ | → | ↘ | ↙ | ← | ↖ | ↖ | ↑ | ↗ | ↘ | ↓ | ↙ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations | | ↰↑↱ | | | ↰↑↱ | | | ✣ | | | ✣ | |
| Traffic Volume (vph) | 0 | 60 | 4 | 92 | 60 | 80 | 4 | 22 | 248 | 47 | 14 | 0 |
| Future Volume (vph) | 0 | 60 | 4 | 92 | 60 | 80 | 4 | 22 | 248 | 47 | 14 | 0 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | | 6.0 | | | 6.0 | | | 6.0 | | | 6.0 | |
| Lane Util. Factor | | 0.95 | | | 0.95 | | | 1.00 | | | 1.00 | |
| Frt | | 0.99 | | | 0.95 | | | 0.88 | | | 1.00 | |
| Flt Protected | | 1.00 | | | 0.98 | | | 1.00 | | | 0.96 | |
| Satd. Flow (prot) | | 3579 | | | 3356 | | | 1666 | | | 1829 | |
| Flt Permitted | | 1.00 | | | 0.82 | | | 1.00 | | | 0.70 | |
| Satd. Flow (perm) | | 3579 | | | 2824 | | | 1663 | | | 1332 | |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 0 | 65 | 4 | 100 | 65 | 87 | 4 | 24 | 270 | 51 | 15 | 0 |
| RTOR Reduction (vph) | 0 | 3 | 0 | 0 | 70 | 0 | 0 | 130 | 0 | 0 | 0 | 0 |
| Lane Group Flow (vph) | 0 | 66 | 0 | 0 | 182 | 0 | 0 | 168 | 0 | 0 | 66 | 0 |
| Turn Type | | NA | | Perm | NA | | Perm | NA | | Perm | NA | |
| Protected Phases | | 4 | | | 8 | | | 2 | | | 6 | |
| Permitted Phases | 4 | | | 8 | | | 2 | | | 6 | | |
| Actuated Green, G (s) | | 7.8 | | | 7.8 | | | 21.3 | | | 21.3 | |
| Effective Green, g (s) | | 7.8 | | | 7.8 | | | 21.3 | | | 21.3 | |
| Actuated g/C Ratio | | 0.19 | | | 0.19 | | | 0.52 | | | 0.52 | |
| Clearance Time (s) | | 6.0 | | | 6.0 | | | 6.0 | | | 6.0 | |
| Vehicle Extension (s) | | 3.0 | | | 3.0 | | | 3.0 | | | 3.0 | |
| Lane Grp Cap (vph) | | 679 | | | 535 | | | 861 | | | 690 | |
| v/s Ratio Prot | | 0.02 | | | | | | | | | | |
| v/s Ratio Perm | | | | | c0.06 | | | c0.10 | | | 0.05 | |
| v/c Ratio | | 0.10 | | | 0.34 | | | 0.20 | | | 0.10 | |
| Uniform Delay, d1 | | 13.7 | | | 14.4 | | | 5.3 | | | 5.0 | |
| Progression Factor | | 1.00 | | | 1.00 | | | 1.00 | | | 1.00 | |
| Incremental Delay, d2 | | 0.1 | | | 0.4 | | | 0.5 | | | 0.3 | |
| Delay (s) | | 13.8 | | | 14.8 | | | 5.8 | | | 5.3 | |
| Level of Service | | B | | | B | | | A | | | A | |
| Approach Delay (s) | | 13.8 | | | 14.8 | | | 5.8 | | | 5.3 | |
| Approach LOS | | B | | | B | | | A | | | A | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM 2000 Control Delay | 9.9 | HCM 2000 Level of Service | A |
| HCM 2000 Volume to Capacity ratio | 0.23 | | |
| Actuated Cycle Length (s) | 41.1 | Sum of lost time (s) | 12.0 |
| Intersection Capacity Utilization | 47.6% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |

c Critical Lane Group

| | → | ↙ | ← | ↖ | ↑ | ↘ | ↓ |
|---|---|---|---|---|---|---|---|
| Lane Group | EBT | WBL | WBT | NBL | NBT | SBL | SBT |
| Lane Group Flow (vph) | 69 | 100 | 152 | 4 | 294 | 51 | 15 |
| v/c Ratio | 0.09 | 0.36 | 0.20 | 0.00 | 0.28 | 0.08 | 0.01 |
| Control Delay | 11.9 | 17.0 | 7.2 | 6.2 | 2.4 | 6.7 | 6.1 |
| Queue Delay | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Delay | 11.9 | 17.0 | 7.2 | 6.2 | 2.4 | 6.7 | 6.1 |
| Queue Length 50th (m) | 1.9 | 6.0 | 1.9 | 0.2 | 0.8 | 1.7 | 0.5 |
| Queue Length 95th (m) | 5.2 | 15.2 | 6.8 | 1.2 | 10.3 | 6.3 | 2.7 |
| Internal Link Dist (m) | 138.1 | | 261.9 | | 130.6 | | 230.8 |
| Turn Bay Length (m) | | | | | | | |
| Base Capacity (vph) | 2602 | 980 | 2422 | 826 | 1065 | 640 | 1104 |
| Starvation Cap Reductn | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Spillback Cap Reductn | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Storage Cap Reductn | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Reduced v/c Ratio | 0.03 | 0.10 | 0.06 | 0.00 | 0.28 | 0.08 | 0.01 |

Intersection Summary

# HCM Signalized Intersection Capacity Analysis
## 1: Bruce County Road 33/Bruce Street & Bruce County Road 25

Alternative 2 - Option C - No. 3
190077 - County of Bruce - BCR 25 EA

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | ↰ | ↑↱ |  | ↰ | ↑↱ |  | ↰ | ↱ |  | ↰ | ↱ |  |
| Traffic Volume (vph) | 0 | 60 | 4 | 92 | 60 | 80 | 4 | 22 | 248 | 47 | 14 | 0 |
| Future Volume (vph) | 0 | 60 | 4 | 92 | 60 | 80 | 4 | 22 | 248 | 47 | 14 | 0 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) |  | 6.0 |  | 6.0 | 6.0 |  | 6.0 | 6.0 |  | 6.0 | 6.0 |  |
| Lane Util. Factor |  | 0.95 |  | 1.00 | 0.95 |  | 1.00 | 1.00 |  | 1.00 | 1.00 |  |
| Frt |  | 0.99 |  | 1.00 | 0.91 |  | 1.00 | 0.86 |  | 1.00 | 1.00 |  |
| Flt Protected |  | 1.00 |  | 0.95 | 1.00 |  | 0.95 | 1.00 |  | 0.95 | 1.00 |  |
| Satd. Flow (prot) |  | 3579 |  | 1805 | 3300 |  | 1805 | 1638 |  | 1805 | 1900 |  |
| Flt Permitted |  | 1.00 |  | 0.71 | 1.00 |  | 0.75 | 1.00 |  | 0.58 | 1.00 |  |
| Satd. Flow (perm) |  | 3579 |  | 1348 | 3300 |  | 1421 | 1638 |  | 1102 | 1900 |  |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 0 | 65 | 4 | 100 | 65 | 87 | 4 | 24 | 270 | 51 | 15 | 0 |
| RTOR Reduction (vph) | 0 | 3 | 0 | 0 | 72 | 0 | 0 | 125 | 0 | 0 | 0 | 0 |
| Lane Group Flow (vph) | 0 | 66 | 0 | 100 | 80 | 0 | 4 | 169 | 0 | 51 | 15 | 0 |
| Turn Type | Perm | NA |  | Perm | NA |  | Perm | NA |  | Perm | NA |  |
| Protected Phases |  | 4 |  |  | 8 |  |  | 2 |  |  | 6 |  |
| Permitted Phases | 4 |  |  | 8 |  |  | 2 |  |  | 6 |  |  |
| Actuated Green, G (s) |  | 7.1 |  | 7.1 | 7.1 |  | 22.0 | 22.0 |  | 22.0 | 22.0 |  |
| Effective Green, g (s) |  | 7.1 |  | 7.1 | 7.1 |  | 22.0 | 22.0 |  | 22.0 | 22.0 |  |
| Actuated g/C Ratio |  | 0.17 |  | 0.17 | 0.17 |  | 0.54 | 0.54 |  | 0.54 | 0.54 |  |
| Clearance Time (s) |  | 6.0 |  | 6.0 | 6.0 |  | 6.0 | 6.0 |  | 6.0 | 6.0 |  |
| Vehicle Extension (s) |  | 3.0 |  | 3.0 | 3.0 |  | 3.0 | 3.0 |  | 3.0 | 3.0 |  |
| Lane Grp Cap (vph) |  | 618 |  | 232 | 570 |  | 760 | 876 |  | 589 | 1017 |  |
| v/s Ratio Prot |  | 0.02 |  |  | 0.02 |  |  | c0.10 |  |  | 0.01 |  |
| v/s Ratio Perm |  |  |  | c0.07 |  |  | 0.00 |  |  | 0.05 |  |  |
| v/c Ratio |  | 0.11 |  | 0.43 | 0.14 |  | 0.01 | 0.19 |  | 0.09 | 0.01 |  |
| Uniform Delay, d1 |  | 14.3 |  | 15.2 | 14.4 |  | 4.5 | 4.9 |  | 4.7 | 4.5 |  |
| Progression Factor |  | 1.00 |  | 1.00 | 1.00 |  | 1.00 | 1.00 |  | 1.00 | 1.00 |  |
| Incremental Delay, d2 |  | 0.1 |  | 1.3 | 0.1 |  | 0.0 | 0.5 |  | 0.3 | 0.0 |  |
| Delay (s) |  | 14.4 |  | 16.5 | 14.5 |  | 4.5 | 5.4 |  | 4.9 | 4.5 |  |
| Level of Service |  | B |  | B | B |  | A | A |  | A | A |  |
| Approach Delay (s) |  | 14.4 |  |  | 15.3 |  |  | 5.4 |  |  | 4.8 |  |
| Approach LOS |  | B |  |  | B |  |  | A |  |  | A |  |

| Intersection Summary |  |  |  |
|---|---|---|---|
| HCM 2000 Control Delay | 9.9 | HCM 2000 Level of Service | A |
| HCM 2000 Volume to Capacity ratio | 0.25 |  |  |
| Actuated Cycle Length (s) | 41.1 | Sum of lost time (s) | 12.0 |
| Intersection Capacity Utilization | 47.4% | ICU Level of Service | A |
| Analysis Period (min) | 15 |  |  |

c Critical Lane Group

# Junctions 8

## ARCADY 8 - Roundabout Module

Version: 8.0.6.541 [19821,26/11/2015]

For sales and distribution information, program advice and maintenance, contact TRL:
Tel: +44 (0)1344 770758    email: software@trl.co.uk    Web: http://www.trlsoftware.co.uk

**Filename:** 25 and Bruce - 1 lane.arc8
**Path:** C:\Users\AdamMorrison\Paradigm\Projects - (190077) CoBruce - Bruce Road 25 EA\2 Forecasting Analysis\Arcady
**Report generation date:** 2019-08-01 6:44:13 PM

---

## Summary of intersection performance

| | PM | | | | | |
|---|---|---|---|---|---|---|
| | Queue (PCE) | Delay (s) | V/C Ratio | LOS | Intersection Delay (s) | Intersection LOS |
| | A1 - 2040 | | | | | |
| **Leg North** | 0.06 | 3.02 | 0.05 | A | 3.40 | A |
| **Leg West** | 0.06 | 3.03 | 0.06 | A | | |
| **Leg South** | 0.30 | 3.64 | 0.23 | A | | |
| **Leg East** | 0.23 | 3.32 | 0.19 | A | | |

*Values shown are the maximum values over all time segments. Delay is the maximum value of average delay per arriving vehicle. Intersection LOS and Intersection Delay are demand-weighted averages.*

*"D1 - 2040, PM " model duration: 4:30 PM - 6:00 PM*

*Run using Junctions 8.0.6.541 at 2019-08-01 6:44:13 PM*

## File summary

| | |
|---|---|
| **Title** | (untitled) |
| **Location** | |
| **Site Number** | |
| **Date** | 2019-08-01 |
| **Version** | |
| **Status** | (new file) |
| **Identifier** | |
| **Client** | |
| **Jobnumber** | |
| **Analyst** | AdamMorrison |
| **Description** | |

## Analysis Options

| Vehicle Length (m) | Do Queue Variations | Calculate Residual Capacity | Residual Capacity Criteria Type | V/C Ratio Threshold | Average Delay Threshold (s) | Queue Threshold (PCE) |
|---|---|---|---|---|---|---|
| 5.75 | ✓ | | N/A | 0.85 | 36.00 | 20.00 |

## Units

| Distance Units | Speed Units | Traffic Units Input | Traffic Units Results | Flow Units | Average Delay Units | Total Delay Units | Rate Of Delay Units |
|---|---|---|---|---|---|---|---|
| m | kph | PCE | PCE | perHour | s | -Min | perMin |

# (Default Analysis Set) - 2040, PM

## Data Errors and Warnings

*No errors or warnings*

## Analysis Set Details

| Name | Roundabout Capacity Model | Description | Include In Report | Use Specific Demand Set(s) | Specific Demand Set (s) | Locked | Network Flow Scaling Factor (%) | Network Capacity Scaling Factor (%) | Reason For Scaling Factors |
|---|---|---|---|---|---|---|---|---|---|
| (Default Analysis Set) | ARCADY | | ✓ | | | | 100.000 | 100.000 | |

## Demand Set Details

| Name | Scenario Name | Time Period Name | Description | Traffic Profile Type | Model Start Time (HH:mm) | Model Finish Time (HH:mm) | Model Time Period Length (min) | Time Segment Length (min) | Results For Central Hour Only | Single Time Segment Only | Locked | Run Automatically | Use Relationship | Relationship |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2040, PM | 2040 | PM | | ONE HOUR | 16:30 | 18:00 | 90 | 15 | | | | ✓ | | |

# Intersection Network

## Intersections

| Intersection | Name | Intersection Type | Leg Order | Grade Separated | Large Roundabout | Do Geometric Delay | Intersection Delay (s) | Intersection LOS |
|---|---|---|---|---|---|---|---|---|
| 1 | (untitled) | Roundabout | North,West,South,East | | | | 3.40 | A |

## Intersection Network Options

| Driving Side | Lighting |
|---|---|
| Right | Normal/unknown |

# Legs

## Legs

| Leg | Leg | Name | Description |
|---|---|---|---|
| **North** | North | Bruce St | |
| **West** | West | County Road 25 | |
| **South** | South | County Road 33 | |
| **East** | East | County Road 25 | |

## Capacity Options

| Leg | Minimum Capacity (PCE/hr) | Maximum Capacity (PCE/hr) | Assume Flat Start Profile | Initial Queue (PCE) |
|---|---|---|---|---|
| **North** | 0.00 | 99999.00 | | 0.00 |
| **West** | 0.00 | 99999.00 | | 0.00 |
| **South** | 0.00 | 99999.00 | | 0.00 |
| **East** | 0.00 | 99999.00 | | 0.00 |

## Roundabout Geometry

| Leg | V - Approach road half-width (m) | E - Entry width (m) | l' - Effective flare length (m) | R - Entry radius (m) | D - Inscribed circle diameter (m) | PHI - Conflict (entry) angle (deg) | Exit Only |
|---|---|---|---|---|---|---|---|
| **North** | 3.50 | 4.50 | 30.00 | 20.00 | 40.00 | 25.00 | |
| **West** | 3.50 | 4.50 | 30.00 | 20.00 | 40.00 | 25.00 | |
| **South** | 3.50 | 4.50 | 30.00 | 20.00 | 40.00 | 25.00 | |
| **East** | 3.50 | 4.50 | 30.00 | 20.00 | 40.00 | 25.00 | |

## Slope / Intercept / Capacity

### Roundabout Slope and Intercept used in model

| Leg | Enter slope and intercept directly | Entered slope | Entered intercept (PCE/hr) | Final Slope | Final Intercept (PCE/hr) |
|---|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| **North** | | (calculated) | (calculated) | 0.579 | 1357.445 |
| **West** | | (calculated) | (calculated) | 0.579 | 1357.445 |
| **South** | | (calculated) | (calculated) | 0.579 | 1357.445 |
| **East** | | (calculated) | (calculated) | 0.579 | 1357.445 |

*The slope and intercept shown above include any corrections and adjustments.*

# Traffic Flows

## Demand Set Data Options

| Default Vehicle Mix | Vehicle Mix Varies Over Time | Vehicle Mix Varies Over Turn | Vehicle Mix Varies Over Entry | Vehicle Mix Source | PCE Factor for a Truck (PCE) | Default Turning Proportions | Estimate from entry/exit counts | Turning Proportions Vary Over Time | Turning Proportions Vary Over Turn | Turning Proportions Vary Over Entry |
|---|---|---|---|---|---|---|---|---|---|---|
| | | ✓ | ✓ | Truck Percentages | 2.00 | | | | ✓ | ✓ |

# Entry Flows

## General Flows Data

| Leg | Profile Type | Use Turning Counts | Average Demand Flow (PCE/hr) | Flow Scaling Factor (%) |
|---|---|---|---|---|
| **North** | ONE HOUR | ✓ | 61.00 | 100.000 |
| **West** | ONE HOUR | ✓ | 64.00 | 100.000 |
| **South** | ONE HOUR | ✓ | 274.00 | 100.000 |
| **East** | ONE HOUR | ✓ | 232.00 | 100.000 |

# Turning Proportions

### Turning Counts / Proportions (PCE/hr) - Intersection 1 (for whole period)

| | | To | | | |
|---|---|---|---|---|---|
| | | **North** | **West** | **South** | **East** |
| **From** | **North** | 0.000 | 0.000 | 14.000 | 47.000 |
| | **West** | 0.000 | 0.000 | 4.000 | 60.000 |
| | **South** | 22.000 | 4.000 | 0.000 | 248.000 |
| | **East** | 80.000 | 60.000 | 92.000 | 0.000 |

### Turning Proportions (PCE) - Intersection 1 (for whole period)

| | | To | | | |
|---|---|---|---|---|---|
| | | **North** | **West** | **South** | **East** |
| **From** | **North** | 0.00 | 0.00 | 0.23 | 0.77 |
| | **West** | 0.00 | 0.00 | 0.06 | 0.94 |
| | **South** | 0.08 | 0.01 | 0.00 | 0.91 |
| | **East** | 0.34 | 0.26 | 0.40 | 0.00 |

# Vehicle Mix

### Average PCE Per Vehicle - Intersection 1 (for whole period)

| | | To | | | |
|---|---|---|---|---|---|
| | | **North** | **West** | **South** | **East** |
| **From** | **North** | 1.000 | 1.000 | 1.000 | 1.000 |
| | **West** | 1.000 | 1.000 | 1.000 | 1.000 |
| | **South** | 1.000 | 1.000 | 1.000 | 1.000 |
| | **East** | 1.000 | 1.000 | 1.000 | 1.000 |

### Truck Percentages - Intersection 1 (for whole period)

| | | To | | | |
|---|---|---|---|---|---|
| From | | North | West | South | East |
| | North | 0.0 | 0.0 | 0.0 | 0.0 |
| | West | 0.0 | 0.0 | 0.0 | 0.0 |
| | South | 0.0 | 0.0 | 0.0 | 0.0 |
| | East | 0.0 | 0.0 | 0.0 | 0.0 |

# Results

## Results Summary for whole modelled period

| Leg | Max V/C Ratio | Max Delay (s) | Max Queue (PCE) | Max 95th percentile Queue (PCE) | Max LOS | Average Demand (PCE/hr) | Total Intersection Arrivals (PCE) | Total Queueing Delay (PCE-min) | Average Queueing Delay (s) | Rate Of Queueing Delay (PCE-min/min) | Inclusive Total Queueing Delay (PCE-min) | Inclusive Average Queueing Delay (s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| North | 0.05 | 3.02 | 0.06 | ~1 | A | 55.97 | 83.96 | 4.13 | 2.95 | 0.05 | 4.13 | 2.95 |
| West | 0.06 | 3.03 | 0.06 | ~1 | A | 58.73 | 88.09 | 4.34 | 2.95 | 0.05 | 4.34 | 2.95 |
| South | 0.23 | 3.64 | 0.30 | ~1 | A | 251.43 | 377.14 | 21.65 | 3.44 | 0.24 | 21.65 | 3.44 |
| East | 0.19 | 3.32 | 0.23 | ~1 | A | 212.89 | 319.33 | 16.96 | 3.19 | 0.19 | 16.96 | 3.19 |

## Main Results for each time segment

### Main results: (16:30-16:45)

| Leg | Total Demand (PCE/hr) | Intersection Arrivals (PCE) | Entry Flow (PCE/hr) | Exit Flow (PCE/hr) | Circulating Flow (PCE/hr) | Pedestrian Demand (Ped/hr) | Capacity (PCE/hr) | Saturation Capacity (PCE/hr) | V/C Ratio | Start Queue (PCE) | End Queue (PCE) | Delay (s) | LOS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| North | 45.92 | 11.48 | 45.78 | 76.53 | 117.04 | 0.00 | 1289.70 | 851.05 | 0.036 | 0.00 | 0.04 | 2.893 | A |
| West | 48.18 | 12.05 | 48.03 | 48.02 | 114.80 | 0.00 | 1291.00 | 561.83 | 0.037 | 0.00 | 0.04 | 2.896 | A |
| South | 206.28 | 51.57 | 205.54 | 82.53 | 80.30 | 0.00 | 1310.97 | 673.09 | 0.157 | 0.00 | 0.19 | 3.255 | A |
| East | 174.66 | 43.67 | 174.07 | 266.33 | 19.50 | 0.00 | 1346.16 | 1320.48 | 0.130 | 0.00 | 0.15 | 3.069 | A |

### Main results: (16:45-17:00)

| Leg | Total Demand (PCE/hr) | Intersection Arrivals (PCE) | Entry Flow (PCE/hr) | Exit Flow (PCE/hr) | Circulating Flow (PCE/hr) | Pedestrian Demand (Ped/hr) | Capacity (PCE/hr) | Saturation Capacity (PCE/hr) | V/C Ratio | Start Queue (PCE) | End Queue (PCE) | Delay (s) | LOS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| North | 54.84 | 13.71 | 54.81 | 91.63 | 140.15 | 0.00 | 1276.33 | 851.05 | 0.043 | 0.04 | 0.04 | 2.946 | A |
| West | 57.53 | 14.38 | 57.50 | 57.50 | 137.46 | 0.00 | 1277.89 | 561.83 | 0.045 | 0.04 | 0.05 | 2.949 | A |
| South | 246.32 | 61.58 | 246.13 | 98.82 | 96.14 | 0.00 | 1301.81 | 673.09 | 0.189 | 0.19 | 0.23 | 3.409 | A |
| East | 208.56 | 52.14 | 208.43 | 318.91 | 23.36 | 0.00 | 1343.93 | 1320.48 | 0.155 | 0.15 | 0.18 | 3.170 | A |

### Main results: (17:00-17:15)

| Leg | Total Demand (PCE/hr) | Intersection Arrivals (PCE) | Entry Flow (PCE/hr) | Exit Flow (PCE/hr) | Circulating Flow (PCE/hr) | Pedestrian Demand (Ped/hr) | Capacity (PCE/hr) | Saturation Capacity (PCE/hr) | V/C Ratio | Start Queue (PCE) | End Queue (PCE) | Delay (s) | LOS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| North | 67.16 | 16.79 | 67.12 | 112.21 | 171.62 | 0.00 | 1258.12 | 851.05 | 0.053 | 0.04 | 0.06 | 3.022 | A |
| West | 70.47 | 17.62 | 70.42 | 70.41 | 168.33 | 0.00 | 1260.02 | 561.83 | 0.056 | 0.05 | 0.06 | 3.025 | A |
| South | 301.68 | 75.42 | 301.39 | 121.02 | 117.73 | 0.00 | 1289.31 | 673.09 | 0.234 | 0.23 | 0.30 | 3.644 | A |
| East | 255.44 | 63.86 | 255.23 | 390.52 | 28.60 | 0.00 | 1340.89 | 1320.48 | 0.191 | 0.18 | 0.23 | 3.315 | A |

### Main results: (17:15-17:30)

| Leg | Total Demand (PCE/hr) | Intersection Arrivals (PCE) | Entry Flow (PCE/hr) | Exit Flow (PCE/hr) | Circulating Flow (PCE/hr) | Pedestrian Demand (Ped/hr) | Capacity (PCE/hr) | Saturation Capacity (PCE/hr) | V/C Ratio | Start Queue (PCE) | End Queue (PCE) | Delay (s) | LOS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| North | 67.16 | 16.79 | 67.16 | 112.30 | 171.76 | 0.00 | 1258.04 | 851.05 | 0.053 | 0.06 | 0.06 | 3.022 | A |
| West | 70.47 | 17.62 | 70.46 | 70.46 | 168.45 | 0.00 | 1259.95 | 561.83 | 0.056 | 0.06 | 0.06 | 3.025 | A |
| South | 301.68 | 75.42 | 301.68 | 121.11 | 117.81 | 0.00 | 1289.26 | 673.09 | 0.234 | 0.30 | 0.30 | 3.644 | A |
| East | 255.44 | 63.86 | 255.43 | 390.86 | 28.63 | 0.00 | 1340.88 | 1320.48 | 0.191 | 0.23 | 0.23 | 3.315 | A |

## Main results: (17:30-17:45)

| Leg | Total Demand (PCE/hr) | Intersection Arrivals (PCE) | Entry Flow (PCE/hr) | Exit Flow (PCE/hr) | Circulating Flow (PCE/hr) | Pedestrian Demand (Ped/hr) | Capacity (PCE/hr) | Saturation Capacity (PCE/hr) | V/C Ratio | Start Queue (PCE) | End Queue (PCE) | Delay (s) | LOS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **North** | 54.84 | 13.71 | 54.88 | 91.79 | 140.38 | 0.00 | 1276.20 | 851.05 | 0.043 | 0.06 | 0.05 | 2.949 | A |
| **West** | 57.53 | 14.38 | 57.58 | 57.59 | 137.67 | 0.00 | 1277.77 | 561.83 | 0.045 | 0.06 | 0.05 | 2.952 | A |
| **South** | 246.32 | 61.58 | 246.60 | 98.98 | 96.27 | 0.00 | 1301.73 | 673.09 | 0.189 | 0.30 | 0.23 | 3.412 | A |
| **East** | 208.56 | 52.14 | 208.76 | 319.47 | 23.40 | 0.00 | 1343.90 | 1320.48 | 0.155 | 0.23 | 0.18 | 3.171 | A |

## Main results: (17:45-18:00)

| Leg | Total Demand (PCE/hr) | Intersection Arrivals (PCE) | Entry Flow (PCE/hr) | Exit Flow (PCE/hr) | Circulating Flow (PCE/hr) | Pedestrian Demand (Ped/hr) | Capacity (PCE/hr) | Saturation Capacity (PCE/hr) | V/C Ratio | Start Queue (PCE) | End Queue (PCE) | Delay (s) | LOS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **North** | 45.92 | 11.48 | 45.96 | 76.85 | 117.54 | 0.00 | 1289.42 | 851.05 | 0.036 | 0.05 | 0.04 | 2.896 | A |
| **West** | 48.18 | 12.05 | 48.22 | 48.22 | 115.27 | 0.00 | 1290.73 | 561.83 | 0.037 | 0.05 | 0.04 | 2.899 | A |
| **South** | 206.28 | 51.57 | 206.47 | 82.88 | 80.61 | 0.00 | 1310.79 | 673.09 | 0.157 | 0.23 | 0.19 | 3.262 | A |
| **East** | 174.66 | 43.67 | 174.80 | 267.49 | 19.59 | 0.00 | 1346.11 | 1320.48 | 0.130 | 0.18 | 0.15 | 3.073 | A |

# Queueing Delay Results for each time segment

## Queueing Delay results: (16:30-16:45)

| Leg | Queueing Total Delay (PCE-min) | Queueing Rate Of Delay (PCE-min/min) | Average Delay Per Arriving Vehicle (s) | Unsignalised Level Of Service | Signalised Level Of Service |
|---|---|---|---|---|---|
| **North** | 0.54 | 0.04 | 2.893 | A | A |
| **West** | 0.57 | 0.04 | 2.896 | A | A |
| **South** | 2.74 | 0.18 | 3.255 | A | A |
| **East** | 2.19 | 0.15 | 3.069 | A | A |

## Queueing Delay results: (16:45-17:00)

| Leg | Queueing Total Delay (PCE-min) | Queueing Rate Of Delay (PCE-min/min) | Average Delay Per Arriving Vehicle (s) | Unsignalised Level Of Service | Signalised Level Of Service |
|---|---|---|---|---|---|
| **North** | 0.66 | 0.04 | 2.946 | A | A |
| **West** | 0.70 | 0.05 | 2.949 | A | A |
| **South** | 3.44 | 0.23 | 3.409 | A | A |
| **East** | 2.71 | 0.18 | 3.170 | A | A |

## Queueing Delay results: (17:00-17:15)

| Leg | Queueing Total Delay (PCE-min) | Queueing Rate Of Delay (PCE-min/min) | Average Delay Per Arriving Vehicle (s) | Unsignalised Level Of Service | Signalised Level Of Service |
|---|---|---|---|---|---|
| **North** | 0.83 | 0.06 | 3.022 | A | A |
| **West** | 0.88 | 0.06 | 3.025 | A | A |
| **South** | 4.49 | 0.30 | 3.644 | A | A |
| **East** | 3.47 | 0.23 | 3.315 | A | A |

## Queueing Delay results: (17:15-17:30)

| Leg | Queueing Total Delay (PCE-min) | Queueing Rate Of Delay (PCE-min/min) | Average Delay Per Arriving Vehicle (s) | Unsignalised Level Of Service | Signalised Level Of Service |
|---|---|---|---|---|---|
| **North** | 0.84 | 0.06 | 3.022 | A | A |
| **West** | 0.89 | 0.06 | 3.025 | A | A |
| **South** | 4.57 | 0.30 | 3.644 | A | A |
| **East** | 3.52 | 0.23 | 3.315 | A | A |

## Queueing Delay results: (17:30-17:45)

| Leg | Queueing Total Delay (PCE-min) | Queueing Rate Of Delay (PCE-min/min) | Average Delay Per Arriving Vehicle (s) | Unsignalised Level Of Service | Signalised Level Of Service |
|---|---|---|---|---|---|
| **North** | 0.68 | 0.05 | 2.949 | A | A |
| **West** | 0.72 | 0.05 | 2.952 | A | A |
| **South** | 3.57 | 0.24 | 3.412 | A | A |
| **East** | 2.80 | 0.19 | 3.171 | A | A |

## Queueing Delay results: (17:45-18:00)

| Leg | Queueing Total Delay (PCE-min) | Queueing Rate Of Delay (PCE-min/min) | Average Delay Per Arriving Vehicle (s) | Unsignalised Level Of Service | Signalised Level Of Service |
|---|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| **North** | 0.56 | 0.04 | 2.896 | A | A |
| **West** | 0.59 | 0.04 | 2.899 | A | A |
| **South** | 2.85 | 0.19 | 3.262 | A | A |
| **East** | 2.27 | 0.15 | 3.073 | A | A |

## Queue Variation Results for each time segment

### Queue Variation results: (16:30-16:45)

| Leg | Mean (PCE) | Q05 (PCE) | Q50 (PCE) | Q90 (PCE) | Q95 (PCE) | Percentile Message | Marker Message | Probability Of Reaching Or Exceeding Marker | Probability Of Exactly Reaching Marker |
|---|---|---|---|---|---|---|---|---|---|
| **North** | 0.04 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **West** | 0.04 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **South** | 0.19 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **East** | 0.15 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |

### Queue Variation results: (16:45-17:00)

| Leg | Mean (PCE) | Q05 (PCE) | Q50 (PCE) | Q90 (PCE) | Q95 (PCE) | Percentile Message | Marker Message | Probability Of Reaching Or Exceeding Marker | Probability Of Exactly Reaching Marker |
|---|---|---|---|---|---|---|---|---|---|
| **North** | 0.04 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **West** | 0.05 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **South** | 0.23 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **East** | 0.18 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |

### Queue Variation results: (17:00-17:15)

| Leg | Mean (PCE) | Q05 (PCE) | Q50 (PCE) | Q90 (PCE) | Q95 (PCE) | Percentile Message | Marker Message | Probability Of Reaching Or Exceeding Marker | Probability Of Exactly Reaching Marker |
|---|---|---|---|---|---|---|---|---|---|
| **North** | 0.06 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **West** | 0.06 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **South** | 0.30 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **East** | 0.23 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |

### Queue Variation results: (17:15-17:30)

| Leg | Mean (PCE) | Q05 (PCE) | Q50 (PCE) | Q90 (PCE) | Q95 (PCE) | Percentile Message | Marker Message | Probability Of Reaching Or Exceeding Marker | Probability Of Exactly Reaching Marker |
|---|---|---|---|---|---|---|---|---|---|
| **North** | 0.06 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **West** | 0.06 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **South** | 0.30 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **East** | 0.23 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |

### Queue Variation results: (17:30-17:45)

| | Mean | Q05 | Q50 | Q90 | Q95 | | Marker | Probability Of Reaching | Probability Of Exactly |
|---|---|---|---|---|---|---|---|---|---|

| Leg | (PCE) | (PCE) | (PCE) | (PCE) | (PCE) | Percentile Message | Message | Or Exceeding Marker | Reaching Marker |
|---|---|---|---|---|---|---|---|---|---|
| **North** | 0.05 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **West** | 0.05 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **South** | 0.23 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **East** | 0.18 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |

## Queue Variation results: (17:45-18:00)

| Leg | Mean (PCE) | Q05 (PCE) | Q50 (PCE) | Q90 (PCE) | Q95 (PCE) | Percentile Message | Marker Message | Probability Of Reaching Or Exceeding Marker | Probability Of Exactly Reaching Marker |
|---|---|---|---|---|---|---|---|---|---|
| **North** | 0.04 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **West** | 0.04 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **South** | 0.19 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **East** | 0.15 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |

# Junctions 8

## ARCADY 8 - Roundabout Module

Version: 8.0.6.541 [19821,26/11/2015]

For sales and distribution information, program advice and maintenance, contact TRL:
Tel: +44 (0)1344 770758    email: software@trl.co.uk    Web: http://www.trlsoftware.co.uk

**Filename:** 25 and Bruce - 2 lane.arc8
**Path:** C:\Users\AdamMorrison\Paradigm\Projects - (190077) CoBruce - Bruce Road 25 EA\2 Forecasting Analysis\Arcady
**Report generation date:** 2019-08-01 6:43:27 PM

---

## Summary of intersection performance

| | PM | | | | | |
|---|---|---|---|---|---|---|
| | Queue (PCE) | Delay (s) | V/C Ratio | LOS | Intersection Delay (s) | Intersection LOS |
| | A1 - 2040 | | | | | |
| **Leg North** | 0.06 | 3.00 | 0.05 | A | 2.64 | A |
| **Leg West** | 0.03 | 1.60 | 0.03 | A | | |
| **Leg South** | 0.30 | 3.62 | 0.23 | A | | |
| **Leg East** | 0.12 | 1.67 | 0.11 | A | | |

*Values shown are the maximum values over all time segments. Delay is the maximum value of average delay per arriving vehicle. Intersection LOS and Intersection Delay are demand-weighted averages.*

*"D1 - 2040, PM " model duration: 4:30 PM - 6:00 PM*

*Run using Junctions 8.0.6.541 at 2019-08-01 6:43:26 PM*

## File summary

| | |
|---|---|
| **Title** | (untitled) |
| **Location** | |
| **Site Number** | |
| **Date** | 2019-08-01 |
| **Version** | |
| **Status** | (new file) |
| **Identifier** | |
| **Client** | |
| **Jobnumber** | |
| **Analyst** | AdamMorrison |
| **Description** | |

## Analysis Options

| Vehicle Length (m) | Do Queue Variations | Calculate Residual Capacity | Residual Capacity Criteria Type | V/C Ratio Threshold | Average Delay Threshold (s) | Queue Threshold (PCE) |
|---|---|---|---|---|---|---|
| 5.75 | ✓ | | N/A | 0.85 | 36.00 | 20.00 |

## Units

| Distance Units | Speed Units | Traffic Units Input | Traffic Units Results | Flow Units | Average Delay Units | Total Delay Units | Rate Of Delay Units |
|---|---|---|---|---|---|---|---|
| m | kph | PCE | PCE | perHour | s | -Min | perMin |

# (Default Analysis Set) - 2040, PM

## Data Errors and Warnings

*No errors or warnings*

## Analysis Set Details

| Name | Roundabout Capacity Model | Description | Include In Report | Use Specific Demand Set(s) | Specific Demand Set (s) | Locked | Network Flow Scaling Factor (%) | Network Capacity Scaling Factor (%) | Reason For Scaling Factors |
|---|---|---|---|---|---|---|---|---|---|
| (Default Analysis Set) | ARCADY | | ✓ | | | | 100.000 | 100.000 | |

## Demand Set Details

| Name | Scenario Name | Time Period Name | Description | Traffic Profile Type | Model Start Time (HH:mm) | Model Finish Time (HH:mm) | Model Time Period Length (min) | Time Segment Length (min) | Results For Central Hour Only | Single Time Segment Only | Locked | Run Automatically | Use Relationship | Relationship |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2040, PM | 2040 | PM | | ONE HOUR | 16:30 | 18:00 | 90 | 15 | | | | ✓ | | |

# Intersection Network

## Intersections

| Intersection | Name | Intersection Type | Leg Order | Grade Separated | Large Roundabout | Do Geometric Delay | Intersection Delay (s) | Intersection LOS |
|---|---|---|---|---|---|---|---|---|
| 1 | (untitled) | Roundabout | North,West,South,East | | | | 2.64 | A |

## Intersection Network Options

| Driving Side | Lighting |
|---|---|
| Right | Normal/unknown |

# Legs

## Legs

| Leg | Leg | Name | Description |
|---|---|---|---|
| **North** | North | Bruce St | |
| **West** | West | County Road 25 | |
| **South** | South | County Road 33 | |
| **East** | East | County Road 25 | |

## Capacity Options

| Leg | Minimum Capacity (PCE/hr) | Maximum Capacity (PCE/hr) | Assume Flat Start Profile | Initial Queue (PCE) |
|---|---|---|---|---|
| **North** | 0.00 | 99999.00 | | 0.00 |
| **West** | 0.00 | 99999.00 | | 0.00 |
| **South** | 0.00 | 99999.00 | | 0.00 |
| **East** | 0.00 | 99999.00 | | 0.00 |

## Roundabout Geometry

| Leg | V - Approach road half-width (m) | E - Entry width (m) | l' - Effective flare length (m) | R - Entry radius (m) | D - Inscribed circle diameter (m) | PHI - Conflict (entry) angle (deg) | Exit Only |
|---|---|---|---|---|---|---|---|
| **North** | 3.50 | 4.50 | 30.00 | 20.00 | 55.00 | 25.00 | |
| **West** | 7.00 | 8.00 | 30.00 | 20.00 | 55.00 | 25.00 | |
| **South** | 3.50 | 4.50 | 30.00 | 20.00 | 55.00 | 25.00 | |
| **East** | 7.00 | 8.00 | 30.00 | 20.00 | 55.00 | 25.00 | |

## Slope / Intercept / Capacity

### Roundabout Slope and Intercept used in model

| Leg | Enter slope and intercept directly | Entered slope | Entered intercept (PCE/hr) | Final Slope | Final Intercept (PCE/hr) |
|---|---|---|---|---|---|

|  |  |  |  |  |  |
|---|---|---|---|---|---|
| **North** |  | (calculated) | (calculated) | 0.527 | 1357.445 |
| **West** |  | (calculated) | (calculated) | 0.723 | 2436.345 |
| **South** |  | (calculated) | (calculated) | 0.527 | 1357.445 |
| **East** |  | (calculated) | (calculated) | 0.723 | 2436.345 |

*The slope and intercept shown above include any corrections and adjustments.*

# Traffic Flows

## Demand Set Data Options

| Default Vehicle Mix | Vehicle Mix Varies Over Time | Vehicle Mix Varies Over Turn | Vehicle Mix Varies Over Entry | Vehicle Mix Source | PCE Factor for a Truck (PCE) | Default Turning Proportions | Estimate from entry/exit counts | Turning Proportions Vary Over Time | Turning Proportions Vary Over Turn | Turning Proportions Vary Over Entry |
|---|---|---|---|---|---|---|---|---|---|---|
|  |  | ✓ | ✓ | Truck Percentages | 2.00 |  |  |  | ✓ | ✓ |

# Entry Flows

## General Flows Data

| Leg | Profile Type | Use Turning Counts | Average Demand Flow (PCE/hr) | Flow Scaling Factor (%) |
|---|---|---|---|---|
| **North** | ONE HOUR | ✓ | 61.00 | 100.000 |
| **West** | ONE HOUR | ✓ | 64.00 | 100.000 |
| **South** | ONE HOUR | ✓ | 274.00 | 100.000 |
| **East** | ONE HOUR | ✓ | 232.00 | 100.000 |

# Turning Proportions

## Turning Counts / Proportions (PCE/hr) - Intersection 1 (for whole period)

|  |  | To |  |  |  |
|---|---|---|---|---|---|
|  |  | **North** | **West** | **South** | **East** |
| **From** | **North** | 0.000 | 0.000 | 14.000 | 47.000 |
|  | **West** | 0.000 | 0.000 | 4.000 | 60.000 |
|  | **South** | 22.000 | 4.000 | 0.000 | 248.000 |
|  | **East** | 80.000 | 60.000 | 92.000 | 0.000 |

## Turning Proportions (PCE) - Intersection 1 (for whole period)

|  |  | To |  |  |  |
|---|---|---|---|---|---|
|  |  | **North** | **West** | **South** | **East** |
| **From** | **North** | 0.00 | 0.00 | 0.23 | 0.77 |
|  | **West** | 0.00 | 0.00 | 0.06 | 0.94 |
|  | **South** | 0.08 | 0.01 | 0.00 | 0.91 |
|  | **East** | 0.34 | 0.26 | 0.40 | 0.00 |

# Vehicle Mix

## Average PCE Per Vehicle - Intersection 1 (for whole period)

|  |  | To |  |  |  |
|---|---|---|---|---|---|
|  |  | **North** | **West** | **South** | **East** |
| **From** | **North** | 1.000 | 1.000 | 1.000 | 1.000 |
|  | **West** | 1.000 | 1.000 | 1.000 | 1.000 |
|  | **South** | 1.000 | 1.000 | 1.000 | 1.000 |
|  | **East** | 1.000 | 1.000 | 1.000 | 1.000 |

### Truck Percentages - Intersection 1 (for whole period)

| | | To | | | |
|---|---|---|---|---|---|
| | | North | West | South | East |
| From | North | 0.0 | 0.0 | 0.0 | 0.0 |
| | West | 0.0 | 0.0 | 0.0 | 0.0 |
| | South | 0.0 | 0.0 | 0.0 | 0.0 |
| | East | 0.0 | 0.0 | 0.0 | 0.0 |

# Results

## Results Summary for whole modelled period

| Leg | Max V/C Ratio | Max Delay (s) | Max Queue (PCE) | Max 95th percentile Queue (PCE) | Max LOS | Average Demand (PCE/hr) | Total Intersection Arrivals (PCE) | Total Queueing Delay (PCE-min) | Average Queueing Delay (s) | Rate Of Queueing Delay (PCE-min/min) | Inclusive Total Queueing Delay (PCE-min) | Inclusive Average Queueing Delay (s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| North | 0.05 | 3.00 | 0.06 | ~1 | A | 55.97 | 83.96 | 4.10 | 2.93 | 0.05 | 4.10 | 2.93 |
| West | 0.03 | 1.60 | 0.03 | ~1 | A | 58.73 | 88.09 | 2.32 | 1.58 | 0.03 | 2.32 | 1.58 |
| South | 0.23 | 3.62 | 0.30 | ~1 | A | 251.43 | 377.14 | 21.54 | 3.43 | 0.24 | 21.54 | 3.43 |
| East | 0.11 | 1.67 | 0.12 | ~1 | A | 212.89 | 319.33 | 8.69 | 1.63 | 0.10 | 8.69 | 1.63 |

## Main Results for each time segment

### Main results: (16:30-16:45)

| Leg | Total Demand (PCE/hr) | Intersection Arrivals (PCE) | Entry Flow (PCE/hr) | Exit Flow (PCE/hr) | Circulating Flow (PCE/hr) | Pedestrian Demand (Ped/hr) | Capacity (PCE/hr) | Saturation Capacity (PCE/hr) | V/C Ratio | Start Queue (PCE) | End Queue (PCE) | Delay (s) | LOS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| North | 45.92 | 11.48 | 45.78 | 76.62 | 117.23 | 0.00 | 1295.68 | 523.96 | 0.035 | 0.00 | 0.04 | 2.879 | A |
| West | 48.18 | 12.05 | 48.10 | 48.09 | 114.92 | 0.00 | 2353.27 | 1368.31 | 0.020 | 0.00 | 0.02 | 1.561 | A |
| South | 206.28 | 51.57 | 205.54 | 82.65 | 80.36 | 0.00 | 1315.10 | 468.90 | 0.157 | 0.00 | 0.19 | 3.243 | A |
| East | 174.66 | 43.67 | 174.35 | 266.40 | 19.50 | 0.00 | 2422.24 | 2404.18 | 0.072 | 0.00 | 0.08 | 1.600 | A |

### Main results: (16:45-17:00)

| Leg | Total Demand (PCE/hr) | Intersection Arrivals (PCE) | Entry Flow (PCE/hr) | Exit Flow (PCE/hr) | Circulating Flow (PCE/hr) | Pedestrian Demand (Ped/hr) | Capacity (PCE/hr) | Saturation Capacity (PCE/hr) | V/C Ratio | Start Queue (PCE) | End Queue (PCE) | Delay (s) | LOS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| North | 54.84 | 13.71 | 54.81 | 91.66 | 140.19 | 0.00 | 1283.58 | 523.96 | 0.043 | 0.04 | 0.04 | 2.929 | A |
| West | 57.53 | 14.38 | 57.52 | 57.51 | 137.49 | 0.00 | 2336.95 | 1368.31 | 0.025 | 0.02 | 0.03 | 1.578 | A |
| South | 246.32 | 61.58 | 246.14 | 98.85 | 96.15 | 0.00 | 1306.79 | 468.90 | 0.188 | 0.19 | 0.23 | 3.393 | A |
| East | 208.56 | 52.14 | 208.50 | 318.93 | 23.36 | 0.00 | 2419.46 | 2404.18 | 0.086 | 0.08 | 0.09 | 1.627 | A |

### Main results: (17:00-17:15)

| Leg | Total Demand (PCE/hr) | Intersection Arrivals (PCE) | Entry Flow (PCE/hr) | Exit Flow (PCE/hr) | Circulating Flow (PCE/hr) | Pedestrian Demand (Ped/hr) | Capacity (PCE/hr) | Saturation Capacity (PCE/hr) | V/C Ratio | Start Queue (PCE) | End Queue (PCE) | Delay (s) | LOS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| North | 67.16 | 16.79 | 67.12 | 112.25 | 171.69 | 0.00 | 1266.99 | 523.96 | 0.053 | 0.04 | 0.06 | 2.999 | A |
| West | 70.47 | 17.62 | 70.44 | 70.44 | 168.37 | 0.00 | 2314.62 | 1368.31 | 0.030 | 0.03 | 0.03 | 1.603 | A |
| South | 301.68 | 75.42 | 301.40 | 121.06 | 117.75 | 0.00 | 1295.41 | 468.90 | 0.233 | 0.23 | 0.30 | 3.621 | A |
| East | 255.44 | 63.86 | 255.34 | 390.55 | 28.60 | 0.00 | 2415.67 | 2404.18 | 0.106 | 0.09 | 0.12 | 1.665 | A |

### Main results: (17:15-17:30)

| Leg | Total Demand (PCE/hr) | Intersection Arrivals (PCE) | Entry Flow (PCE/hr) | Exit Flow (PCE/hr) | Circulating Flow (PCE/hr) | Pedestrian Demand (Ped/hr) | Capacity (PCE/hr) | Saturation Capacity (PCE/hr) | V/C Ratio | Start Queue (PCE) | End Queue (PCE) | Delay (s) | LOS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| North | 67.16 | 16.79 | 67.16 | 112.30 | 171.76 | 0.00 | 1266.95 | 523.96 | 0.053 | 0.06 | 0.06 | 2.999 | A |
| West | 70.47 | 17.62 | 70.47 | 70.47 | 168.46 | 0.00 | 2314.56 | 1368.31 | 0.030 | 0.03 | 0.03 | 1.603 | A |
| South | 301.68 | 75.42 | 301.68 | 121.11 | 117.81 | 0.00 | 1295.38 | 468.90 | 0.233 | 0.30 | 0.30 | 3.621 | A |
| East | 255.44 | 63.86 | 255.44 | 390.86 | 28.63 | 0.00 | 2415.65 | 2404.18 | 0.106 | 0.12 | 0.12 | 1.665 | A |

### Main results: (17:30-17:45)

| Leg | Total Demand (PCE/hr) | Intersection Arrivals (PCE) | Entry Flow (PCE/hr) | Exit Flow (PCE/hr) | Circulating Flow (PCE/hr) | Pedestrian Demand (Ped/hr) | Capacity (PCE/hr) | Saturation Capacity (PCE/hr) | V/C Ratio | Start Queue (PCE) | End Queue (PCE) | Delay (s) | LOS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **North** | 54.84 | 13.71 | 54.88 | 91.75 | 140.31 | 0.00 | 1283.52 | 523.96 | 0.043 | 0.06 | 0.04 | 2.929 | A |
| **West** | 57.53 | 14.38 | 57.56 | 57.56 | 137.63 | 0.00 | 2336.85 | 1368.31 | 0.025 | 0.03 | 0.03 | 1.578 | A |
| **South** | 246.32 | 61.58 | 246.60 | 98.94 | 96.25 | 0.00 | 1306.74 | 468.90 | 0.189 | 0.30 | 0.23 | 3.395 | A |
| **East** | 208.56 | 52.14 | 208.66 | 319.45 | 23.40 | 0.00 | 2419.43 | 2404.18 | 0.086 | 0.12 | 0.09 | 1.627 | A |

### Main results: (17:45-18:00)

| Leg | Total Demand (PCE/hr) | Intersection Arrivals (PCE) | Entry Flow (PCE/hr) | Exit Flow (PCE/hr) | Circulating Flow (PCE/hr) | Pedestrian Demand (Ped/hr) | Capacity (PCE/hr) | Saturation Capacity (PCE/hr) | V/C Ratio | Start Queue (PCE) | End Queue (PCE) | Delay (s) | LOS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **North** | 45.92 | 11.48 | 45.96 | 76.83 | 117.49 | 0.00 | 1295.54 | 523.96 | 0.035 | 0.04 | 0.04 | 2.882 | A |
| **West** | 48.18 | 12.05 | 48.20 | 48.20 | 115.24 | 0.00 | 2353.03 | 1368.31 | 0.020 | 0.03 | 0.02 | 1.561 | A |
| **South** | 206.28 | 51.57 | 206.47 | 82.85 | 80.60 | 0.00 | 1314.98 | 468.90 | 0.157 | 0.23 | 0.19 | 3.249 | A |
| **East** | 174.66 | 43.67 | 174.73 | 267.47 | 19.59 | 0.00 | 2422.18 | 2404.18 | 0.072 | 0.09 | 0.08 | 1.603 | A |

## Queueing Delay Results for each time segment

### Queueing Delay results: (16:30-16:45)

| Leg | Queueing Total Delay (PCE-min) | Queueing Rate Of Delay (PCE-min/min) | Average Delay Per Arriving Vehicle (s) | Unsignalised Level Of Service | Signalised Level Of Service |
|---|---|---|---|---|---|
| **North** | 0.54 | 0.04 | 2.879 | A | A |
| **West** | 0.31 | 0.02 | 1.561 | A | A |
| **South** | 2.73 | 0.18 | 3.243 | A | A |
| **East** | 1.15 | 0.08 | 1.600 | A | A |

### Queueing Delay results: (16:45-17:00)

| Leg | Queueing Total Delay (PCE-min) | Queueing Rate Of Delay (PCE-min/min) | Average Delay Per Arriving Vehicle (s) | Unsignalised Level Of Service | Signalised Level Of Service |
|---|---|---|---|---|---|
| **North** | 0.66 | 0.04 | 2.929 | A | A |
| **West** | 0.38 | 0.03 | 1.578 | A | A |
| **South** | 3.42 | 0.23 | 3.393 | A | A |
| **East** | 1.40 | 0.09 | 1.627 | A | A |

### Queueing Delay results: (17:00-17:15)

| Leg | Queueing Total Delay (PCE-min) | Queueing Rate Of Delay (PCE-min/min) | Average Delay Per Arriving Vehicle (s) | Unsignalised Level Of Service | Signalised Level Of Service |
|---|---|---|---|---|---|
| **North** | 0.83 | 0.06 | 2.999 | A | A |
| **West** | 0.47 | 0.03 | 1.603 | A | A |
| **South** | 4.46 | 0.30 | 3.621 | A | A |
| **East** | 1.76 | 0.12 | 1.665 | A | A |

### Queueing Delay results: (17:15-17:30)

| Leg | Queueing Total Delay (PCE-min) | Queueing Rate Of Delay (PCE-min/min) | Average Delay Per Arriving Vehicle (s) | Unsignalised Level Of Service | Signalised Level Of Service |
|---|---|---|---|---|---|
| **North** | 0.84 | 0.06 | 2.999 | A | A |
| **West** | 0.47 | 0.03 | 1.603 | A | A |
| **South** | 4.54 | 0.30 | 3.621 | A | A |
| **East** | 1.77 | 0.12 | 1.665 | A | A |

### Queueing Delay results: (17:30-17:45)

| Leg | Queueing Total Delay (PCE-min) | Queueing Rate Of Delay (PCE-min/min) | Average Delay Per Arriving Vehicle (s) | Unsignalised Level Of Service | Signalised Level Of Service |
|---|---|---|---|---|---|
| **North** | 0.68 | 0.05 | 2.929 | A | A |
| **West** | 0.38 | 0.03 | 1.578 | A | A |
| **South** | 3.55 | 0.24 | 3.395 | A | A |
| **East** | 1.43 | 0.10 | 1.627 | A | A |

### Queueing Delay results: (17:45-18:00)

| Leg | Queueing Total Delay (PCE-min) | Queueing Rate Of Delay (PCE-min/min) | Average Delay Per Arriving Vehicle (s) | Unsignalised Level Of Service | Signalised Level Of Service |
|---|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| **North** | 0.56 | 0.04 | 2.882 | A | A |
| **West** | 0.32 | 0.02 | 1.561 | A | A |
| **South** | 2.84 | 0.19 | 3.249 | A | A |
| **East** | 1.18 | 0.08 | 1.603 | A | A |

## Queue Variation Results for each time segment

### Queue Variation results: (16:30-16:45)

| Leg | Mean (PCE) | Q05 (PCE) | Q50 (PCE) | Q90 (PCE) | Q95 (PCE) | Percentile Message | Marker Message | Probability Of Reaching Or Exceeding Marker | Probability Of Exactly Reaching Marker |
|---|---|---|---|---|---|---|---|---|---|
| **North** | 0.04 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **West** | 0.02 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **South** | 0.19 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **East** | 0.08 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |

### Queue Variation results: (16:45-17:00)

| Leg | Mean (PCE) | Q05 (PCE) | Q50 (PCE) | Q90 (PCE) | Q95 (PCE) | Percentile Message | Marker Message | Probability Of Reaching Or Exceeding Marker | Probability Of Exactly Reaching Marker |
|---|---|---|---|---|---|---|---|---|---|
| **North** | 0.04 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **West** | 0.03 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **South** | 0.23 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **East** | 0.09 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |

### Queue Variation results: (17:00-17:15)

| Leg | Mean (PCE) | Q05 (PCE) | Q50 (PCE) | Q90 (PCE) | Q95 (PCE) | Percentile Message | Marker Message | Probability Of Reaching Or Exceeding Marker | Probability Of Exactly Reaching Marker |
|---|---|---|---|---|---|---|---|---|---|
| **North** | 0.06 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **West** | 0.03 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **South** | 0.30 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **East** | 0.12 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |

### Queue Variation results: (17:15-17:30)

| Leg | Mean (PCE) | Q05 (PCE) | Q50 (PCE) | Q90 (PCE) | Q95 (PCE) | Percentile Message | Marker Message | Probability Of Reaching Or Exceeding Marker | Probability Of Exactly Reaching Marker |
|---|---|---|---|---|---|---|---|---|---|
| **North** | 0.06 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **West** | 0.03 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **South** | 0.30 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **East** | 0.12 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |

### Queue Variation results: (17:30-17:45)

| | Mean | Q05 | Q50 | Q90 | Q95 | | Marker | Probability Of Reaching | Probability Of Exactly |
|---|---|---|---|---|---|---|---|---|---|

| Leg | (PCE) | (PCE) | (PCE) | (PCE) | (PCE) | Percentile Message | Message | Or Exceeding Marker | Reaching Marker |
|---|---|---|---|---|---|---|---|---|---|
| **North** | 0.04 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **West** | 0.03 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **South** | 0.23 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **East** | 0.09 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |

## Queue Variation results: (17:45-18:00)

| Leg | Mean (PCE) | Q05 (PCE) | Q50 (PCE) | Q90 (PCE) | Q95 (PCE) | Percentile Message | Marker Message | Probability Of Reaching Or Exceeding Marker | Probability Of Exactly Reaching Marker |
|---|---|---|---|---|---|---|---|---|---|
| **North** | 0.04 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **West** | 0.02 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **South** | 0.19 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **East** | 0.08 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |

# Alternative 3

## Future Intersection of Bruce Road 25 and Stickel Street

| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|---|---|---|---|---|---|---|
| Lane Configurations |  | ↰ | ↱ |  | Y |  |
| Traffic Volume (veh/h) | 5 | 350 | 229 | 17 | 10 | 3 |
| Future Volume (Veh/h) | 5 | 350 | 229 | 17 | 10 | 3 |
| Sign Control |  | Free | Free |  | Stop |  |
| Grade |  | 0% | 0% |  | 0% |  |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 5 | 380 | 249 | 18 | 11 | 3 |
| Pedestrians |  |  |  |  |  |  |
| Lane Width (m) |  |  |  |  |  |  |
| Walking Speed (m/s) |  |  |  |  |  |  |
| Percent Blockage |  |  |  |  |  |  |
| Right turn flare (veh) |  |  |  |  |  |  |
| Median type |  | None | None |  |  |  |
| Median storage veh) |  |  |  |  |  |  |
| Upstream signal (m) |  |  |  |  |  |  |
| pX, platoon unblocked |  |  |  |  |  |  |
| vC, conflicting volume | 267 |  |  |  | 648 | 258 |
| vC1, stage 1 conf vol |  |  |  |  |  |  |
| vC2, stage 2 conf vol |  |  |  |  |  |  |
| vCu, unblocked vol | 267 |  |  |  | 648 | 258 |
| tC, single (s) | 4.1 |  |  |  | 6.4 | 6.2 |
| tC, 2 stage (s) |  |  |  |  |  |  |
| tF (s) | 2.2 |  |  |  | 3.5 | 3.3 |
| p0 queue free % | 100 |  |  |  | 97 | 100 |
| cM capacity (veh/h) | 1308 |  |  |  | 436 | 786 |

| Direction, Lane # | EB 1 | WB 1 | SB 1 |
|---|---|---|---|
| Volume Total | 385 | 267 | 14 |
| Volume Left | 5 | 0 | 11 |
| Volume Right | 0 | 18 | 3 |
| cSH | 1308 | 1700 | 482 |
| Volume to Capacity | 0.00 | 0.16 | 0.03 |
| Queue Length 95th (m) | 0.1 | 0.0 | 0.7 |
| Control Delay (s) | 0.1 | 0.0 | 12.7 |
| Lane LOS | A |  | B |
| Approach Delay (s) | 0.1 | 0.0 | 12.7 |
| Approach LOS |  |  | B |

| Intersection Summary |  |  |  |
|---|---|---|---|
| Average Delay | 0.3 |  |  |
| Intersection Capacity Utilization | 32.4% | ICU Level of Service | A |
| Analysis Period (min) | 15 |  |  |

| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|---|---|---|---|---|---|---|
| Lane Configurations | | ↰↑ | ↑↱ | | ↲↳ | |
| Traffic Volume (veh/h) | 5 | 350 | 229 | 17 | 10 | 3 |
| Future Volume (Veh/h) | 5 | 350 | 229 | 17 | 10 | 3 |
| Sign Control | | Free | Free | | Stop | |
| Grade | | 0% | 0% | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 5 | 380 | 249 | 18 | 11 | 3 |
| Pedestrians | | | | | | |
| Lane Width (m) | | | | | | |
| Walking Speed (m/s) | | | | | | |
| Percent Blockage | | | | | | |
| Right turn flare (veh) | | | | | | |
| Median type | | None | None | | | |
| Median storage veh) | | | | | | |
| Upstream signal (m) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 267 | | | | 458 | 134 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 267 | | | | 458 | 134 |
| tC, single (s) | 4.1 | | | | 6.8 | 6.9 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 2.2 | | | | 3.5 | 3.3 |
| p0 queue free % | 100 | | | | 98 | 100 |
| cM capacity (veh/h) | 1308 | | | | 535 | 897 |

| Direction, Lane # | EB 1 | EB 2 | WB 1 | WB 2 | SB 1 |
|---|---|---|---|---|---|
| Volume Total | 132 | 253 | 166 | 101 | 14 |
| Volume Left | 5 | 0 | 0 | 0 | 11 |
| Volume Right | 0 | 0 | 0 | 18 | 3 |
| cSH | 1308 | 1700 | 1700 | 1700 | 585 |
| Volume to Capacity | 0.00 | 0.15 | 0.10 | 0.06 | 0.02 |
| Queue Length 95th (m) | 0.1 | 0.0 | 0.0 | 0.0 | 0.6 |
| Control Delay (s) | 0.3 | 0.0 | 0.0 | 0.0 | 11.3 |
| Lane LOS | A | | | | B |
| Approach Delay (s) | 0.1 | | 0.0 | | 11.3 |
| Approach LOS | | | | | B |

| Intersection Summary | | | |
|---|---|---|---|
| Average Delay | 0.3 | | |
| Intersection Capacity Utilization | 23.2% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |

| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|---|---|---|---|---|---|---|
| Lane Configurations | | ↰↑ | ↑↱ | | Y | |
| Sign Control | | Stop | Stop | | Stop | |
| Traffic Volume (vph) | 5 | 350 | 229 | 17 | 10 | 3 |
| Future Volume (vph) | 5 | 350 | 229 | 17 | 10 | 3 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 5 | 380 | 249 | 18 | 11 | 3 |

| Direction, Lane # | EB 1 | WB 1 | SB 1 |
|---|---|---|---|
| Volume Total (vph) | 385 | 267 | 14 |
| Volume Left (vph) | 5 | 0 | 11 |
| Volume Right (vph) | 0 | 18 | 3 |
| Hadj (s) | 0.00 | -0.04 | 0.03 |
| Departure Headway (s) | 4.2 | 4.3 | 5.3 |
| Degree Utilization, x | 0.45 | 0.32 | 0.02 |
| Capacity (veh/h) | 844 | 820 | 590 |
| Control Delay (s) | 10.6 | 9.2 | 8.4 |
| Approach Delay (s) | 10.6 | 9.2 | 8.4 |
| Approach LOS | B | A | A |

| Intersection Summary | | | |
|---|---|---|---|
| Delay | 10.0 | | |
| Level of Service | B | | |
| Intersection Capacity Utilization | 32.4% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |

| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|---|---|---|---|---|---|---|
| | ↗ | → | ← | ↖ | ↘ | ↙ |
| Lane Configurations | | ↰↑ | ↑↱ | | ↰↱ | |
| Sign Control | | Stop | Stop | | Stop | |
| Traffic Volume (vph) | 5 | 350 | 229 | 17 | 10 | 3 |
| Future Volume (vph) | 5 | 350 | 229 | 17 | 10 | 3 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 5 | 380 | 249 | 18 | 11 | 3 |

| Direction, Lane # | EB 1 | EB 2 | WB 1 | WB 2 | SB 1 |
|---|---|---|---|---|---|
| Volume Total (vph) | 132 | 253 | 166 | 101 | 14 |
| Volume Left (vph) | 5 | 0 | 0 | 0 | 11 |
| Volume Right (vph) | 0 | 0 | 0 | 18 | 3 |
| Hadj (s) | 0.02 | 0.00 | 0.00 | -0.12 | 0.03 |
| Departure Headway (s) | 4.8 | 4.7 | 4.8 | 4.7 | 5.3 |
| Degree Utilization, x | 0.17 | 0.33 | 0.22 | 0.13 | 0.02 |
| Capacity (veh/h) | 746 | 748 | 727 | 747 | 620 |
| Control Delay (s) | 7.6 | 8.9 | 8.0 | 7.2 | 8.4 |
| Approach Delay (s) | 8.4 | | 7.7 | | 8.4 |
| Approach LOS | A | | A | | A |

| Intersection Summary | | | |
|---|---|---|---|
| Delay | 8.1 | | |
| Level of Service | A | | |
| Intersection Capacity Utilization | 23.2% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |

| | → | ← | ↘ |
|---|---|---|---|
| Lane Group | EBT | WBT | SBL |
| Lane Group Flow (vph) | 385 | 267 | 14 |
| v/c Ratio | 0.27 | 0.19 | 0.02 |
| Control Delay | 3.1 | 2.8 | 7.0 |
| Queue Delay | 0.0 | 0.0 | 0.0 |
| Total Delay | 3.1 | 2.8 | 7.0 |
| Queue Length 50th (m) | 0.0 | 0.0 | 0.2 |
| Queue Length 95th (m) | 25.7 | 16.9 | 3.0 |
| Internal Link Dist (m) | 331.7 | 170.9 | 245.3 |
| Turn Bay Length (m) | | | |
| Base Capacity (vph) | 1831 | 1835 | 1623 |
| Starvation Cap Reductn | 0 | 0 | 0 |
| Spillback Cap Reductn | 0 | 0 | 0 |
| Storage Cap Reductn | 0 | 0 | 0 |
| Reduced v/c Ratio | 0.21 | 0.15 | 0.01 |

Intersection Summary

| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|---|---|---|---|---|---|---|
| Lane Configurations | | ↰ | ↱ | | Y | |
| Traffic Volume (vph) | 5 | 350 | 229 | 17 | 10 | 3 |
| Future Volume (vph) | 5 | 350 | 229 | 17 | 10 | 3 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | | 6.0 | 6.0 | | 6.0 | |
| Lane Util. Factor | | 1.00 | 1.00 | | 1.00 | |
| Frt | | 1.00 | 0.99 | | 0.97 | |
| Flt Protected | | 1.00 | 1.00 | | 0.96 | |
| Satd. Flow (prot) | | 1899 | 1883 | | 1775 | |
| Flt Permitted | | 0.99 | 1.00 | | 0.96 | |
| Satd. Flow (perm) | | 1880 | 1883 | | 1775 | |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 5 | 380 | 249 | 18 | 11 | 3 |
| RTOR Reduction (vph) | 0 | 0 | 6 | 0 | 3 | 0 |
| Lane Group Flow (vph) | 0 | 385 | 261 | 0 | 11 | 0 |
| Turn Type | Perm | NA | NA | | Prot | |
| Protected Phases | | 4 | 8 | | 2 | |
| Permitted Phases | 4 | | | | | |
| Actuated Green, G (s) | | 5.3 | 5.3 | | 0.6 | |
| Effective Green, g (s) | | 5.3 | 5.3 | | 0.6 | |
| Actuated g/C Ratio | | 0.30 | 0.30 | | 0.03 | |
| Clearance Time (s) | | 6.0 | 6.0 | | 6.0 | |
| Vehicle Extension (s) | | 3.0 | 3.0 | | 3.0 | |
| Lane Grp Cap (vph) | | 556 | 557 | | 59 | |
| v/s Ratio Prot | | | 0.14 | | c0.01 | |
| v/s Ratio Perm | | c0.20 | | | | |
| v/c Ratio | | 0.69 | 0.47 | | 0.19 | |
| Uniform Delay, d1 | | 5.6 | 5.2 | | 8.4 | |
| Progression Factor | | 1.00 | 1.00 | | 1.00 | |
| Incremental Delay, d2 | | 3.7 | 0.6 | | 1.5 | |
| Delay (s) | | 9.3 | 5.8 | | 10.0 | |
| Level of Service | | A | A | | A | |
| Approach Delay (s) | | 9.3 | 5.8 | | 10.0 | |
| Approach LOS | | A | A | | A | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM 2000 Control Delay | 7.9 | HCM 2000 Level of Service | A |
| HCM 2000 Volume to Capacity ratio | 0.64 | | |
| Actuated Cycle Length (s) | 17.9 | Sum of lost time (s) | 12.0 |
| Intersection Capacity Utilization | 36.6% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |

c Critical Lane Group

# Queues
## 2: Bruce County Road 25 & Stickel Street

| | → | ← | ↳ |
|---|---|---|---|
| Lane Group | EBT | WBT | SBL |
| Lane Group Flow (vph) | 385 | 267 | 14 |
| v/c Ratio | 0.47 | 0.31 | 0.02 |
| Control Delay | 15.3 | 12.8 | 6.1 |
| Queue Delay | 0.0 | 0.0 | 0.0 |
| Total Delay | 15.3 | 12.8 | 6.1 |
| Queue Length 50th (m) | 12.7 | 7.8 | 0.4 |
| Queue Length 95th (m) | 21.7 | 14.8 | 2.5 |
| Internal Link Dist (m) | 331.7 | 170.9 | 245.3 |
| Turn Bay Length (m) | | | |
| Base Capacity (vph) | 2438 | 2552 | 830 |
| Starvation Cap Reductn | 0 | 0 | 0 |
| Spillback Cap Reductn | 0 | 0 | 0 |
| Storage Cap Reductn | 0 | 0 | 0 |
| Reduced v/c Ratio | 0.16 | 0.10 | 0.02 |

Intersection Summary

| | ↗ | → | ← | ↖ | ↘ | ↙ |
|---|---|---|---|---|---|---|
| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
| Lane Configurations | | ↰↑ | ↑↱ | | ↰↱ | |
| Traffic Volume (vph) | 5 | 350 | 229 | 17 | 10 | 3 |
| Future Volume (vph) | 5 | 350 | 229 | 17 | 10 | 3 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | | 6.0 | 6.0 | | 6.0 | |
| Lane Util. Factor | | 0.95 | 0.95 | | 1.00 | |
| Frt | | 1.00 | 0.99 | | 0.97 | |
| Flt Protected | | 1.00 | 1.00 | | 0.96 | |
| Satd. Flow (prot) | | 3608 | 3573 | | 1775 | |
| Flt Permitted | | 0.95 | 1.00 | | 0.96 | |
| Satd. Flow (perm) | | 3421 | 3573 | | 1775 | |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 5 | 380 | 249 | 18 | 11 | 3 |
| RTOR Reduction (vph) | 0 | 0 | 13 | 0 | 2 | 0 |
| Lane Group Flow (vph) | 0 | 385 | 254 | 0 | 12 | 0 |
| Turn Type | Perm | NA | NA | | Prot | |
| Protected Phases | | 4 | 8 | | 2 | |
| Permitted Phases | 4 | | | | | |
| Actuated Green, G (s) | | 9.7 | 9.7 | | 19.0 | |
| Effective Green, g (s) | | 9.7 | 9.7 | | 19.0 | |
| Actuated g/C Ratio | | 0.24 | 0.24 | | 0.47 | |
| Clearance Time (s) | | 6.0 | 6.0 | | 6.0 | |
| Vehicle Extension (s) | | 3.0 | 3.0 | | 3.0 | |
| Lane Grp Cap (vph) | | 815 | 851 | | 828 | |
| v/s Ratio Prot | | | 0.07 | | c0.01 | |
| v/s Ratio Perm | | c0.11 | | | | |
| v/c Ratio | | 0.47 | 0.30 | | 0.01 | |
| Uniform Delay, d1 | | 13.3 | 12.7 | | 5.8 | |
| Progression Factor | | 1.00 | 1.00 | | 1.00 | |
| Incremental Delay, d2 | | 0.4 | 0.2 | | 0.0 | |
| Delay (s) | | 13.7 | 12.9 | | 5.9 | |
| Level of Service | | B | B | | A | |
| Approach Delay (s) | | 13.7 | 12.9 | | 5.9 | |
| Approach LOS | | B | B | | A | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM 2000 Control Delay | 13.2 | HCM 2000 Level of Service | B |
| HCM 2000 Volume to Capacity ratio | 0.17 | | |
| Actuated Cycle Length (s) | 40.7 | Sum of lost time (s) | 12.0 |
| Intersection Capacity Utilization | 27.4% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |

c Critical Lane Group

## Queues
## 2: Bruce County Road 25 & Stickel Street

Alternative 3 - Option C - No. 3
190077 - County of Bruce - BCR 25 EA

| | → | ← | ↘ | ↙ |
|---|---|---|---|---|
| Lane Group | EBT | WBT | SBL | SBR |
| Lane Group Flow (vph) | 385 | 267 | 11 | 3 |
| v/c Ratio | 0.65 | 0.45 | 0.01 | 0.00 |
| Control Delay | 19.0 | 14.4 | 9.5 | 7.3 |
| Queue Delay | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Delay | 19.0 | 14.4 | 9.5 | 7.3 |
| Queue Length 50th (m) | 26.9 | 16.7 | 0.5 | 0.0 |
| Queue Length 95th (m) | 47.7 | 31.5 | 3.1 | 1.3 |
| Internal Link Dist (m) | 331.7 | 170.9 | 245.3 | |
| Turn Bay Length (m) | | | | |
| Base Capacity (vph) | 1215 | 1215 | 761 | 682 |
| Starvation Cap Reductn | 0 | 0 | 0 | 0 |
| Spillback Cap Reductn | 0 | 0 | 0 | 0 |
| Storage Cap Reductn | 0 | 0 | 0 | 0 |
| Reduced v/c Ratio | 0.32 | 0.22 | 0.01 | 0.00 |

Intersection Summary

## 2: Bruce County Road 25 & Stickel Street

| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|---|---|---|---|---|---|---|
| Lane Configurations | | ↰↑ | ↑↱ | | ↰ | ↱ |
| Traffic Volume (vph) | 5 | 350 | 229 | 17 | 10 | 3 |
| Future Volume (vph) | 5 | 350 | 229 | 17 | 10 | 3 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | | 6.0 | 6.0 | | 6.0 | 6.0 |
| Lane Util. Factor | | 1.00 | 1.00 | | 1.00 | 1.00 |
| Frt | | 1.00 | 0.99 | | 1.00 | 0.85 |
| Flt Protected | | 1.00 | 1.00 | | 0.95 | 1.00 |
| Satd. Flow (prot) | | 1899 | 1883 | | 1805 | 1615 |
| Flt Permitted | | 0.99 | 1.00 | | 0.95 | 1.00 |
| Satd. Flow (perm) | | 1889 | 1883 | | 1805 | 1615 |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 5 | 380 | 249 | 18 | 11 | 3 |
| RTOR Reduction (vph) | 0 | 0 | 6 | 0 | 0 | 2 |
| Lane Group Flow (vph) | 0 | 385 | 261 | 0 | 11 | 1 |
| Turn Type | Perm | NA | NA | | Prot | Perm |
| Protected Phases | | 4 | 8 | | 2 | |
| Permitted Phases | 4 | | | | | 2 |
| Actuated Green, G (s) | | 14.1 | 14.1 | | 19.1 | 19.1 |
| Effective Green, g (s) | | 14.1 | 14.1 | | 19.1 | 19.1 |
| Actuated g/C Ratio | | 0.31 | 0.31 | | 0.42 | 0.42 |
| Clearance Time (s) | | 6.0 | 6.0 | | 6.0 | 6.0 |
| Vehicle Extension (s) | | 3.0 | 3.0 | | 3.0 | 3.0 |
| Lane Grp Cap (vph) | | 589 | 587 | | 762 | 682 |
| v/s Ratio Prot | | | 0.14 | | c0.01 | |
| v/s Ratio Perm | | c0.20 | | | | 0.00 |
| v/c Ratio | | 0.65 | 0.45 | | 0.01 | 0.00 |
| Uniform Delay, d1 | | 13.4 | 12.4 | | 7.6 | 7.5 |
| Progression Factor | | 1.00 | 1.00 | | 1.00 | 1.00 |
| Incremental Delay, d2 | | 2.6 | 0.5 | | 0.0 | 0.0 |
| Delay (s) | | 16.0 | 13.0 | | 7.6 | 7.5 |
| Level of Service | | B | B | | A | A |
| Approach Delay (s) | | 16.0 | 13.0 | | 7.6 | |
| Approach LOS | | B | B | | A | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM 2000 Control Delay | 14.6 | HCM 2000 Level of Service | B |
| HCM 2000 Volume to Capacity ratio | 0.29 | | |
| Actuated Cycle Length (s) | 45.2 | Sum of lost time (s) | 12.0 |
| Intersection Capacity Utilization | 36.6% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |

c Critical Lane Group

# Queues
## 2: Bruce County Road 25 & Stickel Street

| | → | ← | ↘ | ↙ |
|---|---|---|---|---|
| Lane Group | EBT | WBT | SBL | SBR |
| Lane Group Flow (vph) | 385 | 267 | 11 | 3 |
| v/c Ratio | 0.47 | 0.31 | 0.01 | 0.00 |
| Control Delay | 15.3 | 12.8 | 6.6 | 5.0 |
| Queue Delay | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Delay | 15.3 | 12.8 | 6.6 | 5.0 |
| Queue Length 50th (m) | 12.7 | 7.8 | 0.4 | 0.0 |
| Queue Length 95th (m) | 21.7 | 14.8 | 2.3 | 1.0 |
| Internal Link Dist (m) | 331.7 | 170.9 | 245.3 | |
| Turn Bay Length (m) | | | | |
| Base Capacity (vph) | 2438 | 2552 | 842 | 755 |
| Starvation Cap Reductn | 0 | 0 | 0 | 0 |
| Spillback Cap Reductn | 0 | 0 | 0 | 0 |
| Storage Cap Reductn | 0 | 0 | 0 | 0 |
| Reduced v/c Ratio | 0.16 | 0.10 | 0.01 | 0.00 |

Intersection Summary

| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|---|---|---|---|---|---|---|
| Lane Configurations | | ↰↑ | ↑↱ | | ↰ | ↱ |
| Traffic Volume (vph) | 5 | 350 | 229 | 17 | 10 | 3 |
| Future Volume (vph) | 5 | 350 | 229 | 17 | 10 | 3 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | | 6.0 | 6.0 | | 6.0 | 6.0 |
| Lane Util. Factor | | 0.95 | 0.95 | | 1.00 | 1.00 |
| Frt | | 1.00 | 0.99 | | 1.00 | 0.85 |
| Flt Protected | | 1.00 | 1.00 | | 0.95 | 1.00 |
| Satd. Flow (prot) | | 3608 | 3573 | | 1805 | 1615 |
| Flt Permitted | | 0.95 | 1.00 | | 0.95 | 1.00 |
| Satd. Flow (perm) | | 3421 | 3573 | | 1805 | 1615 |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 5 | 380 | 249 | 18 | 11 | 3 |
| RTOR Reduction (vph) | 0 | 0 | 13 | 0 | 0 | 2 |
| Lane Group Flow (vph) | 0 | 385 | 254 | 0 | 11 | 1 |
| Turn Type | Perm | NA | NA | | Prot | Perm |
| Protected Phases | | 4 | 8 | | 2 | |
| Permitted Phases | 4 | | | | | 2 |
| Actuated Green, G (s) | | 9.7 | 9.7 | | 19.0 | 19.0 |
| Effective Green, g (s) | | 9.7 | 9.7 | | 19.0 | 19.0 |
| Actuated g/C Ratio | | 0.24 | 0.24 | | 0.47 | 0.47 |
| Clearance Time (s) | | 6.0 | 6.0 | | 6.0 | 6.0 |
| Vehicle Extension (s) | | 3.0 | 3.0 | | 3.0 | 3.0 |
| Lane Grp Cap (vph) | | 815 | 851 | | 842 | 753 |
| v/s Ratio Prot | | | 0.07 | | c0.01 | |
| v/s Ratio Perm | | c0.11 | | | | 0.00 |
| v/c Ratio | | 0.47 | 0.30 | | 0.01 | 0.00 |
| Uniform Delay, d1 | | 13.3 | 12.7 | | 5.8 | 5.8 |
| Progression Factor | | 1.00 | 1.00 | | 1.00 | 1.00 |
| Incremental Delay, d2 | | 0.4 | 0.2 | | 0.0 | 0.0 |
| Delay (s) | | 13.7 | 12.9 | | 5.8 | 5.8 |
| Level of Service | | B | B | | A | A |
| Approach Delay (s) | | 13.7 | 12.9 | | 5.8 | |
| Approach LOS | | B | B | | A | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM 2000 Control Delay | 13.2 | HCM 2000 Level of Service | B |
| HCM 2000 Volume to Capacity ratio | 0.17 | | |
| Actuated Cycle Length (s) | 40.7 | Sum of lost time (s) | 12.0 |
| Intersection Capacity Utilization | 27.4% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |

c Critical Lane Group

# Junctions 8

## ARCADY 8 - Roundabout Module

Version: 8.0.6.541 [19821,26/11/2015]

For sales and distribution information, program advice and maintenance, contact TRL:
Tel: +44 (0)1344 770758 email: software@trl.co.uk Web: http://www.trlsoftware.co.uk

**Filename:** 25 and Stickel - 1 lane.arc8
**Path:** C:\Users\AdamMorrison\Paradigm\Projects - (190077) CoBruce - Bruce Road 25 EA\2 Forecasting Analysis\Arcady
**Report generation date:** 2019-08-01 6:44:32 PM

---

## Summary of intersection performance

| | PM | | | | | |
|---|---|---|---|---|---|---|
| | Queue (PCE) | Delay (s) | V/C Ratio | LOS | Intersection Delay (s) | Intersection LOS |
| | A1 - 2040 | | | | | |
| **Leg North** | 0.01 | 3.01 | 0.01 | A | 3.56 | A |
| **Leg West** | 0.41 | 3.75 | 0.29 | A | | |
| **Leg East** | 0.25 | 3.32 | 0.20 | A | | |

*Values shown are the maximum values over all time segments. Delay is the maximum value of average delay per arriving vehicle. Intersection LOS and Intersection Delay are demand-weighted averages.*

*"D1 - 2040, PM " model duration: 4:00 PM - 5:30 PM*

*Run using Junctions 8.0.6.541 at 2019-08-01 6:44:31 PM*

## File summary

| | |
|---|---|
| **Title** | (untitled) |
| **Location** | |
| **Site Number** | |
| **Date** | 2019-08-01 |
| **Version** | |
| **Status** | (new file) |
| **Identifier** | |
| **Client** | |
| **Jobnumber** | |
| **Analyst** | AdamMorrison |
| **Description** | |

## Analysis Options

| Vehicle Length (m) | Do Queue Variations | Calculate Residual Capacity | Residual Capacity Criteria Type | V/C Ratio Threshold | Average Delay Threshold (s) | Queue Threshold (PCE) |
|---|---|---|---|---|---|---|
| 5.75 | ✓ | | N/A | 0.85 | 36.00 | 20.00 |

## Units

| Distance Units | Speed Units | Traffic Units Input | Traffic Units Results | Flow Units | Average Delay Units | Total Delay Units | Rate Of Delay Units |
|---|---|---|---|---|---|---|---|
| m | kph | PCE | PCE | perHour | s | -Min | perMin |

# (Default Analysis Set) - 2040, PM

## Data Errors and Warnings

*No errors or warnings*

## Analysis Set Details

| Name | Roundabout Capacity Model | Description | Include In Report | Use Specific Demand Set(s) | Specific Demand Set (s) | Locked | Network Flow Scaling Factor (%) | Network Capacity Scaling Factor (%) | Reason For Scaling Factors |
|---|---|---|---|---|---|---|---|---|---|
| (Default Analysis Set) | ARCADY | | ✓ | | | | 100.000 | 100.000 | |

## Demand Set Details

| Name | Scenario Name | Time Period Name | Description | Traffic Profile Type | Model Start Time (HH:mm) | Model Finish Time (HH:mm) | Model Time Period Length (min) | Time Segment Length (min) | Results For Central Hour Only | Single Time Segment Only | Locked | Run Automatically | Use Relationship | Relationship |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2040, PM | 2040 | PM | | ONE HOUR | 16:00 | 17:30 | 90 | 15 | | | | ✓ | | |

# Intersection Network

## Intersections

| Intersection | Name | Intersection Type | Leg Order | Grade Separated | Large Roundabout | Do Geometric Delay | Intersection Delay (s) | Intersection LOS |
|---|---|---|---|---|---|---|---|---|
| 1 | (untitled) | Roundabout | North,West,East | | | | 3.56 | A |

## Intersection Network Options

| Driving Side | Lighting |
|---|---|
| Right | Normal/unknown |

# Legs

## Legs

| Leg | Leg | Name | Description |
|---|---|---|---|
| **North** | North | Stickel St | |
| **West** | West | County Road 25 | |
| **East** | East | County Road 25 | |

## Capacity Options

| Leg | Minimum Capacity (PCE/hr) | Maximum Capacity (PCE/hr) | Assume Flat Start Profile | Initial Queue (PCE) |
|---|---|---|---|---|
| **North** | 0.00 | 99999.00 | | 0.00 |
| **West** | 0.00 | 99999.00 | | 0.00 |
| **East** | 0.00 | 99999.00 | | 0.00 |

## Roundabout Geometry

| Leg | V - Approach road half-width (m) | E - Entry width (m) | l' - Effective flare length (m) | R - Entry radius (m) | D - Inscribed circle diameter (m) | PHI - Conflict (entry) angle (deg) | Exit Only |
|---|---|---|---|---|---|---|---|
| **North** | 3.50 | 4.50 | 30.00 | 20.00 | 40.00 | 25.00 | |
| **West** | 3.50 | 4.50 | 30.00 | 20.00 | 40.00 | 25.00 | |
| **East** | 3.50 | 4.50 | 30.00 | 20.00 | 40.00 | 25.00 | |

## Slope / Intercept / Capacity

### Roundabout Slope and Intercept used in model

| Leg | Enter slope and intercept directly | Entered slope | Entered intercept (PCE/hr) | Final Slope | Final Intercept (PCE/hr) |
|---|---|---|---|---|---|
| **North** | | (calculated) | (calculated) | 0.579 | 1357.445 |
| **West** | | (calculated) | (calculated) | 0.579 | 1357.445 |
| **East** | | (calculated) | (calculated) | 0.579 | 1357.445 |

*The slope and intercept shown above include any corrections and adjustments.*

# Traffic Flows

## Demand Set Data Options

| Default Vehicle Mix | Vehicle Mix Varies Over Time | Vehicle Mix Varies Over Turn | Vehicle Mix Varies Over Entry | Vehicle Mix Source | PCE Factor for a Truck (PCE) | Default Turning Proportions | Estimate from entry/exit counts | Turning Proportions Vary Over Time | Turning Proportions Vary Over Turn | Turning Proportions Vary Over Entry |
|---|---|---|---|---|---|---|---|---|---|---|
| | | ✓ | ✓ | Truck Percentages | 2.00 | | | | ✓ | ✓ |

# Entry Flows

## General Flows Data

| Leg | Profile Type | Use Turning Counts | Average Demand Flow (PCE/hr) | Flow Scaling Factor (%) |
|---|---|---|---|---|
| **North** | ONE HOUR | ✓ | 13.00 | 100.000 |
| **West** | ONE HOUR | ✓ | 355.00 | 100.000 |
| **East** | ONE HOUR | ✓ | 246.00 | 100.000 |

# Turning Proportions

### Turning Counts / Proportions (PCE/hr) - Intersection 1 (for whole period)

| | | To | | |
|---|---|---|---|---|
| | | North | West | East |
| From | North | 0.000 | 3.000 | 10.000 |
| | West | 5.000 | 0.000 | 350.000 |
| | East | 17.000 | 229.000 | 0.000 |

### Turning Proportions (PCE) - Intersection 1 (for whole period)

| | | To | | |
|---|---|---|---|---|
| | | North | West | East |
| From | North | 0.00 | 0.23 | 0.77 |
| | West | 0.01 | 0.00 | 0.99 |
| | East | 0.07 | 0.93 | 0.00 |

# Vehicle Mix

### Average PCE Per Vehicle - Intersection 1 (for whole period)

| | | To | | |
|---|---|---|---|---|
| | | North | West | East |
| From | North | 1.000 | 1.000 | 1.000 |
| | West | 1.000 | 1.000 | 1.000 |
| | East | 1.000 | 1.000 | 1.000 |

### Truck Percentages - Intersection 1 (for whole period)

| | | To | | |
|---|---|---|---|---|
| | | North | West | East |
| From | North | 0.0 | 0.0 | 0.0 |
| | West | 0.0 | 0.0 | 0.0 |
| | East | 0.0 | 0.0 | 0.0 |

# Results

## Results Summary for whole modelled period

| Leg | Max V/C Ratio | Max Delay (s) | Max Queue (PCE) | Max 95th percentile Queue (PCE) | Max LOS | Average Demand (PCE/hr) | Total Intersection Arrivals (PCE) | Total Queueing Delay (PCE-min) | Average Queueing Delay (s) | Rate Of Queueing Delay (PCE-min/min) | Inclusive Total Queueing Delay (PCE-min) | Inclusive Average Queueing Delay (s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **North** | 0.01 | 3.01 | 0.01 | ~1 | A | 11.93 | 17.89 | 0.88 | 2.94 | 0.01 | 0.88 | 2.94 |
| **West** | 0.29 | 3.75 | 0.41 | ~1 | A | 325.75 | 488.63 | 28.69 | 3.52 | 0.32 | 28.69 | 3.52 |
| **East** | 0.20 | 3.32 | 0.25 | ~1 | A | 225.73 | 338.60 | 18.01 | 3.19 | 0.20 | 18.01 | 3.19 |

## Main Results for each time segment

### Main results: (16:00-16:15)

| Leg | Total Demand (PCE/hr) | Intersection Arrivals (PCE) | Entry Flow (PCE/hr) | Exit Flow (PCE/hr) | Circulating Flow (PCE/hr) | Pedestrian Demand (Ped/hr) | Capacity (PCE/hr) | Saturation Capacity (PCE/hr) | V/C Ratio | Start Queue (PCE) | End Queue (PCE) | Delay (s) | LOS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **North** | 9.79 | 2.45 | 9.76 | 16.51 | 171.82 | 0.00 | 1258.00 | 630.83 | 0.008 | 0.00 | 0.01 | 2.883 | A |
| **West** | 267.26 | 66.82 | 266.28 | 174.07 | 7.50 | 0.00 | 1353.10 | 1076.60 | 0.198 | 0.00 | 0.25 | 3.309 | A |
| **East** | 185.20 | 46.30 | 184.57 | 270.04 | 3.75 | 0.00 | 1355.27 | 1348.67 | 0.137 | 0.00 | 0.16 | 3.073 | A |

### Main results: (16:15-16:30)

| Leg | Total Demand (PCE/hr) | Intersection Arrivals (PCE) | Entry Flow (PCE/hr) | Exit Flow (PCE/hr) | Circulating Flow (PCE/hr) | Pedestrian Demand (Ped/hr) | Capacity (PCE/hr) | Saturation Capacity (PCE/hr) | V/C Ratio | Start Queue (PCE) | End Queue (PCE) | Delay (s) | LOS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **North** | 11.69 | 2.92 | 11.68 | 19.76 | 205.73 | 0.00 | 1238.38 | 630.83 | 0.009 | 0.01 | 0.01 | 2.934 | A |
| **West** | 319.14 | 79.78 | 318.89 | 208.43 | 8.98 | 0.00 | 1352.25 | 1076.60 | 0.236 | 0.25 | 0.31 | 3.483 | A |
| **East** | 221.15 | 55.29 | 221.00 | 323.38 | 4.49 | 0.00 | 1354.85 | 1348.67 | 0.163 | 0.16 | 0.19 | 3.174 | A |

### Main results: (16:30-16:45)

| Leg | Total Demand (PCE/hr) | Intersection Arrivals (PCE) | Entry Flow (PCE/hr) | Exit Flow (PCE/hr) | Circulating Flow (PCE/hr) | Pedestrian Demand (Ped/hr) | Capacity (PCE/hr) | Saturation Capacity (PCE/hr) | V/C Ratio | Start Queue (PCE) | End Queue (PCE) | Delay (s) | LOS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **North** | 14.31 | 3.58 | 14.30 | 24.20 | 251.93 | 0.00 | 1211.64 | 630.83 | 0.012 | 0.01 | 0.01 | 3.006 | A |
| **West** | 390.86 | 97.72 | 390.47 | 255.23 | 11.00 | 0.00 | 1351.08 | 1076.60 | 0.289 | 0.31 | 0.40 | 3.745 | A |
| **East** | 270.85 | 67.71 | 270.63 | 395.98 | 5.50 | 0.00 | 1354.26 | 1348.67 | 0.200 | 0.19 | 0.25 | 3.322 | A |

### Main results: (16:45-17:00)

| Leg | Total Demand (PCE/hr) | Intersection Arrivals (PCE) | Entry Flow (PCE/hr) | Exit Flow (PCE/hr) | Circulating Flow (PCE/hr) | Pedestrian Demand (Ped/hr) | Capacity (PCE/hr) | Saturation Capacity (PCE/hr) | V/C Ratio | Start Queue (PCE) | End Queue (PCE) | Delay (s) | LOS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **North** | 14.31 | 3.58 | 14.31 | 24.22 | 252.13 | 0.00 | 1211.52 | 630.83 | 0.012 | 0.01 | 0.01 | 3.006 | A |
| **West** | 390.86 | 97.72 | 390.86 | 255.43 | 11.01 | 0.00 | 1351.07 | 1076.60 | 0.289 | 0.40 | 0.41 | 3.748 | A |
| **East** | 270.85 | 67.71 | 270.85 | 396.36 | 5.51 | 0.00 | 1354.26 | 1348.67 | 0.200 | 0.25 | 0.25 | 3.322 | A |

### Main results: (17:00-17:15)

| Leg | Total Demand (PCE/hr) | Intersection Arrivals (PCE) | Entry Flow (PCE/hr) | Exit Flow (PCE/hr) | Circulating Flow (PCE/hr) | Pedestrian Demand (Ped/hr) | Capacity (PCE/hr) | Saturation Capacity (PCE/hr) | V/C Ratio | Start Queue (PCE) | End Queue (PCE) | Delay (s) | LOS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **North** | 11.69 | 2.92 | 11.70 | 19.80 | 206.07 | 0.00 | 1238.18 | 630.83 | 0.009 | 0.01 | 0.01 | 2.936 | A |
| **West** | 319.14 | 79.78 | 319.52 | 208.76 | 9.00 | 0.00 | 1352.24 | 1076.60 | 0.236 | 0.41 | 0.31 | 3.489 | A |
| **East** | 221.15 | 55.29 | 221.36 | 324.02 | 4.50 | 0.00 | 1354.84 | 1348.67 | 0.163 | 0.25 | 0.20 | 3.178 | A |

### Main results: (17:15-17:30)

| Leg | Total Demand (PCE/hr) | Intersection Arrivals (PCE) | Entry Flow (PCE/hr) | Exit Flow (PCE/hr) | Circulating Flow (PCE/hr) | Pedestrian Demand (Ped/hr) | Capacity (PCE/hr) | Saturation Capacity (PCE/hr) | V/C Ratio | Start Queue (PCE) | End Queue (PCE) | Delay (s) | LOS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **North** | 9.79 | 2.45 | 9.79 | 16.58 | 172.54 | 0.00 | 1257.59 | 630.83 | 0.008 | 0.01 | 0.01 | 2.886 | A |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **West** | 267.26 | 66.82 | 267.52 | 174.80 | 7.53 | 0.00 | 1353.08 | 1076.60 | 0.198 | 0.31 | 0.25 | 3.316 | A |
| **East** | 185.20 | 46.30 | 185.35 | 271.28 | 3.77 | 0.00 | 1355.26 | 1348.67 | 0.137 | 0.20 | 0.16 | 3.079 | A |

## Queueing Delay Results for each time segment

### Queueing Delay results: (16:00-16:15)

| Leg | Queueing Total Delay (PCE-min) | Queueing Rate Of Delay (PCE-min/min) | Average Delay Per Arriving Vehicle (s) | Unsignalised Level Of Service | Signalised Level Of Service |
|---|---|---|---|---|---|
| **North** | 0.12 | 0.01 | 2.883 | A | A |
| **West** | 3.60 | 0.24 | 3.309 | A | A |
| **East** | 2.32 | 0.15 | 3.073 | A | A |

### Queueing Delay results: (16:15-16:30)

| Leg | Queueing Total Delay (PCE-min) | Queueing Rate Of Delay (PCE-min/min) | Average Delay Per Arriving Vehicle (s) | Unsignalised Level Of Service | Signalised Level Of Service |
|---|---|---|---|---|---|
| **North** | 0.14 | 0.01 | 2.934 | A | A |
| **West** | 4.55 | 0.30 | 3.483 | A | A |
| **East** | 2.88 | 0.19 | 3.174 | A | A |

### Queueing Delay results: (16:30-16:45)

| Leg | Queueing Total Delay (PCE-min) | Queueing Rate Of Delay (PCE-min/min) | Average Delay Per Arriving Vehicle (s) | Unsignalised Level Of Service | Signalised Level Of Service |
|---|---|---|---|---|---|
| **North** | 0.18 | 0.01 | 3.006 | A | A |
| **West** | 5.97 | 0.40 | 3.745 | A | A |
| **East** | 3.68 | 0.25 | 3.322 | A | A |

### Queueing Delay results: (16:45-17:00)

| Leg | Queueing Total Delay (PCE-min) | Queueing Rate Of Delay (PCE-min/min) | Average Delay Per Arriving Vehicle (s) | Unsignalised Level Of Service | Signalised Level Of Service |
|---|---|---|---|---|---|
| **North** | 0.18 | 0.01 | 3.006 | A | A |
| **West** | 6.08 | 0.41 | 3.748 | A | A |
| **East** | 3.74 | 0.25 | 3.322 | A | A |

### Queueing Delay results: (17:00-17:15)

| Leg | Queueing Total Delay (PCE-min) | Queueing Rate Of Delay (PCE-min/min) | Average Delay Per Arriving Vehicle (s) | Unsignalised Level Of Service | Signalised Level Of Service |
|---|---|---|---|---|---|
| **North** | 0.14 | 0.01 | 2.936 | A | A |
| **West** | 4.73 | 0.32 | 3.489 | A | A |
| **East** | 2.98 | 0.20 | 3.178 | A | A |

### Queueing Delay results: (17:15-17:30)

| Leg | Queueing Total Delay (PCE-min) | Queueing Rate Of Delay (PCE-min/min) | Average Delay Per Arriving Vehicle (s) | Unsignalised Level Of Service | Signalised Level Of Service |
|---|---|---|---|---|---|
| **North** | 0.12 | 0.01 | 2.886 | A | A |
| **West** | 3.76 | 0.25 | 3.316 | A | A |
| **East** | 2.41 | 0.16 | 3.079 | A | A |

## Queue Variation Results for each time segment

### Queue Variation results: (16:00-16:15)

| Leg | Mean (PCE) | Q05 (PCE) | Q50 (PCE) | Q90 (PCE) | Q95 (PCE) | Percentile Message | Marker Message | Probability Of Reaching Or Exceeding Marker | Probability Of Exactly Reaching Marker |
|---|---|---|---|---|---|---|---|---|---|
| **North** | 0.01 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **West** | 0.25 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **East** | 0.16 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |

### Queue Variation results: (16:15-16:30)

| Leg | Mean (PCE) | Q05 (PCE) | Q50 (PCE) | Q90 (PCE) | Q95 (PCE) | Percentile Message | Marker Message | Probability Of Reaching Or Exceeding Marker | Probability Of Exactly Reaching Marker |
|---|---|---|---|---|---|---|---|---|---|
| **North** | 0.01 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **West** | 0.31 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **East** | 0.19 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |

## Queue Variation results: (16:30-16:45)

| Leg | Mean (PCE) | Q05 (PCE) | Q50 (PCE) | Q90 (PCE) | Q95 (PCE) | Percentile Message | Marker Message | Probability Of Reaching Or Exceeding Marker | Probability Of Exactly Reaching Marker |
|---|---|---|---|---|---|---|---|---|---|
| **North** | 0.01 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **West** | 0.40 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **East** | 0.25 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |

## Queue Variation results: (16:45-17:00)

| Leg | Mean (PCE) | Q05 (PCE) | Q50 (PCE) | Q90 (PCE) | Q95 (PCE) | Percentile Message | Marker Message | Probability Of Reaching Or Exceeding Marker | Probability Of Exactly Reaching Marker |
|---|---|---|---|---|---|---|---|---|---|
| **North** | 0.01 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **West** | 0.41 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **East** | 0.25 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |

## Queue Variation results: (17:00-17:15)

| Leg | Mean (PCE) | Q05 (PCE) | Q50 (PCE) | Q90 (PCE) | Q95 (PCE) | Percentile Message | Marker Message | Probability Of Reaching Or Exceeding Marker | Probability Of Exactly Reaching Marker |
|---|---|---|---|---|---|---|---|---|---|
| **North** | 0.01 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **West** | 0.31 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **East** | 0.20 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |

## Queue Variation results: (17:15-17:30)

| Leg | Mean (PCE) | Q05 (PCE) | Q50 (PCE) | Q90 (PCE) | Q95 (PCE) | Percentile Message | Marker Message | Probability Of Reaching Or Exceeding Marker | Probability Of Exactly Reaching Marker |
|---|---|---|---|---|---|---|---|---|---|
| **North** | 0.01 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **West** | 0.25 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **East** | 0.16 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |

# Junctions 8

## ARCADY 8 - Roundabout Module

Version: 8.0.6.541 [19821,26/11/2015]

For sales and distribution information, program advice and maintenance, contact TRL:
Tel: +44 (0)1344 770758 email: software@trl.co.uk Web: http://www.trlsoftware.co.uk

**Filename:** 25 and Stickel - 2 lane.arc8
**Path:** C:\Users\AdamMorrison\Paradigm\Projects - (190077) CoBruce - Bruce Road 25 EA\2 Forecasting Analysis\Arcady
**Report generation date:** 2019-08-01 6:45:47 PM

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## Summary of intersection performance

| | PM | | | | | |
|---|---|---|---|---|---|---|
| | **Queue (PCE)** | **Delay (s)** | **V/C Ratio** | **LOS** | **Intersection Delay (s)** | **Intersection LOS** |
| | A1 - 2040 | | | | | |
| **Leg North** | 0.01 | 2.97 | 0.01 | A | 1.75 | A |
| **Leg West** | 0.19 | 1.77 | 0.16 | A | | |
| **Leg East** | 0.13 | 1.66 | 0.11 | A | | |

*Values shown are the maximum values over all time segments. Delay is the maximum value of average delay per arriving vehicle. Intersection LOS and Intersection Delay are demand-weighted averages.*

*"D1 - 2040, PM " model duration: 4:00 PM - 5:30 PM*

*Run using Junctions 8.0.6.541 at 2019-08-01 6:45:47 PM*

## File summary

| | |
|---|---|
| **Title** | (untitled) |
| **Location** | |
| **Site Number** | |
| **Date** | 2019-08-01 |
| **Version** | |
| **Status** | (new file) |
| **Identifier** | |
| **Client** | |
| **Jobnumber** | |
| **Analyst** | AdamMorrison |
| **Description** | |

## Analysis Options

| Vehicle Length (m) | Do Queue Variations | Calculate Residual Capacity | Residual Capacity Criteria Type | V/C Ratio Threshold | Average Delay Threshold (s) | Queue Threshold (PCE) |
|---|---|---|---|---|---|---|
| 5.75 | ✓ | | N/A | 0.85 | 36.00 | 20.00 |

## Units

| Distance Units | Speed Units | Traffic Units Input | Traffic Units Results | Flow Units | Average Delay Units | Total Delay Units | Rate Of Delay Units |
|---|---|---|---|---|---|---|---|
| m | kph | PCE | PCE | perHour | s | -Min | perMin |

# (Default Analysis Set) - 2040, PM

## Data Errors and Warnings

*No errors or warnings*

## Analysis Set Details

| Name | Roundabout Capacity Model | Description | Include In Report | Use Specific Demand Set(s) | Specific Demand Set (s) | Locked | Network Flow Scaling Factor (%) | Network Capacity Scaling Factor (%) | Reason For Scaling Factors |
|---|---|---|---|---|---|---|---|---|---|
| (Default Analysis Set) | ARCADY | | ✓ | | | | 100.000 | 100.000 | |

## Demand Set Details

| Name | Scenario Name | Time Period Name | Description | Traffic Profile Type | Model Start Time (HH:mm) | Model Finish Time (HH:mm) | Model Time Period Length (min) | Time Segment Length (min) | Results For Central Hour Only | Single Time Segment Only | Locked | Run Automatically | Use Relationship | Relationship |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2040, PM | 2040 | PM | | ONE HOUR | 16:00 | 17:30 | 90 | 15 | | | | ✓ | | |

# Intersection Network

## Intersections

| Intersection | Name | Intersection Type | Leg Order | Grade Separated | Large Roundabout | Do Geometric Delay | Intersection Delay (s) | Intersection LOS |
|---|---|---|---|---|---|---|---|---|
| 1 | (untitled) | Roundabout | North,West,East | | | | 1.75 | A |

## Intersection Network Options

| Driving Side | Lighting |
|---|---|
| Right | Normal/unknown |

# Legs

## Legs

| Leg | Leg | Name | Description |
|---|---|---|---|
| **North** | North | Stickel St | |
| **West** | West | County Road 25 | |
| **East** | East | County Road 25 | |

## Capacity Options

| Leg | Minimum Capacity (PCE/hr) | Maximum Capacity (PCE/hr) | Assume Flat Start Profile | Initial Queue (PCE) |
|---|---|---|---|---|
| **North** | 0.00 | 99999.00 | | 0.00 |
| **West** | 0.00 | 99999.00 | | 0.00 |
| **East** | 0.00 | 99999.00 | | 0.00 |

## Roundabout Geometry

| Leg | V - Approach road half-width (m) | E - Entry width (m) | l' - Effective flare length (m) | R - Entry radius (m) | D - Inscribed circle diameter (m) | PHI - Conflict (entry) angle (deg) | Exit Only |
|---|---|---|---|---|---|---|---|
| **North** | 3.50 | 4.50 | 30.00 | 20.00 | 55.00 | 25.00 | |
| **West** | 7.00 | 8.00 | 30.00 | 20.00 | 55.00 | 25.00 | |
| **East** | 7.00 | 8.00 | 30.00 | 20.00 | 55.00 | 25.00 | |

## Slope / Intercept / Capacity

### Roundabout Slope and Intercept used in model

| Leg | Enter slope and intercept directly | Entered slope | Entered intercept (PCE/hr) | Final Slope | Final Intercept (PCE/hr) |
|---|---|---|---|---|---|
| **North** | | (calculated) | (calculated) | 0.527 | 1357.445 |
| **West** | | (calculated) | (calculated) | 0.723 | 2436.345 |
| **East** | | (calculated) | (calculated) | 0.723 | 2436.345 |

*The slope and intercept shown above include any corrections and adjustments.*

# Traffic Flows

## Demand Set Data Options

| Default Vehicle Mix | Vehicle Mix Varies Over Time | Vehicle Mix Varies Over Turn | Vehicle Mix Varies Over Entry | Vehicle Mix Source | PCE Factor for a Truck (PCE) | Default Turning Proportions | Estimate from entry/exit counts | Turning Proportions Vary Over Time | Turning Proportions Vary Over Turn | Turning Proportions Vary Over Entry |
|---|---|---|---|---|---|---|---|---|---|---|
| | | ✓ | ✓ | Truck Percentages | 2.00 | | | | ✓ | ✓ |

# Entry Flows

## General Flows Data

| Leg | Profile Type | Use Turning Counts | Average Demand Flow (PCE/hr) | Flow Scaling Factor (%) |
|---|---|---|---|---|
| **North** | ONE HOUR | ✓ | 13.00 | 100.000 |
| **West** | ONE HOUR | ✓ | 355.00 | 100.000 |
| **East** | ONE HOUR | ✓ | 246.00 | 100.000 |

# Turning Proportions

### Turning Counts / Proportions (PCE/hr) - Intersection 1 (for whole period)

| | | To | | |
|---|---|---|---|---|
| | | **North** | **West** | **East** |
| **From** | **North** | 0.000 | 3.000 | 10.000 |
| | **West** | 5.000 | 0.000 | 350.000 |
| | **East** | 17.000 | 229.000 | 0.000 |

### Turning Proportions (PCE) - Intersection 1 (for whole period)

| | | To | | |
|---|---|---|---|---|
| | | **North** | **West** | **East** |
| **From** | **North** | 0.00 | 0.23 | 0.77 |
| | **West** | 0.01 | 0.00 | 0.99 |
| | **East** | 0.07 | 0.93 | 0.00 |

# Vehicle Mix

### Average PCE Per Vehicle - Intersection 1 (for whole period)

| | | To | | |
|---|---|---|---|---|
| | | **North** | **West** | **East** |
| **From** | **North** | 1.000 | 1.000 | 1.000 |
| | **West** | 1.000 | 1.000 | 1.000 |
| | **East** | 1.000 | 1.000 | 1.000 |

### Truck Percentages - Intersection 1 (for whole period)

| | | To | | |
|---|---|---|---|---|
| | | **North** | **West** | **East** |
| **From** | **North** | 0.0 | 0.0 | 0.0 |
| | **West** | 0.0 | 0.0 | 0.0 |
| | **East** | 0.0 | 0.0 | 0.0 |

# Results

## Results Summary for whole modelled period

| Leg | Max V/C Ratio | Max Delay (s) | Max Queue (PCE) | Max 95th percentile Queue (PCE) | Max LOS | Average Demand (PCE/hr) | Total Intersection Arrivals (PCE) | Total Queueing Delay (PCE-min) | Average Queueing Delay (s) | Rate Of Queueing Delay (PCE-min/min) | Inclusive Total Queueing Delay (PCE-min) | Inclusive Average Queueing Delay (s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **North** | 0.01 | 2.97 | 0.01 | ~1 | A | 11.93 | 17.89 | 0.87 | 2.91 | 0.01 | 0.87 | 2.91 |
| **West** | 0.16 | 1.77 | 0.19 | ~1 | A | 325.75 | 488.63 | 13.96 | 1.71 | 0.16 | 13.96 | 1.71 |
| **East** | 0.11 | 1.66 | 0.13 | ~1 | A | 225.73 | 338.60 | 9.21 | 1.63 | 0.10 | 9.21 | 1.63 |

## Main Results for each time segment

### Main results: (16:00-16:15)

| Leg | Total Demand (PCE/hr) | Intersection Arrivals (PCE) | Entry Flow (PCE/hr) | Exit Flow (PCE/hr) | Circulating Flow (PCE/hr) | Pedestrian Demand (Ped/hr) | Capacity (PCE/hr) | Saturation Capacity (PCE/hr) | V/C Ratio | Start Queue (PCE) | End Queue (PCE) | Delay (s) | LOS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **North** | 9.79 | 2.45 | 9.76 | 16.53 | 172.10 | 0.00 | 1266.77 | 174.22 | 0.008 | 0.00 | 0.01 | 2.863 | A |
| **West** | 267.26 | 66.82 | 266.77 | 174.35 | 7.50 | 0.00 | 2430.92 | 2339.46 | 0.110 | 0.00 | 0.12 | 1.663 | A |
| **East** | 185.20 | 46.30 | 184.87 | 270.52 | 3.76 | 0.00 | 2433.63 | 2412.52 | 0.076 | 0.00 | 0.08 | 1.600 | A |

### Main results: (16:15-16:30)

| Leg | Total Demand (PCE/hr) | Intersection Arrivals (PCE) | Entry Flow (PCE/hr) | Exit Flow (PCE/hr) | Circulating Flow (PCE/hr) | Pedestrian Demand (Ped/hr) | Capacity (PCE/hr) | Saturation Capacity (PCE/hr) | V/C Ratio | Start Queue (PCE) | End Queue (PCE) | Delay (s) | LOS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **North** | 11.69 | 2.92 | 11.68 | 19.77 | 205.80 | 0.00 | 1249.02 | 174.22 | 0.009 | 0.01 | 0.01 | 2.908 | A |
| **West** | 319.14 | 79.78 | 319.03 | 208.50 | 8.98 | 0.00 | 2429.85 | 2339.46 | 0.131 | 0.12 | 0.15 | 1.704 | A |
| **East** | 221.15 | 55.29 | 221.08 | 323.52 | 4.49 | 0.00 | 2433.10 | 2412.52 | 0.091 | 0.08 | 0.10 | 1.626 | A |

### Main results: (16:30-16:45)

| Leg | Total Demand (PCE/hr) | Intersection Arrivals (PCE) | Entry Flow (PCE/hr) | Exit Flow (PCE/hr) | Circulating Flow (PCE/hr) | Pedestrian Demand (Ped/hr) | Capacity (PCE/hr) | Saturation Capacity (PCE/hr) | V/C Ratio | Start Queue (PCE) | End Queue (PCE) | Delay (s) | LOS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **North** | 14.31 | 3.58 | 14.30 | 24.21 | 252.04 | 0.00 | 1224.66 | 174.22 | 0.012 | 0.01 | 0.01 | 2.973 | A |
| **West** | 390.86 | 97.72 | 390.70 | 255.34 | 11.00 | 0.00 | 2428.39 | 2339.46 | 0.161 | 0.15 | 0.19 | 1.765 | A |
| **East** | 270.85 | 67.71 | 270.75 | 396.20 | 5.50 | 0.00 | 2432.37 | 2412.52 | 0.111 | 0.10 | 0.13 | 1.664 | A |

### Main results: (16:45-17:00)

| Leg | Total Demand (PCE/hr) | Intersection Arrivals (PCE) | Entry Flow (PCE/hr) | Exit Flow (PCE/hr) | Circulating Flow (PCE/hr) | Pedestrian Demand (Ped/hr) | Capacity (PCE/hr) | Saturation Capacity (PCE/hr) | V/C Ratio | Start Queue (PCE) | End Queue (PCE) | Delay (s) | LOS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **North** | 14.31 | 3.58 | 14.31 | 24.22 | 252.13 | 0.00 | 1224.61 | 174.22 | 0.012 | 0.01 | 0.01 | 2.973 | A |
| **West** | 390.86 | 97.72 | 390.86 | 255.44 | 11.01 | 0.00 | 2428.39 | 2339.46 | 0.161 | 0.19 | 0.19 | 1.765 | A |
| **East** | 270.85 | 67.71 | 270.85 | 396.37 | 5.51 | 0.00 | 2432.36 | 2412.52 | 0.111 | 0.13 | 0.13 | 1.664 | A |

### Main results: (17:00-17:15)

| Leg | Total Demand (PCE/hr) | Intersection Arrivals (PCE) | Entry Flow (PCE/hr) | Exit Flow (PCE/hr) | Circulating Flow (PCE/hr) | Pedestrian Demand (Ped/hr) | Capacity (PCE/hr) | Saturation Capacity (PCE/hr) | V/C Ratio | Start Queue (PCE) | End Queue (PCE) | Delay (s) | LOS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **North** | 11.69 | 2.92 | 11.70 | 19.79 | 205.96 | 0.00 | 1248.93 | 174.22 | 0.009 | 0.01 | 0.01 | 2.911 | A |
| **West** | 319.14 | 79.78 | 319.30 | 208.66 | 9.00 | 0.00 | 2429.84 | 2339.46 | 0.131 | 0.19 | 0.15 | 1.707 | A |
| **East** | 221.15 | 55.29 | 221.25 | 323.80 | 4.50 | 0.00 | 2433.09 | 2412.52 | 0.091 | 0.13 | 0.10 | 1.629 | A |

### Main results: (17:15-17:30)

| Leg | Total Demand (PCE/hr) | Intersection Arrivals (PCE) | Entry Flow (PCE/hr) | Exit Flow (PCE/hr) | Circulating Flow (PCE/hr) | Pedestrian Demand (Ped/hr) | Capacity (PCE/hr) | Saturation Capacity (PCE/hr) | V/C Ratio | Start Queue (PCE) | End Queue (PCE) | Delay (s) | LOS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **North** | 9.79 | 2.45 | 9.79 | 16.57 | 172.47 | 0.00 | 1266.58 | 174.22 | 0.008 | 0.01 | 0.01 | 2.863 | A |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **West** | 267.26 | 66.82 | 267.37 | 174.73 | 7.53 | 0.00 | 2430.90 | 2339.46 | 0.110 | 0.15 | 0.12 | 1.665 | A |
| **East** | 185.20 | 46.30 | 185.27 | 271.14 | 3.77 | 0.00 | 2433.62 | 2412.52 | 0.076 | 0.10 | 0.08 | 1.602 | A |

## Queueing Delay Results for each time segment

### Queueing Delay results: (16:00-16:15)

| Leg | Queueing Total Delay (PCE-min) | Queueing Rate Of Delay (PCE-min/min) | Average Delay Per Arriving Vehicle (s) | Unsignalised Level Of Service | Signalised Level Of Service |
|---|---|---|---|---|---|
| **North** | 0.11 | 0.01 | 2.863 | A | A |
| **West** | 1.83 | 0.12 | 1.663 | A | A |
| **East** | 1.22 | 0.08 | 1.600 | A | A |

### Queueing Delay results: (16:15-16:30)

| Leg | Queueing Total Delay (PCE-min) | Queueing Rate Of Delay (PCE-min/min) | Average Delay Per Arriving Vehicle (s) | Unsignalised Level Of Service | Signalised Level Of Service |
|---|---|---|---|---|---|
| **North** | 0.14 | 0.01 | 2.908 | A | A |
| **West** | 2.25 | 0.15 | 1.704 | A | A |
| **East** | 1.49 | 0.10 | 1.626 | A | A |

### Queueing Delay results: (16:30-16:45)

| Leg | Queueing Total Delay (PCE-min) | Queueing Rate Of Delay (PCE-min/min) | Average Delay Per Arriving Vehicle (s) | Unsignalised Level Of Service | Signalised Level Of Service |
|---|---|---|---|---|---|
| **North** | 0.17 | 0.01 | 2.973 | A | A |
| **West** | 2.85 | 0.19 | 1.765 | A | A |
| **East** | 1.86 | 0.12 | 1.664 | A | A |

### Queueing Delay results: (16:45-17:00)

| Leg | Queueing Total Delay (PCE-min) | Queueing Rate Of Delay (PCE-min/min) | Average Delay Per Arriving Vehicle (s) | Unsignalised Level Of Service | Signalised Level Of Service |
|---|---|---|---|---|---|
| **North** | 0.18 | 0.01 | 2.973 | A | A |
| **West** | 2.87 | 0.19 | 1.765 | A | A |
| **East** | 1.88 | 0.13 | 1.664 | A | A |

### Queueing Delay results: (17:00-17:15)

| Leg | Queueing Total Delay (PCE-min) | Queueing Rate Of Delay (PCE-min/min) | Average Delay Per Arriving Vehicle (s) | Unsignalised Level Of Service | Signalised Level Of Service |
|---|---|---|---|---|---|
| **North** | 0.14 | 0.01 | 2.911 | A | A |
| **West** | 2.29 | 0.15 | 1.707 | A | A |
| **East** | 1.51 | 0.10 | 1.629 | A | A |

### Queueing Delay results: (17:15-17:30)

| Leg | Queueing Total Delay (PCE-min) | Queueing Rate Of Delay (PCE-min/min) | Average Delay Per Arriving Vehicle (s) | Unsignalised Level Of Service | Signalised Level Of Service |
|---|---|---|---|---|---|
| **North** | 0.12 | 0.01 | 2.863 | A | A |
| **West** | 1.87 | 0.12 | 1.665 | A | A |
| **East** | 1.25 | 0.08 | 1.602 | A | A |

## Queue Variation Results for each time segment

### Queue Variation results: (16:00-16:15)

| Leg | Mean (PCE) | Q05 (PCE) | Q50 (PCE) | Q90 (PCE) | Q95 (PCE) | Percentile Message | Marker Message | Probability Of Reaching Or Exceeding Marker | Probability Of Exactly Reaching Marker |
|---|---|---|---|---|---|---|---|---|---|
| **North** | 0.01 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **West** | 0.12 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **East** | 0.08 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |

### Queue Variation results: (16:15-16:30)

| Leg | Mean (PCE) | Q05 (PCE) | Q50 (PCE) | Q90 (PCE) | Q95 (PCE) | Percentile Message | Marker Message | Probability Of Reaching Or Exceeding Marker | Probability Of Exactly Reaching Marker |
|---|---|---|---|---|---|---|---|---|---|
| **North** | 0.01 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **West** | 0.15 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **East** | 0.10 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |

## Queue Variation results: (16:30-16:45)

| Leg | Mean (PCE) | Q05 (PCE) | Q50 (PCE) | Q90 (PCE) | Q95 (PCE) | Percentile Message | Marker Message | Probability Of Reaching Or Exceeding Marker | Probability Of Exactly Reaching Marker |
|---|---|---|---|---|---|---|---|---|---|
| **North** | 0.01 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **West** | 0.19 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **East** | 0.13 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |

## Queue Variation results: (16:45-17:00)

| Leg | Mean (PCE) | Q05 (PCE) | Q50 (PCE) | Q90 (PCE) | Q95 (PCE) | Percentile Message | Marker Message | Probability Of Reaching Or Exceeding Marker | Probability Of Exactly Reaching Marker |
|---|---|---|---|---|---|---|---|---|---|
| **North** | 0.01 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **West** | 0.19 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **East** | 0.13 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |

## Queue Variation results: (17:00-17:15)

| Leg | Mean (PCE) | Q05 (PCE) | Q50 (PCE) | Q90 (PCE) | Q95 (PCE) | Percentile Message | Marker Message | Probability Of Reaching Or Exceeding Marker | Probability Of Exactly Reaching Marker |
|---|---|---|---|---|---|---|---|---|---|
| **North** | 0.01 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **West** | 0.15 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **East** | 0.10 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |

## Queue Variation results: (17:15-17:30)

| Leg | Mean (PCE) | Q05 (PCE) | Q50 (PCE) | Q90 (PCE) | Q95 (PCE) | Percentile Message | Marker Message | Probability Of Reaching Or Exceeding Marker | Probability Of Exactly Reaching Marker |
|---|---|---|---|---|---|---|---|---|---|
| **North** | 0.01 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **West** | 0.12 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **East** | 0.08 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |

# Alternative 4

# Future Intersection of Bruce Road 25 and Ridge Street

| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|---|---|---|---|---|---|---|
| Lane Configurations | | ↰ | ↱ | | ↲↳ | |
| Traffic Volume (veh/h) | 0 | 51 | 43 | 21 | 13 | 0 |
| Future Volume (Veh/h) | 0 | 51 | 43 | 21 | 13 | 0 |
| Sign Control | | Free | Free | | Stop | |
| Grade | | 0% | 0% | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 0 | 55 | 47 | 23 | 14 | 0 |
| Pedestrians | | | | | | |
| Lane Width (m) | | | | | | |
| Walking Speed (m/s) | | | | | | |
| Percent Blockage | | | | | | |
| Right turn flare (veh) | | | | | | |
| Median type | | None | None | | | |
| Median storage veh) | | | | | | |
| Upstream signal (m) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 70 | | | | 114 | 58 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 70 | | | | 114 | 58 |
| tC, single (s) | 4.1 | | | | 6.4 | 6.2 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 2.2 | | | | 3.5 | 3.3 |
| p0 queue free % | 100 | | | | 98 | 100 |
| cM capacity (veh/h) | 1544 | | | | 888 | 1013 |

| Direction, Lane # | EB 1 | WB 1 | SB 1 |
|---|---|---|---|
| Volume Total | 55 | 70 | 14 |
| Volume Left | 0 | 0 | 14 |
| Volume Right | 0 | 23 | 0 |
| cSH | 1544 | 1700 | 888 |
| Volume to Capacity | 0.00 | 0.04 | 0.02 |
| Queue Length 95th (m) | 0.0 | 0.0 | 0.4 |
| Control Delay (s) | 0.0 | 0.0 | 9.1 |
| Lane LOS | | | A |
| Approach Delay (s) | 0.0 | 0.0 | 9.1 |
| Approach LOS | | | A |

| Intersection Summary | | | |
|---|---|---|---|
| Average Delay | 0.9 | | |
| Intersection Capacity Utilization | 13.5% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |

| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|---|---|---|---|---|---|---|
| Lane Configurations | | ↰↑ | ↑↱ | | ↲↳ | |
| Traffic Volume (veh/h) | 0 | 51 | 43 | 21 | 13 | 0 |
| Future Volume (Veh/h) | 0 | 51 | 43 | 21 | 13 | 0 |
| Sign Control | | Free | Free | | Stop | |
| Grade | | 0% | 0% | | 0% | |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 0 | 55 | 47 | 23 | 14 | 0 |
| Pedestrians | | | | | | |
| Lane Width (m) | | | | | | |
| Walking Speed (m/s) | | | | | | |
| Percent Blockage | | | | | | |
| Right turn flare (veh) | | | | | | |
| Median type | | None | None | | | |
| Median storage veh) | | | | | | |
| Upstream signal (m) | | | | | | |
| pX, platoon unblocked | | | | | | |
| vC, conflicting volume | 70 | | | | 86 | 35 |
| vC1, stage 1 conf vol | | | | | | |
| vC2, stage 2 conf vol | | | | | | |
| vCu, unblocked vol | 70 | | | | 86 | 35 |
| tC, single (s) | 4.1 | | | | 6.8 | 6.9 |
| tC, 2 stage (s) | | | | | | |
| tF (s) | 2.2 | | | | 3.5 | 3.3 |
| p0 queue free % | 100 | | | | 98 | 100 |
| cM capacity (veh/h) | 1544 | | | | 911 | 1037 |

| Direction, Lane # | EB 1 | EB 2 | WB 1 | WB 2 | SB 1 |
|---|---|---|---|---|---|
| Volume Total | 18 | 37 | 31 | 39 | 14 |
| Volume Left | 0 | 0 | 0 | 0 | 14 |
| Volume Right | 0 | 0 | 0 | 23 | 0 |
| cSH | 1544 | 1700 | 1700 | 1700 | 911 |
| Volume to Capacity | 0.00 | 0.02 | 0.02 | 0.02 | 0.02 |
| Queue Length 95th (m) | 0.0 | 0.0 | 0.0 | 0.0 | 0.4 |
| Control Delay (s) | 0.0 | 0.0 | 0.0 | 0.0 | 9.0 |
| Lane LOS | | | | | A |
| Approach Delay (s) | 0.0 | | 0.0 | | 9.0 |
| Approach LOS | | | | | A |

| Intersection Summary | | | |
|---|---|---|---|
| Average Delay | 0.9 | | |
| Intersection Capacity Utilization | 13.3% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |

| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|---|---|---|---|---|---|---|
| Lane Configurations |  | ↰ | ↱ |  | ↲↳ |  |
| Sign Control |  | Stop | Stop |  | Stop |  |
| Traffic Volume (vph) | 0 | 51 | 43 | 21 | 13 | 0 |
| Future Volume (vph) | 0 | 51 | 43 | 21 | 13 | 0 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 0 | 55 | 47 | 23 | 14 | 0 |

| Direction, Lane # | EB 1 | WB 1 | SB 1 |
|---|---|---|---|
| Volume Total (vph) | 55 | 70 | 14 |
| Volume Left (vph) | 0 | 0 | 14 |
| Volume Right (vph) | 0 | 23 | 0 |
| Hadj (s) | 0.00 | -0.20 | 0.20 |
| Departure Headway (s) | 4.0 | 3.8 | 4.4 |
| Degree Utilization, x | 0.06 | 0.07 | 0.02 |
| Capacity (veh/h) | 889 | 940 | 794 |
| Control Delay (s) | 7.3 | 7.1 | 7.4 |
| Approach Delay (s) | 7.3 | 7.1 | 7.4 |
| Approach LOS | A | A | A |

| Intersection Summary |  |  |  |
|---|---|---|---|
| Delay | 7.2 |  |  |
| Level of Service | A |  |  |
| Intersection Capacity Utilization | 13.5% | ICU Level of Service | A |
| Analysis Period (min) | 15 |  |  |

# HCM Unsignalized Intersection Capacity Analysis
## 4: Bruce County Road 25 & Ridge Street

| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|---|---|---|---|---|---|---|
| Lane Configurations | | ↰↑ | ↑↱ | | ↲↳ | |
| Sign Control | | Stop | Stop | | Stop | |
| Traffic Volume (vph) | 0 | 51 | 43 | 21 | 13 | 0 |
| Future Volume (vph) | 0 | 51 | 43 | 21 | 13 | 0 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Hourly flow rate (vph) | 0 | 55 | 47 | 23 | 14 | 0 |

| Direction, Lane # | EB 1 | EB 2 | WB 1 | WB 2 | SB 1 |
|---|---|---|---|---|---|
| Volume Total (vph) | 18 | 37 | 31 | 39 | 14 |
| Volume Left (vph) | 0 | 0 | 0 | 0 | 14 |
| Volume Right (vph) | 0 | 0 | 0 | 23 | 0 |
| Hadj (s) | 0.00 | 0.00 | 0.00 | -0.42 | 0.20 |
| Departure Headway (s) | 4.6 | 4.6 | 4.6 | 4.2 | 4.4 |
| Degree Utilization, x | 0.02 | 0.05 | 0.04 | 0.04 | 0.02 |
| Capacity (veh/h) | 778 | 772 | 781 | 851 | 793 |
| Control Delay (s) | 6.5 | 6.6 | 6.6 | 6.1 | 7.4 |
| Approach Delay (s) | 6.6 | | 6.3 | | 7.4 |
| Approach LOS | A | | A | | A |

| Intersection Summary | | | |
|---|---|---|---|
| Delay | 6.5 | | |
| Level of Service | A | | |
| Intersection Capacity Utilization | 13.3% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |

| | → | ← | ↘ |
|---|---|---|---|
| Lane Group | EBT | WBT | SBL |
| Lane Group Flow (vph) | 55 | 70 | 14 |
| v/c Ratio | 0.17 | 0.22 | 0.01 |
| Control Delay | 14.5 | 11.7 | 4.5 |
| Queue Delay | 0.0 | 0.0 | 0.0 |
| Total Delay | 14.5 | 11.7 | 4.5 |
| Queue Length 50th (m) | 3.1 | 2.7 | 0.0 |
| Queue Length 95th (m) | 9.3 | 9.6 | 2.1 |
| Internal Link Dist (m) | 78.6 | 117.0 | 195.6 |
| Turn Bay Length (m) | | | |
| Base Capacity (vph) | 1419 | 1361 | 1439 |
| Starvation Cap Reductn | 0 | 0 | 0 |
| Spillback Cap Reductn | 0 | 0 | 0 |
| Storage Cap Reductn | 0 | 0 | 0 |
| Reduced v/c Ratio | 0.04 | 0.05 | 0.01 |

Intersection Summary

| | ↗ | → | ← | ↖ | ↘ | ↙ |
|---|---|---|---|---|---|---|
| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
| Lane Configurations | | ↰ | ↱ | | ⋎ | |
| Traffic Volume (vph) | 0 | 51 | 43 | 21 | 13 | 0 |
| Future Volume (vph) | 0 | 51 | 43 | 21 | 13 | 0 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | | 6.0 | 6.0 | | 6.0 | |
| Lane Util. Factor | | 1.00 | 1.00 | | 1.00 | |
| Frt | | 1.00 | 0.96 | | 1.00 | |
| Flt Protected | | 1.00 | 1.00 | | 0.95 | |
| Satd. Flow (prot) | | 1900 | 1816 | | 1805 | |
| Flt Permitted | | 1.00 | 1.00 | | 0.95 | |
| Satd. Flow (perm) | | 1900 | 1816 | | 1805 | |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 0 | 55 | 47 | 23 | 14 | 0 |
| RTOR Reduction (vph) | 0 | 0 | 21 | 0 | 0 | 0 |
| Lane Group Flow (vph) | 0 | 55 | 49 | 0 | 14 | 0 |
| Turn Type | | NA | NA | | Prot | |
| Protected Phases | | 4 | 8 | | 6 | |
| Permitted Phases | 4 | | | | | |
| Actuated Green, G (s) | | 3.0 | 3.0 | | 27.4 | |
| Effective Green, g (s) | | 3.0 | 3.0 | | 27.4 | |
| Actuated g/C Ratio | | 0.07 | 0.07 | | 0.65 | |
| Clearance Time (s) | | 6.0 | 6.0 | | 6.0 | |
| Vehicle Extension (s) | | 3.0 | 3.0 | | 3.0 | |
| Lane Grp Cap (vph) | | 134 | 128 | | 1166 | |
| v/s Ratio Prot | | c0.03 | 0.03 | | c0.01 | |
| v/s Ratio Perm | | | | | | |
| v/c Ratio | | 0.41 | 0.38 | | 0.01 | |
| Uniform Delay, d1 | | 18.9 | 18.8 | | 2.7 | |
| Progression Factor | | 1.00 | 1.00 | | 1.00 | |
| Incremental Delay, d2 | | 2.0 | 1.9 | | 0.0 | |
| Delay (s) | | 20.9 | 20.7 | | 2.7 | |
| Level of Service | | C | C | | A | |
| Approach Delay (s) | | 20.9 | 20.7 | | 2.7 | |
| Approach LOS | | C | C | | A | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM 2000 Control Delay | 19.0 | HCM 2000 Level of Service | B |
| HCM 2000 Volume to Capacity ratio | 0.05 | | |
| Actuated Cycle Length (s) | 42.4 | Sum of lost time (s) | 12.0 |
| Intersection Capacity Utilization | 18.3% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |

c Critical Lane Group

## Queues

## 4: Bruce County Road 25 & Ridge Street

| | → | ← | ↘ |
|---|---|---|---|
| Lane Group | EBT | WBT | SBL |
| Lane Group Flow (vph) | 55 | 70 | 14 |
| v/c Ratio | 0.10 | 0.13 | 0.01 |
| Control Delay | 13.6 | 10.6 | 4.2 |
| Queue Delay | 0.0 | 0.0 | 0.0 |
| Total Delay | 13.6 | 10.6 | 4.2 |
| Queue Length 50th (m) | 1.6 | 1.4 | 0.0 |
| Queue Length 95th (m) | 4.7 | 4.8 | 1.9 |
| Internal Link Dist (m) | 78.6 | 117.0 | 195.6 |
| Turn Bay Length (m) | | | |
| Base Capacity (vph) | 2725 | 2597 | 1448 |
| Starvation Cap Reductn | 0 | 0 | 0 |
| Spillback Cap Reductn | 0 | 0 | 0 |
| Storage Cap Reductn | 0 | 0 | 0 |
| Reduced v/c Ratio | 0.02 | 0.03 | 0.01 |

Intersection Summary

| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|---|---|---|---|---|---|---|
| Lane Configurations | | ↰↑ | ↑↱ | | ↰↱ | |
| Traffic Volume (vph) | 0 | 51 | 43 | 21 | 13 | 0 |
| Future Volume (vph) | 0 | 51 | 43 | 21 | 13 | 0 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | | 6.0 | 6.0 | | 6.0 | |
| Lane Util. Factor | | 0.95 | 0.95 | | 1.00 | |
| Frt | | 1.00 | 0.95 | | 1.00 | |
| Flt Protected | | 1.00 | 1.00 | | 0.95 | |
| Satd. Flow (prot) | | 3610 | 3432 | | 1805 | |
| Flt Permitted | | 1.00 | 1.00 | | 0.95 | |
| Satd. Flow (perm) | | 3610 | 3432 | | 1805 | |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 0 | 55 | 47 | 23 | 14 | 0 |
| RTOR Reduction (vph) | 0 | 0 | 22 | 0 | 0 | 0 |
| Lane Group Flow (vph) | 0 | 55 | 48 | 0 | 14 | 0 |
| Turn Type | | NA | NA | | Prot | |
| Protected Phases | | 4 | 8 | | 6 | |
| Permitted Phases | 4 | | | | | |
| Actuated Green, G (s) | | 2.7 | 2.7 | | 27.3 | |
| Effective Green, g (s) | | 2.7 | 2.7 | | 27.3 | |
| Actuated g/C Ratio | | 0.06 | 0.06 | | 0.65 | |
| Clearance Time (s) | | 6.0 | 6.0 | | 6.0 | |
| Vehicle Extension (s) | | 3.0 | 3.0 | | 3.0 | |
| Lane Grp Cap (vph) | | 232 | 220 | | 1173 | |
| v/s Ratio Prot | | c0.02 | 0.01 | | c0.01 | |
| v/s Ratio Perm | | | | | | |
| v/c Ratio | | 0.24 | 0.22 | | 0.01 | |
| Uniform Delay, d1 | | 18.7 | 18.7 | | 2.6 | |
| Progression Factor | | 1.00 | 1.00 | | 1.00 | |
| Incremental Delay, d2 | | 0.5 | 0.5 | | 0.0 | |
| Delay (s) | | 19.2 | 19.2 | | 2.6 | |
| Level of Service | | B | B | | A | |
| Approach Delay (s) | | 19.2 | 19.2 | | 2.6 | |
| Approach LOS | | B | B | | A | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM 2000 Control Delay | 17.5 | HCM 2000 Level of Service | B |
| HCM 2000 Volume to Capacity ratio | 0.03 | | |
| Actuated Cycle Length (s) | 42.0 | Sum of lost time (s) | 12.0 |
| Intersection Capacity Utilization | 18.3% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |

c Critical Lane Group

# Queues
## 4: Bruce County Road 25 & Ridge Street

| Lane Group | EBT | WBT | SBL |
|---|---|---|---|
| Lane Group Flow (vph) | 55 | 70 | 14 |
| v/c Ratio | 0.17 | 0.22 | 0.01 |
| Control Delay | 14.5 | 11.7 | 4.5 |
| Queue Delay | 0.0 | 0.0 | 0.0 |
| Total Delay | 14.5 | 11.7 | 4.5 |
| Queue Length 50th (m) | 3.1 | 2.7 | 0.0 |
| Queue Length 95th (m) | 9.3 | 9.6 | 2.1 |
| Internal Link Dist (m) | 78.6 | 117.0 | 195.6 |
| Turn Bay Length (m) | | | |
| Base Capacity (vph) | 1419 | 1361 | 1439 |
| Starvation Cap Reductn | 0 | 0 | 0 |
| Spillback Cap Reductn | 0 | 0 | 0 |
| Storage Cap Reductn | 0 | 0 | 0 |
| Reduced v/c Ratio | 0.04 | 0.05 | 0.01 |

Intersection Summary

| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
|---|---|---|---|---|---|---|
| Lane Configurations | | ↰↑ | ↑↱ | | ↰ | ↱ |
| Traffic Volume (vph) | 0 | 51 | 43 | 21 | 13 | 0 |
| Future Volume (vph) | 0 | 51 | 43 | 21 | 13 | 0 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | | 6.0 | 6.0 | | 6.0 | |
| Lane Util. Factor | | 1.00 | 1.00 | | 1.00 | |
| Frt | | 1.00 | 0.96 | | 1.00 | |
| Flt Protected | | 1.00 | 1.00 | | 0.95 | |
| Satd. Flow (prot) | | 1900 | 1816 | | 1805 | |
| Flt Permitted | | 1.00 | 1.00 | | 0.95 | |
| Satd. Flow (perm) | | 1900 | 1816 | | 1805 | |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 0 | 55 | 47 | 23 | 14 | 0 |
| RTOR Reduction (vph) | 0 | 0 | 21 | 0 | 0 | 0 |
| Lane Group Flow (vph) | 0 | 55 | 49 | 0 | 14 | 0 |
| Turn Type | | NA | NA | | Prot | Perm |
| Protected Phases | | 4 | 8 | | 6 | |
| Permitted Phases | 4 | | | | | 6 |
| Actuated Green, G (s) | | 3.0 | 3.0 | | 27.4 | |
| Effective Green, g (s) | | 3.0 | 3.0 | | 27.4 | |
| Actuated g/C Ratio | | 0.07 | 0.07 | | 0.65 | |
| Clearance Time (s) | | 6.0 | 6.0 | | 6.0 | |
| Vehicle Extension (s) | | 3.0 | 3.0 | | 3.0 | |
| Lane Grp Cap (vph) | | 134 | 128 | | 1166 | |
| v/s Ratio Prot | | c0.03 | 0.03 | | c0.01 | |
| v/s Ratio Perm | | | | | | |
| v/c Ratio | | 0.41 | 0.38 | | 0.01 | |
| Uniform Delay, d1 | | 18.9 | 18.8 | | 2.7 | |
| Progression Factor | | 1.00 | 1.00 | | 1.00 | |
| Incremental Delay, d2 | | 2.0 | 1.9 | | 0.0 | |
| Delay (s) | | 20.9 | 20.7 | | 2.7 | |
| Level of Service | | C | C | | A | |
| Approach Delay (s) | | 20.9 | 20.7 | | 2.7 | |
| Approach LOS | | C | C | | A | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM 2000 Control Delay | 19.0 | HCM 2000 Level of Service | B |
| HCM 2000 Volume to Capacity ratio | 0.05 | | |
| Actuated Cycle Length (s) | 42.4 | Sum of lost time (s) | 12.0 |
| Intersection Capacity Utilization | 18.3% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |

c Critical Lane Group

# Queues

## 4: Bruce County Road 25 & Ridge Street

| | → | ← | ↳ |
|---|---|---|---|
| Lane Group | EBT | WBT | SBL |
| Lane Group Flow (vph) | 55 | 70 | 14 |
| v/c Ratio | 0.10 | 0.13 | 0.01 |
| Control Delay | 13.6 | 10.6 | 4.2 |
| Queue Delay | 0.0 | 0.0 | 0.0 |
| Total Delay | 13.6 | 10.6 | 4.2 |
| Queue Length 50th (m) | 1.6 | 1.4 | 0.0 |
| Queue Length 95th (m) | 4.7 | 4.8 | 1.9 |
| Internal Link Dist (m) | 78.6 | 117.0 | 195.6 |
| Turn Bay Length (m) | | | |
| Base Capacity (vph) | 2725 | 2597 | 1448 |
| Starvation Cap Reductn | 0 | 0 | 0 |
| Spillback Cap Reductn | 0 | 0 | 0 |
| Storage Cap Reductn | 0 | 0 | 0 |
| Reduced v/c Ratio | 0.02 | 0.03 | 0.01 |

Intersection Summary

| | ↗ | → | ← | ↖ | ↘ | ↙ |
|---|---|---|---|---|---|---|
| Movement | EBL | EBT | WBT | WBR | SBL | SBR |
| Lane Configurations | | ↰↑ | ↑↱ | | ↰ | ↱ |
| Traffic Volume (vph) | 0 | 51 | 43 | 21 | 13 | 0 |
| Future Volume (vph) | 0 | 51 | 43 | 21 | 13 | 0 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | | 6.0 | 6.0 | | 6.0 | |
| Lane Util. Factor | | 0.95 | 0.95 | | 1.00 | |
| Frt | | 1.00 | 0.95 | | 1.00 | |
| Flt Protected | | 1.00 | 1.00 | | 0.95 | |
| Satd. Flow (prot) | | 3610 | 3432 | | 1805 | |
| Flt Permitted | | 1.00 | 1.00 | | 0.95 | |
| Satd. Flow (perm) | | 3610 | 3432 | | 1805 | |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 0 | 55 | 47 | 23 | 14 | 0 |
| RTOR Reduction (vph) | 0 | 0 | 22 | 0 | 0 | 0 |
| Lane Group Flow (vph) | 0 | 55 | 48 | 0 | 14 | 0 |
| Turn Type | | NA | NA | | Prot | Perm |
| Protected Phases | | 4 | 8 | | 6 | |
| Permitted Phases | 4 | | | | | 6 |
| Actuated Green, G (s) | | 2.7 | 2.7 | | 27.3 | |
| Effective Green, g (s) | | 2.7 | 2.7 | | 27.3 | |
| Actuated g/C Ratio | | 0.06 | 0.06 | | 0.65 | |
| Clearance Time (s) | | 6.0 | 6.0 | | 6.0 | |
| Vehicle Extension (s) | | 3.0 | 3.0 | | 3.0 | |
| Lane Grp Cap (vph) | | 232 | 220 | | 1173 | |
| v/s Ratio Prot | | c0.02 | 0.01 | | c0.01 | |
| v/s Ratio Perm | | | | | | |
| v/c Ratio | | 0.24 | 0.22 | | 0.01 | |
| Uniform Delay, d1 | | 18.7 | 18.7 | | 2.6 | |
| Progression Factor | | 1.00 | 1.00 | | 1.00 | |
| Incremental Delay, d2 | | 0.5 | 0.5 | | 0.0 | |
| Delay (s) | | 19.2 | 19.2 | | 2.6 | |
| Level of Service | | B | B | | A | |
| Approach Delay (s) | | 19.2 | 19.2 | | 2.6 | |
| Approach LOS | | B | B | | A | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM 2000 Control Delay | 17.5 | HCM 2000 Level of Service | B |
| HCM 2000 Volume to Capacity ratio | 0.03 | | |
| Actuated Cycle Length (s) | 42.0 | Sum of lost time (s) | 12.0 |
| Intersection Capacity Utilization | 18.3% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |

c Critical Lane Group

# Junctions 8

## ARCADY 8 - Roundabout Module

Version: 8.0.6.541 [19821,26/11/2015]

For sales and distribution information, program advice and maintenance, contact TRL:
Tel: +44 (0)1344 770758    email: software@trl.co.uk    Web: http://www.trlsoftware.co.uk

**Filename:** 25 and Ridge - 1 lane.arc8
**Path:** C:\Users\AdamMorrison\Paradigm\Projects - (190077) CoBruce - Bruce Road 25 EA\2 Forecasting Analysis\Arcady
**Report generation date:** 2019-08-01 6:41:03 PM

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## Summary of intersection performance

| | PM | | | | | |
|---|---|---|---|---|---|---|
| | Queue (PCE) | Delay (s) | V/C Ratio | LOS | Intersection Delay (s) | Intersection LOS |
| | A1 - 2040 | | | | | |
| **Leg North** | 0.01 | 2.74 | 0.01 | A | 2.78 | A |
| **Leg West** | 0.04 | 2.78 | 0.04 | A | | |
| **Leg East** | 0.05 | 2.80 | 0.05 | A | | |

*Values shown are the maximum values over all time segments. Delay is the maximum value of average delay per arriving vehicle. Intersection LOS and Intersection Delay are demand-weighted averages.*

*"D1 - 2040, PM " model duration: 4:00 PM - 5:30 PM*

*Run using Junctions 8.0.6.541 at 2019-08-01 6:41:02 PM*

## File summary

| | |
|---|---|
| **Title** | (untitled) |
| **Location** | |
| **Site Number** | |
| **Date** | 2019-08-01 |
| **Version** | |
| **Status** | (new file) |
| **Identifier** | |
| **Client** | |
| **Jobnumber** | |
| **Analyst** | AdamMorrison |
| **Description** | |

## Analysis Options

| Vehicle Length (m) | Do Queue Variations | Calculate Residual Capacity | Residual Capacity Criteria Type | V/C Ratio Threshold | Average Delay Threshold (s) | Queue Threshold (PCE) |
|---|---|---|---|---|---|---|
| 5.75 | ✓ | | N/A | 0.85 | 36.00 | 20.00 |

## Units

| Distance Units | Speed Units | Traffic Units Input | Traffic Units Results | Flow Units | Average Delay Units | Total Delay Units | Rate Of Delay Units |
|---|---|---|---|---|---|---|---|
| m | kph | PCE | PCE | perHour | s | -Min | perMin |

# (Default Analysis Set) - 2040, PM

## Data Errors and Warnings

*No errors or warnings*

## Analysis Set Details

| Name | Roundabout Capacity Model | Description | Include In Report | Use Specific Demand Set(s) | Specific Demand Set (s) | Locked | Network Flow Scaling Factor (%) | Network Capacity Scaling Factor (%) | Reason For Scaling Factors |
|---|---|---|---|---|---|---|---|---|---|
| (Default Analysis Set) | ARCADY |  | ✓ |  |  |  | 100.000 | 100.000 |  |

## Demand Set Details

| Name | Scenario Name | Time Period Name | Description | Traffic Profile Type | Model Start Time (HH:mm) | Model Finish Time (HH:mm) | Model Time Period Length (min) | Time Segment Length (min) | Results For Central Hour Only | Single Time Segment Only | Locked | Run Automatically | Use Relationship | Relationship |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2040, PM | 2040 | PM |  | ONE HOUR | 16:00 | 17:30 | 90 | 15 |  |  |  | ✓ |  |  |

# Intersection Network

## Intersections

| Intersection | Name | Intersection Type | Leg Order | Grade Separated | Large Roundabout | Do Geometric Delay | Intersection Delay (s) | Intersection LOS |
|---|---|---|---|---|---|---|---|---|
| 1 | (untitled) | Roundabout | North,West,East |  |  |  | 2.78 | A |

## Intersection Network Options

| Driving Side | Lighting |
|---|---|
| Right | Normal/unknown |

# Legs

## Legs

| Leg | Leg | Name | Description |
|---|---|---|---|
| **North** | North | Ridge St |  |
| **West** | West | County Road 25 |  |
| **East** | East | County Road 25 |  |

## Capacity Options

| Leg | Minimum Capacity (PCE/hr) | Maximum Capacity (PCE/hr) | Assume Flat Start Profile | Initial Queue (PCE) |
|---|---|---|---|---|
| **North** | 0.00 | 99999.00 |  | 0.00 |
| **West** | 0.00 | 99999.00 |  | 0.00 |
| **East** | 0.00 | 99999.00 |  | 0.00 |

## Roundabout Geometry

| Leg | V - Approach road half-width (m) | E - Entry width (m) | l' - Effective flare length (m) | R - Entry radius (m) | D - Inscribed circle diameter (m) | PHI - Conflict (entry) angle (deg) | Exit Only |
|---|---|---|---|---|---|---|---|
| **North** | 3.50 | 4.50 | 30.00 | 20.00 | 40.00 | 25.00 |  |
| **West** | 3.50 | 4.50 | 30.00 | 20.00 | 40.00 | 25.00 |  |
| **East** | 3.50 | 4.50 | 30.00 | 20.00 | 40.00 | 25.00 |  |

## Slope / Intercept / Capacity

### Roundabout Slope and Intercept used in model

| Leg | Enter slope and intercept directly | Entered slope | Entered intercept (PCE/hr) | Final Slope | Final Intercept (PCE/hr) |
|---|---|---|---|---|---|
| **North** |  | (calculated) | (calculated) | 0.579 | 1357.445 |
| **West** |  | (calculated) | (calculated) | 0.579 | 1357.445 |
| **East** |  | (calculated) | (calculated) | 0.579 | 1357.445 |

*The slope and intercept shown above include any corrections and adjustments.*

# Traffic Flows

## Demand Set Data Options

| Default Vehicle Mix | Vehicle Mix Varies Over Time | Vehicle Mix Varies Over Turn | Vehicle Mix Varies Over Entry | Vehicle Mix Source | PCE Factor for a Truck (PCE) | Default Turning Proportions | Estimate from entry/exit counts | Turning Proportions Vary Over Time | Turning Proportions Vary Over Turn | Turning Proportions Vary Over Entry |
|---|---|---|---|---|---|---|---|---|---|---|
| | | ✓ | ✓ | Truck Percentages | 2.00 | | | | ✓ | ✓ |

# Entry Flows

## General Flows Data

| Leg | Profile Type | Use Turning Counts | Average Demand Flow (PCE/hr) | Flow Scaling Factor (%) |
|---|---|---|---|---|
| **North** | ONE HOUR | ✓ | 13.00 | 100.000 |
| **West** | ONE HOUR | ✓ | 51.00 | 100.000 |
| **East** | ONE HOUR | ✓ | 64.00 | 100.000 |

# Turning Proportions

### Turning Counts / Proportions (PCE/hr) - Intersection 1 (for whole period)

| | | To | | |
|---|---|---|---|---|
| | | **North** | **West** | **East** |
| **From** | **North** | 0.000 | 0.000 | 13.000 |
| | **West** | 0.000 | 0.000 | 51.000 |
| | **East** | 21.000 | 43.000 | 0.000 |

### Turning Proportions (PCE) - Intersection 1 (for whole period)

| | | To | | |
|---|---|---|---|---|
| | | **North** | **West** | **East** |
| **From** | **North** | 0.00 | 0.00 | 1.00 |
| | **West** | 0.00 | 0.00 | 1.00 |
| | **East** | 0.33 | 0.67 | 0.00 |

# Vehicle Mix

### Average PCE Per Vehicle - Intersection 1 (for whole period)

| | | To | | |
|---|---|---|---|---|
| | | **North** | **West** | **East** |
| **From** | **North** | 1.000 | 1.000 | 1.000 |
| | **West** | 1.000 | 1.000 | 1.000 |
| | **East** | 1.000 | 1.000 | 1.000 |

### Truck Percentages - Intersection 1 (for whole period)

| | | To | | |
|---|---|---|---|---|
| | | **North** | **West** | **East** |
| **From** | **North** | 0.0 | 0.0 | 0.0 |
| | **West** | 0.0 | 0.0 | 0.0 |
| | **East** | 0.0 | 0.0 | 0.0 |

# Results

## Results Summary for whole modelled period

| Leg | Max V/C Ratio | Max Delay (s) | Max Queue (PCE) | Max 95th percentile Queue (PCE) | Max LOS | Average Demand (PCE/hr) | Total Intersection Arrivals (PCE) | Total Queueing Delay (PCE-min) | Average Queueing Delay (s) | Rate Of Queueing Delay (PCE-min/min) | Inclusive Total Queueing Delay (PCE-min) | Inclusive Average Queueing Delay (s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **North** | 0.01 | 2.74 | 0.01 | ~1 | A | 11.93 | 17.89 | 0.81 | 2.72 | 0.01 | 0.81 | 2.72 |
| **West** | 0.04 | 2.78 | 0.04 | ~1 | A | 46.80 | 70.20 | 3.22 | 2.75 | 0.04 | 3.22 | 2.75 |
| **East** | 0.05 | 2.80 | 0.05 | ~1 | A | 58.73 | 88.09 | 4.06 | 2.76 | 0.05 | 4.06 | 2.77 |

## Main Results for each time segment

### Main results: (16:00-16:15)

| Leg | Total Demand (PCE/hr) | Intersection Arrivals (PCE) | Entry Flow (PCE/hr) | Exit Flow (PCE/hr) | Circulating Flow (PCE/hr) | Pedestrian Demand (Ped/hr) | Capacity (PCE/hr) | Saturation Capacity (PCE/hr) | V/C Ratio | Start Queue (PCE) | End Queue (PCE) | Delay (s) | LOS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **North** | 9.79 | 2.45 | 9.76 | 15.76 | 32.27 | 0.00 | 1338.77 | 829.60 | 0.007 | 0.00 | 0.01 | 2.708 | A |
| **West** | 38.40 | 9.60 | 38.28 | 32.27 | 9.76 | 0.00 | 1351.80 | 877.31 | 0.028 | 0.00 | 0.03 | 2.740 | A |
| **East** | 48.18 | 12.05 | 48.04 | 48.04 | 0.00 | 0.00 | 1357.45 | 1357.45 | 0.036 | 0.00 | 0.04 | 2.749 | A |

### Main results: (16:15-16:30)

| Leg | Total Demand (PCE/hr) | Intersection Arrivals (PCE) | Entry Flow (PCE/hr) | Exit Flow (PCE/hr) | Circulating Flow (PCE/hr) | Pedestrian Demand (Ped/hr) | Capacity (PCE/hr) | Saturation Capacity (PCE/hr) | V/C Ratio | Start Queue (PCE) | End Queue (PCE) | Delay (s) | LOS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **North** | 11.69 | 2.92 | 11.68 | 18.87 | 38.64 | 0.00 | 1335.08 | 829.60 | 0.009 | 0.01 | 0.01 | 2.719 | A |
| **West** | 45.85 | 11.46 | 45.82 | 38.64 | 11.68 | 0.00 | 1350.68 | 877.31 | 0.034 | 0.03 | 0.04 | 2.758 | A |
| **East** | 57.53 | 14.38 | 57.50 | 57.51 | 0.00 | 0.00 | 1357.45 | 1357.45 | 0.042 | 0.04 | 0.04 | 2.768 | A |

### Main results: (16:30-16:45)

| Leg | Total Demand (PCE/hr) | Intersection Arrivals (PCE) | Entry Flow (PCE/hr) | Exit Flow (PCE/hr) | Circulating Flow (PCE/hr) | Pedestrian Demand (Ped/hr) | Capacity (PCE/hr) | Saturation Capacity (PCE/hr) | V/C Ratio | Start Queue (PCE) | End Queue (PCE) | Delay (s) | LOS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **North** | 14.31 | 3.58 | 14.31 | 23.11 | 47.32 | 0.00 | 1330.06 | 829.60 | 0.011 | 0.01 | 0.01 | 2.735 | A |
| **West** | 56.15 | 14.04 | 56.12 | 47.32 | 14.31 | 0.00 | 1349.17 | 877.31 | 0.042 | 0.04 | 0.04 | 2.783 | A |
| **East** | 70.47 | 17.62 | 70.42 | 70.42 | 0.00 | 0.00 | 1357.45 | 1357.45 | 0.052 | 0.04 | 0.05 | 2.796 | A |

### Main results: (16:45-17:00)

| Leg | Total Demand (PCE/hr) | Intersection Arrivals (PCE) | Entry Flow (PCE/hr) | Exit Flow (PCE/hr) | Circulating Flow (PCE/hr) | Pedestrian Demand (Ped/hr) | Capacity (PCE/hr) | Saturation Capacity (PCE/hr) | V/C Ratio | Start Queue (PCE) | End Queue (PCE) | Delay (s) | LOS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **North** | 14.31 | 3.58 | 14.31 | 23.12 | 47.34 | 0.00 | 1330.04 | 829.60 | 0.011 | 0.01 | 0.01 | 2.735 | A |
| **West** | 56.15 | 14.04 | 56.15 | 47.34 | 14.31 | 0.00 | 1349.16 | 877.31 | 0.042 | 0.04 | 0.04 | 2.783 | A |
| **East** | 70.47 | 17.62 | 70.46 | 70.46 | 0.00 | 0.00 | 1357.45 | 1357.45 | 0.052 | 0.05 | 0.05 | 2.796 | A |

### Main results: (17:00-17:15)

| Leg | Total Demand (PCE/hr) | Intersection Arrivals (PCE) | Entry Flow (PCE/hr) | Exit Flow (PCE/hr) | Circulating Flow (PCE/hr) | Pedestrian Demand (Ped/hr) | Capacity (PCE/hr) | Saturation Capacity (PCE/hr) | V/C Ratio | Start Queue (PCE) | End Queue (PCE) | Delay (s) | LOS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **North** | 11.69 | 2.92 | 11.69 | 18.89 | 38.68 | 0.00 | 1335.06 | 829.60 | 0.009 | 0.01 | 0.01 | 2.721 | A |
| **West** | 45.85 | 11.46 | 45.88 | 38.68 | 11.69 | 0.00 | 1350.68 | 877.31 | 0.034 | 0.04 | 0.04 | 2.758 | A |
| **East** | 57.53 | 14.38 | 57.58 | 57.58 | 0.00 | 0.00 | 1357.45 | 1357.45 | 0.042 | 0.05 | 0.04 | 2.769 | A |

### Main results: (17:15-17:30)

| Leg | Total Demand (PCE/hr) | Intersection Arrivals (PCE) | Entry Flow (PCE/hr) | Exit Flow (PCE/hr) | Circulating Flow (PCE/hr) | Pedestrian Demand (Ped/hr) | Capacity (PCE/hr) | Saturation Capacity (PCE/hr) | V/C Ratio | Start Queue (PCE) | End Queue (PCE) | Delay (s) | LOS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **North** | 9.79 | 2.45 | 9.79 | 15.82 | 32.39 | 0.00 | 1338.70 | 829.60 | 0.007 | 0.01 | 0.01 | 2.708 | A |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **West** | 38.40 | 9.60 | 38.42 | 32.39 | 9.79 | 0.00 | 1351.78 | 877.31 | 0.028 | 0.04 | 0.03 | 2.740 | A |
| **East** | 48.18 | 12.05 | 48.21 | 48.21 | 0.00 | 0.00 | 1357.45 | 1357.45 | 0.036 | 0.04 | 0.04 | 2.751 | A |

## Queueing Delay Results for each time segment

### Queueing Delay results: (16:00-16:15)

| Leg | Queueing Total Delay (PCE-min) | Queueing Rate Of Delay (PCE-min/min) | Average Delay Per Arriving Vehicle (s) | Unsignalised Level Of Service | Signalised Level Of Service |
|---|---|---|---|---|---|
| **North** | 0.11 | 0.01 | 2.708 | A | A |
| **West** | 0.43 | 0.03 | 2.740 | A | A |
| **East** | 0.54 | 0.04 | 2.749 | A | A |

### Queueing Delay results: (16:15-16:30)

| Leg | Queueing Total Delay (PCE-min) | Queueing Rate Of Delay (PCE-min/min) | Average Delay Per Arriving Vehicle (s) | Unsignalised Level Of Service | Signalised Level Of Service |
|---|---|---|---|---|---|
| **North** | 0.13 | 0.01 | 2.719 | A | A |
| **West** | 0.52 | 0.03 | 2.758 | A | A |
| **East** | 0.66 | 0.04 | 2.768 | A | A |

### Queueing Delay results: (16:30-16:45)

| Leg | Queueing Total Delay (PCE-min) | Queueing Rate Of Delay (PCE-min/min) | Average Delay Per Arriving Vehicle (s) | Unsignalised Level Of Service | Signalised Level Of Service |
|---|---|---|---|---|---|
| **North** | 0.16 | 0.01 | 2.735 | A | A |
| **West** | 0.64 | 0.04 | 2.783 | A | A |
| **East** | 0.81 | 0.05 | 2.796 | A | A |

### Queueing Delay results: (16:45-17:00)

| Leg | Queueing Total Delay (PCE-min) | Queueing Rate Of Delay (PCE-min/min) | Average Delay Per Arriving Vehicle (s) | Unsignalised Level Of Service | Signalised Level Of Service |
|---|---|---|---|---|---|
| **North** | 0.16 | 0.01 | 2.735 | A | A |
| **West** | 0.65 | 0.04 | 2.783 | A | A |
| **East** | 0.82 | 0.05 | 2.796 | A | A |

### Queueing Delay results: (17:00-17:15)

| Leg | Queueing Total Delay (PCE-min) | Queueing Rate Of Delay (PCE-min/min) | Average Delay Per Arriving Vehicle (s) | Unsignalised Level Of Service | Signalised Level Of Service |
|---|---|---|---|---|---|
| **North** | 0.13 | 0.01 | 2.721 | A | A |
| **West** | 0.53 | 0.04 | 2.758 | A | A |
| **East** | 0.67 | 0.04 | 2.769 | A | A |

### Queueing Delay results: (17:15-17:30)

| Leg | Queueing Total Delay (PCE-min) | Queueing Rate Of Delay (PCE-min/min) | Average Delay Per Arriving Vehicle (s) | Unsignalised Level Of Service | Signalised Level Of Service |
|---|---|---|---|---|---|
| **North** | 0.11 | 0.01 | 2.708 | A | A |
| **West** | 0.44 | 0.03 | 2.740 | A | A |
| **East** | 0.56 | 0.04 | 2.751 | A | A |

## Queue Variation Results for each time segment

### Queue Variation results: (16:00-16:15)

| Leg | Mean (PCE) | Q05 (PCE) | Q50 (PCE) | Q90 (PCE) | Q95 (PCE) | Percentile Message | Marker Message | Probability Of Reaching Or Exceeding Marker | Probability Of Exactly Reaching Marker |
|---|---|---|---|---|---|---|---|---|---|
| **North** | 0.01 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **West** | 0.03 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **East** | 0.04 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |

### Queue Variation results: (16:15-16:30)

| Leg | Mean (PCE) | Q05 (PCE) | Q50 (PCE) | Q90 (PCE) | Q95 (PCE) | Percentile Message | Marker Message | Probability Of Reaching Or Exceeding Marker | Probability Of Exactly Reaching Marker |
|---|---|---|---|---|---|---|---|---|---|
| **North** | 0.01 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **West** | 0.04 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **East** | 0.04 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |

## Queue Variation results: (16:30-16:45)

| Leg | Mean (PCE) | Q05 (PCE) | Q50 (PCE) | Q90 (PCE) | Q95 (PCE) | Percentile Message | Marker Message | Probability Of Reaching Or Exceeding Marker | Probability Of Exactly Reaching Marker |
|---|---|---|---|---|---|---|---|---|---|
| **North** | 0.01 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **West** | 0.04 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **East** | 0.05 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |

## Queue Variation results: (16:45-17:00)

| Leg | Mean (PCE) | Q05 (PCE) | Q50 (PCE) | Q90 (PCE) | Q95 (PCE) | Percentile Message | Marker Message | Probability Of Reaching Or Exceeding Marker | Probability Of Exactly Reaching Marker |
|---|---|---|---|---|---|---|---|---|---|
| **North** | 0.01 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **West** | 0.04 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **East** | 0.05 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |

## Queue Variation results: (17:00-17:15)

| Leg | Mean (PCE) | Q05 (PCE) | Q50 (PCE) | Q90 (PCE) | Q95 (PCE) | Percentile Message | Marker Message | Probability Of Reaching Or Exceeding Marker | Probability Of Exactly Reaching Marker |
|---|---|---|---|---|---|---|---|---|---|
| **North** | 0.01 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **West** | 0.04 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **East** | 0.04 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |

## Queue Variation results: (17:15-17:30)

| Leg | Mean (PCE) | Q05 (PCE) | Q50 (PCE) | Q90 (PCE) | Q95 (PCE) | Percentile Message | Marker Message | Probability Of Reaching Or Exceeding Marker | Probability Of Exactly Reaching Marker |
|---|---|---|---|---|---|---|---|---|---|
| **North** | 0.01 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **West** | 0.03 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **East** | 0.04 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |

Alternative 4 - Option D - No. 2

# Junctions 8

## ARCADY 8 - Roundabout Module

Version: 8.0.6.541 [19821,26/11/2015]

For sales and distribution information, program advice and maintenance, contact TRL:
Tel: +44 (0)1344 770758    email: software@trl.co.uk    Web: http://www.trlsoftware.co.uk

**Filename:** 25 and Ridge - 2 lane.arc8
**Path:** C:\Users\AdamMorrison\Paradigm\Projects - (190077) CoBruce - Bruce Road 25 EA\2 Forecasting Analysis\Arcady
**Report generation date:** 2019-08-01 6:42:50 PM

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## Summary of intersection performance

| | PM | | | | | |
|---|---|---|---|---|---|---|
| | **Queue (PCE)** | **Delay (s)** | **V/C Ratio** | **LOS** | **Intersection Delay (s)** | **Intersection LOS** |
| | **A1 - 2040** | | | | | |
| **Leg North** | 0.01 | 2.73 | 0.01 | A | 1.64 | A |
| **Leg West** | 0.02 | 1.52 | 0.02 | A | | |
| **Leg East** | 0.03 | 1.52 | 0.03 | A | | |

*Values shown are the maximum values over all time segments. Delay is the maximum value of average delay per arriving vehicle. Intersection LOS and Intersection Delay are demand-weighted averages.*

*"D1 - 2040, PM " model duration: 4:00 PM - 5:30 PM*

*Run using Junctions 8.0.6.541 at 2019-08-01 6:42:49 PM*

## File summary

| | |
|---|---|
| **Title** | (untitled) |
| **Location** | |
| **Site Number** | |
| **Date** | 2019-08-01 |
| **Version** | |
| **Status** | (new file) |
| **Identifier** | |
| **Client** | |
| **Jobnumber** | |
| **Analyst** | AdamMorrison |
| **Description** | |

## Analysis Options

| Vehicle Length (m) | Do Queue Variations | Calculate Residual Capacity | Residual Capacity Criteria Type | V/C Ratio Threshold | Average Delay Threshold (s) | Queue Threshold (PCE) |
|---|---|---|---|---|---|---|
| 5.75 | ✓ | | N/A | 0.85 | 36.00 | 20.00 |

## Units

| Distance Units | Speed Units | Traffic Units Input | Traffic Units Results | Flow Units | Average Delay Units | Total Delay Units | Rate Of Delay Units |
|---|---|---|---|---|---|---|---|
| m | kph | PCE | PCE | perHour | s | -Min | perMin |

# (Default Analysis Set) - 2040, PM

## Data Errors and Warnings

*No errors or warnings*

## Analysis Set Details

| Name | Roundabout Capacity Model | Description | Include In Report | Use Specific Demand Set(s) | Specific Demand Set (s) | Locked | Network Flow Scaling Factor (%) | Network Capacity Scaling Factor (%) | Reason For Scaling Factors |
|---|---|---|---|---|---|---|---|---|---|
| (Default Analysis Set) | ARCADY | | ✓ | | | | 100.000 | 100.000 | |

## Demand Set Details

| Name | Scenario Name | Time Period Name | Description | Traffic Profile Type | Model Start Time (HH:mm) | Model Finish Time (HH:mm) | Model Time Period Length (min) | Time Segment Length (min) | Results For Central Hour Only | Single Time Segment Only | Locked | Run Automatically | Use Relationship | Relationship |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2040, PM | 2040 | PM | | ONE HOUR | 16:00 | 17:30 | 90 | 15 | | | | ✓ | | |

# Intersection Network

## Intersections

| Intersection | Name | Intersection Type | Leg Order | Grade Separated | Large Roundabout | Do Geometric Delay | Intersection Delay (s) | Intersection LOS |
|---|---|---|---|---|---|---|---|---|
| 1 | (untitled) | Roundabout | North,West,East | | | | 1.64 | A |

## Intersection Network Options

| Driving Side | Lighting |
|---|---|
| Right | Normal/unknown |

# Legs

## Legs

| Leg | Leg | Name | Description |
|---|---|---|---|
| **North** | North | Ridge St | |
| **West** | West | County Road 25 | |
| **East** | East | County Road 25 | |

## Capacity Options

| Leg | Minimum Capacity (PCE/hr) | Maximum Capacity (PCE/hr) | Assume Flat Start Profile | Initial Queue (PCE) |
|---|---|---|---|---|
| **North** | 0.00 | 99999.00 | | 0.00 |
| **West** | 0.00 | 99999.00 | | 0.00 |
| **East** | 0.00 | 99999.00 | | 0.00 |

## Roundabout Geometry

| Leg | V - Approach road half-width (m) | E - Entry width (m) | l' - Effective flare length (m) | R - Entry radius (m) | D - Inscribed circle diameter (m) | PHI - Conflict (entry) angle (deg) | Exit Only |
|---|---|---|---|---|---|---|---|
| **North** | 3.50 | 4.50 | 30.00 | 20.00 | 55.00 | 25.00 | |
| **West** | 7.00 | 8.00 | 30.00 | 20.00 | 55.00 | 25.00 | |
| **East** | 7.00 | 8.00 | 30.00 | 20.00 | 55.00 | 25.00 | |

## Slope / Intercept / Capacity

### Roundabout Slope and Intercept used in model

| Leg | Enter slope and intercept directly | Entered slope | Entered intercept (PCE/hr) | Final Slope | Final Intercept (PCE/hr) |
|---|---|---|---|---|---|
| **North** | | (calculated) | (calculated) | 0.527 | 1357.445 |
| **West** | | (calculated) | (calculated) | 0.723 | 2436.345 |
| **East** | | (calculated) | (calculated) | 0.723 | 2436.345 |

*The slope and intercept shown above include any corrections and adjustments.*

# Traffic Flows

## Demand Set Data Options

| Default Vehicle Mix | Vehicle Mix Varies Over Time | Vehicle Mix Varies Over Turn | Vehicle Mix Varies Over Entry | Vehicle Mix Source | PCE Factor for a Truck (PCE) | Default Turning Proportions | Estimate from entry/exit counts | Turning Proportions Vary Over Time | Turning Proportions Vary Over Turn | Turning Proportions Vary Over Entry |
|---|---|---|---|---|---|---|---|---|---|---|
| | | ✓ | ✓ | Truck Percentages | 2.00 | | | | ✓ | ✓ |

# Entry Flows

## General Flows Data

| Leg | Profile Type | Use Turning Counts | Average Demand Flow (PCE/hr) | Flow Scaling Factor (%) |
|---|---|---|---|---|
| **North** | ONE HOUR | ✓ | 13.00 | 100.000 |
| **West** | ONE HOUR | ✓ | 51.00 | 100.000 |
| **East** | ONE HOUR | ✓ | 64.00 | 100.000 |

# Turning Proportions

### Turning Counts / Proportions (PCE/hr) - Intersection 1 (for whole period)

| | | To | | |
|---|---|---|---|---|
| | | North | West | East |
| From | North | 0.000 | 0.000 | 13.000 |
| | West | 0.000 | 0.000 | 51.000 |
| | East | 21.000 | 43.000 | 0.000 |

### Turning Proportions (PCE) - Intersection 1 (for whole period)

| | | To | | |
|---|---|---|---|---|
| | | North | West | East |
| From | North | 0.00 | 0.00 | 1.00 |
| | West | 0.00 | 0.00 | 1.00 |
| | East | 0.33 | 0.67 | 0.00 |

# Vehicle Mix

### Average PCE Per Vehicle - Intersection 1 (for whole period)

| | | To | | |
|---|---|---|---|---|
| | | North | West | East |
| From | North | 1.000 | 1.000 | 1.000 |
| | West | 1.000 | 1.000 | 1.000 |
| | East | 1.000 | 1.000 | 1.000 |

### Truck Percentages - Intersection 1 (for whole period)

| | | To | | |
|---|---|---|---|---|
| | | North | West | East |
| From | North | 0.0 | 0.0 | 0.0 |
| | West | 0.0 | 0.0 | 0.0 |
| | East | 0.0 | 0.0 | 0.0 |

# Results

## Results Summary for whole modelled period

| Leg | Max V/C Ratio | Max Delay (s) | Max Queue (PCE) | Max 95th percentile Queue (PCE) | Max LOS | Average Demand (PCE/hr) | Total Intersection Arrivals (PCE) | Total Queueing Delay (PCE-min) | Average Queueing Delay (s) | Rate Of Queueing Delay (PCE-min/min) | Inclusive Total Queueing Delay (PCE-min) | Inclusive Average Queueing Delay (s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **North** | 0.01 | 2.73 | 0.01 | ~1 | A | 11.93 | 17.89 | 0.81 | 2.71 | 0.01 | 0.81 | 2.71 |
| **West** | 0.02 | 1.52 | 0.02 | ~1 | A | 46.80 | 70.20 | 1.77 | 1.51 | 0.02 | 1.77 | 1.51 |
| **East** | 0.03 | 1.52 | 0.03 | ~1 | A | 58.73 | 88.09 | 2.22 | 1.51 | 0.02 | 2.22 | 1.51 |

## Main Results for each time segment

### Main results: (16:00-16:15)

| Leg | Total Demand (PCE/hr) | Intersection Arrivals (PCE) | Entry Flow (PCE/hr) | Exit Flow (PCE/hr) | Circulating Flow (PCE/hr) | Pedestrian Demand (Ped/hr) | Capacity (PCE/hr) | Saturation Capacity (PCE/hr) | V/C Ratio | Start Queue (PCE) | End Queue (PCE) | Delay (s) | LOS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **North** | 9.79 | 2.45 | 9.76 | 15.78 | 32.32 | 0.00 | 1340.42 | 495.02 | 0.007 | 0.00 | 0.01 | 2.704 | A |
| **West** | 38.40 | 9.60 | 38.33 | 32.32 | 9.76 | 0.00 | 2429.29 | 2078.47 | 0.016 | 0.00 | 0.02 | 1.505 | A |
| **East** | 48.18 | 12.05 | 48.10 | 48.09 | 0.00 | 0.00 | 2436.34 | 2436.34 | 0.020 | 0.00 | 0.02 | 1.506 | A |

### Main results: (16:15-16:30)

| Leg | Total Demand (PCE/hr) | Intersection Arrivals (PCE) | Entry Flow (PCE/hr) | Exit Flow (PCE/hr) | Circulating Flow (PCE/hr) | Pedestrian Demand (Ped/hr) | Capacity (PCE/hr) | Saturation Capacity (PCE/hr) | V/C Ratio | Start Queue (PCE) | End Queue (PCE) | Delay (s) | LOS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **North** | 11.69 | 2.92 | 11.68 | 18.87 | 38.65 | 0.00 | 1337.08 | 495.02 | 0.009 | 0.01 | 0.01 | 2.715 | A |
| **West** | 45.85 | 11.46 | 45.84 | 38.65 | 11.68 | 0.00 | 2427.90 | 2078.47 | 0.019 | 0.02 | 0.02 | 1.510 | A |
| **East** | 57.53 | 14.38 | 57.52 | 57.52 | 0.00 | 0.00 | 2436.34 | 2436.34 | 0.024 | 0.02 | 0.02 | 1.512 | A |

### Main results: (16:30-16:45)

| Leg | Total Demand (PCE/hr) | Intersection Arrivals (PCE) | Entry Flow (PCE/hr) | Exit Flow (PCE/hr) | Circulating Flow (PCE/hr) | Pedestrian Demand (Ped/hr) | Capacity (PCE/hr) | Saturation Capacity (PCE/hr) | V/C Ratio | Start Queue (PCE) | End Queue (PCE) | Delay (s) | LOS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **North** | 14.31 | 3.58 | 14.31 | 23.11 | 47.33 | 0.00 | 1332.51 | 495.02 | 0.011 | 0.01 | 0.01 | 2.730 | A |
| **West** | 56.15 | 14.04 | 56.13 | 47.33 | 14.31 | 0.00 | 2426.00 | 2078.47 | 0.023 | 0.02 | 0.02 | 1.518 | A |
| **East** | 70.47 | 17.62 | 70.44 | 70.44 | 0.00 | 0.00 | 2436.34 | 2436.34 | 0.029 | 0.02 | 0.03 | 1.520 | A |

### Main results: (16:45-17:00)

| Leg | Total Demand (PCE/hr) | Intersection Arrivals (PCE) | Entry Flow (PCE/hr) | Exit Flow (PCE/hr) | Circulating Flow (PCE/hr) | Pedestrian Demand (Ped/hr) | Capacity (PCE/hr) | Saturation Capacity (PCE/hr) | V/C Ratio | Start Queue (PCE) | End Queue (PCE) | Delay (s) | LOS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **North** | 14.31 | 3.58 | 14.31 | 23.12 | 47.34 | 0.00 | 1332.50 | 495.02 | 0.011 | 0.01 | 0.01 | 2.730 | A |
| **West** | 56.15 | 14.04 | 56.15 | 47.34 | 14.31 | 0.00 | 2426.00 | 2078.47 | 0.023 | 0.02 | 0.02 | 1.518 | A |
| **East** | 70.47 | 17.62 | 70.47 | 70.47 | 0.00 | 0.00 | 2436.34 | 2436.34 | 0.029 | 0.03 | 0.03 | 1.520 | A |

### Main results: (17:00-17:15)

| Leg | Total Demand (PCE/hr) | Intersection Arrivals (PCE) | Entry Flow (PCE/hr) | Exit Flow (PCE/hr) | Circulating Flow (PCE/hr) | Pedestrian Demand (Ped/hr) | Capacity (PCE/hr) | Saturation Capacity (PCE/hr) | V/C Ratio | Start Queue (PCE) | End Queue (PCE) | Delay (s) | LOS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **North** | 11.69 | 2.92 | 11.69 | 18.89 | 38.67 | 0.00 | 1337.07 | 495.02 | 0.009 | 0.01 | 0.01 | 2.717 | A |
| **West** | 45.85 | 11.46 | 45.87 | 38.67 | 11.69 | 0.00 | 2427.89 | 2078.47 | 0.019 | 0.02 | 0.02 | 1.510 | A |
| **East** | 57.53 | 14.38 | 57.56 | 57.56 | 0.00 | 0.00 | 2436.34 | 2436.34 | 0.024 | 0.03 | 0.02 | 1.512 | A |

### Main results: (17:15-17:30)

| Leg | Total Demand (PCE/hr) | Intersection Arrivals (PCE) | Entry Flow (PCE/hr) | Exit Flow (PCE/hr) | Circulating Flow (PCE/hr) | Pedestrian Demand (Ped/hr) | Capacity (PCE/hr) | Saturation Capacity (PCE/hr) | V/C Ratio | Start Queue (PCE) | End Queue (PCE) | Delay (s) | LOS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **North** | 9.79 | 2.45 | 9.79 | 15.82 | 32.38 | 0.00 | 1340.38 | 495.02 | 0.007 | 0.01 | 0.01 | 2.707 | A |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **West** | 38.40 | 9.60 | 38.41 | 32.38 | 9.79 | 0.00 | 2429.27 | 2078.47 | 0.016 | 0.02 | 0.02 | 1.505 | A |
| **East** | 48.18 | 12.05 | 48.20 | 48.20 | 0.00 | 0.00 | 2436.34 | 2436.34 | 0.020 | 0.02 | 0.02 | 1.509 | A |

## Queueing Delay Results for each time segment

### Queueing Delay results: (16:00-16:15)

| Leg | Queueing Total Delay (PCE-min) | Queueing Rate Of Delay (PCE-min/min) | Average Delay Per Arriving Vehicle (s) | Unsignalised Level Of Service | Signalised Level Of Service |
|---|---|---|---|---|---|
| **North** | 0.11 | 0.01 | 2.704 | A | A |
| **West** | 0.24 | 0.02 | 1.505 | A | A |
| **East** | 0.30 | 0.02 | 1.506 | A | A |

### Queueing Delay results: (16:15-16:30)

| Leg | Queueing Total Delay (PCE-min) | Queueing Rate Of Delay (PCE-min/min) | Average Delay Per Arriving Vehicle (s) | Unsignalised Level Of Service | Signalised Level Of Service |
|---|---|---|---|---|---|
| **North** | 0.13 | 0.01 | 2.715 | A | A |
| **West** | 0.29 | 0.02 | 1.510 | A | A |
| **East** | 0.36 | 0.02 | 1.512 | A | A |

### Queueing Delay results: (16:30-16:45)

| Leg | Queueing Total Delay (PCE-min) | Queueing Rate Of Delay (PCE-min/min) | Average Delay Per Arriving Vehicle (s) | Unsignalised Level Of Service | Signalised Level Of Service |
|---|---|---|---|---|---|
| **North** | 0.16 | 0.01 | 2.730 | A | A |
| **West** | 0.35 | 0.02 | 1.518 | A | A |
| **East** | 0.44 | 0.03 | 1.520 | A | A |

### Queueing Delay results: (16:45-17:00)

| Leg | Queueing Total Delay (PCE-min) | Queueing Rate Of Delay (PCE-min/min) | Average Delay Per Arriving Vehicle (s) | Unsignalised Level Of Service | Signalised Level Of Service |
|---|---|---|---|---|---|
| **North** | 0.16 | 0.01 | 2.730 | A | A |
| **West** | 0.36 | 0.02 | 1.518 | A | A |
| **East** | 0.45 | 0.03 | 1.520 | A | A |

### Queueing Delay results: (17:00-17:15)

| Leg | Queueing Total Delay (PCE-min) | Queueing Rate Of Delay (PCE-min/min) | Average Delay Per Arriving Vehicle (s) | Unsignalised Level Of Service | Signalised Level Of Service |
|---|---|---|---|---|---|
| **North** | 0.13 | 0.01 | 2.717 | A | A |
| **West** | 0.29 | 0.02 | 1.510 | A | A |
| **East** | 0.37 | 0.02 | 1.512 | A | A |

### Queueing Delay results: (17:15-17:30)

| Leg | Queueing Total Delay (PCE-min) | Queueing Rate Of Delay (PCE-min/min) | Average Delay Per Arriving Vehicle (s) | Unsignalised Level Of Service | Signalised Level Of Service |
|---|---|---|---|---|---|
| **North** | 0.11 | 0.01 | 2.707 | A | A |
| **West** | 0.24 | 0.02 | 1.505 | A | A |
| **East** | 0.31 | 0.02 | 1.509 | A | A |

## Queue Variation Results for each time segment

### Queue Variation results: (16:00-16:15)

| Leg | Mean (PCE) | Q05 (PCE) | Q50 (PCE) | Q90 (PCE) | Q95 (PCE) | Percentile Message | Marker Message | Probability Of Reaching Or Exceeding Marker | Probability Of Exactly Reaching Marker |
|---|---|---|---|---|---|---|---|---|---|
| **North** | 0.01 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **West** | 0.02 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **East** | 0.02 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |

### Queue Variation results: (16:15-16:30)

| Leg | Mean (PCE) | Q05 (PCE) | Q50 (PCE) | Q90 (PCE) | Q95 (PCE) | Percentile Message | Marker Message | Probability Of Reaching Or Exceeding Marker | Probability Of Exactly Reaching Marker |
|---|---|---|---|---|---|---|---|---|---|
| **North** | 0.01 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **West** | 0.02 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **East** | 0.02 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |

## Queue Variation results: (16:30-16:45)

| Leg | Mean (PCE) | Q05 (PCE) | Q50 (PCE) | Q90 (PCE) | Q95 (PCE) | Percentile Message | Marker Message | Probability Of Reaching Or Exceeding Marker | Probability Of Exactly Reaching Marker |
|---|---|---|---|---|---|---|---|---|---|
| **North** | 0.01 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **West** | 0.02 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **East** | 0.03 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |

## Queue Variation results: (16:45-17:00)

| Leg | Mean (PCE) | Q05 (PCE) | Q50 (PCE) | Q90 (PCE) | Q95 (PCE) | Percentile Message | Marker Message | Probability Of Reaching Or Exceeding Marker | Probability Of Exactly Reaching Marker |
|---|---|---|---|---|---|---|---|---|---|
| **North** | 0.01 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **West** | 0.02 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **East** | 0.03 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |

## Queue Variation results: (17:00-17:15)

| Leg | Mean (PCE) | Q05 (PCE) | Q50 (PCE) | Q90 (PCE) | Q95 (PCE) | Percentile Message | Marker Message | Probability Of Reaching Or Exceeding Marker | Probability Of Exactly Reaching Marker |
|---|---|---|---|---|---|---|---|---|---|
| **North** | 0.01 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **West** | 0.02 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **East** | 0.02 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |

## Queue Variation results: (17:15-17:30)

| Leg | Mean (PCE) | Q05 (PCE) | Q50 (PCE) | Q90 (PCE) | Q95 (PCE) | Percentile Message | Marker Message | Probability Of Reaching Or Exceeding Marker | Probability Of Exactly Reaching Marker |
|---|---|---|---|---|---|---|---|---|---|
| **North** | 0.01 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **West** | 0.02 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |
| **East** | 0.02 | ~1 | ~1 | ~1 | ~1 | Percentiles could not be calculated. This may be because the mean queue is very small or very big. | | N/A | N/A |

# Alternative 5

# Existing Intersection of Bruce Road 25 and Concession Road 6 with Goderich Street (Highway 21)

# 1: Goderich Street & Bruce County Road 25/Concession Road 6

| Lane Group | EBL | EBT | WBL | WBT | NBL | NBT | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|
| Lane Group Flow (vph) | 295 | 96 | 13 | 64 | 128 | 1130 | 92 | 363 | 128 |
| v/c Ratio | 0.80 | 0.21 | 0.03 | 0.12 | 0.37 | 0.77 | 0.72 | 0.23 | 0.17 |
| Control Delay | 38.3 | 8.0 | 14.8 | 10.5 | 18.9 | 22.2 | 56.0 | 13.7 | 3.8 |
| Queue Delay | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Delay | 38.3 | 8.0 | 14.8 | 10.5 | 18.9 | 22.2 | 56.0 | 13.7 | 3.8 |
| Queue Length 50th (m) | 35.6 | 2.6 | 1.2 | 3.4 | 11.1 | 65.0 | 9.8 | 15.5 | 0.0 |
| Queue Length 95th (m) | 64.4 | 11.7 | 4.5 | 10.8 | 28.9 | #117.7 | #39.6 | 28.6 | 9.7 |
| Internal Link Dist (m) |  | 171.0 |  | 387.3 |  | 265.8 |  | 282.8 |  |
| Turn Bay Length (m) | 85.0 |  | 50.0 |  | 75.0 |  | 65.0 |  | 70.0 |
| Base Capacity (vph) | 492 | 578 | 579 | 716 | 345 | 1466 | 127 | 1552 | 759 |
| Starvation Cap Reductn | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Spillback Cap Reductn | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Storage Cap Reductn | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Reduced v/c Ratio | 0.60 | 0.17 | 0.02 | 0.09 | 0.37 | 0.77 | 0.72 | 0.23 | 0.17 |

Intersection Summary

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

## 1: Goderich Street & Bruce County Road 25/Concession Road 6

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | ↰ | ↱ |  | ↰ | ↱ |  | ↰ | ↑↱ |  | ↰ | ↑↑ | ↱ |
| Traffic Volume (vph) | 271 | 27 | 62 | 12 | 10 | 49 | 118 | 991 | 49 | 85 | 334 | 118 |
| Future Volume (vph) | 271 | 27 | 62 | 12 | 10 | 49 | 118 | 991 | 49 | 85 | 334 | 118 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | 8.0 | 8.0 |  | 8.0 | 8.0 |  | 8.0 | 8.0 |  | 8.0 | 8.0 | 8.0 |
| Lane Util. Factor | 1.00 | 1.00 |  | 1.00 | 1.00 |  | 1.00 | 0.95 |  | 1.00 | 0.95 | 1.00 |
| Frt | 1.00 | 0.90 |  | 1.00 | 0.88 |  | 1.00 | 0.99 |  | 1.00 | 1.00 | 0.85 |
| Flt Protected | 0.95 | 1.00 |  | 0.95 | 1.00 |  | 0.95 | 1.00 |  | 0.95 | 1.00 | 1.00 |
| Satd. Flow (prot) | 1492 | 1234 |  | 1805 | 1598 |  | 1399 | 3331 |  | 1719 | 3539 | 1568 |
| Flt Permitted | 0.72 | 1.00 |  | 0.69 | 1.00 |  | 0.54 | 1.00 |  | 0.16 | 1.00 | 1.00 |
| Satd. Flow (perm) | 1123 | 1234 |  | 1320 | 1598 |  | 788 | 3331 |  | 290 | 3539 | 1568 |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 295 | 29 | 67 | 13 | 11 | 53 | 128 | 1077 | 53 | 92 | 363 | 128 |
| RTOR Reduction (vph) | 0 | 45 | 0 | 0 | 18 | 0 | 0 | 4 | 0 | 0 | 0 | 72 |
| Lane Group Flow (vph) | 295 | 51 | 0 | 13 | 46 | 0 | 128 | 1126 | 0 | 92 | 363 | 56 |
| Heavy Vehicles (%) | 21% | 33% | 40% | 0% | 0% | 5% | 29% | 8% | 0% | 5% | 2% | 3% |
| Turn Type | Perm | NA |  | Perm | NA |  | Perm | NA |  | Perm | NA | Perm |
| Protected Phases |  | 4 |  |  | 8 |  |  | 2 |  |  | 6 |  |
| Permitted Phases | 4 |  |  | 8 |  |  | 2 |  |  | 6 |  | 6 |
| Actuated Green, G (s) | 22.5 | 22.5 |  | 22.5 | 22.5 |  | 30.2 | 30.2 |  | 30.2 | 30.2 | 30.2 |
| Effective Green, g (s) | 22.5 | 22.5 |  | 22.5 | 22.5 |  | 30.2 | 30.2 |  | 30.2 | 30.2 | 30.2 |
| Actuated g/C Ratio | 0.33 | 0.33 |  | 0.33 | 0.33 |  | 0.44 | 0.44 |  | 0.44 | 0.44 | 0.44 |
| Clearance Time (s) | 8.0 | 8.0 |  | 8.0 | 8.0 |  | 8.0 | 8.0 |  | 8.0 | 8.0 | 8.0 |
| Vehicle Extension (s) | 3.0 | 3.0 |  | 3.0 | 3.0 |  | 3.0 | 3.0 |  | 3.0 | 3.0 | 3.0 |
| Lane Grp Cap (vph) | 367 | 404 |  | 432 | 523 |  | 346 | 1464 |  | 127 | 1555 | 689 |
| v/s Ratio Prot |  | 0.04 |  |  | 0.03 |  |  | c0.34 |  |  | 0.10 |  |
| v/s Ratio Perm | c0.26 |  |  | 0.01 |  |  | 0.16 |  |  | 0.32 |  | 0.04 |
| v/c Ratio | 0.80 | 0.13 |  | 0.03 | 0.09 |  | 0.37 | 0.77 |  | 0.72 | 0.23 | 0.08 |
| Uniform Delay, d1 | 21.1 | 16.2 |  | 15.7 | 16.0 |  | 12.9 | 16.3 |  | 15.8 | 12.0 | 11.2 |
| Progression Factor | 1.00 | 1.00 |  | 1.00 | 1.00 |  | 1.00 | 1.00 |  | 1.00 | 1.00 | 1.00 |
| Incremental Delay, d2 | 12.0 | 0.1 |  | 0.0 | 0.1 |  | 0.7 | 2.5 |  | 18.4 | 0.1 | 0.1 |
| Delay (s) | 33.1 | 16.3 |  | 15.7 | 16.1 |  | 13.6 | 18.8 |  | 34.3 | 12.1 | 11.2 |
| Level of Service | C | B |  | B | B |  | B | B |  | C | B | B |
| Approach Delay (s) |  | 29.0 |  |  | 16.0 |  |  | 18.3 |  |  | 15.4 |  |
| Approach LOS |  | C |  |  | B |  |  | B |  |  | B |  |

| Intersection Summary |  |  |  |
|---|---|---|---|
| HCM 2000 Control Delay | 19.3 | HCM 2000 Level of Service | B |
| HCM 2000 Volume to Capacity ratio | 0.78 |  |  |
| Actuated Cycle Length (s) | 68.7 | Sum of lost time (s) | 16.0 |
| Intersection Capacity Utilization | 95.6% | ICU Level of Service | F |
| Analysis Period (min) | 15 |  |  |
| c Critical Lane Group |  |  |  |

## 1: Goderich Street & Bruce County Road 25/Concession Road 6

| | ↗ | → | ← | ↖ | ↑ | ↘ | ↓ | ↙ |
|---|---|---|---|---|---|---|---|---|
| Lane Group | EBL | EBT | WBT | NBL | NBT | SBL | SBT | SBR |
| Lane Group Flow (vph) | 295 | 96 | 77 | 128 | 1130 | 92 | 363 | 128 |
| v/c Ratio | 0.82 | 0.21 | 0.08 | 0.36 | 0.75 | 0.70 | 0.23 | 0.16 |
| Control Delay | 41.9 | 8.6 | 10.3 | 18.5 | 21.3 | 50.4 | 13.6 | 3.5 |
| Queue Delay | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Delay | 41.9 | 8.6 | 10.3 | 18.5 | 21.3 | 50.4 | 13.6 | 3.5 |
| Queue Length 50th (m) | 39.4 | 2.9 | 2.1 | 12.0 | 70.0 | 10.5 | 16.6 | 0.0 |
| Queue Length 95th (m) | #77.7 | 12.7 | 6.5 | 28.6 | 105.8 | #39.0 | 28.2 | 9.5 |
| Internal Link Dist (m) | | 171.0 | 387.3 | | 265.8 | | 282.8 | |
| Turn Bay Length (m) | 85.0 | | | 75.0 | | 65.0 | | 70.0 |
| Base Capacity (vph) | 463 | 556 | 1211 | 374 | 1587 | 140 | 1682 | 812 |
| Starvation Cap Reductn | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Spillback Cap Reductn | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Storage Cap Reductn | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Reduced v/c Ratio | 0.64 | 0.17 | 0.06 | 0.34 | 0.71 | 0.66 | 0.22 | 0.16 |

Intersection Summary

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

## 1: Goderich Street & Bruce County Road 25/Concession Road 6

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | ↰ | ↱ |  |  | ↰↱ |  | ↰ | ↑↱ |  | ↰ | ↑↑ | ↱ |
| Traffic Volume (vph) | 271 | 27 | 62 | 12 | 10 | 49 | 118 | 991 | 49 | 85 | 334 | 118 |
| Future Volume (vph) | 271 | 27 | 62 | 12 | 10 | 49 | 118 | 991 | 49 | 85 | 334 | 118 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | 8.0 | 8.0 |  |  | 8.0 |  | 8.0 | 8.0 |  | 8.0 | 8.0 | 8.0 |
| Lane Util. Factor | 1.00 | 1.00 |  |  | 0.95 |  | 1.00 | 0.95 |  | 1.00 | 0.95 | 1.00 |
| Frt | 1.00 | 0.90 |  |  | 0.90 |  | 1.00 | 0.99 |  | 1.00 | 1.00 | 0.85 |
| Flt Protected | 0.95 | 1.00 |  |  | 0.99 |  | 0.95 | 1.00 |  | 0.95 | 1.00 | 1.00 |
| Satd. Flow (prot) | 1492 | 1234 |  |  | 3103 |  | 1399 | 3331 |  | 1719 | 3539 | 1568 |
| Flt Permitted | 0.70 | 1.00 |  |  | 0.91 |  | 0.54 | 1.00 |  | 0.16 | 1.00 | 1.00 |
| Satd. Flow (perm) | 1106 | 1234 |  |  | 2840 |  | 788 | 3331 |  | 294 | 3539 | 1568 |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 295 | 29 | 67 | 13 | 11 | 53 | 128 | 1077 | 53 | 92 | 363 | 128 |
| RTOR Reduction (vph) | 0 | 45 | 0 | 0 | 24 | 0 | 0 | 4 | 0 | 0 | 0 | 70 |
| Lane Group Flow (vph) | 295 | 51 | 0 | 0 | 53 | 0 | 128 | 1126 | 0 | 92 | 363 | 58 |
| Heavy Vehicles (%) | 21% | 33% | 40% | 0% | 0% | 5% | 29% | 8% | 0% | 5% | 2% | 3% |
| Turn Type | Perm | NA |  | Perm | NA |  | Perm | NA |  | Perm | NA | Perm |
| Protected Phases |  | 4 |  |  | 8 |  |  | 2 |  |  | 6 |  |
| Permitted Phases | 4 |  |  | 8 |  |  | 2 |  |  | 6 |  | 6 |
| Actuated Green, G (s) | 23.6 | 23.6 |  |  | 23.6 |  | 32.6 | 32.6 |  | 32.6 | 32.6 | 32.6 |
| Effective Green, g (s) | 23.6 | 23.6 |  |  | 23.6 |  | 32.6 | 32.6 |  | 32.6 | 32.6 | 32.6 |
| Actuated g/C Ratio | 0.33 | 0.33 |  |  | 0.33 |  | 0.45 | 0.45 |  | 0.45 | 0.45 | 0.45 |
| Clearance Time (s) | 8.0 | 8.0 |  |  | 8.0 |  | 8.0 | 8.0 |  | 8.0 | 8.0 | 8.0 |
| Vehicle Extension (s) | 3.0 | 3.0 |  |  | 3.0 |  | 3.0 | 3.0 |  | 3.0 | 3.0 | 3.0 |
| Lane Grp Cap (vph) | 361 | 403 |  |  | 928 |  | 355 | 1504 |  | 132 | 1597 | 707 |
| v/s Ratio Prot |  | 0.04 |  |  |  |  |  | c0.34 |  |  | 0.10 |  |
| v/s Ratio Perm | c0.27 |  |  |  | 0.02 |  | 0.16 |  |  | 0.31 |  | 0.04 |
| v/c Ratio | 0.82 | 0.13 |  |  | 0.06 |  | 0.36 | 0.75 |  | 0.70 | 0.23 | 0.08 |
| Uniform Delay, d1 | 22.3 | 17.1 |  |  | 16.7 |  | 13.0 | 16.4 |  | 15.8 | 12.1 | 11.3 |
| Progression Factor | 1.00 | 1.00 |  |  | 1.00 |  | 1.00 | 1.00 |  | 1.00 | 1.00 | 1.00 |
| Incremental Delay, d2 | 13.3 | 0.1 |  |  | 0.0 |  | 0.6 | 2.1 |  | 14.8 | 0.1 | 0.0 |
| Delay (s) | 35.7 | 17.2 |  |  | 16.7 |  | 13.6 | 18.5 |  | 30.7 | 12.2 | 11.3 |
| Level of Service | D | B |  |  | B |  | B | B |  | C | B | B |
| Approach Delay (s) |  | 31.1 |  |  | 16.7 |  |  | 18.0 |  |  | 14.9 |  |
| Approach LOS |  | C |  |  | B |  |  | B |  |  | B |  |

| Intersection Summary |  |  |  |
|---|---|---|---|
| HCM 2000 Control Delay | 19.4 | HCM 2000 Level of Service | B |
| HCM 2000 Volume to Capacity ratio | 0.78 |  |  |
| Actuated Cycle Length (s) | 72.2 | Sum of lost time (s) | 16.0 |
| Intersection Capacity Utilization | 95.6% | ICU Level of Service | F |
| Analysis Period (min) | 15 |  |  |
| c Critical Lane Group |  |  |  |

# Queues

## 1: Goderich Street & Bruce County Road 25/Concession Road 6

| | ↗ | → | ↙ | ← | ↖ | ↑ | ↘ | ↓ | ↙ |
|---|---|---|---|---|---|---|---|---|---|
| Lane Group | EBL | EBT | WBL | WBT | NBL | NBT | SBL | SBT | SBR |
| Lane Group Flow (vph) | 295 | 96 | 13 | 64 | 128 | 1130 | 92 | 363 | 128 |
| v/c Ratio | 0.81 | 0.12 | 0.03 | 0.06 | 0.36 | 0.75 | 0.69 | 0.23 | 0.16 |
| Control Delay | 41.0 | 7.6 | 16.3 | 9.2 | 18.4 | 21.2 | 50.1 | 13.6 | 3.5 |
| Queue Delay | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Delay | 41.0 | 7.6 | 16.3 | 9.2 | 18.4 | 21.2 | 50.1 | 13.6 | 3.5 |
| Queue Length 50th (m) | 39.2 | 1.5 | 1.3 | 1.4 | 11.8 | 68.9 | 10.3 | 16.4 | 0.0 |
| Queue Length 95th (m) | #76.7 | 6.3 | 4.9 | 5.3 | 28.6 | 105.8 | #39.0 | 28.2 | 9.5 |
| Internal Link Dist (m) | | 171.0 | | 387.3 | | 265.8 | | 282.8 | |
| Turn Bay Length (m) | 85.0 | | 50.0 | | 75.0 | | 65.0 | | 70.0 |
| Base Capacity (vph) | 471 | 1023 | 553 | 1297 | 375 | 1591 | 140 | 1686 | 814 |
| Starvation Cap Reductn | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Spillback Cap Reductn | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Storage Cap Reductn | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Reduced v/c Ratio | 0.63 | 0.09 | 0.02 | 0.05 | 0.34 | 0.71 | 0.66 | 0.22 | 0.16 |

Intersection Summary

# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

## 1: Goderich Street & Bruce County Road 25/Concession Road 6

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | ↰ | ↑↱ |  | ↰ | ↑↱ |  | ↰ | ↑↱ |  | ↰ | ↑↑ | ↱ |
| Traffic Volume (vph) | 271 | 27 | 62 | 12 | 10 | 49 | 118 | 991 | 49 | 85 | 334 | 118 |
| Future Volume (vph) | 271 | 27 | 62 | 12 | 10 | 49 | 118 | 991 | 49 | 85 | 334 | 118 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | 8.0 | 8.0 |  | 8.0 | 8.0 |  | 8.0 | 8.0 |  | 8.0 | 8.0 | 8.0 |
| Lane Util. Factor | 1.00 | 0.95 |  | 1.00 | 0.95 |  | 1.00 | 0.95 |  | 1.00 | 0.95 | 1.00 |
| Frt | 1.00 | 0.90 |  | 1.00 | 0.88 |  | 1.00 | 0.99 |  | 1.00 | 1.00 | 0.85 |
| Flt Protected | 0.95 | 1.00 |  | 0.95 | 1.00 |  | 0.95 | 1.00 |  | 0.95 | 1.00 | 1.00 |
| Satd. Flow (prot) | 1492 | 2344 |  | 1805 | 3036 |  | 1399 | 3331 |  | 1719 | 3539 | 1568 |
| Flt Permitted | 0.71 | 1.00 |  | 0.69 | 1.00 |  | 0.54 | 1.00 |  | 0.16 | 1.00 | 1.00 |
| Satd. Flow (perm) | 1120 | 2344 |  | 1314 | 3036 |  | 788 | 3331 |  | 296 | 3539 | 1568 |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 295 | 29 | 67 | 13 | 11 | 53 | 128 | 1077 | 53 | 92 | 363 | 128 |
| RTOR Reduction (vph) | 0 | 45 | 0 | 0 | 24 | 0 | 0 | 4 | 0 | 0 | 0 | 70 |
| Lane Group Flow (vph) | 295 | 51 | 0 | 13 | 40 | 0 | 128 | 1126 | 0 | 92 | 363 | 58 |
| Heavy Vehicles (%) | 21% | 33% | 40% | 0% | 0% | 5% | 29% | 8% | 0% | 5% | 2% | 3% |
| Turn Type | Perm | NA |  | Perm | NA |  | Perm | NA |  | Perm | NA | Perm |
| Protected Phases |  | 4 |  |  | 8 |  |  | 2 |  |  | 6 |  |
| Permitted Phases | 4 |  |  | 8 |  |  | 2 |  |  | 6 |  | 6 |
| Actuated Green, G (s) | 23.4 | 23.4 |  | 23.4 | 23.4 |  | 32.6 | 32.6 |  | 32.6 | 32.6 | 32.6 |
| Effective Green, g (s) | 23.4 | 23.4 |  | 23.4 | 23.4 |  | 32.6 | 32.6 |  | 32.6 | 32.6 | 32.6 |
| Actuated g/C Ratio | 0.32 | 0.32 |  | 0.32 | 0.32 |  | 0.45 | 0.45 |  | 0.45 | 0.45 | 0.45 |
| Clearance Time (s) | 8.0 | 8.0 |  | 8.0 | 8.0 |  | 8.0 | 8.0 |  | 8.0 | 8.0 | 8.0 |
| Vehicle Extension (s) | 3.0 | 3.0 |  | 3.0 | 3.0 |  | 3.0 | 3.0 |  | 3.0 | 3.0 | 3.0 |
| Lane Grp Cap (vph) | 364 | 761 |  | 427 | 986 |  | 356 | 1508 |  | 134 | 1602 | 709 |
| v/s Ratio Prot |  | 0.02 |  |  | 0.01 |  |  | c0.34 |  |  | 0.10 |  |
| v/s Ratio Perm | c0.26 |  |  | 0.01 |  |  | 0.16 |  |  | 0.31 |  | 0.04 |
| v/c Ratio | 0.81 | 0.07 |  | 0.03 | 0.04 |  | 0.36 | 0.75 |  | 0.69 | 0.23 | 0.08 |
| Uniform Delay, d1 | 22.3 | 16.8 |  | 16.6 | 16.6 |  | 12.9 | 16.3 |  | 15.6 | 12.0 | 11.2 |
| Progression Factor | 1.00 | 1.00 |  | 1.00 | 1.00 |  | 1.00 | 1.00 |  | 1.00 | 1.00 | 1.00 |
| Incremental Delay, d2 | 12.8 | 0.0 |  | 0.0 | 0.0 |  | 0.6 | 2.1 |  | 13.6 | 0.1 | 0.0 |
| Delay (s) | 35.1 | 16.8 |  | 16.6 | 16.6 |  | 13.5 | 18.3 |  | 29.3 | 12.1 | 11.2 |
| Level of Service | D | B |  | B | B |  | B | B |  | C | B | B |
| Approach Delay (s) |  | 30.6 |  |  | 16.6 |  |  | 17.8 |  |  | 14.6 |  |
| Approach LOS |  | C |  |  | B |  |  | B |  |  | B |  |

| Intersection Summary |  |  |  |
|---|---|---|---|
| HCM 2000 Control Delay | 19.1 | HCM 2000 Level of Service | B |
| HCM 2000 Volume to Capacity ratio | 0.77 |  |  |
| Actuated Cycle Length (s) | 72.0 | Sum of lost time (s) | 16.0 |
| Intersection Capacity Utilization | 95.6% | ICU Level of Service | F |
| Analysis Period (min) | 15 |  |  |
| c Critical Lane Group |  |  |  |

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December 23, 2019 Reference No. 192089

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GM BluePlan Engineering Limited
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**Re: Traffic Control Evaluation, Bruce County Road 25 and Road 33**

## 1 Introduction

Bruce County Road 25 and Road 33 are located in the Town of Saugeen Shores, Ontario. The study area, illustrated in Figure 1, comprises Road 25 between Goderich Street (Highway 21) to the east, and Road 33 to the west. The area has experienced significant development pressures and continues to evolve from rural to urban land uses; future developments will extend three roads to create new intersections with Bruce County Road 25.

Figure 1: Study area context

The *Bruce Roads 25 and 33 Roads and Drainage Master Plan, July 2016* was completed to perform a comprehensive review of road and drainage systems in the area and develop a comprehensive planning strategy. The preferred alternative recommended by the Master Plan includes two major changes to the road system:

1. The realignment of Road 33 to intersect Road 25 at the future Bruce Street location. The new intersection would be signalized with dedicated left turn lanes all approaches.
2. The widening of Bruce Road 25 from Highway 21 to the future Bruce Street location

The *Bruce Road 25 Class EA Transportation Assessment, November 2019* was completed in support of the proposed widening of Bruce Road 25 to determine intersection configurations and basic lane requirements for the subject section of Bruce Road 25. The transportation assessment concluded that a four-lane cross-section was not necessary from an operational perspective to accommodate future traffic forecasts and that the future intersection of Bruce County Road 25, Road 33 and Bruce Street would operate at acceptable levels of service under two-way stop control, traffic control signals or roundabout control. The report recommended:

1. Maintaining a two-lane cross section on Road 25.
2. Providing two-way stop control at the intersection of Road 25, Road 33 and Bruce Street with one lane per direction on each approach and stop control on Route 33 and Bruce Street.
3. Providing a buffered multi-use trail along the north side of Road 25 with appropriate crossing treatments at intersections.

The subsequent *Bruce County Road 33 -Re-Alignment Schedule B Municipal Class EA, April 2018 (Update November 2019)* recommended that the ultimate configuration of the Road 25, Road 33 and Bruce Street should be reconsidered when Bruce Street is constructed and that roundabout control should be considered.

The traffic control evaluation was completed to address the recommendation of *Bruce County Road 33 - Re-Alignment Schedule B Municipal Class EA* to consider roundabout control at the intersection of Bruce County Road 25, re-aligned Road 33 and Bruce Street. This technical memorandum details the review of the intersection, the development of a roundabout option, the evaluation of traffic control options and the identification of a preferred option.

## 2 Traffic Control Options

There types of traffic control were considered for the intersection of Bruce County Road 25, Road 33 and Bruce Street: two-way stop control (TWSC), traffic control signals (TCS) and roundabout control (RDBT). The TCS and RBDT options were considered under both the 2-lane cross section on Road 25 and widening to a 4-lane cross section on Road 25. The traffic control options include:

- **Option 0 TWSC:** The TWSC option a 2-lane cross section on Road 25 and Road 33. The TWSC configuration includes one lane per direction on each approach with stop control on Route 33 and Bruce Street. The TWSC option was used as the base case to compare traffic control options.

- **Option 1 TCS BR25 2-LN:** The traffic control signal option for a 2-lane cross section on Road 25 and Road 33. The traffic control signal configuration includes one lane per direction on each approach. The intersection configuration is illustrated in Figure 2.
- **Option 2 SGL RDBT:** The roundabout option for a 2-lane cross section on Road 25 and Road 33. The single lane roundabout option has single lane entries on all approaches and a 35 metre inscribed circle diameter. The single lane roundabout configuration is illustrated in Figure 3.
- **Option 3 TCS BR25 4-LN**: The traffic control signal option for a 4-lane cross section on Road 25 and a 2-lane cross section on Road 33. The traffic control signal configuration includes three lanes on Road 25 approaches (left lane, through lane and shared through/right lane) and two lanes on Road 33 and Bruce Street approaches (left lane and shared through/right lane). This traffic control signal option was recommended in the *Bruce Road 25 Class EA Transportation Assessment*. The intersection configuration is illustrated in Figure 4.
- **Option 4 MULT RDBT:** The roundabout option for a 4-lane cross section on Road 25 and a 2-lane cross section on Road 33. The multilane roundabout has two lane entries on Road 25 and single lane entries on Road 33 and Bruce Street and a 45 metre inscribed circle diameter. The roundabout configuration is illustrated in Figure 5.

## 3 Land Acquisition

Approximate land acquisition areas required for the construction of each traffic control option were estimated based on the conceptual drawings. The roundabout options will require additional land acquisition when compared to the traffic control signal options. Land acquisition should be refined where possible during detailed design.

| | |
|---|---|
| Option 2 SGL RDBT | 25 $m^2$ |
| Option 4 MULT RDBT | 300 $m^2$ |

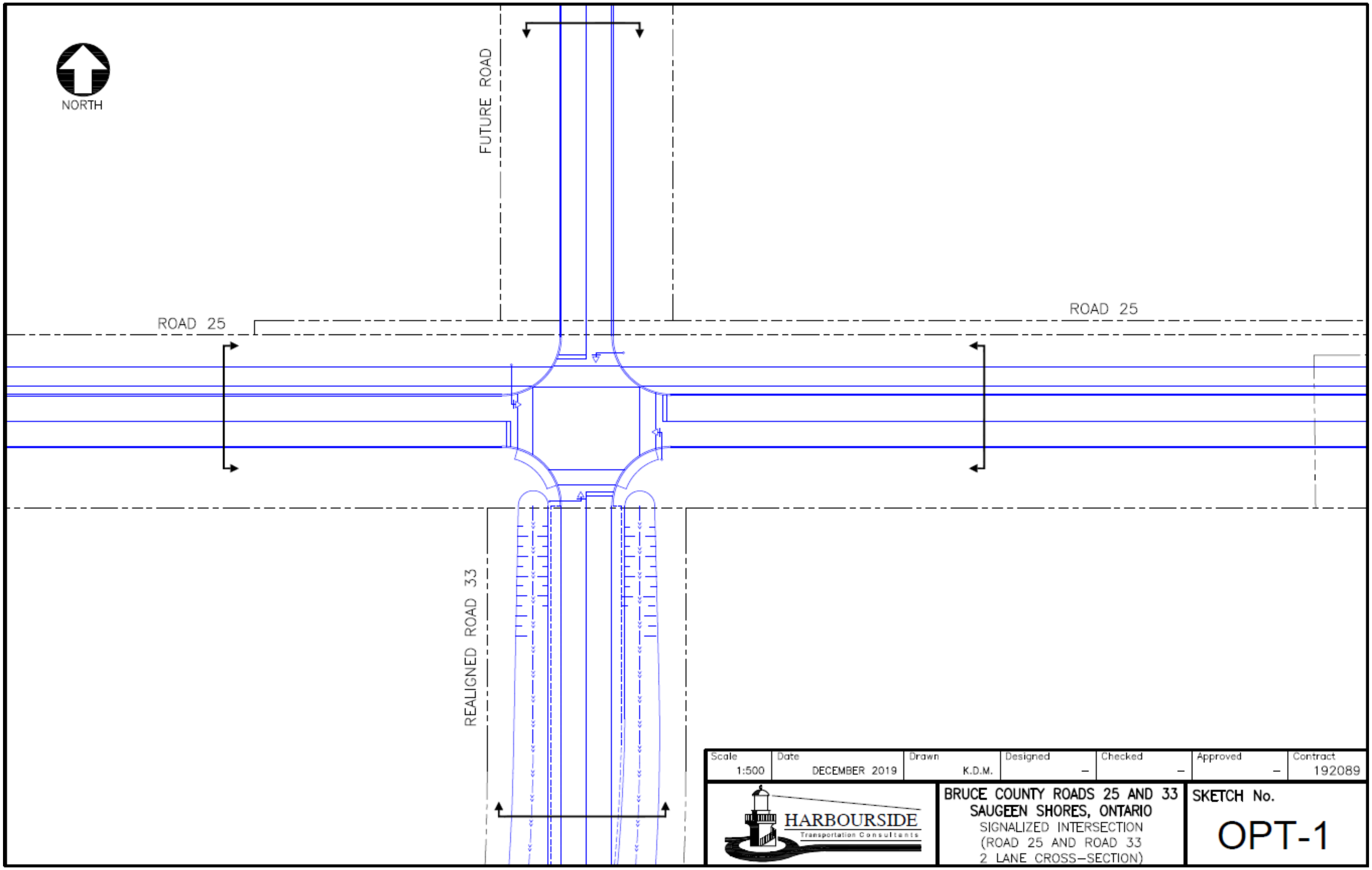


Figure 2: Traffic control signal concept

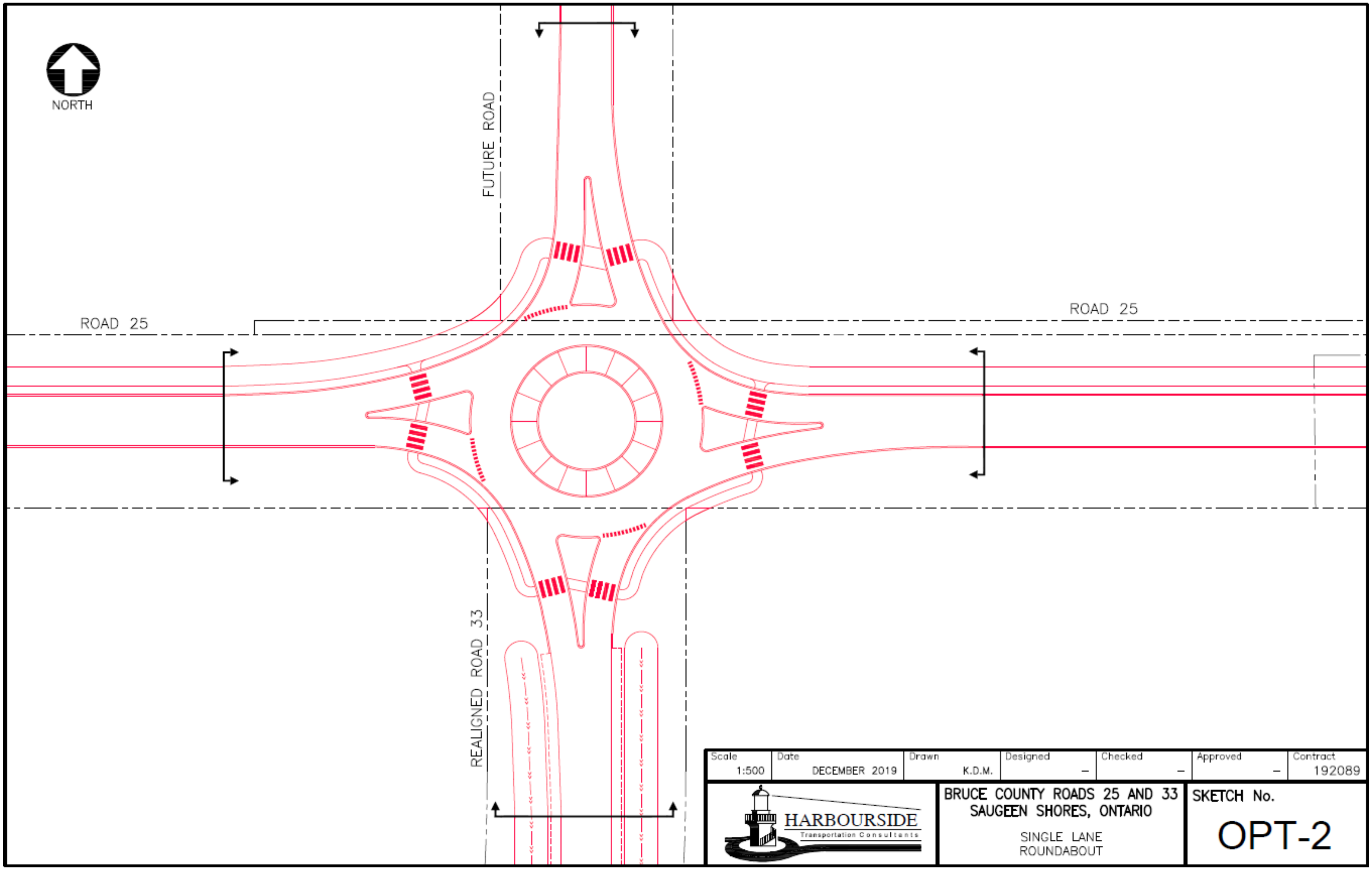


Figure 3: Single lane roundabout concept

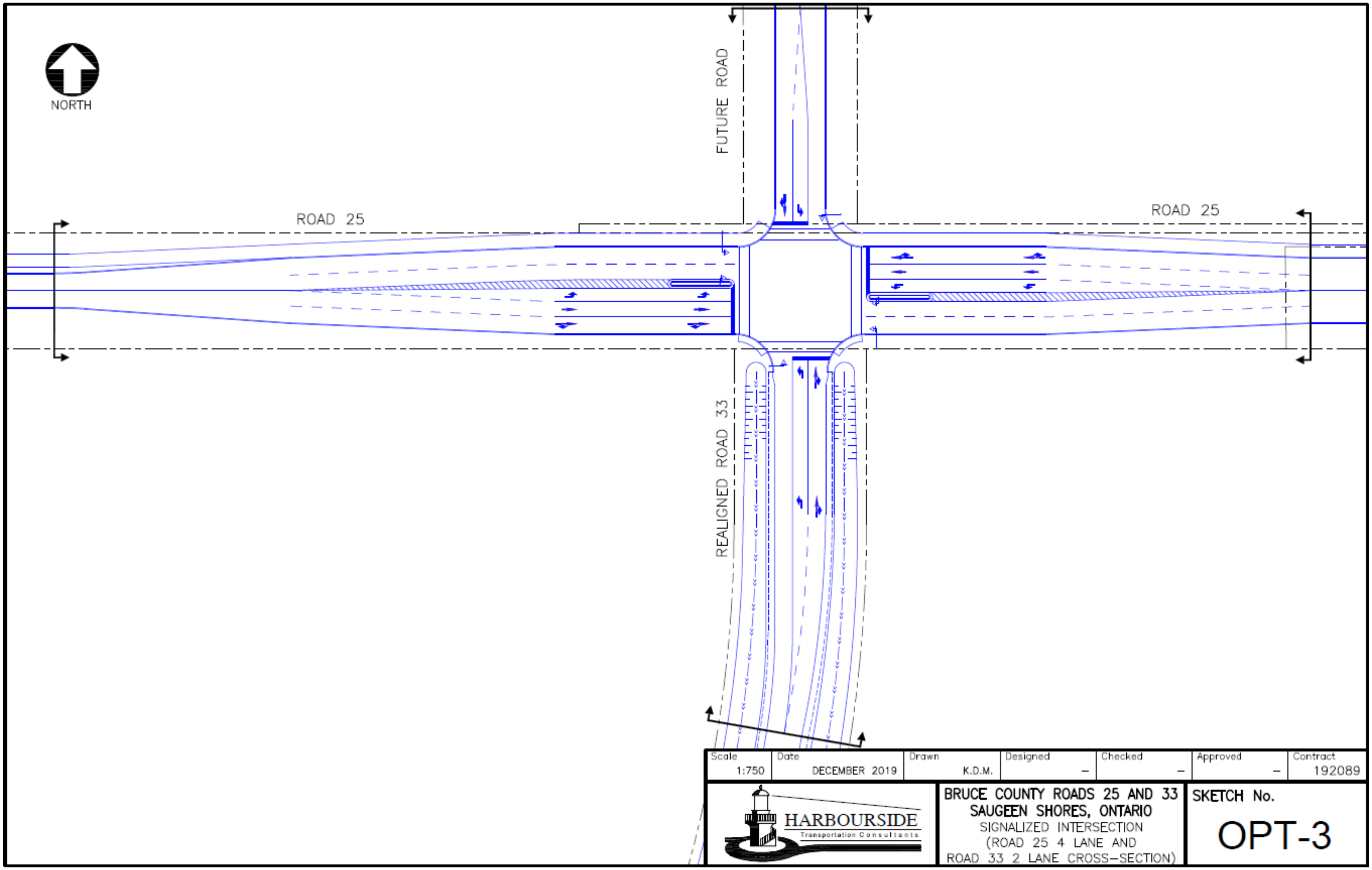


Figure 4: Traffic control signal concept

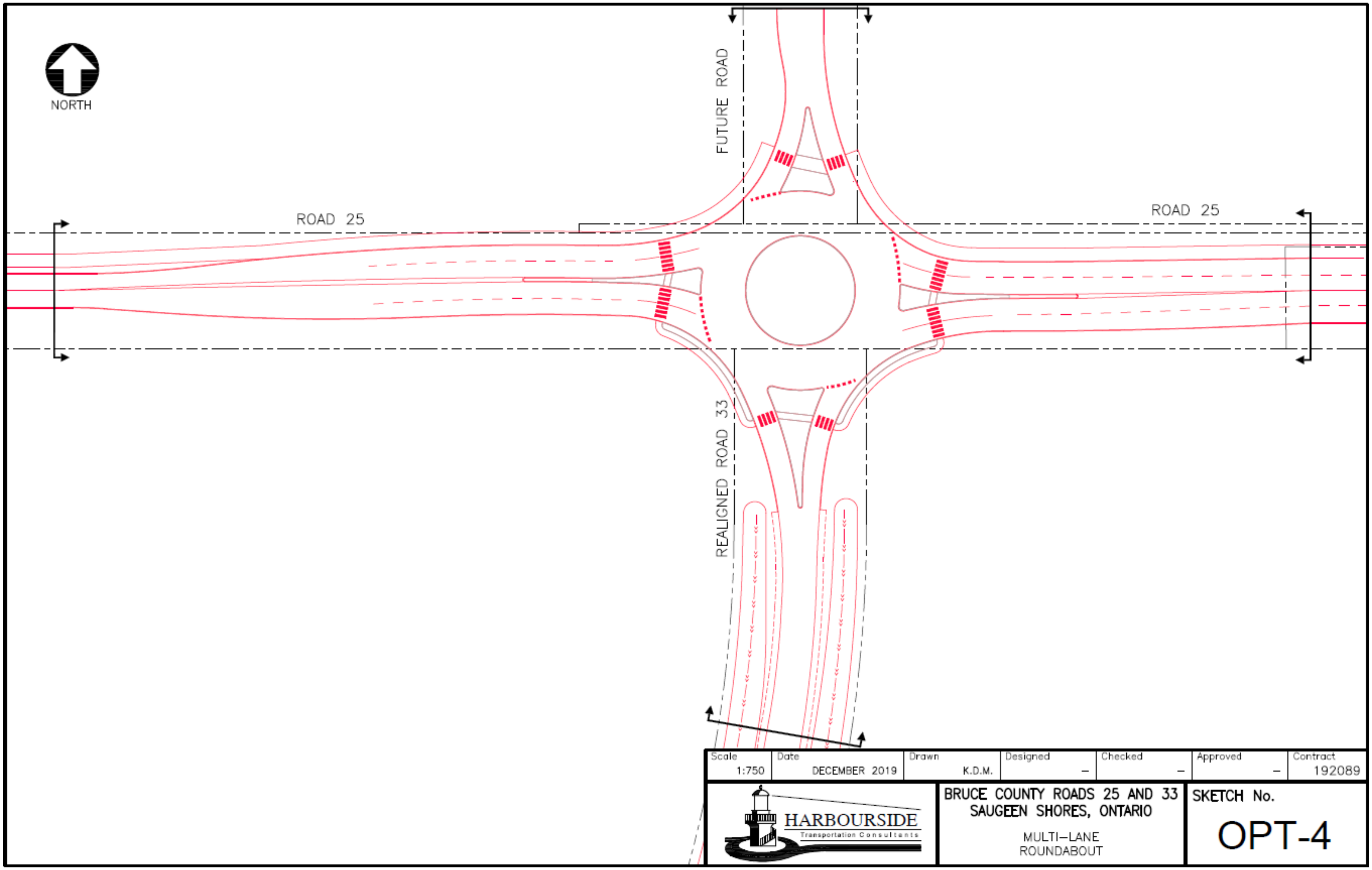


Figure 5: Roundabout control concept

## 4 Construction Costs

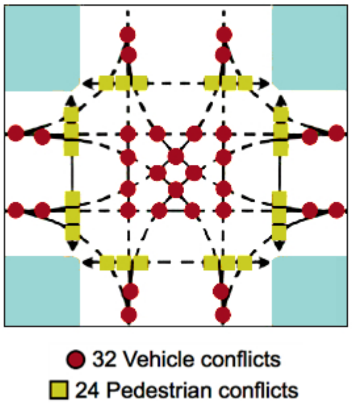
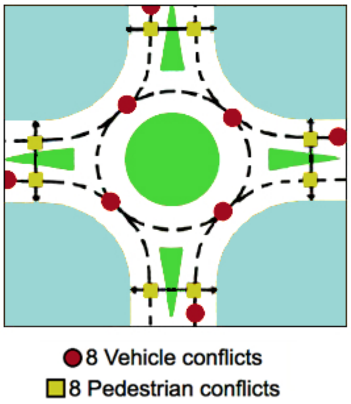
Class ‘D’ cost estimates were prepared for the traffic control options. The cost estimates do not include removals, engineering services and harmonized sales tax (HST). The breakdown of costs for each option are included in Appendix B.

| | |
|---|---|
| Option 1 TWSC | $475,500 |
| Option 1 TCS BR25 2-LN | $725,500 |
| Option 2 SGL RDBT | $763,250 |
| Option 3 TCS BR25 4-LN | $1,477,000 |
| Option 4 MULT RDBT | $1,420,250 |

## 5 Advantages and Disadvantages

There are a number of advantages and disadvantages to traffic control signals and roundabouts. Table 1 compares the two traffic control options under a number of parameters that should be considered when selecting the appropriate method of control for an intersection.

Table 1: Comparison of traffic control signals and roundabouts

| Parameter | | Traffic Control Signal | Roundabout |
|---|---|---|---|
| Community | Aesthetics | Limited options for landscaping and enhancements on the perimeter of the intersection. | The central island and perimeter of the intersection can be landscaped and used for enhancements. |
| Environment | Emissions | Stopping and idling during red light increases emissions and fuel consumption. | Less frequent stopping due to yield control and increased efficiency of traffic flow reduces emissions. |
| | Noise | Noise caused by vehicles stopping and starting. | Less frequent stopping reduces noise. |
| Safety | Conflicts |  |  |
| | Collision Frequency/ Severity | Traffic control signals have higher frequency and severity of collisions than roundabouts. | Roundabouts reduce the frequency and severity of collisions.<br>Property damage collisions can increase at multilane roundabouts. |

| Parameter | | Traffic Control Signal | Roundabout |
|---|---|---|---|
| | Driver Decision | Drivers need to be aware of left, through and right turning vehicles. | Drivers only need to be aware of vehicles on their immediate left. |
| | Driver Error | Higher speeds and higher difference in speeds create a more critical situation. | Lower speeds and lower speed differences create a less critical situation. |
| Vulnerable Road Users | Pedestrians | Pedestrians must wait until the pedestrian signal to cross the intersection.<br>Pedestrian are required to cross two or more lanes with traffic travelling in both directions. | Pedestrians have the right-of-way at a roundabout, vehicles are required to yield.<br>Pedestrians are only required to cross one or two travel lanes at once with traffic travelling in only one direction. |
| | Bicyclists | Bicycles must travel through the intersection as a vehicle unless facilities with bicycle signals are provided. | Bicycles have two options to navigate a roundabout: travel through the intersection as a vehicle or dismount and travel on the sidewalk.<br>Lower speeds through the roundabout increase bicycle safety while travelling through the intersection. |
| Operations | Delay and queues | Traffic control signals introduce delays on all approaches and can be inefficient during off-peak periods. Longer cycle lengths will increase queues. | Roundabouts have lower delays and shorter queues than traffic control signals. Roundabouts are more efficient during both peak and off-peak periods. |
| | Heavy Vehicles | Require a wide turn radius and may encroach into adjacent traffic lanes where vehicles may be queued or moving in the opposite direction. | Heavy vehicles are often required to encroach in the adjacent lane to navigate a multilane roundabout. Rules on how to navigate a roundabout indicate that other users should never enter a roundabout next to a heavy vehicle. |
| | Familiarity | Drivers are familiar with traffic control signals and their operation. | Drivers can be less familiar with roundabouts. |
| Costs | Construction | Traffic control signals typically have a lower capital cost than roundabouts. However, for lager new intersections, traffic control signals can cost as much as a roundabout. | Roundabout typically have a higher capital cost. |
| | Operation and Maintenance | Higher operation and maintenance cost: power, annual equipment inspections, equipment replacement and pavement markings.<br>Power outages and damage to equipment can affect operations. | Lower operation and maintenance cost: pavement markings and landscaping.<br>Roundabout operations are not affected by power outages. |

## 6 Life Cycle Cost Analysis

A life-cycle cost (LCC) analysis was completed to evaluate the traffic control options for the intersection. The LCC analysis was completed using the U.S. Transportation Research Board's spreadsheet-based tool for comparing life-cycle costs of alternative designs for new and existing intersections. The Life-Cycle Cost Estimating Tool (LCCET) was developed as part of the National Cooperative Highway Research Program's *Project 03-110 Estimating the Life-Cycle Cost of Intersection Designs*.

The LCCET uses a benefit-cost analysis approach and provides estimates of net present values of benefits and costs of intersection alternatives. LCCET outputs include:

- Net present value of benefits: Total net present value of benefits compared to the base case. Net benefits are considered to be reductions in the following types of costs relative to the base case: travel time costs, travel time reliability costs, collision costs and emissions costs
- Net present value of costs: Total net present value of costs compared to the base case.
- Present value of net benefits: Net present value of benefits minus the net present value of costs; i.e., the incremental net benefit value of the alternative compared to the base case.
- Benefit-cost ratio: Ratio of net present value of costs to net present value of benefits.

The life-cycle costs over a 20-year period (2020-2040) for the traffic control options were compared against a base case. The unsignalized two-way stop control (TWSC) option was used as the base case to which the traffic control signal and roundabout options are compared. The cost and benefit categories included in the traffic control evaluation are summarized in Table 2. The benefit categories represent reductions in the type of costs relative to the base case.

Table 2: Life-cycle cost and benefit categories

| Costs | Benefits |
|---|---|
| Planning and construction<br>Operating and maintenance<br>Auto passenger time<br>Truck time<br>Safety | Auto passenger time<br>Truck time<br>Safety |

## 6.1 Inputs

The data input for the LCCET included: weekday morning and afternoon traffic demand in the opening year and end year; planning and construction costs; operating and maintenance costs; weekday morning and afternoon travel delays in the opening year and end year; and collision frequencies in the opening year and end year.

**Traffic Demand:** Weekday morning (AM) and afternoon (PM) peak hour traffic volumes were obtained from the *Bruce Road 25 Class EA Transportation Assessment*. The study included 2019 traffic volumes and a forecast of 2040 traffic volumes based on the development potential in the Town of Saugeen Shores. The traffic volumes are illustrated in Appendix A. The 2019 traffic volumes were redistributed to the new intersection to reflect 2020 volumes.

**Planning and Construction Costs:** High level cost estimates for planning and design, right of way acquisition, equipment, utility relocations and construction.

**Operating and Maintenance Cost:** High level cost estimates for operating and maintenance costs including: power for street lighting and traffic signal equipment; traffic signal equipment inspections; and signage and pavement markings.

**Travel Delays:** The average delay per vehicle was computed for each intersection control option during the weekday morning (AM) and afternoon (PM) peak hour under 2020 and 2040 conditions. Synchro Studio (version 10) was used to evaluate operations for the unsignalized and signalized intersection control options and Junctions 8 ARCADY was used to evaluate operations for the roundabout control options. The Synchro and ARCADY reports are included in Appendix C.

**Collision Frequencies:** The collision information available for the intersection was insufficient to develop site specific collision rates and calculate expected collision frequencies for property damage, injury and fatal collisions. The expected collision frequencies for the traffic control options were calculated using the Region of Waterloo's *Collision Estimation and Cost Calculation* (2014) rates-based methodology. Collision frequencies were calculated based on average collision rates for Township intersections in the Region of Waterloo and average annual daily traffic (AADT) values estimated by the LCCET based on peak hour volumes.

The cost, delay and collision input data for the traffic control options at the intersection of Bruce County Road 25 and Road 33 are summarized in Table 3. The LCCET worksheets are included in Appendix D.

Table 3: LCCET input data

| Input Category | TWSC | TCS BR25 2-LN | SGL RDBT | TCS BR25 4-LN | MULT RDBT |
|---|---|---|---|---|---|
| Planning and construction costs | $515,500 | $765,500 | $803,250 | $1,552,000 | $1,495,250 |
| Annual operating and maintenance costs | $5,750 | $11,600 | $6,500 | $11,600 | $6,500 |
| Opening year average travel delay | | | | | |
| AM | 3.7 s/veh | 4.7 s/veh | 3.1 s/veh | 5.3 s/veh | 1.8 s/veh |
| PM | 6.1 s/veh | 11.2 s/veh | 3.2 s/veh | 11.5 s/veh | 2.6 s/veh |
| End year average travel delay | | | | | |
| AM | 6.8 s/veh | 8.3 s/veh | 3.4 s/veh | 8.2 s/veh | 2.2 s/veh |
| PM | 7.6 s/veh | 11.9 s/veh | 3.7 s/veh | 11.9 s/veh | 2.8 s/veh |
| Opening year collisions | | | | | |
| Property Damage/Non-Injury | 0.09 col/yr | 0.48 col/yr | 0.95 col/yr | 0.48 col/yr | 0.95 col/yr |
| Injury | 0.03 col/yr | 0.08 col/yr | 0.02 col/yr | 0.08 col/yr | 0.02 col/yr |
| Fatality | 0.00 col/yr | 0.00 col/yr | 0.00 col/yr | 0.00 col/yr | 0.00 col/yr |
| End year collisions | | | | | |
| Property Damage/Non-Injury | 0.33 col/yr | 0.90 col/yr | 1.80 col/yr | 0.90 col/yr | 1.80 col/yr |
| Injury | 0.19 col/yr | 0.24 col/yr | 0.06 col/yr | 0.24 col/yr | 0.06 col/yr |
| Fatality | 0.00 col/yr | 0.00 col/yr | 0.00 col/yr | 0.00 col/yr | 0.00 col/yr |

## 6.2 Preferred Option

The LCC analysis outputs including NPV of total costs, NPV of benefits relative to base case, NPV of costs relative to base case and benefit-cost ratio are summarized in Table 4. The NPV of total costs for the traffic control options are illustrated in Figure 6.

The LCC analysis indicates that over a 20-year period, the single lane roundabout has a lower NPV of total costs and higher benefit-cost ratio than the other options. The single lane roundabout is the preferred traffic control option for the intersection of Road 25 and Road 33. It will provide the best value for the County and provide the best results for safety, traffic operations and greenhouse gas emissions.

Table 4: LCCET output data

| Output Category | TWSC | TCS BR25 2-LN | SGL RDBT | TCS BR25 4-LN | MULT RDBT |
|---|---|---|---|---|---|
| Total Costs | $1,185,493 | $1,405,036 | $1,069,243 | $2,195,802 | $1,752,629 |
| NPV of Benefits Relative to TWSC | - | $120,635 | $415,561 | $116,370 | $424,175 |
| NPV of Costs Relative to TWSC | - | $340,178 | $299,311 | $1,126,678 | $991,311 |
| Benefit-Cost Ratio | - | 0.35 | 1.39 | 0.1 | 0.43 |

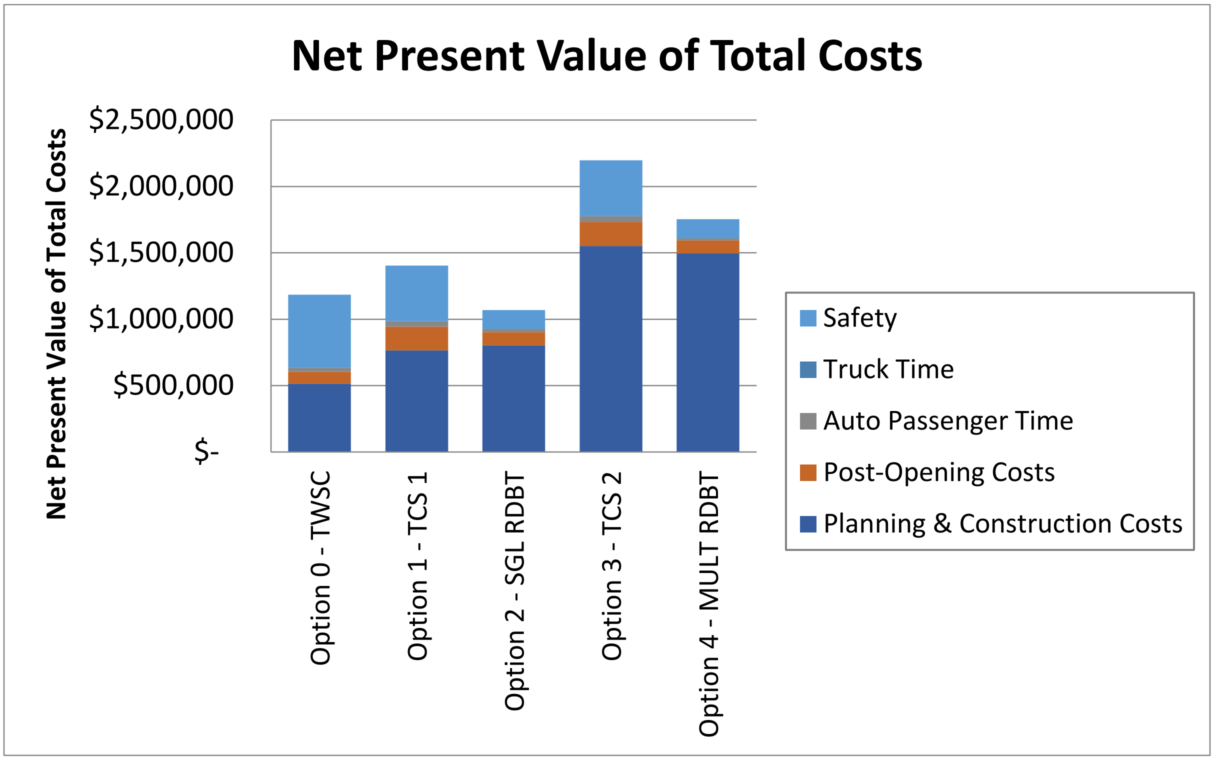


Figure 6: Total net present value

If you have any questions or additional discussion, please feel free to contact the undersigned.

Regards,

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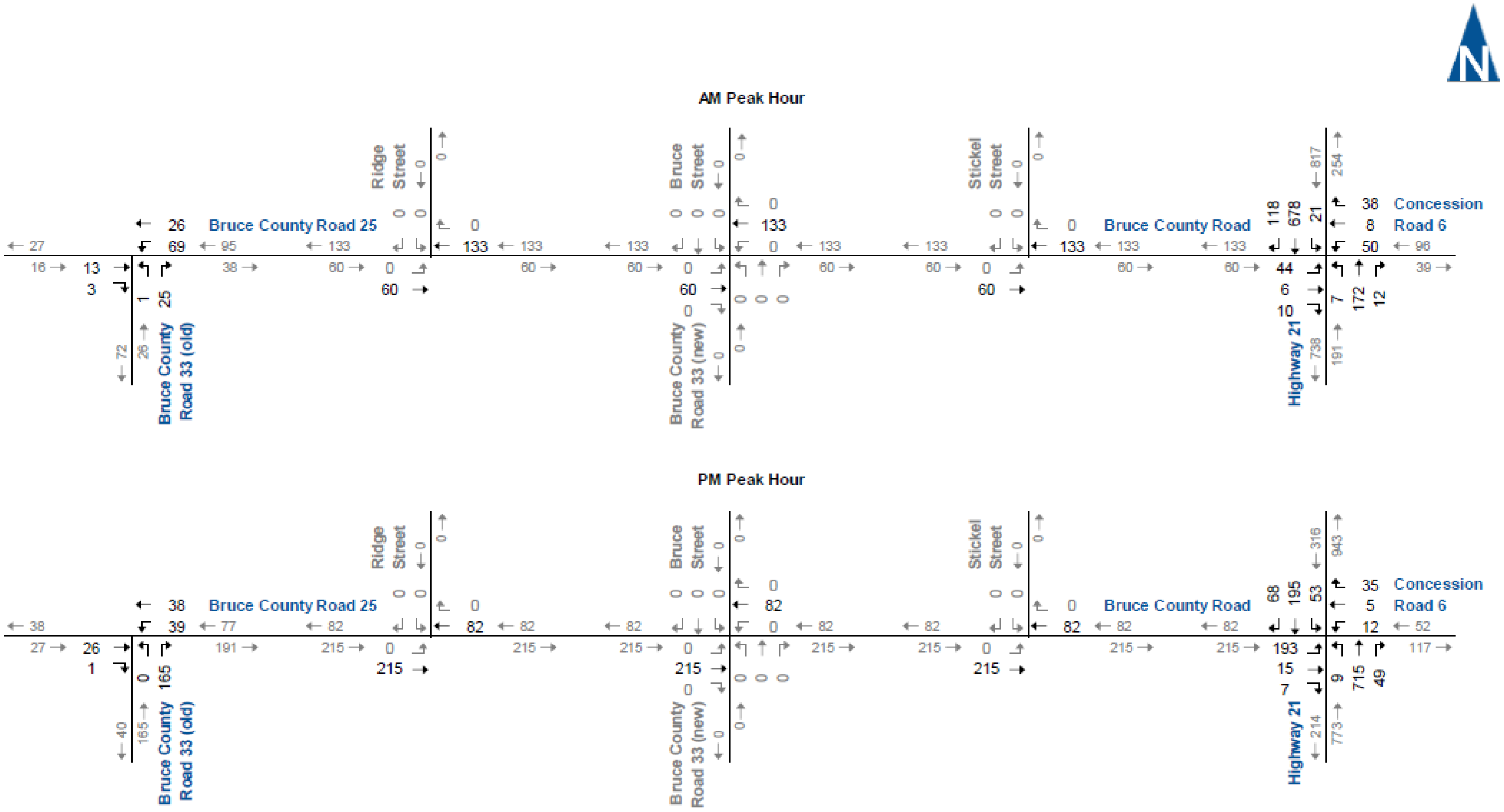
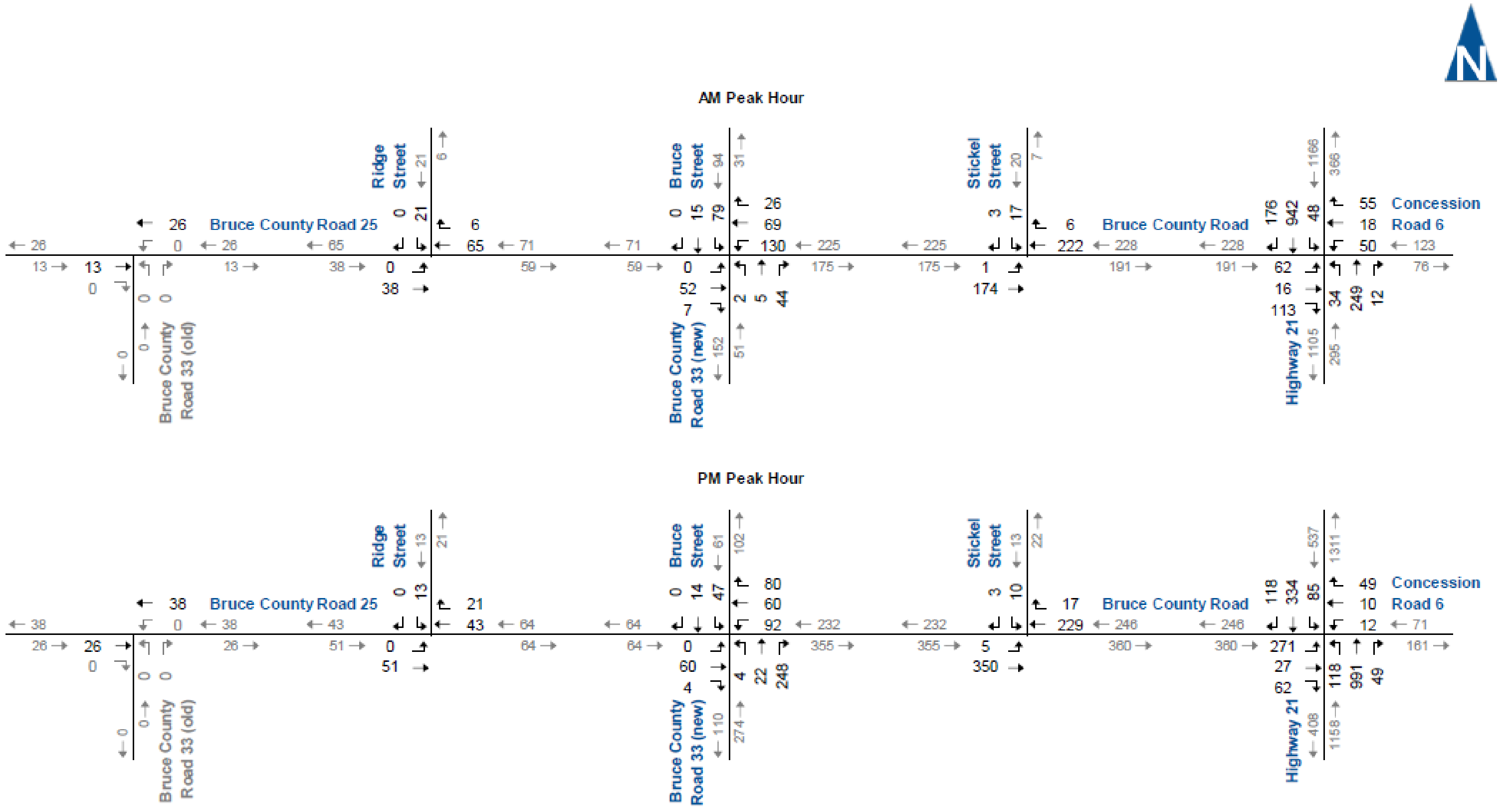
# Appendix A

Traffic Volumes



## 2019 Existing Volumes



Total Volumes for the Future 2040 Horizon

# Appendix B

Cost Estimates

**Bruce County Ontario - Roads 25 and 33**

**Road 25 and 33 2 Lane Cross-Section Signalized Intersection Vs. Single Lane Roundabout Construction Costing**

**OPTION 1: 2 LANE SIGNALIZED INTERSECTION**

| | | | | | | |
|---|---|---|---|---|---|---|
| Asphalt - Top Lift (50mm) | 1800 | m² | $ | 20 | $ | 36,000 |
| Asphalt - Base (Lift 75mm) | 1800 | m² | $ | 25 | $ | 45,000 |
| Granular 'Type 1' (150mm) | 1800 | m² | $ | 15 | $ | 27,000 |
| Granular 'Type 2' (400mm) | 1800 | m² | $ | 25 | $ | 45,000 |
| Gravel Shoulder | 145 | m² | $ | 40 | $ | 5,800 |
| Asphalt Trail | 305 | m² | $ | 80 | $ | 24,400 |
| Concrete Sidewalk (100mm) | 25 | m² | $ | 105 | $ | 2,625 |
| Curb and Gutter | 330 | m | $ | 120 | $ | 39,600 |
| Lighting | 1 | L.S. | $ | 40,000 | $ | 40,000 |
| Traffic Signals, Poles,Controller, Etc. | 1 | L.S. | $ | 200,000 | $ | 200,000 |
| Pavement Markings | 1 | L.S. | $ | 10,000 | $ | 10,000 |
| Signage | 1 | L.S. | $ | 2,500 | $ | 2,500 |
| Topsoil and Sod | 165 | $m^2$ | $ | 15 | $ | 2,475 |
| Drainage | 1 | L.S. | $ | 100,000 | $ | 100,000 |
| | | | | Subtotal | $ | 580,400 |
| | | | | 25% Contingency | $ | 145,100 |
| | | | | **TOTAL** | **$** | **725,500** |

**OPTION 2: SINGLE LANE ROUNDABOUT**

| | | | | | | |
|---|---|---|---|---|---|---|
| Hydro Pole Relocation | 1 | Ea | $ | 25,000 | $ | 25,000 |
| Additional Land Acquisition | 25 | m² | $ | 300 | $ | 7,500 |
| Asphalt - Top Lift (50mm) | 2070 | m² | $ | 20 | $ | 41,400 |
| Asphalt - Base Lift (75mm) | 2070 | m² | $ | 25 | $ | 51,750 |
| Granular 'Type 1' (150mm) | 2070 | m² | $ | 15 | $ | 31,050 |
| Granular 'Type 2' (400mm) | 2070 | m² | $ | 25 | $ | 51,750 |
| Gravel Shoulder | 75 | m² | $ | 40 | $ | 3,000 |
| Asphalt Trail | 365 | m² | $ | 80 | $ | 29,200 |
| Concrete Sidewalk (100mm) | 110 | m² | $ | 105 | $ | 11,550 |
| Curb and Gutter | 635 | m | $ | 120 | $ | 76,200 |
| Concrete Truck Apron | 240 | m² | $ | 150 | $ | 36,000 |
| Lighting | 1 | L.S. | $ | 75,000 | $ | 75,000 |
| Central Island Plantings | 1 | L.S. | $ | 30,000 | $ | 30,000 |
| Pavement Markings | 1 | L.S. | $ | 15,000 | $ | 15,000 |
| Signage | 1 | L.S. | $ | 15,000 | $ | 15,000 |
| Topsoil and Sod | 745 | $m^2$ | $ | 15 | $ | 11,175 |
| Drainage | 1 | L.S. | $ | 100,000 | $ | 100,000 |
| | | | | Subtotal | $ | 610,575 |
| | | | | 25% Contingency | $ | 152,644 |
| | | | | **TOTAL** | **$** | **763,219** |

## Bruce County Ontario - Roads 25 and 33
## Road 25 4 Lane Cross-Section Signalized Intersection Vs. Multi-Lane Roundabout Construction Costing

### OPTION 3: 4 LANE SIGNALIZED INTERSECTION

| | | | | | | |
|---|---|---|---|---|---|---|
| Asphalt - Top Lift (50mm) | 6260 | $m^2$ | $ | 20 | $ | 125,200 |
| Asphalt - Base (Lift 75mm) | 6260 | $m^2$ | $ | 25 | $ | 156,500 |
| Granular ‘Type 1’ (150mm) | 6260 | $m^2$ | $ | 15 | $ | 93,900 |
| Granular ‘Type 2’ (400mm) | 6260 | $m^2$ | $ | 25 | $ | 156,500 |
| Gravel Shoulder | 240 | $m^2$ | $ | 40 | $ | 9,600 |
| Asphalt Trail | 810 | $m^2$ | $ | 80 | $ | 64,800 |
| Concrete Sidewalk (100mm) | 25 | $m^2$ | $ | 105 | $ | 2,625 |
| Curb and Gutter | 720 | m | $ | 120 | $ | 86,400 |
| Concrete Island | 30 | $m^2$ | $ | 105 | $ | 3,150 |
| Lighting | 1 | L.S. | $ | 55,000 | $ | 55,000 |
| Traffic Signals, Poles,Controller, Etc. | 1 | L.S. | $ | 300,000 | $ | 300,000 |
| Pavement Markings | 1 | L.S. | $ | 20,000 | $ | 20,000 |
| Signage | 1 | L.S. | $ | 2,500 | $ | 2,500 |
| Topsoil and Sod | 360 | $m^2$ | $ | 15 | $ | 5,400 |
| Drainage | 1 | L.S. | $ | 100,000 | $ | 100,000 |
| | | | | Subtotal | $ | 1,181,575 |
| | | | | 25% Contingency | $ | 295,394 |
| | | | | **TOTAL** | **$** | **1,476,969** |

### OPTION 4: MULTI -LANE ROUNDABOUT

| | | | | | | |
|---|---|---|---|---|---|---|
| Hydro Pole Relocation | 1 | Ea | $ | 25,000 | $ | 25,000 |
| Additional Land Acquisition | 300 | $m^2$ | $ | 300 | $ | 90,000 |
| Asphalt - Top Lift (50mm) | 5795 | $m^2$ | $ | 20 | $ | 115,900 |
| Asphalt - Base Lift (75mm) | 5795 | $m^2$ | $ | 25 | $ | 144,875 |
| Granular ‘Type 1’ (150mm) | 5795 | $m^2$ | $ | 15 | $ | 86,925 |
| Granular ‘Type 2’ (400mm) | 5795 | $m^2$ | $ | 25 | $ | 144,875 |
| Gravel Shoulder | 150 | $m^2$ | $ | 40 | $ | 6,000 |
| Asphalt Trail | 880 | $m^2$ | $ | 80 | $ | 70,400 |
| Concrete Sidewalk (100mm) | 145 | $m^2$ | $ | 105 | $ | 15,225 |
| Curb and Gutter | 1065 | m | $ | 120 | $ | 127,800 |
| Concrete Island | 10 | $m^2$ | $ | 105 | $ | 1,050 |
| Lighting | 1 | L.S. | $ | 100,000 | $ | 100,000 |
| Central Island Plantings | 1 | L.S. | $ | 50,000 | $ | 50,000 |
| Pavement Markings | 1 | L.S. | $ | 20,000 | $ | 20,000 |
| Signage | 1 | L.S. | $ | 20,000 | $ | 20,000 |
| Topsoil and Sod | 1200 | $m^2$ | $ | 15 | $ | 18,000 |
| Drainage | 1 | L.S. | $ | 100,000 | $ | 100,000 |
| | | | | Subtotal | $ | 1,136,050 |
| | | | | 25% Contingency | $ | 284,013 |
| | | | | **TOTAL** | **$** | **1,420,063** |

## Appendix C

Synchro/Arcady

| Intersection | |
|---|---|
| Int Delay, s/veh | 3.7 |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | ✣ | | | ✣ | | | ✣ | | | ✣ | |
| Traffic Vol, veh/h | 0 | 35 | 3 | 69 | 64 | 0 | 1 | 0 | 25 | 0 | 0 | 0 |
| Future Vol, veh/h | 0 | 35 | 3 | 69 | 64 | 0 | 1 | 0 | 25 | 0 | 0 | 0 |
| Conflicting Peds, #/hr | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sign Control | Free | Free | Free | Free | Free | Free | Stop | Stop | Stop | Stop | Stop | Stop |
| RT Channelized | - | - | None | - | - | None | - | - | None | - | - | None |
| Storage Length | - | - | - | - | - | - | - | - | - | - | - | - |
| Veh in Median Storage, # | - | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - |
| Grade, % | - | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - |
| Peak Hour Factor | 92 | 92 | 92 | 92 | 92 | 92 | 92 | 92 | 92 | 92 | 92 | 92 |
| Heavy Vehicles, % | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Mvmt Flow | 0 | 38 | 3 | 75 | 70 | 0 | 1 | 0 | 27 | 0 | 0 | 0 |

| Major/Minor | Major1 | | | Major2 | | | Minor1 | | | Minor2 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Conflicting Flow All | 70 | 0 | 0 | 41 | 0 | 0 | 260 | 260 | 40 | 273 | 261 | 70 |
| Stage 1 | - | - | - | - | - | - | 40 | 40 | - | 220 | 220 | - |
| Stage 2 | - | - | - | - | - | - | 220 | 220 | - | 53 | 41 | - |
| Critical Hdwy | 4.12 | - | - | 4.12 | - | - | 7.12 | 6.52 | 6.22 | 7.12 | 6.52 | 6.22 |
| Critical Hdwy Stg 1 | - | - | - | - | - | - | 6.12 | 5.52 | - | 6.12 | 5.52 | - |
| Critical Hdwy Stg 2 | - | - | - | - | - | - | 6.12 | 5.52 | - | 6.12 | 5.52 | - |
| Follow-up Hdwy | 2.218 | - | - | 2.218 | - | - | 3.518 | 4.018 | 3.318 | 3.518 | 4.018 | 3.318 |
| Pot Cap-1 Maneuver | 1531 | - | - | 1568 | - | - | 693 | 645 | 1031 | 679 | 644 | 993 |
| Stage 1 | - | - | - | - | - | - | 975 | 862 | - | 782 | 721 | - |
| Stage 2 | - | - | - | - | - | - | 782 | 721 | - | 960 | 861 | - |
| Platoon blocked, % | | - | - | | - | - | | | | | | |
| Mov Cap-1 Maneuver | 1531 | - | - | 1568 | - | - | 667 | 613 | 1031 | 636 | 612 | 993 |
| Mov Cap-2 Maneuver | - | - | - | - | - | - | 667 | 613 | - | 636 | 612 | - |
| Stage 1 | - | - | - | - | - | - | 975 | 862 | - | 782 | 685 | - |
| Stage 2 | - | - | - | - | - | - | 743 | 685 | - | 935 | 861 | - |

| Approach | EB | WB | NB | SB |
|---|---|---|---|---|
| HCM Control Delay, s | 0 | 3.8 | 8.7 | 0 |
| HCM LOS | | | A | A |

| Minor Lane/Major Mvmt | NBLn1 | EBL | EBT | EBR | WBL | WBT | WBR | SBLn1 |
|---|---|---|---|---|---|---|---|---|
| Capacity (veh/h) | 1010 | 1531 | - | - | 1568 | - | - | - |
| HCM Lane V/C Ratio | 0.028 | - | - | - | 0.048 | - | - | - |
| HCM Control Delay (s) | 8.7 | 0 | - | - | 7.4 | 0 | - | 0 |
| HCM Lane LOS | A | A | - | - | A | A | - | A |
| HCM 95th %tile Q(veh) | 0.1 | 0 | - | - | 0.2 | - | - | - |

| Intersection | |
|---|---|
| Int Delay, s/veh | 6.1 |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | ✥ | | | ✥ | | | ✥ | | | ✥ | |
| Traffic Vol, veh/h | 0 | 50 | 1 | 39 | 43 | 0 | 1 | 0 | 165 | 0 | 0 | 0 |
| Future Vol, veh/h | 0 | 50 | 1 | 39 | 43 | 0 | 1 | 0 | 165 | 0 | 0 | 0 |
| Conflicting Peds, #/hr | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sign Control | Free | Free | Free | Free | Free | Free | Stop | Stop | Stop | Stop | Stop | Stop |
| RT Channelized | - | - | None | - | - | None | - | - | None | - | - | None |
| Storage Length | - | - | - | - | - | - | - | - | - | - | - | - |
| Veh in Median Storage, # | - | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - |
| Grade, % | - | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - |
| Peak Hour Factor | 92 | 92 | 92 | 92 | 92 | 92 | 92 | 92 | 92 | 92 | 92 | 92 |
| Heavy Vehicles, % | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Mvmt Flow | 0 | 54 | 1 | 42 | 47 | 0 | 1 | 0 | 179 | 0 | 0 | 0 |

| Major/Minor | Major1 | | | Major2 | | | Minor1 | | | Minor2 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Conflicting Flow All | 47 | 0 | 0 | 55 | 0 | 0 | 186 | 186 | 55 | 275 | 186 | 47 |
| Stage 1 | - | - | - | - | - | - | 55 | 55 | - | 131 | 131 | - |
| Stage 2 | - | - | - | - | - | - | 131 | 131 | - | 144 | 55 | - |
| Critical Hdwy | 4.12 | - | - | 4.12 | - | - | 7.12 | 6.52 | 6.22 | 7.12 | 6.52 | 6.22 |
| Critical Hdwy Stg 1 | - | - | - | - | - | - | 6.12 | 5.52 | - | 6.12 | 5.52 | - |
| Critical Hdwy Stg 2 | - | - | - | - | - | - | 6.12 | 5.52 | - | 6.12 | 5.52 | - |
| Follow-up Hdwy | 2.218 | - | - | 2.218 | - | - | 3.518 | 4.018 | 3.318 | 3.518 | 4.018 | 3.318 |
| Pot Cap-1 Maneuver | 1560 | - | - | 1550 | - | - | 775 | 708 | 1012 | 677 | 708 | 1022 |
| Stage 1 | - | - | - | - | - | - | 957 | 849 | - | 873 | 788 | - |
| Stage 2 | - | - | - | - | - | - | 873 | 788 | - | 859 | 849 | - |
| Platoon blocked, % | | - | - | | - | - | | | | | | |
| Mov Cap-1 Maneuver | 1560 | - | - | 1550 | - | - | 759 | 688 | 1012 | 545 | 688 | 1022 |
| Mov Cap-2 Maneuver | - | - | - | - | - | - | 759 | 688 | - | 545 | 688 | - |
| Stage 1 | - | - | - | - | - | - | 957 | 849 | - | 873 | 766 | - |
| Stage 2 | - | - | - | - | - | - | 849 | 766 | - | 707 | 849 | - |

| Approach | EB | WB | NB | SB |
|---|---|---|---|---|
| HCM Control Delay, s | 0 | 3.5 | 9.3 | 0 |
| HCM LOS | | | A | A |

| Minor Lane/Major Mvmt | NBLn1 | EBL | EBT | EBR | WBL | WBT | WBR | SBLn1 |
|---|---|---|---|---|---|---|---|---|
| Capacity (veh/h) | 1010 | 1560 | - | - | 1550 | - | - | - |
| HCM Lane V/C Ratio | 0.179 | - | - | - | 0.027 | - | - | - |
| HCM Control Delay (s) | 9.3 | 0 | - | - | 7.4 | 0 | - | 0 |
| HCM Lane LOS | A | A | - | - | A | A | - | A |
| HCM 95th %tile Q(veh) | 0.6 | 0 | - | - | 0.1 | - | - | - |

Bruce County Road 25 and Road 33 Intersection Control Evaluation
TWSC 2040 AM

## Road 25 & Road 33/Bruce Street

12-19-2019

| Intersection | |
|---|---|
| Int Delay, s/veh | 6.8 |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | ✣ | | | ✣ | | | ✣ | | | ✣ | |
| Traffic Vol, veh/h | 1 | 52 | 7 | 130 | 69 | 26 | 2 | 5 | 44 | 79 | 15 | 1 |
| Future Vol, veh/h | 1 | 52 | 7 | 130 | 69 | 26 | 2 | 5 | 44 | 79 | 15 | 1 |
| Conflicting Peds, #/hr | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sign Control | Free | Free | Free | Free | Free | Free | Stop | Stop | Stop | Stop | Stop | Stop |
| RT Channelized | - | - | None | - | - | None | - | - | None | - | - | None |
| Storage Length | - | - | - | - | - | - | - | - | - | - | - | - |
| Veh in Median Storage, # | - | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - |
| Grade, % | - | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - |
| Peak Hour Factor | 92 | 92 | 92 | 92 | 92 | 92 | 92 | 92 | 92 | 92 | 92 | 92 |
| Heavy Vehicles, % | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Mvmt Flow | 1 | 57 | 8 | 141 | 75 | 28 | 2 | 5 | 48 | 86 | 16 | 1 |

| Major/Minor | Major1 | | | Major2 | | | Minor1 | | | Minor2 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Conflicting Flow All | 103 | 0 | 0 | 65 | 0 | 0 | 443 | 448 | 61 | 461 | 438 | 89 |
| Stage 1 | - | - | - | - | - | - | 63 | 63 | - | 371 | 371 | - |
| Stage 2 | - | - | - | - | - | - | 380 | 385 | - | 90 | 67 | - |
| Critical Hdwy | 4.12 | - | - | 4.12 | - | - | 7.12 | 6.52 | 6.22 | 7.12 | 6.52 | 6.22 |
| Critical Hdwy Stg 1 | - | - | - | - | - | - | 6.12 | 5.52 | - | 6.12 | 5.52 | - |
| Critical Hdwy Stg 2 | - | - | - | - | - | - | 6.12 | 5.52 | - | 6.12 | 5.52 | - |
| Follow-up Hdwy | 2.218 | - | - | 2.218 | - | - | 3.518 | 4.018 | 3.318 | 3.518 | 4.018 | 3.318 |
| Pot Cap-1 Maneuver | 1489 | - | - | 1537 | - | - | 525 | 506 | 1004 | 511 | 512 | 969 |
| Stage 1 | - | - | - | - | - | - | 948 | 842 | - | 649 | 620 | - |
| Stage 2 | - | - | - | - | - | - | 642 | 611 | - | 917 | 839 | - |
| Platoon blocked, % | | - | - | | - | - | | | | | | |
| Mov Cap-1 Maneuver | 1489 | - | - | 1537 | - | - | 472 | 456 | 1004 | 446 | 461 | 969 |
| Mov Cap-2 Maneuver | - | - | - | - | - | - | 472 | 456 | - | 446 | 461 | - |
| Stage 1 | - | - | - | - | - | - | 947 | 841 | - | 648 | 559 | - |
| Stage 2 | - | - | - | - | - | - | 562 | 551 | - | 867 | 838 | - |

| Approach | EB | WB | NB | SB |
|---|---|---|---|---|
| HCM Control Delay, s | 0.1 | 4.4 | 9.5 | 15.3 |
| HCM LOS | | | A | C |

| Minor Lane/Major Mvmt | NBLn1 | EBL | EBT | EBR | WBL | WBT | WBR | SBLn1 |
|---|---|---|---|---|---|---|---|---|
| Capacity (veh/h) | 864 | 1489 | - | - | 1537 | - | - | 451 |
| HCM Lane V/C Ratio | 0.064 | 0.001 | - | - | 0.092 | - | - | 0.229 |
| HCM Control Delay (s) | 9.5 | 7.4 | 0 | - | 7.6 | 0 | - | 15.3 |
| HCM Lane LOS | A | A | A | - | A | A | - | C |
| HCM 95th %tile Q(veh) | 0.2 | 0 | - | - | 0.3 | - | - | 0.9 |

| Intersection | |
|---|---|
| Int Delay, s/veh | 7.6 |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | ✣ | | | ✣ | | | ✣ | | | ✣ | |
| Traffic Vol, veh/h | 1 | 60 | 4 | 92 | 60 | 80 | 4 | 22 | 248 | 47 | 14 | 1 |
| Future Vol, veh/h | 1 | 60 | 4 | 92 | 60 | 80 | 4 | 22 | 248 | 47 | 14 | 1 |
| Conflicting Peds, #/hr | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sign Control | Free | Free | Free | Free | Free | Free | Stop | Stop | Stop | Stop | Stop | Stop |
| RT Channelized | - | - | None | - | - | None | - | - | None | - | - | None |
| Storage Length | - | - | - | - | - | - | - | - | - | - | - | - |
| Veh in Median Storage, # | - | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - |
| Grade, % | - | 0 | - | - | 0 | - | - | 0 | - | - | 0 | - |
| Peak Hour Factor | 92 | 92 | 92 | 92 | 92 | 92 | 92 | 92 | 92 | 92 | 92 | 92 |
| Heavy Vehicles, % | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Mvmt Flow | 1 | 65 | 4 | 100 | 65 | 87 | 4 | 24 | 270 | 51 | 15 | 1 |

| Major/Minor | Major1 | | | Major2 | | | Minor1 | | | Minor2 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Conflicting Flow All | 152 | 0 | 0 | 69 | 0 | 0 | 386 | 421 | 67 | 525 | 380 | 109 |
| Stage 1 | - | - | - | - | - | - | 69 | 69 | - | 309 | 309 | - |
| Stage 2 | - | - | - | - | - | - | 317 | 352 | - | 216 | 71 | - |
| Critical Hdwy | 4.12 | - | - | 4.12 | - | - | 7.12 | 6.52 | 6.22 | 7.12 | 6.52 | 6.22 |
| Critical Hdwy Stg 1 | - | - | - | - | - | - | 6.12 | 5.52 | - | 6.12 | 5.52 | - |
| Critical Hdwy Stg 2 | - | - | - | - | - | - | 6.12 | 5.52 | - | 6.12 | 5.52 | - |
| Follow-up Hdwy | 2.218 | - | - | 2.218 | - | - | 3.518 | 4.018 | 3.318 | 3.518 | 4.018 | 3.318 |
| Pot Cap-1 Maneuver | 1429 | - | - | 1532 | - | - | 573 | 524 | 997 | 463 | 552 | 945 |
| Stage 1 | - | - | - | - | - | - | 941 | 837 | - | 701 | 660 | - |
| Stage 2 | - | - | - | - | - | - | 694 | 632 | - | 786 | 836 | - |
| Platoon blocked, % | | - | - | | - | - | | | | | | |
| Mov Cap-1 Maneuver | 1429 | - | - | 1532 | - | - | 528 | 486 | 997 | 307 | 512 | 945 |
| Mov Cap-2 Maneuver | - | - | - | - | - | - | 528 | 486 | - | 307 | 512 | - |
| Stage 1 | - | - | - | - | - | - | 940 | 836 | - | 700 | 612 | - |
| Stage 2 | - | - | - | - | - | - | 627 | 586 | - | 557 | 835 | - |

| Approach | EB | WB | NB | SB |
|---|---|---|---|---|
| HCM Control Delay, s | 0.1 | 3 | 10.9 | 18.1 |
| HCM LOS | | | B | C |

| Minor Lane/Major Mvmt | NBLn1 | EBL | EBT | EBR | WBL | WBT | WBR | SBLn1 |
|---|---|---|---|---|---|---|---|---|
| Capacity (veh/h) | 909 | 1429 | - | - | 1532 | - | - | 342 |
| HCM Lane V/C Ratio | 0.328 | 0.001 | - | - | 0.065 | - | - | 0.197 |
| HCM Control Delay (s) | 10.9 | 7.5 | 0 | - | 7.5 | 0 | - | 18.1 |
| HCM Lane LOS | B | A | A | - | A | A | - | C |
| HCM 95th %tile Q(veh) | 1.4 | 0 | - | - | 0.2 | - | - | 0.7 |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | ✣ | | | ✣ | | | ✣ | | | ✣ | |
| Traffic Volume (veh/h) | 0 | 35 | 3 | 69 | 64 | 0 | 1 | 0 | 25 | 0 | 0 | 0 |
| Future Volume (veh/h) | 0 | 35 | 3 | 69 | 64 | 0 | 1 | 0 | 25 | 0 | 0 | 0 |
| Initial Q (Qb), veh | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ped-Bike Adj(A_pbT) | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 |
| Parking Bus, Adj | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Work Zone On Approach | | No | | | No | | | No | | | No | |
| Adj Sat Flow, veh/h/ln | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 |
| Adj Flow Rate, veh/h | 0 | 38 | 3 | 75 | 70 | 0 | 1 | 0 | 27 | 0 | 0 | 0 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Percent Heavy Veh, % | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Cap, veh/h | 0 | 1052 | 83 | 615 | 527 | 0 | 111 | 0 | 52 | 0 | 64 | 0 |
| Arrive On Green | 0.00 | 0.61 | 0.61 | 0.61 | 0.61 | 0.00 | 0.03 | 0.00 | 0.03 | 0.00 | 0.00 | 0.00 |
| Sat Flow, veh/h | 0 | 1711 | 135 | 740 | 857 | 0 | 56 | 0 | 1522 | 0 | 1870 | 0 |
| Grp Volume(v), veh/h | 0 | 0 | 41 | 145 | 0 | 0 | 28 | 0 | 0 | 0 | 0 | 0 |
| Grp Sat Flow(s),veh/h/ln | 0 | 0 | 1846 | 1597 | 0 | 0 | 1578 | 0 | 0 | 0 | 1870 | 0 |
| Q Serve(g_s), s | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 | 0.0 | 0.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Cycle Q Clear(g_c), s | 0.0 | 0.0 | 0.3 | 1.1 | 0.0 | 0.0 | 0.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Prop In Lane | 0.00 | | 0.07 | 0.52 | | 0.00 | 0.04 | | 0.96 | 0.00 | | 0.00 |
| Lane Grp Cap(c), veh/h | 0 | 0 | 1135 | 1141 | 0 | 0 | 163 | 0 | 0 | 0 | 64 | 0 |
| V/C Ratio(X) | 0.00 | 0.00 | 0.04 | 0.13 | 0.00 | 0.00 | 0.17 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Avail Cap(c_a), veh/h | 0 | 0 | 1135 | 1141 | 0 | 0 | 1125 | 0 | 0 | 0 | 1204 | 0 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Upstream Filter(I) | 0.00 | 0.00 | 1.00 | 1.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Uniform Delay (d), s/veh | 0.0 | 0.0 | 2.6 | 2.8 | 0.0 | 0.0 | 16.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Incr Delay (d2), s/veh | 0.0 | 0.0 | 0.1 | 0.2 | 0.0 | 0.0 | 0.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Initial Q Delay(d3),s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile BackOfQ(50%),veh/ln | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Unsig. Movement Delay, s/veh | | | | | | | | | | | | |
| LnGrp Delay(d),s/veh | 0.0 | 0.0 | 2.7 | 3.0 | 0.0 | 0.0 | 16.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| LnGrp LOS | A | A | A | A | A | A | B | A | A | A | A | A |
| Approach Vol, veh/h | | 41 | | | 145 | | | 28 | | | 0 | |
| Approach Delay, s/veh | | 2.7 | | | 3.0 | | | 16.7 | | | 0.0 | |
| Approach LOS | | A | | | A | | | B | | | | |

| Timer - Assigned Phs | | 2 | | 4 | | 6 | | 8 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Phs Duration (G+Y+Rc), s | | 27.0 | | 7.2 | | 27.0 | | 7.2 | | | | |
| Change Period (Y+Rc), s | | 6.0 | | 6.0 | | 6.0 | | 6.0 | | | | |
| Max Green Setting (Gmax), s | | 21.0 | | 22.0 | | 21.0 | | 22.0 | | | | |
| Max Q Clear Time (g_c+I1), s | | 2.3 | | 0.0 | | 3.1 | | 2.6 | | | | |
| Green Ext Time (p_c), s | | 0.3 | | 0.0 | | 1.7 | | 0.2 | | | | |

| Intersection Summary | | |
|---|---|---|
| HCM 6th Ctrl Delay | | 4.7 |
| HCM 6th LOS | | A |

# Bruce County Road 25 and Road 33 Intersection Control Evaluation
## Road 25 & Road 33/Bruce Street

TCS 2019 PM
12-19-2019

| | ↗ | → | ↘ | ↙ | ← | ↖ | ↖ | ↑ | ↗ | ↘ | ↓ | ↙ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations | | ✣ | | | ✣ | | | ✣ | | | ✣ | |
| Traffic Volume (veh/h) | 0 | 50 | 1 | 39 | 43 | 0 | 1 | 0 | 165 | 0 | 0 | 0 |
| Future Volume (veh/h) | 0 | 50 | 1 | 39 | 43 | 0 | 1 | 0 | 165 | 0 | 0 | 0 |
| Initial Q (Qb), veh | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ped-Bike Adj(A_pbT) | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 |
| Parking Bus, Adj | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Work Zone On Approach | | No | | | No | | | No | | | No | |
| Adj Sat Flow, veh/h/ln | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 |
| Adj Flow Rate, veh/h | 0 | 54 | 1 | 42 | 47 | 0 | 1 | 0 | 179 | 0 | 0 | 0 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Percent Heavy Veh, % | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Cap, veh/h | 0 | 953 | 18 | 479 | 492 | 0 | 90 | 1 | 286 | 0 | 340 | 0 |
| Arrive On Green | 0.00 | 0.52 | 0.52 | 0.52 | 0.52 | 0.00 | 0.18 | 0.00 | 0.18 | 0.00 | 0.00 | 0.00 |
| Sat Flow, veh/h | 0 | 1830 | 34 | 667 | 945 | 0 | 3 | 6 | 1577 | 0 | 1870 | 0 |
| Grp Volume(v), veh/h | 0 | 0 | 55 | 89 | 0 | 0 | 180 | 0 | 0 | 0 | 0 | 0 |
| Grp Sat Flow(s),veh/h/ln | 0 | 0 | 1864 | 1612 | 0 | 0 | 1586 | 0 | 0 | 0 | 1870 | 0 |
| Q Serve(g_s), s | 0.0 | 0.0 | 0.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Cycle Q Clear(g_c), s | 0.0 | 0.0 | 0.6 | 1.0 | 0.0 | 0.0 | 4.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Prop In Lane | 0.00 | | 0.02 | 0.47 | | 0.00 | 0.01 | | 0.99 | 0.00 | | 0.00 |
| Lane Grp Cap(c), veh/h | 0 | 0 | 971 | 971 | 0 | 0 | 378 | 0 | 0 | 0 | 340 | 0 |
| V/C Ratio(X) | 0.00 | 0.00 | 0.06 | 0.09 | 0.00 | 0.00 | 0.48 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Avail Cap(c_a), veh/h | 0 | 0 | 971 | 971 | 0 | 0 | 954 | 0 | 0 | 0 | 1020 | 0 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Upstream Filter(I) | 0.00 | 0.00 | 1.00 | 1.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Uniform Delay (d), s/veh | 0.0 | 0.0 | 4.8 | 4.9 | 0.0 | 0.0 | 15.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Incr Delay (d2), s/veh | 0.0 | 0.0 | 0.1 | 0.2 | 0.0 | 0.0 | 0.9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Initial Q Delay(d3),s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile BackOfQ(50%),veh/ln | 0.0 | 0.0 | 0.1 | 0.2 | 0.0 | 0.0 | 1.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Unsig. Movement Delay, s/veh | | | | | | | | | | | | |
| LnGrp Delay(d),s/veh | 0.0 | 0.0 | 4.9 | 5.0 | 0.0 | 0.0 | 16.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| LnGrp LOS | A | A | A | A | A | A | B | A | A | A | A | A |
| Approach Vol, veh/h | | 55 | | | 89 | | | 180 | | | 0 | |
| Approach Delay, s/veh | | 4.9 | | | 5.0 | | | 16.2 | | | 0.0 | |
| Approach LOS | | A | | | A | | | B | | | | |
| Timer - Assigned Phs | | 2 | | 4 | | 6 | | 8 | | | | |
| Phs Duration (G+Y+Rc), s | | 27.0 | | 13.3 | | 27.0 | | 13.3 | | | | |
| Change Period (Y+Rc), s | | 6.0 | | 6.0 | | 6.0 | | 6.0 | | | | |
| Max Green Setting (Gmax), s | | 21.0 | | 22.0 | | 21.0 | | 22.0 | | | | |
| Max Q Clear Time (g_c+I1), s | | 2.6 | | 0.0 | | 3.0 | | 6.2 | | | | |
| Green Ext Time (p_c), s | | 0.5 | | 0.0 | | 0.9 | | 2.2 | | | | |
| Intersection Summary | | | | | | | | | | | | |
| HCM 6th Ctrl Delay | | | 11.2 | | | | | | | | | |
| HCM 6th LOS | | | B | | | | | | | | | |

| | ↗ | → | ↘ | ↙ | ← | ↖ | ↖ | ↑ | ↗ | ↘ | ↓ | ↙ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations | | ✣ | | | ✣ | | | ✣ | | | ✣ | |
| Traffic Volume (veh/h) | 1 | 52 | 7 | 130 | 69 | 26 | 2 | 5 | 44 | 79 | 15 | 1 |
| Future Volume (veh/h) | 1 | 52 | 7 | 130 | 69 | 26 | 2 | 5 | 44 | 79 | 15 | 1 |
| Initial Q (Qb), veh | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ped-Bike Adj(A_pbT) | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 |
| Parking Bus, Adj | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Work Zone On Approach | | No | | | No | | | No | | | No | |
| Adj Sat Flow, veh/h/ln | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 |
| Adj Flow Rate, veh/h | 1 | 57 | 8 | 141 | 75 | 28 | 2 | 5 | 48 | 86 | 16 | 1 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Percent Heavy Veh, % | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Cap, veh/h | 100 | 902 | 125 | 604 | 304 | 98 | 104 | 20 | 164 | 324 | 27 | 2 |
| Arrive On Green | 0.56 | 0.56 | 0.56 | 0.56 | 0.56 | 0.56 | 0.12 | 0.12 | 0.12 | 0.12 | 0.12 | 0.12 |
| Sat Flow, veh/h | 4 | 1603 | 222 | 804 | 540 | 174 | 32 | 175 | 1415 | 1266 | 236 | 15 |
| Grp Volume(v), veh/h | 66 | 0 | 0 | 244 | 0 | 0 | 55 | 0 | 0 | 103 | 0 | 0 |
| Grp Sat Flow(s),veh/h/ln | 1829 | 0 | 0 | 1518 | 0 | 0 | 1622 | 0 | 0 | 1516 | 0 | 0 |
| Q Serve(g_s), s | 0.0 | 0.0 | 0.0 | 1.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.1 | 0.0 | 0.0 |
| Cycle Q Clear(g_c), s | 0.6 | 0.0 | 0.0 | 2.8 | 0.0 | 0.0 | 1.2 | 0.0 | 0.0 | 2.3 | 0.0 | 0.0 |
| Prop In Lane | 0.02 | | 0.12 | 0.58 | | 0.11 | 0.04 | | 0.87 | 0.83 | | 0.01 |
| Lane Grp Cap(c), veh/h | 1126 | 0 | 0 | 1006 | 0 | 0 | 288 | 0 | 0 | 353 | 0 | 0 |
| V/C Ratio(X) | 0.06 | 0.00 | 0.00 | 0.24 | 0.00 | 0.00 | 0.19 | 0.00 | 0.00 | 0.29 | 0.00 | 0.00 |
| Avail Cap(c_a), veh/h | 1126 | 0 | 0 | 1006 | 0 | 0 | 1045 | 0 | 0 | 1022 | 0 | 0 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Upstream Filter(I) | 1.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 |
| Uniform Delay (d), s/veh | 3.7 | 0.0 | 0.0 | 4.1 | 0.0 | 0.0 | 15.1 | 0.0 | 0.0 | 15.5 | 0.0 | 0.0 |
| Incr Delay (d2), s/veh | 0.1 | 0.0 | 0.0 | 0.6 | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 | 0.5 | 0.0 | 0.0 |
| Initial Q Delay(d3),s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile BackOfQ(50%),veh/ln | 0.1 | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 | 0.4 | 0.0 | 0.0 | 0.7 | 0.0 | 0.0 |
| Unsig. Movement Delay, s/veh | | | | | | | | | | | | |
| LnGrp Delay(d),s/veh | 3.8 | 0.0 | 0.0 | 4.7 | 0.0 | 0.0 | 15.4 | 0.0 | 0.0 | 16.0 | 0.0 | 0.0 |
| LnGrp LOS | A | A | A | A | A | A | B | A | A | B | A | A |
| Approach Vol, veh/h | | 66 | | | 244 | | | 55 | | | 103 | |
| Approach Delay, s/veh | | 3.8 | | | 4.7 | | | 15.4 | | | 16.0 | |
| Approach LOS | | A | | | A | | | B | | | B | |
| Timer - Assigned Phs | | 2 | | 4 | | 6 | | 8 | | | | |
| Phs Duration (G+Y+Rc), s | | 27.0 | | 10.3 | | 27.0 | | 10.3 | | | | |
| Change Period (Y+Rc), s | | 6.0 | | 6.0 | | 6.0 | | 6.0 | | | | |
| Max Green Setting (Gmax), s | | 21.0 | | 22.0 | | 21.0 | | 22.0 | | | | |
| Max Q Clear Time (g_c+I1), s | | 2.6 | | 4.3 | | 4.8 | | 3.2 | | | | |
| Green Ext Time (p_c), s | | 0.6 | | 1.1 | | 3.0 | | 0.5 | | | | |
| Intersection Summary | | | | | | | | | | | | |
| HCM 6th Ctrl Delay | | | 8.3 | | | | | | | | | |
| HCM 6th LOS | | | A | | | | | | | | | |

| | ↗ | → | ↘ | ↙ | ← | ↖ | ↖ | ↑ | ↗ | ↘ | ↓ | ↙ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations | | ✥ | | | ✥ | | | ✥ | | | ✥ | |
| Traffic Volume (veh/h) | 1 | 60 | 4 | 92 | 60 | 80 | 4 | 22 | 248 | 47 | 14 | 1 |
| Future Volume (veh/h) | 1 | 60 | 4 | 92 | 60 | 80 | 4 | 22 | 248 | 47 | 14 | 1 |
| Initial Q (Qb), veh | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ped-Bike Adj(A_pbT) | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 |
| Parking Bus, Adj | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Work Zone On Approach | | No | | | No | | | No | | | No | |
| Adj Sat Flow, veh/h/ln | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 |
| Adj Flow Rate, veh/h | 1 | 65 | 4 | 100 | 65 | 87 | 4 | 24 | 270 | 51 | 15 | 1 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Percent Heavy Veh, % | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Cap, veh/h | 81 | 797 | 48 | 348 | 231 | 247 | 81 | 41 | 407 | 372 | 94 | 5 |
| Arrive On Green | 0.46 | 0.46 | 0.46 | 0.46 | 0.46 | 0.46 | 0.28 | 0.28 | 0.28 | 0.28 | 0.28 | 0.28 |
| Sat Flow, veh/h | 4 | 1740 | 106 | 520 | 504 | 540 | 6 | 145 | 1455 | 833 | 335 | 18 |
| Grp Volume(v), veh/h | 70 | 0 | 0 | 252 | 0 | 0 | 298 | 0 | 0 | 67 | 0 | 0 |
| Grp Sat Flow(s),veh/h/ln | 1849 | 0 | 0 | 1563 | 0 | 0 | 1606 | 0 | 0 | 1186 | 0 | 0 |
| Q Serve(g_s), s | 0.0 | 0.0 | 0.0 | 1.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Cycle Q Clear(g_c), s | 1.0 | 0.0 | 0.0 | 4.3 | 0.0 | 0.0 | 7.5 | 0.0 | 0.0 | 1.7 | 0.0 | 0.0 |
| Prop In Lane | 0.01 | | 0.06 | 0.40 | | 0.35 | 0.01 | | 0.91 | 0.76 | | 0.01 |
| Lane Grp Cap(c), veh/h | 927 | 0 | 0 | 826 | 0 | 0 | 529 | 0 | 0 | 470 | 0 | 0 |
| V/C Ratio(X) | 0.08 | 0.00 | 0.00 | 0.31 | 0.00 | 0.00 | 0.56 | 0.00 | 0.00 | 0.14 | 0.00 | 0.00 |
| Avail Cap(c_a), veh/h | 927 | 0 | 0 | 826 | 0 | 0 | 850 | 0 | 0 | 711 | 0 | 0 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Upstream Filter(I) | 1.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 |
| Uniform Delay (d), s/veh | 7.0 | 0.0 | 0.0 | 7.9 | 0.0 | 0.0 | 14.6 | 0.0 | 0.0 | 12.4 | 0.0 | 0.0 |
| Incr Delay (d2), s/veh | 0.2 | 0.0 | 0.0 | 1.0 | 0.0 | 0.0 | 0.9 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 |
| Initial Q Delay(d3),s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile BackOfQ(50%),veh/ln | 0.2 | 0.0 | 0.0 | 1.0 | 0.0 | 0.0 | 2.4 | 0.0 | 0.0 | 0.4 | 0.0 | 0.0 |
| Unsig. Movement Delay, s/veh | | | | | | | | | | | | |
| LnGrp Delay(d),s/veh | 7.1 | 0.0 | 0.0 | 8.8 | 0.0 | 0.0 | 15.5 | 0.0 | 0.0 | 12.5 | 0.0 | 0.0 |
| LnGrp LOS | A | A | A | A | A | A | B | A | A | B | A | A |
| Approach Vol, veh/h | | 70 | | | 252 | | | 298 | | | 67 | |
| Approach Delay, s/veh | | 7.1 | | | 8.8 | | | 15.5 | | | 12.5 | |
| Approach LOS | | A | | | A | | | B | | | B | |

| Timer - Assigned Phs | | 2 | | 4 | | 6 | | 8 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Phs Duration (G+Y+Rc), s | | 27.0 | | 18.8 | | 27.0 | | 18.8 | | | | |
| Change Period (Y+Rc), s | | 6.0 | | 6.0 | | 6.0 | | 6.0 | | | | |
| Max Green Setting (Gmax), s | | 21.0 | | 22.0 | | 21.0 | | 22.0 | | | | |
| Max Q Clear Time (g_c+I1), s | | 3.0 | | 3.7 | | 6.3 | | 9.5 | | | | |
| Green Ext Time (p_c), s | | 0.6 | | 0.7 | | 2.9 | | 3.4 | | | | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM 6th Ctrl Delay | | | 11.9 |
| HCM 6th LOS | | | B |

# Junctions 8

## ARCADY 8 - Roundabout Module

Version: 8.0.4.487 [15039,24/03/2014]

For sales and distribution information, program advice and maintenance, contact TRL:
Tel: +44 (0)1344 770758    email: software@trl.co.uk    Web: http://www.trlsoftware.co.uk

**Filename:** 192089-Bruce County-25-33-Single Lane Roundabout.arc8
**Path:** Z:\Harbourside Transportation Consultants\Projects\192089 Bruce County Roads 25-33\Cad
**Report generation date:** 20/12/2019 9:51:20 AM

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## Summary of intersection performance

| | AM | | | | | | | PM | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Queue (PCE) | 95% Queue (PCE) | Delay (s) | V/C Ratio | LOS | Intersection Delay (s) | Intersection LOS | Queue (PCE) | 95% Queue (PCE) | Delay (s) | V/C Ratio | LOS | Intersection Delay (s) | Intersection LOS |
| | Existing 2019 | | | | | | | | | | | | | |
| **Road 25-West Leg** | 0.04 | ~1 | 3.02 | 0.03 | A | 3.12 | A | 0.05 | ~1 | 3.01 | 0.04 | A | 3.23 | A |
| **Realigned Road 33-South Leg** | 0.02 | ~1 | 2.94 | 0.02 | A | | | 0.17 | ~1 | 3.39 | 0.15 | A | | |
| **Road 25-East Leg** | 0.13 | ~1 | 3.19 | 0.11 | A | | | 0.08 | ~1 | 3.04 | 0.07 | A | | |
| **Future-North Leg** | 0.00 | ~1 | 0.00 | 0.00 | A | | | 0.00 | ~1 | 0.00 | 0.00 | A | | |

| | Future 2040 | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Road 25-West Leg** | 0.06 | ~1 | 3.37 | 0.06 | A | 3.44 | A | 0.06 | ~1 | 3.25 | 0.06 | A | 3.69 | A |
| **Realigned Road 33-South Leg** | 0.05 | ~1 | 3.17 | 0.05 | A | | | 0.33 | ~1 | 3.97 | 0.25 | A | | |
| **Road 25-East Leg** | 0.24 | ~1 | 3.52 | 0.19 | A | | | 0.25 | ~1 | 3.59 | 0.20 | A | | |
| **Future-North Leg** | 0.10 | ~1 | 3.45 | 0.09 | A | | | 0.06 | ~1 | 3.24 | 0.06 | A | | |

*Values shown are the maximum values over all time segments. Delay is the maximum value of average delay per arriving vehicle. Intersection LOS and Intersection Delay are demand-weighted averages.*

*"D1 - Existing 2019, AM " model duration: 8:00 AM - 9:30 AM*
*"D2 - Existing 2019, PM" model duration: 5:00 PM - 6:30 PM*
*"D3 - Future 2040, AM" model duration: 8:00 AM - 9:30 AM*
*"D4 - Future 2040, PM" model duration: 5:00 PM - 6:30 PM*

*Run using Junctions 8.0.4.487 at 20/12/2019 9:51:18 AM*

## Analysis Options

| Vehicle Length (m) | Do Queue Variations | Calculate Residual Capacity | Residual Capacity Criteria Type | V/C Ratio Threshold | Average Delay Threshold (s) | Queue Threshold (PCE) |
|---|---|---|---|---|---|---|
| 7.00 | ✓ | | N/A | 0.85 | 36.00 | 20.00 |

## Units

| Distance Units | Speed Units | Traffic Units Input | Traffic Units Results | Flow Units | Average Delay Units | Total Delay Units | Rate Of Delay Units |
|---|---|---|---|---|---|---|---|
| m | kph | PCE | PCE | perHour | s | -Min | perMin |

# Existing 2019, AM

## Data Errors and Warnings

*No errors or warnings*

## Analysis Set Details

| Name | Roundabout Capacity Model | Description | Locked | Network Flow Scaling Factor (%) | Reason For Scaling Factors |
|---|---|---|---|---|---|
|  | ARCADY |  |  | 100.000 |  |

## Demand Set Details

| Name | Scenario Name | Time Period Name | Description | Traffic Profile Type | Model Start Time (HH:mm) | Model Finish Time (HH:mm) | Model Time Period Length (min) | Time Segment Length (min) | Single Time Segment Only | Locked |
|---|---|---|---|---|---|---|---|---|---|---|
| Existing 2019, AM | Existing 2019 | AM |  | ONE HOUR | 08:00 | 09:30 | 90 | 15 |  |  |

# Intersection Network

## Intersections

| Intersection | Name | Intersection Type | Leg Order | Grade Separated | Large Roundabout | Intersection Delay (s) | Intersection LOS |
|---|---|---|---|---|---|---|---|
| 1-1 | Road 25 and 33 | Roundabout | 1,2,3,4 |  |  | 3.12 | A |

## Intersection Network Options

| Driving Side | Lighting |
|---|---|
| Right | Normal/unknown |

# Legs

## Legs

| Name | Leg | Name | Description |
|---|---|---|---|
| **Road 25-West Leg** | 1 | Road 25-West Leg | |
| **Realigned Road 33-South Leg** | 2 | Realigned Road 33-South Leg | |
| **Road 25-East Leg** | 3 | Road 25-East Leg | |
| **Future-North Leg** | 4 | Future-North Leg | |

## Capacity Options

| Name | Minimum Capacity (PCE/hr) | Maximum Capacity (PCE/hr) |
|---|---|---|
| **Road 25-West Leg** | 0.00 | 99999.00 |
| **Realigned Road 33-South Leg** | 0.00 | 99999.00 |
| **Road 25-East Leg** | 0.00 | 99999.00 |
| **Future-North Leg** | 0.00 | 99999.00 |

## Roundabout Geometry

| Name | V - Approach road half-width (m) | E - Entry width (m) | l' - Effective flare length (m) | R - Entry radius (m) | D - Inscribed circle diameter (m) | PHI - Conflict (entry) angle (deg) | Exit Only |
|---|---|---|---|---|---|---|---|
| **Road 25-West Leg** | 3.50 | 4.20 | 10.00 | 30.00 | 35.00 | 25.00 | |
| **Realigned Road 33-South Leg** | 3.50 | 4.20 | 10.00 | 30.00 | 35.00 | 25.00 | |
| **Road 25-East Leg** | 3.50 | 4.20 | 10.00 | 30.00 | 35.00 | 25.00 | |
| **Future-North Leg** | 3.50 | 4.20 | 10.00 | 30.00 | 35.00 | 25.00 | |

## Slope / Intercept / Capacity

### Roundabout Slope and Intercept used in model

| Name | Enter slope and intercept directly | Entered slope | Entered intercept (PCE/hr) | Final Slope | Final Intercept (PCE/hr) |
|---|---|---|---|---|---|
| **Road 25-West Leg** | | (calculated) | (calculated) | 0.576 | 1275.301 |
| **Realigned Road 33-South Leg** | | (calculated) | (calculated) | 0.576 | 1275.301 |
| **Road 25-East Leg** | | (calculated) | (calculated) | 0.576 | 1275.301 |
| **Future-North Leg** | | (calculated) | (calculated) | 0.576 | 1275.301 |

*The slope and intercept shown above include any corrections and adjustments.*

# Traffic Flows

## Demand Set Data Options

| Default Vehicle Mix | Vehicle Mix Varies Over Time | Vehicle Mix Varies Over Turn | Vehicle Mix Varies Over Entry | Vehicle Mix Source | PCE Factor for a Truck (PCE) | Default Turning Proportions | Estimate from entry/exit counts | Turning Proportions Vary Over Time | Turning Proportions Vary Over Turn | Turning Proportions Vary Over Entry |
|---|---|---|---|---|---|---|---|---|---|---|
|  |  | ✓ | ✓ | Truck Percentages | 2.00 |  |  |  | ✓ | ✓ |

# Entry Flows

## General Flows Data

| Name | Profile Type | Use Turning Counts | Average Demand Flow (PCE/hr) | Flow Scaling Factor (%) |
|---|---|---|---|---|
| **Road 25-West Leg** | ONE HOUR | ✓ | 38.00 | 100.000 |
| **Realigned Road 33-South Leg** | ONE HOUR | ✓ | 26.00 | 100.000 |
| **Road 25-East Leg** | ONE HOUR | ✓ | 133.00 | 100.000 |
| **Future-North Leg** | ONE HOUR | ✓ | 0.00 | 100.000 |

# Direct/Resultant Flows

## Direct Flows Data

| Time Segment | Name | Direct Demand Entry Flow (PCE/hr) | DirectDemandEntryFlowInPCE (PCE/hr) | Direct Demand Exit Flow (PCE/hr) | Direct Demand Pedestrian Flow (Ped/hr) |
|---|---|---|---|---|---|
| **08:00-08:15** | **Road 25-West Leg** | 28.61 | 28.61 | | |
| **08:15-08:30** | **Road 25-West Leg** | 34.16 | 34.16 | | |
| **08:30-08:45** | **Road 25-West Leg** | 41.84 | 41.84 | | |
| **08:45-09:00** | **Road 25-West Leg** | 41.84 | 41.84 | | |
| **09:00-09:15** | **Road 25-West Leg** | 34.16 | 34.16 | | |
| **09:15-09:30** | **Road 25-West Leg** | 28.61 | 28.61 | | |
| **08:00-08:15** | **Realigned Road 33-South Leg** | 19.57 | 19.57 | | |
| **08:15-08:30** | **Realigned Road 33-South Leg** | 23.37 | 23.37 | | |
| **08:30-08:45** | **Realigned Road 33-South Leg** | 28.63 | 28.63 | | |
| **08:45-09:00** | **Realigned Road 33-South Leg** | 28.63 | 28.63 | | |
| **09:00-09:15** | **Realigned Road 33-South Leg** | 23.37 | 23.37 | | |
| **09:15-09:30** | **Realigned Road 33-South Leg** | 19.57 | 19.57 | | |
| **08:00-08:15** | **Road 25-East Leg** | 100.13 | 100.13 | | |

| | | | | | |
|---|---|---|---|---|---|
| **08:15-08:30** | **Road 25-East Leg** | 119.56 | 119.56 | | |
| **08:30-08:45** | **Road 25-East Leg** | 146.44 | 146.44 | | |
| **08:45-09:00** | **Road 25-East Leg** | 146.44 | 146.44 | | |
| **09:00-09:15** | **Road 25-East Leg** | 119.56 | 119.56 | | |
| **09:15-09:30** | **Road 25-East Leg** | 100.13 | 100.13 | | |
| **08:00-08:15** | **Future-North Leg** | 0.00 | 0.00 | | |
| **08:15-08:30** | **Future-North Leg** | 0.00 | 0.00 | | |
| **08:30-08:45** | **Future-North Leg** | 0.00 | 0.00 | | |
| **08:45-09:00** | **Future-North Leg** | 0.00 | 0.00 | | |
| **09:00-09:15** | **Future-North Leg** | 0.00 | 0.00 | | |
| **09:15-09:30** | **Future-North Leg** | 0.00 | 0.00 | | |

# Turning Proportions

## Turning Counts / Proportions (PCE/hr) - Road 25 and 33 (for whole period)

| | To | | | | |
|---|---|---|---|---|---|
| From | | Road 25-West Leg | Realigned Road 33-South Leg | Road 25-East Leg | Future-North Leg |
| | **Road 25-West Leg** | 0.000 | 3.000 | 35.000 | 0.000 |
| | **Realigned Road 33-South Leg** | 1.000 | 0.000 | 25.000 | 0.000 |
| | **Road 25-East Leg** | 64.000 | 69.000 | 0.000 | 0.000 |
| | **Future-North Leg** | 0.000 | 0.000 | 0.000 | 0.000 |

## Turning Proportions (PCE) - Road 25 and 33 (for whole period)

| | To | | | | |
|---|---|---|---|---|---|
| From | | Road 25-West Leg | Realigned Road 33-South Leg | Road 25-East Leg | Future-North Leg |
| | **Road 25-West Leg** | 0.00 | 0.08 | 0.92 | 0.00 |
| | **Realigned Road 33-South Leg** | 0.04 | 0.00 | 0.96 | 0.00 |
| | **Road 25-East Leg** | 0.48 | 0.52 | 0.00 | 0.00 |
| | **Future-North Leg** | 0.25 | 0.25 | 0.25 | 0.25 |

# Vehicle Mix

## Average PCE Per Vehicle - Road 25 and 33 (for whole period)

| | | To | | | |
|---|---|---|---|---|---|
| From | | Road 25-West Leg | Realigned Road 33-South Leg | Road 25-East Leg | Future-North Leg |
| | Road 25-West Leg | 1.000 | 1.000 | 1.000 | 1.000 |
| | Realigned Road 33-South Leg | 1.000 | 1.000 | 1.000 | 1.000 |
| | Road 25-East Leg | 1.000 | 1.000 | 1.000 | 1.000 |
| | Future-North Leg | 1.000 | 1.000 | 1.000 | 1.000 |

## Truck Percentages - Road 25 and 33 (for whole period)

| | | To | | | |
|---|---|---|---|---|---|
| From | | Road 25-West Leg | Realigned Road 33-South Leg | Road 25-East Leg | Future-North Leg |
| | Road 25-West Leg | 0.0 | 0.0 | 0.0 | 0.0 |
| | Realigned Road 33-South Leg | 0.0 | 0.0 | 0.0 | 0.0 |
| | Road 25-East Leg | 0.0 | 0.0 | 0.0 | 0.0 |
| | Future-North Leg | 0.0 | 0.0 | 0.0 | 0.0 |

# Results

## Results Summary for whole modelled period

| Name | Max V/C Ratio | Max Delay (s) | Max Queue (PCE) | Max 95th percentile Queue (PCE) | Max LOS |
|---|---|---|---|---|---|
| **Road 25-West Leg** | 0.03 | 3.02 | 0.04 | ~1 | A |
| **Realigned Road 33-South Leg** | 0.02 | 2.94 | 0.02 | ~1 | A |
| **Road 25-East Leg** | 0.11 | 3.19 | 0.13 | ~1 | A |
| **Future-North Leg** | 0.00 | 0.00 | 0.00 | ~1 | A |

# Existing 2019, PM

## Data Errors and Warnings

*No errors or warnings*

## Analysis Set Details

| Name | Roundabout Capacity Model | Description | Locked | Network Flow Scaling Factor (%) | Reason For Scaling Factors |
|---|---|---|---|---|---|
|  | ARCADY |  |  | 100.000 |  |

## Demand Set Details

| Name | Scenario Name | Time Period Name | Description | Traffic Profile Type | Model Start Time (HH:mm) | Model Finish Time (HH:mm) | Model Time Period Length (min) | Time Segment Length (min) | Single Time Segment Only | Locked |
|---|---|---|---|---|---|---|---|---|---|---|
| Existing 2019, PM | Existing 2019 | PM |  | ONE HOUR | 17:00 | 18:30 | 90 | 15 |  |  |

# Intersection Network

## Intersections

| Intersection | Name | Intersection Type | Leg Order | Grade Separated | Large Roundabout | Intersection Delay (s) | Intersection LOS |
|---|---|---|---|---|---|---|---|
| 1-1 | Road 25 and 33 | Roundabout | 1,2,3,4 | | | 3.23 | A |

## Intersection Network Options

| Driving Side | Lighting |
|---|---|
| Right | Normal/unknown |

# Legs

## Legs

| Name | Leg | Name | Description |
|---|---|---|---|
| **Road 25-West Leg** | 1 | Road 25-West Leg | |
| **Realigned Road 33-South Leg** | 2 | Realigned Road 33-South Leg | |
| **Road 25-East Leg** | 3 | Road 25-East Leg | |
| **Future-North Leg** | 4 | Future-North Leg | |

## Capacity Options

| Name | Minimum Capacity (PCE/hr) | Maximum Capacity (PCE/hr) |
|---|---|---|
| **Road 25-West Leg** | 0.00 | 99999.00 |
| **Realigned Road 33-South Leg** | 0.00 | 99999.00 |
| **Road 25-East Leg** | 0.00 | 99999.00 |
| **Future-North Leg** | 0.00 | 99999.00 |

## Roundabout Geometry

| Name | V - Approach road half-width (m) | E - Entry width (m) | l' - Effective flare length (m) | R - Entry radius (m) | D - Inscribed circle diameter (m) | PHI - Conflict (entry) angle (deg) | Exit Only |
|---|---|---|---|---|---|---|---|
| **Road 25-West Leg** | 3.50 | 4.20 | 10.00 | 30.00 | 35.00 | 25.00 | |
| **Realigned Road 33-South Leg** | 3.50 | 4.20 | 10.00 | 30.00 | 35.00 | 25.00 | |
| **Road 25-East Leg** | 3.50 | 4.20 | 10.00 | 30.00 | 35.00 | 25.00 | |
| **Future-North Leg** | 3.50 | 4.20 | 10.00 | 30.00 | 35.00 | 25.00 | |

## Slope / Intercept / Capacity

### Roundabout Slope and Intercept used in model

| Name | Enter slope and intercept directly | Entered slope | Entered intercept (PCE/hr) | Final Slope | Final Intercept (PCE/hr) |
|---|---|---|---|---|---|
| **Road 25-West Leg** | | (calculated) | (calculated) | 0.576 | 1275.301 |
| **Realigned Road 33-South Leg** | | (calculated) | (calculated) | 0.576 | 1275.301 |
| **Road 25-East Leg** | | (calculated) | (calculated) | 0.576 | 1275.301 |
| **Future-North Leg** | | (calculated) | (calculated) | 0.576 | 1275.301 |

*The slope and intercept shown above include any corrections and adjustments.*

# Traffic Flows

### Demand Set Data Options

| Default Vehicle Mix | Vehicle Mix Varies Over Time | Vehicle Mix Varies Over Turn | Vehicle Mix Varies Over Entry | Vehicle Mix Source | PCE Factor for a Truck (PCE) | Default Turning Proportions | Estimate from entry/exit counts | Turning Proportions Vary Over Time | Turning Proportions Vary Over Turn | Turning Proportions Vary Over Entry |
|---|---|---|---|---|---|---|---|---|---|---|
| | | ✓ | ✓ | Truck Percentages | 2.00 | | | | ✓ | ✓ |

# Entry Flows

## General Flows Data

| Name | Profile Type | Use Turning Counts | Average Demand Flow (PCE/hr) | Flow Scaling Factor (%) |
|---|---|---|---|---|
| **Road 25-West Leg** | ONE HOUR | ✓ | 51.00 | 100.000 |
| **Realigned Road 33-South Leg** | ONE HOUR | ✓ | 165.00 | 100.000 |
| **Road 25-East Leg** | ONE HOUR | ✓ | 82.00 | 100.000 |
| **Future-North Leg** | ONE HOUR | ✓ | 0.00 | 100.000 |

# Direct/Resultant Flows

## Direct Flows Data

| Time Segment | Name | Direct Demand Entry Flow (PCE/hr) | DirectDemandEntryFlowInPCE (PCE/hr) | Direct Demand Exit Flow (PCE/hr) | Direct Demand Pedestrian Flow (Ped/hr) |
|---|---|---|---|---|---|
| **17:00-17:15** | **Road 25-West Leg** | 38.40 | 38.40 | | |
| **17:15-17:30** | **Road 25-West Leg** | 45.85 | 45.85 | | |
| **17:30-17:45** | **Road 25-West Leg** | 56.15 | 56.15 | | |
| **17:45-18:00** | **Road 25-West Leg** | 56.15 | 56.15 | | |
| **18:00-18:15** | **Road 25-West Leg** | 45.85 | 45.85 | | |
| **18:15-18:30** | **Road 25-West Leg** | 38.40 | 38.40 | | |
| **17:00-17:15** | **Realigned Road 33-South Leg** | 124.22 | 124.22 | | |

| | | | | | |
|---|---|---|---|---|---|
| **17:15-17:30** | **Realigned Road 33-South Leg** | 148.33 | 148.33 | | |
| **17:30-17:45** | **Realigned Road 33-South Leg** | 181.67 | 181.67 | | |
| **17:45-18:00** | **Realigned Road 33-South Leg** | 181.67 | 181.67 | | |
| **18:00-18:15** | **Realigned Road 33-South Leg** | 148.33 | 148.33 | | |
| **18:15-18:30** | **Realigned Road 33-South Leg** | 124.22 | 124.22 | | |
| **17:00-17:15** | **Road 25-East Leg** | 61.73 | 61.73 | | |
| **17:15-17:30** | **Road 25-East Leg** | 73.72 | 73.72 | | |
| **17:30-17:45** | **Road 25-East Leg** | 90.28 | 90.28 | | |
| **17:45-18:00** | **Road 25-East Leg** | 90.28 | 90.28 | | |
| **18:00-18:15** | **Road 25-East Leg** | 73.72 | 73.72 | | |
| **18:15-18:30** | **Road 25-East Leg** | 61.73 | 61.73 | | |
| **17:00-17:15** | **Future-North Leg** | 0.00 | 0.00 | | |
| **17:15-17:30** | **Future-North Leg** | 0.00 | 0.00 | | |
| **17:30-17:45** | **Future-North Leg** | 0.00 | 0.00 | | |
| **17:45-18:00** | **Future-North Leg** | 0.00 | 0.00 | | |
| **18:00-18:15** | **Future-North Leg** | 0.00 | 0.00 | | |
| **18:15-18:30** | **Future-North Leg** | 0.00 | 0.00 | | |

# Turning Proportions

## Turning Counts / Proportions (PCE/hr) - Road 25 and 33 (for whole period)

| | To | | | | |
|---|---|---|---|---|---|
| From | | Road 25-West Leg | Realigned Road 33-South Leg | Road 25-East Leg | Future-North Leg |
| | Road 25-West Leg | 0.000 | 1.000 | 50.000 | 0.000 |
| | Realigned Road 33-South Leg | 0.000 | 0.000 | 165.000 | 0.000 |
| | Road 25-East Leg | 43.000 | 39.000 | 0.000 | 0.000 |
| | Future-North Leg | 0.000 | 0.000 | 0.000 | 0.000 |

## Turning Proportions (PCE) - Road 25 and 33 (for whole period)

| | To | | | | |
|---|---|---|---|---|---|
| From | | Road 25-West Leg | Realigned Road 33-South Leg | Road 25-East Leg | Future-North Leg |
| | Road 25-West Leg | 0.00 | 0.02 | 0.98 | 0.00 |
| | Realigned Road 33-South Leg | 0.00 | 0.00 | 1.00 | 0.00 |
| | Road 25-East Leg | 0.52 | 0.48 | 0.00 | 0.00 |
| | Future-North Leg | 0.25 | 0.25 | 0.25 | 0.25 |

# Vehicle Mix

## Average PCE Per Vehicle - Road 25 and 33 (for whole period)

| | | To | | | |
|---|---|---|---|---|---|
| | | Road 25-West Leg | Realigned Road 33-South Leg | Road 25-East Leg | Future-North Leg |
| From | Road 25-West Leg | 1.000 | 1.000 | 1.000 | 1.000 |
| | Realigned Road 33-South Leg | 1.000 | 1.000 | 1.000 | 1.000 |
| | Road 25-East Leg | 1.000 | 1.000 | 1.000 | 1.000 |
| | Future-North Leg | 1.000 | 1.000 | 1.000 | 1.000 |

## Truck Percentages - Road 25 and 33 (for whole period)

| | | To | | | |
|---|---|---|---|---|---|
| | | Road 25-West Leg | Realigned Road 33-South Leg | Road 25-East Leg | Future-North Leg |
| From | Road 25-West Leg | 0.0 | 0.0 | 0.0 | 0.0 |
| | Realigned Road 33-South Leg | 0.0 | 0.0 | 0.0 | 0.0 |
| | Road 25-East Leg | 0.0 | 0.0 | 0.0 | 0.0 |
| | Future-North Leg | 0.0 | 0.0 | 0.0 | 0.0 |

# Results

## Results Summary for whole modelled period

| Name | Max V/C Ratio | Max Delay (s) | Max Queue (PCE) | Max 95th percentile Queue (PCE) | Max LOS |
|---|---|---|---|---|---|
| **Road 25-West Leg** | 0.04 | 3.01 | 0.05 | ~1 | A |
| **Realigned Road 33-South Leg** | 0.15 | 3.39 | 0.17 | ~1 | A |
| **Road 25-East Leg** | 0.07 | 3.04 | 0.08 | ~1 | A |
| **Future-North Leg** | 0.00 | 0.00 | 0.00 | ~1 | A |

# Future 2040, AM

## Data Errors and Warnings

*No errors or warnings*

## Analysis Set Details

| Name | Roundabout Capacity Model | Description | Locked | Network Flow Scaling Factor (%) | Reason For Scaling Factors |
|---|---|---|---|---|---|
|  | ARCADY |  |  | 100.000 |  |

## Demand Set Details

| Name | Scenario Name | Time Period Name | Description | Traffic Profile Type | Model Start Time (HH:mm) | Model Finish Time (HH:mm) | Model Time Period Length (min) | Time Segment Length (min) | Single Time Segment Only | Locked |
|---|---|---|---|---|---|---|---|---|---|---|
| Future 2040, AM | Future 2040 | AM |  | ONE HOUR | 08:00 | 09:30 | 90 | 15 |  |  |

# Intersection Network

## Intersections

| Intersection | Name | Intersection Type | Leg Order | Grade Separated | Large Roundabout | Intersection Delay (s) | Intersection LOS |
|---|---|---|---|---|---|---|---|
| 1-1 | Road 25 and 33 | Roundabout | 1,2,3,4 | | | 3.44 | A |

## Intersection Network Options

| Driving Side | Lighting |
|---|---|
| Right | Normal/unknown |

# Legs

## Legs

| Name | Leg | Name | Description |
|---|---|---|---|
| **Road 25-West Leg** | 1 | Road 25-West Leg | |
| **Realigned Road 33-South Leg** | 2 | Realigned Road 33-South Leg | |
| **Road 25-East Leg** | 3 | Road 25-East Leg | |
| **Future-North Leg** | 4 | Future-North Leg | |

## Capacity Options

| Name | Minimum Capacity (PCE/hr) | Maximum Capacity (PCE/hr) |
|---|---|---|
| **Road 25-West Leg** | 0.00 | 99999.00 |
| **Realigned Road 33-South Leg** | 0.00 | 99999.00 |
| **Road 25-East Leg** | 0.00 | 99999.00 |
| **Future-North Leg** | 0.00 | 99999.00 |

## Roundabout Geometry

| Name | V - Approach road half-width (m) | E - Entry width (m) | l' - Effective flare length (m) | R - Entry radius (m) | D - Inscribed circle diameter (m) | PHI - Conflict (entry) angle (deg) | Exit Only |
|---|---|---|---|---|---|---|---|
| **Road 25-West Leg** | 3.50 | 4.20 | 10.00 | 30.00 | 35.00 | 25.00 | |
| **Realigned Road 33-South Leg** | 3.50 | 4.20 | 10.00 | 30.00 | 35.00 | 25.00 | |
| **Road 25-East Leg** | 3.50 | 4.20 | 10.00 | 30.00 | 35.00 | 25.00 | |
| **Future-North Leg** | 3.50 | 4.20 | 10.00 | 30.00 | 35.00 | 25.00 | |

## Slope / Intercept / Capacity

### Roundabout Slope and Intercept used in model

| Name | Enter slope and intercept directly | Entered slope | Entered intercept (PCE/hr) | Final Slope | Final Intercept (PCE/hr) |
|---|---|---|---|---|---|
| **Road 25-West Leg** | | (calculated) | (calculated) | 0.576 | 1275.301 |
| **Realigned Road 33-South Leg** | | (calculated) | (calculated) | 0.576 | 1275.301 |
| **Road 25-East Leg** | | (calculated) | (calculated) | 0.576 | 1275.301 |
| **Future-North Leg** | | (calculated) | (calculated) | 0.576 | 1275.301 |

*The slope and intercept shown above include any corrections and adjustments.*

# Traffic Flows

### Demand Set Data Options

| Default Vehicle Mix | Vehicle Mix Varies Over Time | Vehicle Mix Varies Over Turn | Vehicle Mix Varies Over Entry | Vehicle Mix Source | PCE Factor for a Truck (PCE) | Default Turning Proportions | Estimate from entry/exit counts | Turning Proportions Vary Over Time | Turning Proportions Vary Over Turn | Turning Proportions Vary Over Entry |
|---|---|---|---|---|---|---|---|---|---|---|
| | | ✓ | ✓ | Truck Percentages | 2.00 | | | | ✓ | ✓ |

# Entry Flows

## General Flows Data

| Name | Profile Type | Use Turning Counts | Average Demand Flow (PCE/hr) | Flow Scaling Factor (%) |
|---|---|---|---|---|
| **Road 25-West Leg** | ONE HOUR | ✓ | 59.00 | 100.000 |
| **Realigned Road 33-South Leg** | ONE HOUR | ✓ | 51.00 | 100.000 |
| **Road 25-East Leg** | ONE HOUR | ✓ | 225.00 | 100.000 |
| **Future-North Leg** | ONE HOUR | ✓ | 94.00 | 100.000 |

# Direct/Resultant Flows

## Direct Flows Data

| Time Segment | Name | Direct Demand Entry Flow (PCE/hr) | DirectDemandEntryFlowInPCE (PCE/hr) | Direct Demand Exit Flow (PCE/hr) | Direct Demand Pedestrian Flow (Ped/hr) |
|---|---|---|---|---|---|
| **08:00-08:15** | **Road 25-West Leg** | 44.42 | 44.42 | | |
| **08:15-08:30** | **Road 25-West Leg** | 53.04 | 53.04 | | |
| **08:30-08:45** | **Road 25-West Leg** | 64.96 | 64.96 | | |
| **08:45-09:00** | **Road 25-West Leg** | 64.96 | 64.96 | | |
| **09:00-09:15** | **Road 25-West Leg** | 53.04 | 53.04 | | |
| **09:15-09:30** | **Road 25-West Leg** | 44.42 | 44.42 | | |
| **08:00-08:15** | **Realigned Road 33-South Leg** | 38.40 | 38.40 | | |

| | | | | | |
|---|---|---|---|---|---|
| **08:15-08:30** | **Realigned Road 33-South Leg** | 45.85 | 45.85 | | |
| **08:30-08:45** | **Realigned Road 33-South Leg** | 56.15 | 56.15 | | |
| **08:45-09:00** | **Realigned Road 33-South Leg** | 56.15 | 56.15 | | |
| **09:00-09:15** | **Realigned Road 33-South Leg** | 45.85 | 45.85 | | |
| **09:15-09:30** | **Realigned Road 33-South Leg** | 38.40 | 38.40 | | |
| **08:00-08:15** | **Road 25-East Leg** | 169.39 | 169.39 | | |
| **08:15-08:30** | **Road 25-East Leg** | 202.27 | 202.27 | | |
| **08:30-08:45** | **Road 25-East Leg** | 247.73 | 247.73 | | |
| **08:45-09:00** | **Road 25-East Leg** | 247.73 | 247.73 | | |
| **09:00-09:15** | **Road 25-East Leg** | 202.27 | 202.27 | | |
| **09:15-09:30** | **Road 25-East Leg** | 169.39 | 169.39 | | |
| **08:00-08:15** | **Future-North Leg** | 70.77 | 70.77 | | |
| **08:15-08:30** | **Future-North Leg** | 84.50 | 84.50 | | |
| **08:30-08:45** | **Future-North Leg** | 103.50 | 103.50 | | |
| **08:45-09:00** | **Future-North Leg** | 103.50 | 103.50 | | |
| **09:00-09:15** | **Future-North Leg** | 84.50 | 84.50 | | |
| **09:15-09:30** | **Future-North Leg** | 70.77 | 70.77 | | |

# Turning Proportions

## Turning Counts / Proportions (PCE/hr) - Road 25 and 33 (for whole period)

| | To | | | | |
|---|---|---|---|---|---|
| From | | **Road 25-West Leg** | **Realigned Road 33-South Leg** | **Road 25-East Leg** | **Future-North Leg** |
| | **Road 25-West Leg** | 0.000 | 7.000 | 52.000 | 0.000 |
| | **Realigned Road 33-South Leg** | 2.000 | 0.000 | 44.000 | 5.000 |
| | **Road 25-East Leg** | 69.000 | 130.000 | 0.000 | 26.000 |
| | **Future-North Leg** | 0.000 | 15.000 | 79.000 | 0.000 |

## Turning Proportions (PCE) - Road 25 and 33 (for whole period)

| | To | | | | |
|---|---|---|---|---|---|
| From | | **Road 25-West Leg** | **Realigned Road 33-South Leg** | **Road 25-East Leg** | **Future-North Leg** |
| | **Road 25-West Leg** | 0.00 | 0.12 | 0.88 | 0.00 |
| | **Realigned Road 33-South Leg** | 0.04 | 0.00 | 0.86 | 0.10 |
| | **Road 25-East Leg** | 0.31 | 0.58 | 0.00 | 0.12 |
| | **Future-North Leg** | 0.00 | 0.16 | 0.84 | 0.00 |

# Vehicle Mix

## Average PCE Per Vehicle - Road 25 and 33 (for whole period)

| | | To | | | |
|---|---|---|---|---|---|
| | | Road 25-West Leg | Realigned Road 33-South Leg | Road 25-East Leg | Future-North Leg |
| From | Road 25-West Leg | 1.000 | 1.000 | 1.000 | 1.000 |
| | Realigned Road 33-South Leg | 1.000 | 1.000 | 1.000 | 1.000 |
| | Road 25-East Leg | 1.000 | 1.000 | 1.000 | 1.000 |
| | Future-North Leg | 1.000 | 1.000 | 1.000 | 1.000 |

## Truck Percentages - Road 25 and 33 (for whole period)

| | | To | | | |
|---|---|---|---|---|---|
| | | Road 25-West Leg | Realigned Road 33-South Leg | Road 25-East Leg | Future-North Leg |
| From | Road 25-West Leg | 0.0 | 0.0 | 0.0 | 0.0 |
| | Realigned Road 33-South Leg | 0.0 | 0.0 | 0.0 | 0.0 |
| | Road 25-East Leg | 0.0 | 0.0 | 0.0 | 0.0 |
| | Future-North Leg | 0.0 | 0.0 | 0.0 | 0.0 |

# Results

## Results Summary for whole modelled period

| Name | Max V/C Ratio | Max Delay (s) | Max Queue (PCE) | Max 95th percentile Queue (PCE) | Max LOS |
|---|---|---|---|---|---|
| **Road 25-West Leg** | 0.06 | 3.37 | 0.06 | ~1 | A |
| **Realigned Road 33-South Leg** | 0.05 | 3.17 | 0.05 | ~1 | A |
| **Road 25-East Leg** | 0.19 | 3.52 | 0.24 | ~1 | A |
| **Future-North Leg** | 0.09 | 3.45 | 0.10 | ~1 | A |

# Future 2040, PM

## Data Errors and Warnings

*No errors or warnings*

## Analysis Set Details

| Name | Roundabout Capacity Model | Description | Locked | Network Flow Scaling Factor (%) | Reason For Scaling Factors |
|---|---|---|---|---|---|
|  | ARCADY |  |  | 100.000 |  |

## Demand Set Details

| Name | Scenario Name | Time Period Name | Description | Traffic Profile Type | Model Start Time (HH:mm) | Model Finish Time (HH:mm) | Model Time Period Length (min) | Time Segment Length (min) | Single Time Segment Only | Locked |
|---|---|---|---|---|---|---|---|---|---|---|
| Future 2040, PM | Future 2040 | PM |  | ONE HOUR | 17:00 | 18:30 | 90 | 15 |  |  |

# Intersection Network

## Intersections

| Intersection | Name | Intersection Type | Leg Order | Grade Separated | Large Roundabout | Intersection Delay (s) | Intersection LOS |
|---|---|---|---|---|---|---|---|
| 1-1 | Road 25 and 33 | Roundabout | 1,2,3,4 | | | 3.69 | A |

## Intersection Network Options

| Driving Side | Lighting |
|---|---|
| Right | Normal/unknown |

# Legs

## Legs

| Name | Leg | Name | Description |
|---|---|---|---|
| **Road 25-West Leg** | 1 | Road 25-West Leg | |
| **Realigned Road 33-South Leg** | 2 | Realigned Road 33-South Leg | |
| **Road 25-East Leg** | 3 | Road 25-East Leg | |
| **Future-North Leg** | 4 | Future-North Leg | |

## Capacity Options

| Name | Minimum Capacity (PCE/hr) | Maximum Capacity (PCE/hr) |
|---|---|---|
| **Road 25-West Leg** | 0.00 | 99999.00 |
| **Realigned Road 33-South Leg** | 0.00 | 99999.00 |
| **Road 25-East Leg** | 0.00 | 99999.00 |
| **Future-North Leg** | 0.00 | 99999.00 |

## Roundabout Geometry

| Name | V - Approach road half-width (m) | E - Entry width (m) | I' - Effective flare length (m) | R - Entry radius (m) | D - Inscribed circle diameter (m) | PHI - Conflict (entry) angle (deg) | Exit Only |
|---|---|---|---|---|---|---|---|
| **Road 25-West Leg** | 3.50 | 4.20 | 10.00 | 30.00 | 35.00 | 25.00 | |
| **Realigned Road 33-South Leg** | 3.50 | 4.20 | 10.00 | 30.00 | 35.00 | 25.00 | |
| **Road 25-East Leg** | 3.50 | 4.20 | 10.00 | 30.00 | 35.00 | 25.00 | |
| **Future-North Leg** | 3.50 | 4.20 | 10.00 | 30.00 | 35.00 | 25.00 | |

## Slope / Intercept / Capacity

### Roundabout Slope and Intercept used in model

| Name | Enter slope and intercept directly | Entered slope | Entered intercept (PCE/hr) | Final Slope | Final Intercept (PCE/hr) |
|---|---|---|---|---|---|
| **Road 25-West Leg** | | (calculated) | (calculated) | 0.576 | 1275.301 |
| **Realigned Road 33-South Leg** | | (calculated) | (calculated) | 0.576 | 1275.301 |
| **Road 25-East Leg** | | (calculated) | (calculated) | 0.576 | 1275.301 |
| **Future-North Leg** | | (calculated) | (calculated) | 0.576 | 1275.301 |

*The slope and intercept shown above include any corrections and adjustments.*

# Traffic Flows

## Demand Set Data Options

| Default Vehicle Mix | Vehicle Mix Varies Over Time | Vehicle Mix Varies Over Turn | Vehicle Mix Varies Over Entry | Vehicle Mix Source | PCE Factor for a Truck (PCE) | Default Turning Proportions | Estimate from entry/exit counts | Turning Proportions Vary Over Time | Turning Proportions Vary Over Turn | Turning Proportions Vary Over Entry |
|---|---|---|---|---|---|---|---|---|---|---|
| | | ✓ | ✓ | Truck Percentages | 2.00 | | | | ✓ | ✓ |

# Entry Flows

## General Flows Data

| Name | Profile Type | Use Turning Counts | Average Demand Flow (PCE/hr) | Flow Scaling Factor (%) |
|---|---|---|---|---|
| **Road 25-West Leg** | ONE HOUR | ✓ | 64.00 | 100.000 |
| **Realigned Road 33-South Leg** | ONE HOUR | ✓ | 274.00 | 100.000 |
| **Road 25-East Leg** | ONE HOUR | ✓ | 232.00 | 100.000 |
| **Future-North Leg** | ONE HOUR | ✓ | 61.00 | 100.000 |

# Direct/Resultant Flows

## Direct Flows Data

| Time Segment | Name | Direct Demand Entry Flow (PCE/hr) | DirectDemandEntryFlowInPCE (PCE/hr) | Direct Demand Exit Flow (PCE/hr) | Direct Demand Pedestrian Flow (Ped/hr) |
|---|---|---|---|---|---|
| **17:00-17:15** | **Road 25-West Leg** | 48.18 | 48.18 | | |
| **17:15-17:30** | **Road 25-West Leg** | 57.53 | 57.53 | | |
| **17:30-17:45** | **Road 25-West Leg** | 70.47 | 70.47 | | |
| **17:45-18:00** | **Road 25-West Leg** | 70.47 | 70.47 | | |
| **18:00-18:15** | **Road 25-West Leg** | 57.53 | 57.53 | | |
| **18:15-18:30** | **Road 25-West Leg** | 48.18 | 48.18 | | |
| **17:00-17:15** | **Realigned Road 33-South Leg** | 206.28 | 206.28 | | |

| | | | | | |
|---|---|---|---|---|---|
| **17:15-17:30** | **Realigned Road 33-South Leg** | 246.32 | 246.32 | | |
| **17:30-17:45** | **Realigned Road 33-South Leg** | 301.68 | 301.68 | | |
| **17:45-18:00** | **Realigned Road 33-South Leg** | 301.68 | 301.68 | | |
| **18:00-18:15** | **Realigned Road 33-South Leg** | 246.32 | 246.32 | | |
| **18:15-18:30** | **Realigned Road 33-South Leg** | 206.28 | 206.28 | | |
| **17:00-17:15** | **Road 25-East Leg** | 174.66 | 174.66 | | |
| **17:15-17:30** | **Road 25-East Leg** | 208.56 | 208.56 | | |
| **17:30-17:45** | **Road 25-East Leg** | 255.44 | 255.44 | | |
| **17:45-18:00** | **Road 25-East Leg** | 255.44 | 255.44 | | |
| **18:00-18:15** | **Road 25-East Leg** | 208.56 | 208.56 | | |
| **18:15-18:30** | **Road 25-East Leg** | 174.66 | 174.66 | | |
| **17:00-17:15** | **Future-North Leg** | 45.92 | 45.92 | | |
| **17:15-17:30** | **Future-North Leg** | 54.84 | 54.84 | | |
| **17:30-17:45** | **Future-North Leg** | 67.16 | 67.16 | | |
| **17:45-18:00** | **Future-North Leg** | 67.16 | 67.16 | | |
| **18:00-18:15** | **Future-North Leg** | 54.84 | 54.84 | | |
| **18:15-18:30** | **Future-North Leg** | 45.92 | 45.92 | | |

# Turning Proportions

## Turning Counts / Proportions (PCE/hr) - Road 25 and 33 (for whole period)

| | To | | | | |
|---|---|---|---|---|---|
| | | **Road 25-West Leg** | **Realigned Road 33-South Leg** | **Road 25-East Leg** | **Future-North Leg** |
| **From** | **Road 25-West Leg** | 0.000 | 4.000 | 60.000 | 0.000 |
| | **Realigned Road 33-South Leg** | 4.000 | 0.000 | 248.000 | 22.000 |
| | **Road 25-East Leg** | 60.000 | 92.000 | 0.000 | 80.000 |
| | **Future-North Leg** | 0.000 | 14.000 | 47.000 | 0.000 |

## Turning Proportions (PCE) - Road 25 and 33 (for whole period)

| | To | | | | |
|---|---|---|---|---|---|
| | | **Road 25-West Leg** | **Realigned Road 33-South Leg** | **Road 25-East Leg** | **Future-North Leg** |
| **From** | **Road 25-West Leg** | 0.00 | 0.06 | 0.94 | 0.00 |
| | **Realigned Road 33-South Leg** | 0.01 | 0.00 | 0.91 | 0.08 |
| | **Road 25-East Leg** | 0.26 | 0.40 | 0.00 | 0.34 |
| | **Future-North Leg** | 0.00 | 0.23 | 0.77 | 0.00 |

# Vehicle Mix

## Average PCE Per Vehicle - Road 25 and 33 (for whole period)

| | | **To** | | | |
|---|---|---|---|---|---|
| **From** | | **Road 25-West Leg** | **Realigned Road 33-South Leg** | **Road 25-East Leg** | **Future-North Leg** |
| | **Road 25-West Leg** | 1.000 | 1.000 | 1.000 | 1.000 |
| | **Realigned Road 33-South Leg** | 1.000 | 1.000 | 1.000 | 1.000 |
| | **Road 25-East Leg** | 1.000 | 1.000 | 1.000 | 1.000 |
| | **Future-North Leg** | 1.000 | 1.000 | 1.000 | 1.000 |

## Truck Percentages - Road 25 and 33 (for whole period)

| | | **To** | | | |
|---|---|---|---|---|---|
| **From** | | **Road 25-West Leg** | **Realigned Road 33-South Leg** | **Road 25-East Leg** | **Future-North Leg** |
| | **Road 25-West Leg** | 0.0 | 0.0 | 0.0 | 0.0 |
| | **Realigned Road 33-South Leg** | 0.0 | 0.0 | 0.0 | 0.0 |
| | **Road 25-East Leg** | 0.0 | 0.0 | 0.0 | 0.0 |
| | **Future-North Leg** | 0.0 | 0.0 | 0.0 | 0.0 |

# Results

## Results Summary for whole modelled period

| Name | Max V/C Ratio | Max Delay (s) | Max Queue (PCE) | Max 95th percentile Queue (PCE) | Max LOS |
|---|---|---|---|---|---|
| **Road 25-West Leg** | 0.06 | 3.25 | 0.06 | ~1 | A |
| **Realigned Road 33-South Leg** | 0.25 | 3.97 | 0.33 | ~1 | A |
| **Road 25-East Leg** | 0.20 | 3.59 | 0.25 | ~1 | A |
| **Future-North Leg** | 0.06 | 3.24 | 0.06 | ~1 | A |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | ↰ | ↑↱ | | ↰ | ↑↱ | | ↰ | ↱ | | ↰ | ↱ | |
| Traffic Volume (veh/h) | 0 | 35 | 3 | 69 | 64 | 0 | 1 | 0 | 25 | 0 | 0 | 0 |
| Future Volume (veh/h) | 0 | 35 | 3 | 69 | 64 | 0 | 1 | 0 | 25 | 0 | 0 | 0 |
| Initial Q (Qb), veh | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ped-Bike Adj(A_pbT) | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 |
| Parking Bus, Adj | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Work Zone On Approach | | No | | | No | | | No | | | No | |
| Adj Sat Flow, veh/h/ln | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 |
| Adj Flow Rate, veh/h | 0 | 38 | 3 | 75 | 70 | 0 | 1 | 0 | 27 | 0 | 0 | 0 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Percent Heavy Veh, % | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Cap, veh/h | 217 | 2016 | 157 | 1035 | 2145 | 0 | 278 | 0 | 54 | 217 | 64 | 0 |
| Arrive On Green | 0.00 | 0.60 | 0.60 | 0.60 | 0.60 | 0.00 | 0.03 | 0.00 | 0.03 | 0.00 | 0.00 | 0.00 |
| Sat Flow, veh/h | 1331 | 3340 | 260 | 1366 | 3647 | 0 | 1781 | 0 | 1585 | 1383 | 1870 | 0 |
| Grp Volume(v), veh/h | 0 | 20 | 21 | 75 | 70 | 0 | 1 | 0 | 27 | 0 | 0 | 0 |
| Grp Sat Flow(s),veh/h/ln | 1331 | 1777 | 1823 | 1366 | 1777 | 0 | 1781 | 0 | 1585 | 1383 | 1870 | 0 |
| Q Serve(g_s), s | 0.0 | 0.1 | 0.2 | 0.8 | 0.3 | 0.0 | 0.0 | 0.0 | 0.6 | 0.0 | 0.0 | 0.0 |
| Cycle Q Clear(g_c), s | 0.0 | 0.1 | 0.2 | 0.9 | 0.3 | 0.0 | 0.0 | 0.0 | 0.6 | 0.0 | 0.0 | 0.0 |
| Prop In Lane | 1.00 | | 0.14 | 1.00 | | 0.00 | 1.00 | | 1.00 | 1.00 | | 0.00 |
| Lane Grp Cap(c), veh/h | 217 | 1072 | 1101 | 1035 | 2145 | 0 | 278 | 0 | 54 | 217 | 64 | 0 |
| V/C Ratio(X) | 0.00 | 0.02 | 0.02 | 0.07 | 0.03 | 0.00 | 0.00 | 0.00 | 0.50 | 0.00 | 0.00 | 0.00 |
| Avail Cap(c_a), veh/h | 217 | 1072 | 1101 | 1035 | 2145 | 0 | 1454 | 0 | 1100 | 1130 | 1298 | 0 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Upstream Filter(I) | 0.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.00 | 1.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 |
| Uniform Delay (d), s/veh | 0.0 | 2.6 | 2.6 | 2.8 | 2.7 | 0.0 | 15.5 | 0.0 | 15.7 | 0.0 | 0.0 | 0.0 |
| Incr Delay (d2), s/veh | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 6.9 | 0.0 | 0.0 | 0.0 |
| Initial Q Delay(d3),s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile BackOfQ(50%),veh/ln | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 | 0.0 |
| Unsig. Movement Delay, s/veh | | | | | | | | | | | | |
| LnGrp Delay(d),s/veh | 0.0 | 2.7 | 2.7 | 3.0 | 2.7 | 0.0 | 15.5 | 0.0 | 22.6 | 0.0 | 0.0 | 0.0 |
| LnGrp LOS | A | A | A | A | A | A | B | A | C | A | A | A |
| Approach Vol, veh/h | | 41 | | | 145 | | | 28 | | | 0 | |
| Approach Delay, s/veh | | 2.7 | | | 2.8 | | | 22.3 | | | 0.0 | |
| Approach LOS | | A | | | A | | | C | | | | |
| Timer - Assigned Phs | | 2 | | 4 | | 6 | | 8 | | | | |
| Phs Duration (G+Y+Rc), s | | 26.0 | | 7.1 | | 26.0 | | 7.1 | | | | |
| Change Period (Y+Rc), s | | 6.0 | | 6.0 | | 6.0 | | 6.0 | | | | |
| Max Green Setting (Gmax), s | | 20.0 | | 23.0 | | 20.0 | | 23.0 | | | | |
| Max Q Clear Time (g_c+I1), s | | 2.2 | | 0.0 | | 2.9 | | 2.6 | | | | |
| Green Ext Time (p_c), s | | 0.3 | | 0.0 | | 1.1 | | 0.2 | | | | |
| Intersection Summary | | | | | | | | | | | | |
| HCM 6th Ctrl Delay | | | 5.3 | | | | | | | | | |
| HCM 6th LOS | | | A | | | | | | | | | |

## Road 25 & Road 33/Bruce Street

| | ↗ | → | ↘ | ↙ | ← | ↖ | ↖ | ↑ | ↗ | ↘ | ↓ | ↙ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
| Lane Configurations | ↰ | ↑↱ | | ↰ | ↑↱ | | ↰ | ↱ | | ↰ | ↱ | |
| Traffic Volume (veh/h) | 0 | 50 | 1 | 39 | 43 | 0 | 1 | 0 | 165 | 0 | 0 | 0 |
| Future Volume (veh/h) | 0 | 50 | 1 | 39 | 43 | 0 | 1 | 0 | 165 | 0 | 0 | 0 |
| Initial Q (Qb), veh | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ped-Bike Adj(A_pbT) | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 | 1.00 | | 1.00 |
| Parking Bus, Adj | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Work Zone On Approach | | No | | | No | | | No | | | No | |
| Adj Sat Flow, veh/h/ln | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 |
| Adj Flow Rate, veh/h | 0 | 54 | 1 | 42 | 47 | 0 | 1 | 0 | 179 | 0 | 0 | 0 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Percent Heavy Veh, % | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Cap, veh/h | 184 | 1821 | 34 | 861 | 1813 | 0 | 511 | 0 | 291 | 184 | 344 | 0 |
| Arrive On Green | 0.00 | 0.51 | 0.51 | 0.51 | 0.51 | 0.00 | 0.18 | 0.00 | 0.18 | 0.00 | 0.00 | 0.00 |
| Sat Flow, veh/h | 1359 | 3569 | 66 | 1349 | 3647 | 0 | 1781 | 0 | 1585 | 1205 | 1870 | 0 |
| Grp Volume(v), veh/h | 0 | 27 | 28 | 42 | 47 | 0 | 1 | 0 | 179 | 0 | 0 | 0 |
| Grp Sat Flow(s),veh/h/ln | 1359 | 1777 | 1858 | 1349 | 1777 | 0 | 1781 | 0 | 1585 | 1205 | 1870 | 0 |
| Q Serve(g_s), s | 0.0 | 0.3 | 0.3 | 0.6 | 0.3 | 0.0 | 0.0 | 0.0 | 4.1 | 0.0 | 0.0 | 0.0 |
| Cycle Q Clear(g_c), s | 0.0 | 0.3 | 0.3 | 0.9 | 0.3 | 0.0 | 0.0 | 0.0 | 4.1 | 0.0 | 0.0 | 0.0 |
| Prop In Lane | 1.00 | | 0.04 | 1.00 | | 0.00 | 1.00 | | 1.00 | 1.00 | | 0.00 |
| Lane Grp Cap(c), veh/h | 184 | 906 | 948 | 861 | 1813 | 0 | 511 | 0 | 291 | 184 | 344 | 0 |
| V/C Ratio(X) | 0.00 | 0.03 | 0.03 | 0.05 | 0.03 | 0.00 | 0.00 | 0.00 | 0.61 | 0.00 | 0.00 | 0.00 |
| Avail Cap(c_a), veh/h | 184 | 906 | 948 | 861 | 1813 | 0 | 1229 | 0 | 930 | 669 | 1097 | 0 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Upstream Filter(I) | 0.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.00 | 1.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 |
| Uniform Delay (d), s/veh | 0.0 | 4.8 | 4.8 | 5.0 | 4.8 | 0.0 | 13.1 | 0.0 | 14.7 | 0.0 | 0.0 | 0.0 |
| Incr Delay (d2), s/veh | 0.0 | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 2.1 | 0.0 | 0.0 | 0.0 |
| Initial Q Delay(d3),s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile BackOfQ(50%),veh/ln | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 1.3 | 0.0 | 0.0 | 0.0 |
| Unsig. Movement Delay, s/veh | | | | | | | | | | | | |
| LnGrp Delay(d),s/veh | 0.0 | 4.8 | 4.8 | 5.1 | 4.8 | 0.0 | 13.1 | 0.0 | 16.8 | 0.0 | 0.0 | 0.0 |
| LnGrp LOS | A | A | A | A | A | A | B | A | B | A | A | A |
| Approach Vol, veh/h | | 55 | | | 89 | | | 180 | | | 0 | |
| Approach Delay, s/veh | | 4.8 | | | 4.9 | | | 16.8 | | | 0.0 | |
| Approach LOS | | A | | | A | | | B | | | | |

| Timer - Assigned Phs | | 2 | | 4 | | 6 | | 8 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Phs Duration (G+Y+Rc), s | | 26.0 | | 13.2 | | 26.0 | | 13.2 | | | | |
| Change Period (Y+Rc), s | | 6.0 | | 6.0 | | 6.0 | | 6.0 | | | | |
| Max Green Setting (Gmax), s | | 20.0 | | 23.0 | | 20.0 | | 23.0 | | | | |
| Max Q Clear Time (g_c+I1), s | | 2.3 | | 0.0 | | 2.9 | | 6.1 | | | | |
| Green Ext Time (p_c), s | | 0.4 | | 0.0 | | 0.6 | | 2.3 | | | | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM 6th Ctrl Delay | | | 11.5 |
| HCM 6th LOS | | | B |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | ↰ | ↑↱ |  | ↰ | ↑↱ |  | ↰ | ↱ |  | ↰ | ↱ |  |
| Traffic Volume (veh/h) | 1 | 52 | 7 | 130 | 69 | 26 | 2 | 5 | 44 | 79 | 15 | 1 |
| Future Volume (veh/h) | 1 | 52 | 7 | 130 | 69 | 26 | 2 | 5 | 44 | 79 | 15 | 1 |
| Initial Q (Qb), veh | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ped-Bike Adj(A_pbT) | 1.00 |  | 1.00 | 1.00 |  | 1.00 | 1.00 |  | 1.00 | 1.00 |  | 1.00 |
| Parking Bus, Adj | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Work Zone On Approach |  | No |  |  | No |  |  | No |  |  | No |  |
| Adj Sat Flow, veh/h/ln | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 |
| Adj Flow Rate, veh/h | 1 | 57 | 8 | 141 | 75 | 28 | 2 | 5 | 48 | 86 | 16 | 1 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Percent Heavy Veh, % | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Cap, veh/h | 882 | 1711 | 235 | 914 | 1401 | 498 | 363 | 19 | 186 | 329 | 222 | 14 |
| Arrive On Green | 0.55 | 0.55 | 0.55 | 0.55 | 0.55 | 0.55 | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 |
| Sat Flow, veh/h | 1291 | 3138 | 431 | 1337 | 2570 | 913 | 1396 | 152 | 1456 | 1351 | 1742 | 109 |
| Grp Volume(v), veh/h | 1 | 32 | 33 | 141 | 51 | 52 | 2 | 0 | 53 | 86 | 0 | 17 |
| Grp Sat Flow(s),veh/h/ln | 1291 | 1777 | 1793 | 1337 | 1777 | 1706 | 1396 | 0 | 1608 | 1351 | 0 | 1851 |
| Q Serve(g_s), s | 0.0 | 0.3 | 0.3 | 2.0 | 0.5 | 0.5 | 0.0 | 0.0 | 1.1 | 2.2 | 0.0 | 0.3 |
| Cycle Q Clear(g_c), s | 0.5 | 0.3 | 0.3 | 2.3 | 0.5 | 0.5 | 0.3 | 0.0 | 1.1 | 3.3 | 0.0 | 0.3 |
| Prop In Lane | 1.00 |  | 0.24 | 1.00 |  | 0.54 | 1.00 |  | 0.91 | 1.00 |  | 0.06 |
| Lane Grp Cap(c), veh/h | 882 | 969 | 977 | 914 | 969 | 930 | 363 | 0 | 205 | 329 | 0 | 236 |
| V/C Ratio(X) | 0.00 | 0.03 | 0.03 | 0.15 | 0.05 | 0.06 | 0.01 | 0.00 | 0.26 | 0.26 | 0.00 | 0.07 |
| Avail Cap(c_a), veh/h | 882 | 969 | 977 | 914 | 969 | 930 | 1060 | 0 | 1008 | 1003 | 0 | 1160 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Upstream Filter(I) | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.00 | 1.00 | 1.00 | 0.00 | 1.00 |
| Uniform Delay (d), s/veh | 4.0 | 3.9 | 3.9 | 4.4 | 3.9 | 3.9 | 14.2 | 0.0 | 14.4 | 15.9 | 0.0 | 14.1 |
| Incr Delay (d2), s/veh | 0.0 | 0.1 | 0.1 | 0.4 | 0.1 | 0.1 | 0.0 | 0.0 | 0.7 | 0.4 | 0.0 | 0.1 |
| Initial Q Delay(d3),s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile BackOfQ(50%),veh/ln | 0.0 | 0.0 | 0.0 | 0.2 | 0.1 | 0.1 | 0.0 | 0.0 | 0.4 | 0.6 | 0.0 | 0.1 |
| Unsig. Movement Delay, s/veh |  |  |  |  |  |  |  |  |  |  |  |  |
| LnGrp Delay(d),s/veh | 4.0 | 3.9 | 3.9 | 4.8 | 4.0 | 4.0 | 14.2 | 0.0 | 15.1 | 16.4 | 0.0 | 14.2 |
| LnGrp LOS | A | A | A | A | A | A | B | A | B | B | A | B |
| Approach Vol, veh/h |  | 66 |  |  | 244 |  |  | 55 |  |  | 103 |  |
| Approach Delay, s/veh |  | 3.9 |  |  | 4.4 |  |  | 15.1 |  |  | 16.0 |  |
| Approach LOS |  | A |  |  | A |  |  | B |  |  | B |  |

| Timer - Assigned Phs |  | 2 |  | 4 |  | 6 |  | 8 |  |  |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Phs Duration (G+Y+Rc), s |  | 26.0 |  | 10.7 |  | 26.0 |  | 10.7 |  |  |  |  |
| Change Period (Y+Rc), s |  | 6.0 |  | 6.0 |  | 6.0 |  | 6.0 |  |  |  |  |
| Max Green Setting (Gmax), s |  | 20.0 |  | 23.0 |  | 20.0 |  | 23.0 |  |  |  |  |
| Max Q Clear Time (g_c+I1), s |  | 2.5 |  | 5.3 |  | 4.3 |  | 3.1 |  |  |  |  |
| Green Ext Time (p_c), s |  | 0.6 |  | 0.5 |  | 1.8 |  | 0.5 |  |  |  |  |

| Intersection Summary |  |  |  |
|---|---|---|---|
| HCM 6th Ctrl Delay |  |  | 8.2 |
| HCM 6th LOS |  |  | A |

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | ↰ | ↑↱ |  | ↰ | ↑↱ |  | ↰ | ↱ |  | ↰ | ↱ |  |
| Traffic Volume (veh/h) | 1 | 60 | 4 | 92 | 60 | 80 | 4 | 22 | 248 | 47 | 14 | 1 |
| Future Volume (veh/h) | 1 | 60 | 4 | 92 | 60 | 80 | 4 | 22 | 248 | 47 | 14 | 1 |
| Initial Q (Qb), veh | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ped-Bike Adj(A_pbT) | 1.00 |  | 1.00 | 1.00 |  | 1.00 | 1.00 |  | 1.00 | 1.00 |  | 1.00 |
| Parking Bus, Adj | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Work Zone On Approach |  | No |  |  | No |  |  | No |  |  | No |  |
| Adj Sat Flow, veh/h/ln | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 | 1870 |
| Adj Flow Rate, veh/h | 1 | 65 | 4 | 100 | 65 | 87 | 4 | 24 | 270 | 51 | 15 | 1 |
| Peak Hour Factor | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Percent Heavy Veh, % | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Cap, veh/h | 674 | 1523 | 93 | 743 | 795 | 709 | 549 | 37 | 419 | 295 | 492 | 33 |
| Arrive On Green | 0.45 | 0.45 | 0.45 | 0.45 | 0.45 | 0.45 | 0.28 | 0.28 | 0.28 | 0.28 | 0.28 | 0.28 |
| Sat Flow, veh/h | 1235 | 3402 | 207 | 1332 | 1777 | 1585 | 1397 | 131 | 1474 | 1085 | 1734 | 116 |
| Grp Volume(v), veh/h | 1 | 34 | 35 | 100 | 65 | 87 | 4 | 0 | 294 | 51 | 0 | 16 |
| Grp Sat Flow(s),veh/h/ln | 1235 | 1777 | 1833 | 1332 | 1777 | 1585 | 1397 | 0 | 1605 | 1085 | 0 | 1850 |
| Q Serve(g_s), s | 0.0 | 0.5 | 0.5 | 2.0 | 0.9 | 1.4 | 0.1 | 0.0 | 7.2 | 1.9 | 0.0 | 0.3 |
| Cycle Q Clear(g_c), s | 1.5 | 0.5 | 0.5 | 2.5 | 0.9 | 1.4 | 0.4 | 0.0 | 7.2 | 9.1 | 0.0 | 0.3 |
| Prop In Lane | 1.00 |  | 0.11 | 1.00 |  | 1.00 | 1.00 |  | 0.92 | 1.00 |  | 0.06 |
| Lane Grp Cap(c), veh/h | 674 | 795 | 820 | 743 | 795 | 709 | 549 | 0 | 456 | 295 | 0 | 525 |
| V/C Ratio(X) | 0.00 | 0.04 | 0.04 | 0.13 | 0.08 | 0.12 | 0.01 | 0.00 | 0.64 | 0.17 | 0.00 | 0.03 |
| Avail Cap(c_a), veh/h | 674 | 795 | 820 | 743 | 795 | 709 | 871 | 0 | 826 | 545 | 0 | 952 |
| HCM Platoon Ratio | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Upstream Filter(I) | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.00 | 1.00 | 1.00 | 0.00 | 1.00 |
| Uniform Delay (d), s/veh | 7.6 | 7.0 | 7.0 | 7.7 | 7.1 | 7.2 | 11.7 | 0.0 | 14.0 | 18.0 | 0.0 | 11.6 |
| Incr Delay (d2), s/veh | 0.0 | 0.1 | 0.1 | 0.4 | 0.2 | 0.4 | 0.0 | 0.0 | 1.5 | 0.3 | 0.0 | 0.0 |
| Initial Q Delay(d3),s/veh | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| %ile BackOfQ(50%),veh/ln | 0.0 | 0.1 | 0.1 | 0.4 | 0.2 | 0.3 | 0.0 | 0.0 | 2.3 | 0.4 | 0.0 | 0.1 |
| Unsig. Movement Delay, s/veh |  |  |  |  |  |  |  |  |  |  |  |  |
| LnGrp Delay(d),s/veh | 7.6 | 7.1 | 7.1 | 8.0 | 7.3 | 7.6 | 11.7 | 0.0 | 15.6 | 18.3 | 0.0 | 11.6 |
| LnGrp LOS | A | A | A | A | A | A | B | A | B | B | A | B |
| Approach Vol, veh/h |  | 70 |  |  | 252 |  |  | 298 |  |  | 67 |  |
| Approach Delay, s/veh |  | 7.1 |  |  | 7.7 |  |  | 15.5 |  |  | 16.7 |  |
| Approach LOS |  | A |  |  | A |  |  | B |  |  | B |  |

| Timer - Assigned Phs |  | 2 |  | 4 |  | 6 |  | 8 |  |  |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Phs Duration (G+Y+Rc), s |  | 26.0 |  | 18.7 |  | 26.0 |  | 18.7 |  |  |  |  |
| Change Period (Y+Rc), s |  | 6.0 |  | 6.0 |  | 6.0 |  | 6.0 |  |  |  |  |
| Max Green Setting (Gmax), s |  | 20.0 |  | 23.0 |  | 20.0 |  | 23.0 |  |  |  |  |
| Max Q Clear Time (g_c+I1), s |  | 3.5 |  | 11.1 |  | 4.5 |  | 9.2 |  |  |  |  |
| Green Ext Time (p_c), s |  | 0.6 |  | 0.3 |  | 2.2 |  | 3.7 |  |  |  |  |

| Intersection Summary |  |  |  |
|---|---|---|---|
| HCM 6th Ctrl Delay |  |  | 11.9 |
| HCM 6th LOS |  |  | B |

# Junctions 8

## ARCADY 8 - Roundabout Module

Version: 8.0.4.487 [15039,24/03/2014]

For sales and distribution information, program advice and maintenance, contact TRL:
Tel: +44 (0)1344 770758 email: software@trl.co.uk Web: http://www.trlsoftware.co.uk

**Filename:** 192089-Bruce County-25-33.arc8
**Path:** Z:\Harbourside Transportation Consultants\Projects\192089 Bruce County Roads 25-33\Cad
**Report generation date:** 17/12/2019 2:19:04 PM

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## Summary of intersection performance

| | AM | | | | | | | PM | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Queue (PCE) | 95% Queue (PCE) | Delay (s) | V/C Ratio | LOS | Intersection Delay (s) | Intersection LOS | Queue (PCE) | 95% Queue (PCE) | Delay (s) | V/C Ratio | LOS | Intersection Delay (s) | Intersection LOS |
| | Existing 2019 | | | | | | | | | | | | | |
| **Road 25-West Leg** | 0.02 | ~1 | 1.54 | 0.02 | A | 1.75 | A | 0.02 | ~1 | 1.54 | 0.02 | A | 2.56 | A |
| **Realigned Road 33-South Leg** | 0.02 | ~1 | 2.94 | 0.02 | A | | | 0.17 | ~1 | 3.39 | 0.15 | A | | |
| **Road 25-East Leg** | 0.06 | ~1 | 1.58 | 0.06 | A | | | 0.04 | ~1 | 1.54 | 0.04 | A | | |
| **Future-North Leg** | 0.00 | ~1 | 0.00 | 0.00 | A | | | 0.00 | ~1 | 0.00 | 0.00 | A | | |

|  | Future 2040 |  |  |  |  |  |  |  |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Road 25-West Leg** | 0.03 | ~1 | 1.66 | 0.03 | A | 2.22 | A | 0.03 | ~1 | 1.61 | 0.03 | A | 2.81 | A |
| **Realigned Road 33-South Leg** | 0.05 | ~1 | 3.16 | 0.05 | A |  |  | 0.33 | ~1 | 3.96 | 0.25 | A |  |  |
| **Road 25-East Leg** | 0.11 | ~1 | 1.65 | 0.10 | A |  |  | 0.12 | ~1 | 1.67 | 0.11 | A |  |  |
| **Future-North Leg** | 0.10 | ~1 | 3.43 | 0.09 | A |  |  | 0.06 | ~1 | 3.23 | 0.06 | A |  |  |

*Values shown are the maximum values over all time segments. Delay is the maximum value of average delay per arriving vehicle. Intersection LOS and Intersection Delay are demand-weighted averages.*

*"D1 - Existing 2019, AM " model duration: 8:00 AM - 9:30 AM*
*"D2 - Existing 2019, PM" model duration: 5:00 PM - 6:30 PM*
*"D3 - Future 2040, AM" model duration: 8:00 AM - 9:30 AM*
*"D4 - Future 2040, PM" model duration: 5:00 PM - 6:30 PM*

*Run using Junctions 8.0.4.487 at 17/12/2019 2:19:02 PM*

## Analysis Options

| Vehicle Length (m) | Do Queue Variations | Calculate Residual Capacity | Residual Capacity Criteria Type | V/C Ratio Threshold | Average Delay Threshold (s) | Queue Threshold (PCE) |
|---|---|---|---|---|---|---|
| 7.00 | ✓ |  | N/A | 0.85 | 36.00 | 20.00 |

## Units

| Distance Units | Speed Units | Traffic Units Input | Traffic Units Results | Flow Units | Average Delay Units | Total Delay Units | Rate Of Delay Units |
|---|---|---|---|---|---|---|---|
| m | kph | PCE | PCE | perHour | s | -Min | perMin |

# Existing 2019, AM

## Data Errors and Warnings

*No errors or warnings*

## Analysis Set Details

| Name | Roundabout Capacity Model | Description | Locked | Network Flow Scaling Factor (%) | Reason For Scaling Factors |
|---|---|---|---|---|---|
| | ARCADY | | | 100.000 | |

## Demand Set Details

| Name | Scenario Name | Time Period Name | Description | Traffic Profile Type | Model Start Time (HH:mm) | Model Finish Time (HH:mm) | Model Time Period Length (min) | Time Segment Length (min) | Single Time Segment Only | Locked |
|---|---|---|---|---|---|---|---|---|---|---|
| Existing 2019, AM | Existing 2019 | AM | | ONE HOUR | 08:00 | 09:30 | 90 | 15 | | |

# Intersection Network

## Intersections

| Intersection | Name | Intersection Type | Leg Order | Grade Separated | Large Roundabout | Intersection Delay (s) | Intersection LOS |
|---|---|---|---|---|---|---|---|
| 1-1 | Road 25 and 33 | Roundabout | 1,2,3,4 | | | 1.75 | A |

## Intersection Network Options

| Driving Side | Lighting |
|---|---|
| Right | Normal/unknown |

# Legs

## Legs

| Name | Leg | Name | Description |
|---|---|---|---|
| **Road 25-West Leg** | 1 | Road 25-West Leg | |
| **Realigned Road 33-South Leg** | 2 | Realigned Road 33-South Leg | |
| **Road 25-East Leg** | 3 | Road 25-East Leg | |
| **Future-North Leg** | 4 | Future-North Leg | |

## Capacity Options

| Name | Minimum Capacity (PCE/hr) | Maximum Capacity (PCE/hr) |
|---|---|---|
| **Road 25-West Leg** | 0.00 | 99999.00 |
| **Realigned Road 33-South Leg** | 0.00 | 99999.00 |
| **Road 25-East Leg** | 0.00 | 99999.00 |
| **Future-North Leg** | 0.00 | 99999.00 |

## Roundabout Geometry

| Name | V - Approach road half-width (m) | E - Entry width (m) | I' - Effective flare length (m) | R - Entry radius (m) | D - Inscribed circle diameter (m) | PHI - Conflict (entry) angle (deg) | Exit Only |
|---|---|---|---|---|---|---|---|
| **Road 25-West Leg** | 7.00 | 8.00 | 10.00 | 30.00 | 45.00 | 25.00 | |
| **Realigned Road 33-South Leg** | 3.50 | 4.20 | 10.00 | 30.00 | 45.00 | 25.00 | |
| **Road 25-East Leg** | 7.00 | 8.00 | 10.00 | 30.00 | 45.00 | 25.00 | |
| **Future-North Leg** | 3.50 | 4.20 | 10.00 | 30.00 | 45.00 | 25.00 | |

## Slope / Intercept / Capacity

### Roundabout Slope and Intercept used in model

| Name | Enter slope and intercept directly | Entered slope | Entered intercept (PCE/hr) | Final Slope | Final Intercept (PCE/hr) |
|---|---|---|---|---|---|
| **Road 25-West Leg** | | (calculated) | (calculated) | 0.780 | 2429.641 |
| **Realigned Road 33-South Leg** | | (calculated) | (calculated) | 0.555 | 1275.301 |
| **Road 25-East Leg** | | (calculated) | (calculated) | 0.780 | 2429.641 |
| **Future-North Leg** | | (calculated) | (calculated) | 0.555 | 1275.301 |

*The slope and intercept shown above include any corrections and adjustments.*

# Traffic Flows

## Demand Set Data Options

| Default Vehicle Mix | Vehicle Mix Varies Over Time | Vehicle Mix Varies Over Turn | Vehicle Mix Varies Over Entry | Vehicle Mix Source | PCE Factor for a Truck (PCE) | Default Turning Proportions | Estimate from entry/exit counts | Turning Proportions Vary Over Time | Turning Proportions Vary Over Turn | Turning Proportions Vary Over Entry |
|---|---|---|---|---|---|---|---|---|---|---|
|  |  | ✓ | ✓ | Truck Percentages | 2.00 |  |  |  | ✓ | ✓ |

# Entry Flows

## General Flows Data

| Name | Profile Type | Use Turning Counts | Average Demand Flow (PCE/hr) | Flow Scaling Factor (%) |
|---|---|---|---|---|
| **Road 25-West Leg** | ONE HOUR | ✓ | 38.00 | 100.000 |
| **Realigned Road 33-South Leg** | ONE HOUR | ✓ | 26.00 | 100.000 |
| **Road 25-East Leg** | ONE HOUR | ✓ | 133.00 | 100.000 |
| **Future-North Leg** | ONE HOUR | ✓ | 0.00 | 100.000 |

# Direct/Resultant Flows

## Direct Flows Data

| Time Segment | Name | Direct Demand Entry Flow (PCE/hr) | DirectDemandEntryFlowInPCE (PCE/hr) | Direct Demand Exit Flow (PCE/hr) | Direct Demand Pedestrian Flow (Ped/hr) |
|---|---|---|---|---|---|
| **08:00-08:15** | **Road 25-West Leg** | 28.61 | 28.61 | | |
| **08:15-08:30** | **Road 25-West Leg** | 34.16 | 34.16 | | |
| **08:30-08:45** | **Road 25-West Leg** | 41.84 | 41.84 | | |
| **08:45-09:00** | **Road 25-West Leg** | 41.84 | 41.84 | | |
| **09:00-09:15** | **Road 25-West Leg** | 34.16 | 34.16 | | |
| **09:15-09:30** | **Road 25-West Leg** | 28.61 | 28.61 | | |
| **08:00-08:15** | **Realigned Road 33-South Leg** | 19.57 | 19.57 | | |
| **08:15-08:30** | **Realigned Road 33-South Leg** | 23.37 | 23.37 | | |
| **08:30-08:45** | **Realigned Road 33-South Leg** | 28.63 | 28.63 | | |
| **08:45-09:00** | **Realigned Road 33-South Leg** | 28.63 | 28.63 | | |
| **09:00-09:15** | **Realigned Road 33-South Leg** | 23.37 | 23.37 | | |
| **09:15-09:30** | **Realigned Road 33-South Leg** | 19.57 | 19.57 | | |
| **08:00-08:15** | **Road 25-East Leg** | 100.13 | 100.13 | | |

| | | | | | |
|---|---|---|---|---|---|
| **08:15-08:30** | **Road 25-East Leg** | 119.56 | 119.56 | | |
| **08:30-08:45** | **Road 25-East Leg** | 146.44 | 146.44 | | |
| **08:45-09:00** | **Road 25-East Leg** | 146.44 | 146.44 | | |
| **09:00-09:15** | **Road 25-East Leg** | 119.56 | 119.56 | | |
| **09:15-09:30** | **Road 25-East Leg** | 100.13 | 100.13 | | |
| **08:00-08:15** | **Future-North Leg** | 0.00 | 0.00 | | |
| **08:15-08:30** | **Future-North Leg** | 0.00 | 0.00 | | |
| **08:30-08:45** | **Future-North Leg** | 0.00 | 0.00 | | |
| **08:45-09:00** | **Future-North Leg** | 0.00 | 0.00 | | |
| **09:00-09:15** | **Future-North Leg** | 0.00 | 0.00 | | |
| **09:15-09:30** | **Future-North Leg** | 0.00 | 0.00 | | |

# Turning Proportions

## Turning Counts / Proportions (PCE/hr) - Road 25 and 33 (for whole period)

| | | To | | | |
|---|---|---|---|---|---|
| **From** | | **Road 25-West Leg** | **Realigned Road 33-South Leg** | **Road 25-East Leg** | **Future-North Leg** |
| | **Road 25-West Leg** | 0.000 | 3.000 | 35.000 | 0.000 |
| | **Realigned Road 33-South Leg** | 1.000 | 0.000 | 25.000 | 0.000 |
| | **Road 25-East Leg** | 64.000 | 69.000 | 0.000 | 0.000 |
| | **Future-North Leg** | 0.000 | 0.000 | 0.000 | 0.000 |

## Turning Proportions (PCE) - Road 25 and 33 (for whole period)

| | | To | | | |
|---|---|---|---|---|---|
| **From** | | **Road 25-West Leg** | **Realigned Road 33-South Leg** | **Road 25-East Leg** | **Future-North Leg** |
| | **Road 25-West Leg** | 0.00 | 0.08 | 0.92 | 0.00 |
| | **Realigned Road 33-South Leg** | 0.04 | 0.00 | 0.96 | 0.00 |
| | **Road 25-East Leg** | 0.48 | 0.52 | 0.00 | 0.00 |
| | **Future-North Leg** | 0.25 | 0.25 | 0.25 | 0.25 |

# Vehicle Mix

## Average PCE Per Vehicle - Road 25 and 33 (for whole period)

| | To | | | | |
|---|---|---|---|---|---|
| From | | Road 25-West Leg | Realigned Road 33-South Leg | Road 25-East Leg | Future-North Leg |
| | Road 25-West Leg | 1.000 | 1.000 | 1.000 | 1.000 |
| | Realigned Road 33-South Leg | 1.000 | 1.000 | 1.000 | 1.000 |
| | Road 25-East Leg | 1.000 | 1.000 | 1.000 | 1.000 |
| | Future-North Leg | 1.000 | 1.000 | 1.000 | 1.000 |

## Truck Percentages - Road 25 and 33 (for whole period)

| | To | | | | |
|---|---|---|---|---|---|
| From | | Road 25-West Leg | Realigned Road 33-South Leg | Road 25-East Leg | Future-North Leg |
| | Road 25-West Leg | 0.0 | 0.0 | 0.0 | 0.0 |
| | Realigned Road 33-South Leg | 0.0 | 0.0 | 0.0 | 0.0 |
| | Road 25-East Leg | 0.0 | 0.0 | 0.0 | 0.0 |
| | Future-North Leg | 0.0 | 0.0 | 0.0 | 0.0 |

# Results

## Results Summary for whole modelled period

| Name | Max V/C Ratio | Max Delay (s) | Max Queue (PCE) | Max 95th percentile Queue (PCE) | Max LOS |
|---|---|---|---|---|---|
| **Road 25-West Leg** | 0.02 | 1.54 | 0.02 | ~1 | A |
| **Realigned Road 33-South Leg** | 0.02 | 2.94 | 0.02 | ~1 | A |
| **Road 25-East Leg** | 0.06 | 1.58 | 0.06 | ~1 | A |
| **Future-North Leg** | 0.00 | 0.00 | 0.00 | ~1 | A |

# Existing 2019, PM

## Data Errors and Warnings

*No errors or warnings*

## Analysis Set Details

| Name | Roundabout Capacity Model | Description | Locked | Network Flow Scaling Factor (%) | Reason For Scaling Factors |
|---|---|---|---|---|---|
|  | ARCADY |  |  | 100.000 |  |

## Demand Set Details

| Name | Scenario Name | Time Period Name | Description | Traffic Profile Type | Model Start Time (HH:mm) | Model Finish Time (HH:mm) | Model Time Period Length (min) | Time Segment Length (min) | Single Time Segment Only | Locked |
|---|---|---|---|---|---|---|---|---|---|---|
| Existing 2019, PM | Existing 2019 | PM |  | ONE HOUR | 17:00 | 18:30 | 90 | 15 |  |  |

# Intersection Network

## Intersections

| Intersection | Name | Intersection Type | Leg Order | Grade Separated | Large Roundabout | Intersection Delay (s) | Intersection LOS |
|---|---|---|---|---|---|---|---|
| 1-1 | Road 25 and 33 | Roundabout | 1,2,3,4 | | | 2.56 | A |

## Intersection Network Options

| Driving Side | Lighting |
|---|---|
| Right | Normal/unknown |

# Legs

## Legs

| Name | Leg | Name | Description |
|---|---|---|---|
| **Road 25-West Leg** | 1 | Road 25-West Leg | |
| **Realigned Road 33-South Leg** | 2 | Realigned Road 33-South Leg | |
| **Road 25-East Leg** | 3 | Road 25-East Leg | |
| **Future-North Leg** | 4 | Future-North Leg | |

## Capacity Options

| Name | Minimum Capacity (PCE/hr) | Maximum Capacity (PCE/hr) |
|---|---|---|
| **Road 25-West Leg** | 0.00 | 99999.00 |
| **Realigned Road 33-South Leg** | 0.00 | 99999.00 |
| **Road 25-East Leg** | 0.00 | 99999.00 |
| **Future-North Leg** | 0.00 | 99999.00 |

## Roundabout Geometry

| Name | V - Approach road half-width (m) | E - Entry width (m) | l' - Effective flare length (m) | R - Entry radius (m) | D - Inscribed circle diameter (m) | PHI - Conflict (entry) angle (deg) | Exit Only |
|---|---|---|---|---|---|---|---|
| **Road 25-West Leg** | 7.00 | 8.00 | 10.00 | 30.00 | 45.00 | 25.00 | |
| **Realigned Road 33-South Leg** | 3.50 | 4.20 | 10.00 | 30.00 | 45.00 | 25.00 | |
| **Road 25-East Leg** | 7.00 | 8.00 | 10.00 | 30.00 | 45.00 | 25.00 | |
| **Future-North Leg** | 3.50 | 4.20 | 10.00 | 30.00 | 45.00 | 25.00 | |

## Slope / Intercept / Capacity

### Roundabout Slope and Intercept used in model

| Name | Enter slope and intercept directly | Entered slope | Entered intercept (PCE/hr) | Final Slope | Final Intercept (PCE/hr) |
|---|---|---|---|---|---|
| **Road 25-West Leg** | | (calculated) | (calculated) | 0.780 | 2429.641 |
| **Realigned Road 33-South Leg** | | (calculated) | (calculated) | 0.555 | 1275.301 |
| **Road 25-East Leg** | | (calculated) | (calculated) | 0.780 | 2429.641 |
| **Future-North Leg** | | (calculated) | (calculated) | 0.555 | 1275.301 |

*The slope and intercept shown above include any corrections and adjustments.*

# Traffic Flows

### Demand Set Data Options

| Default Vehicle Mix | Vehicle Mix Varies Over Time | Vehicle Mix Varies Over Turn | Vehicle Mix Varies Over Entry | Vehicle Mix Source | PCE Factor for a Truck (PCE) | Default Turning Proportions | Estimate from entry/exit counts | Turning Proportions Vary Over Time | Turning Proportions Vary Over Turn | Turning Proportions Vary Over Entry |
|---|---|---|---|---|---|---|---|---|---|---|
| | | ✓ | ✓ | Truck Percentages | 2.00 | | | | ✓ | ✓ |

# Entry Flows

## General Flows Data

| Name | Profile Type | Use Turning Counts | Average Demand Flow (PCE/hr) | Flow Scaling Factor (%) |
|---|---|---|---|---|
| **Road 25-West Leg** | ONE HOUR | ✓ | 51.00 | 100.000 |
| **Realigned Road 33-South Leg** | ONE HOUR | ✓ | 165.00 | 100.000 |
| **Road 25-East Leg** | ONE HOUR | ✓ | 82.00 | 100.000 |
| **Future-North Leg** | ONE HOUR | ✓ | 0.00 | 100.000 |

# Direct/Resultant Flows

## Direct Flows Data

| Time Segment | Name | Direct Demand Entry Flow (PCE/hr) | DirectDemandEntryFlowInPCE (PCE/hr) | Direct Demand Exit Flow (PCE/hr) | Direct Demand Pedestrian Flow (Ped/hr) |
|---|---|---|---|---|---|
| **17:00-17:15** | **Road 25-West Leg** | 38.40 | 38.40 | | |
| **17:15-17:30** | **Road 25-West Leg** | 45.85 | 45.85 | | |
| **17:30-17:45** | **Road 25-West Leg** | 56.15 | 56.15 | | |
| **17:45-18:00** | **Road 25-West Leg** | 56.15 | 56.15 | | |
| **18:00-18:15** | **Road 25-West Leg** | 45.85 | 45.85 | | |
| **18:15-18:30** | **Road 25-West Leg** | 38.40 | 38.40 | | |
| **17:00-17:15** | **Realigned Road 33-South Leg** | 124.22 | 124.22 | | |

| | | | | | |
|---|---|---|---|---|---|
| **17:15-17:30** | **Realigned Road 33-South Leg** | 148.33 | 148.33 | | |
| **17:30-17:45** | **Realigned Road 33-South Leg** | 181.67 | 181.67 | | |
| **17:45-18:00** | **Realigned Road 33-South Leg** | 181.67 | 181.67 | | |
| **18:00-18:15** | **Realigned Road 33-South Leg** | 148.33 | 148.33 | | |
| **18:15-18:30** | **Realigned Road 33-South Leg** | 124.22 | 124.22 | | |
| **17:00-17:15** | **Road 25-East Leg** | 61.73 | 61.73 | | |
| **17:15-17:30** | **Road 25-East Leg** | 73.72 | 73.72 | | |
| **17:30-17:45** | **Road 25-East Leg** | 90.28 | 90.28 | | |
| **17:45-18:00** | **Road 25-East Leg** | 90.28 | 90.28 | | |
| **18:00-18:15** | **Road 25-East Leg** | 73.72 | 73.72 | | |
| **18:15-18:30** | **Road 25-East Leg** | 61.73 | 61.73 | | |
| **17:00-17:15** | **Future-North Leg** | 0.00 | 0.00 | | |
| **17:15-17:30** | **Future-North Leg** | 0.00 | 0.00 | | |
| **17:30-17:45** | **Future-North Leg** | 0.00 | 0.00 | | |
| **17:45-18:00** | **Future-North Leg** | 0.00 | 0.00 | | |
| **18:00-18:15** | **Future-North Leg** | 0.00 | 0.00 | | |
| **18:15-18:30** | **Future-North Leg** | 0.00 | 0.00 | | |

# Turning Proportions

## Turning Counts / Proportions (PCE/hr) - Road 25 and 33 (for whole period)

| | **To** | | | | |
|---|---|---|---|---|---|
| **From** | | **Road 25-West Leg** | **Realigned Road 33-South Leg** | **Road 25-East Leg** | **Future-North Leg** |
| | **Road 25-West Leg** | 0.000 | 1.000 | 50.000 | 0.000 |
| | **Realigned Road 33-South Leg** | 0.000 | 0.000 | 165.000 | 0.000 |
| | **Road 25-East Leg** | 43.000 | 39.000 | 0.000 | 0.000 |
| | **Future-North Leg** | 0.000 | 0.000 | 0.000 | 0.000 |

## Turning Proportions (PCE) - Road 25 and 33 (for whole period)

| | **To** | | | | |
|---|---|---|---|---|---|
| **From** | | **Road 25-West Leg** | **Realigned Road 33-South Leg** | **Road 25-East Leg** | **Future-North Leg** |
| | **Road 25-West Leg** | 0.00 | 0.02 | 0.98 | 0.00 |
| | **Realigned Road 33-South Leg** | 0.00 | 0.00 | 1.00 | 0.00 |
| | **Road 25-East Leg** | 0.52 | 0.48 | 0.00 | 0.00 |
| | **Future-North Leg** | 0.25 | 0.25 | 0.25 | 0.25 |

# Vehicle Mix

## Average PCE Per Vehicle - Road 25 and 33 (for whole period)

| | To | | | | |
|---|---|---|---|---|---|
| From | | **Road 25-West Leg** | **Realigned Road 33-South Leg** | **Road 25-East Leg** | **Future-North Leg** |
| | **Road 25-West Leg** | 1.000 | 1.000 | 1.000 | 1.000 |
| | **Realigned Road 33-South Leg** | 1.000 | 1.000 | 1.000 | 1.000 |
| | **Road 25-East Leg** | 1.000 | 1.000 | 1.000 | 1.000 |
| | **Future-North Leg** | 1.000 | 1.000 | 1.000 | 1.000 |

## Truck Percentages - Road 25 and 33 (for whole period)

| | To | | | | |
|---|---|---|---|---|---|
| From | | **Road 25-West Leg** | **Realigned Road 33-South Leg** | **Road 25-East Leg** | **Future-North Leg** |
| | **Road 25-West Leg** | 0.0 | 0.0 | 0.0 | 0.0 |
| | **Realigned Road 33-South Leg** | 0.0 | 0.0 | 0.0 | 0.0 |
| | **Road 25-East Leg** | 0.0 | 0.0 | 0.0 | 0.0 |
| | **Future-North Leg** | 0.0 | 0.0 | 0.0 | 0.0 |

# Results

## Results Summary for whole modelled period

| Name | Max V/C Ratio | Max Delay (s) | Max Queue (PCE) | Max 95th percentile Queue (PCE) | Max LOS |
|---|---|---|---|---|---|
| **Road 25-West Leg** | 0.02 | 1.54 | 0.02 | ~1 | A |
| **Realigned Road 33-South Leg** | 0.15 | 3.39 | 0.17 | ~1 | A |
| **Road 25-East Leg** | 0.04 | 1.54 | 0.04 | ~1 | A |
| **Future-North Leg** | 0.00 | 0.00 | 0.00 | ~1 | A |

# Future 2040, AM

## Data Errors and Warnings

*No errors or warnings*

## Analysis Set Details

| Name | Roundabout Capacity Model | Description | Locked | Network Flow Scaling Factor (%) | Reason For Scaling Factors |
|---|---|---|---|---|---|
|  | ARCADY |  |  | 100.000 |  |

## Demand Set Details

| Name | Scenario Name | Time Period Name | Description | Traffic Profile Type | Model Start Time (HH:mm) | Model Finish Time (HH:mm) | Model Time Period Length (min) | Time Segment Length (min) | Single Time Segment Only | Locked |
|---|---|---|---|---|---|---|---|---|---|---|
| Future 2040, AM | Future 2040 | AM |  | ONE HOUR | 08:00 | 09:30 | 90 | 15 |  |  |

# Intersection Network

## Intersections

| Intersection | Name | Intersection Type | Leg Order | Grade Separated | Large Roundabout | Intersection Delay (s) | Intersection LOS |
|---|---|---|---|---|---|---|---|
| 1-1 | Road 25 and 33 | Roundabout | 1,2,3,4 | | | 2.22 | A |

## Intersection Network Options

| Driving Side | Lighting |
|---|---|
| Right | Normal/unknown |

# Legs

## Legs

| Name | Leg | Name | Description |
|---|---|---|---|
| **Road 25-West Leg** | 1 | Road 25-West Leg | |
| **Realigned Road 33-South Leg** | 2 | Realigned Road 33-South Leg | |
| **Road 25-East Leg** | 3 | Road 25-East Leg | |
| **Future-North Leg** | 4 | Future-North Leg | |

## Capacity Options

| Name | Minimum Capacity (PCE/hr) | Maximum Capacity (PCE/hr) |
|---|---|---|
| **Road 25-West Leg** | 0.00 | 99999.00 |
| **Realigned Road 33-South Leg** | 0.00 | 99999.00 |
| **Road 25-East Leg** | 0.00 | 99999.00 |
| **Future-North Leg** | 0.00 | 99999.00 |

## Roundabout Geometry

| Name | V - Approach road half-width (m) | E - Entry width (m) | I' - Effective flare length (m) | R - Entry radius (m) | D - Inscribed circle diameter (m) | PHI - Conflict (entry) angle (deg) | Exit Only |
|---|---|---|---|---|---|---|---|
| **Road 25-West Leg** | 7.00 | 8.00 | 10.00 | 30.00 | 45.00 | 25.00 | |
| **Realigned Road 33-South Leg** | 3.50 | 4.20 | 10.00 | 30.00 | 45.00 | 25.00 | |
| **Road 25-East Leg** | 7.00 | 8.00 | 10.00 | 30.00 | 45.00 | 25.00 | |
| **Future-North Leg** | 3.50 | 4.20 | 10.00 | 30.00 | 45.00 | 25.00 | |

## Slope / Intercept / Capacity

### Roundabout Slope and Intercept used in model

| Name | Enter slope and intercept directly | Entered slope | Entered intercept (PCE/hr) | Final Slope | Final Intercept (PCE/hr) |
|---|---|---|---|---|---|
| **Road 25-West Leg** |  | (calculated) | (calculated) | 0.780 | 2429.641 |
| **Realigned Road 33-South Leg** |  | (calculated) | (calculated) | 0.555 | 1275.301 |
| **Road 25-East Leg** |  | (calculated) | (calculated) | 0.780 | 2429.641 |
| **Future-North Leg** |  | (calculated) | (calculated) | 0.555 | 1275.301 |

*The slope and intercept shown above include any corrections and adjustments.*

# Traffic Flows

### Demand Set Data Options

| Default Vehicle Mix | Vehicle Mix Varies Over Time | Vehicle Mix Varies Over Turn | Vehicle Mix Varies Over Entry | Vehicle Mix Source | PCE Factor for a Truck (PCE) | Default Turning Proportions | Estimate from entry/exit counts | Turning Proportions Vary Over Time | Turning Proportions Vary Over Turn | Turning Proportions Vary Over Entry |
|---|---|---|---|---|---|---|---|---|---|---|
|  |  | ✓ | ✓ | Truck Percentages | 2.00 |  |  |  | ✓ | ✓ |

# Entry Flows

## General Flows Data

| Name | Profile Type | Use Turning Counts | Average Demand Flow (PCE/hr) | Flow Scaling Factor (%) |
|---|---|---|---|---|
| **Road 25-West Leg** | ONE HOUR | ✓ | 59.00 | 100.000 |
| **Realigned Road 33-South Leg** | ONE HOUR | ✓ | 51.00 | 100.000 |
| **Road 25-East Leg** | ONE HOUR | ✓ | 225.00 | 100.000 |
| **Future-North Leg** | ONE HOUR | ✓ | 94.00 | 100.000 |

# Direct/Resultant Flows

## Direct Flows Data

| Time Segment | Name | Direct Demand Entry Flow (PCE/hr) | DirectDemandEntryFlowInPCE (PCE/hr) | Direct Demand Exit Flow (PCE/hr) | Direct Demand Pedestrian Flow (Ped/hr) |
|---|---|---|---|---|---|
| **08:00-08:15** | **Road 25-West Leg** | 44.42 | 44.42 | | |
| **08:15-08:30** | **Road 25-West Leg** | 53.04 | 53.04 | | |
| **08:30-08:45** | **Road 25-West Leg** | 64.96 | 64.96 | | |
| **08:45-09:00** | **Road 25-West Leg** | 64.96 | 64.96 | | |
| **09:00-09:15** | **Road 25-West Leg** | 53.04 | 53.04 | | |
| **09:15-09:30** | **Road 25-West Leg** | 44.42 | 44.42 | | |
| **08:00-08:15** | **Realigned Road 33-South Leg** | 38.40 | 38.40 | | |

| | | | | | |
|---|---|---|---|---|---|
| **08:15-08:30** | **Realigned Road 33-South Leg** | 45.85 | 45.85 | | |
| **08:30-08:45** | **Realigned Road 33-South Leg** | 56.15 | 56.15 | | |
| **08:45-09:00** | **Realigned Road 33-South Leg** | 56.15 | 56.15 | | |
| **09:00-09:15** | **Realigned Road 33-South Leg** | 45.85 | 45.85 | | |
| **09:15-09:30** | **Realigned Road 33-South Leg** | 38.40 | 38.40 | | |
| **08:00-08:15** | **Road 25-East Leg** | 169.39 | 169.39 | | |
| **08:15-08:30** | **Road 25-East Leg** | 202.27 | 202.27 | | |
| **08:30-08:45** | **Road 25-East Leg** | 247.73 | 247.73 | | |
| **08:45-09:00** | **Road 25-East Leg** | 247.73 | 247.73 | | |
| **09:00-09:15** | **Road 25-East Leg** | 202.27 | 202.27 | | |
| **09:15-09:30** | **Road 25-East Leg** | 169.39 | 169.39 | | |
| **08:00-08:15** | **Future-North Leg** | 70.77 | 70.77 | | |
| **08:15-08:30** | **Future-North Leg** | 84.50 | 84.50 | | |
| **08:30-08:45** | **Future-North Leg** | 103.50 | 103.50 | | |
| **08:45-09:00** | **Future-North Leg** | 103.50 | 103.50 | | |
| **09:00-09:15** | **Future-North Leg** | 84.50 | 84.50 | | |
| **09:15-09:30** | **Future-North Leg** | 70.77 | 70.77 | | |

# Turning Proportions

## Turning Counts / Proportions (PCE/hr) - Road 25 and 33 (for whole period)

| | | To | | | |
|---|---|---|---|---|---|
| | | **Road 25-West Leg** | **Realigned Road 33-South Leg** | **Road 25-East Leg** | **Future-North Leg** |
| **From** | **Road 25-West Leg** | 0.000 | 7.000 | 52.000 | 0.000 |
| | **Realigned Road 33-South Leg** | 2.000 | 0.000 | 44.000 | 5.000 |
| | **Road 25-East Leg** | 69.000 | 130.000 | 0.000 | 26.000 |
| | **Future-North Leg** | 0.000 | 15.000 | 79.000 | 0.000 |

## Turning Proportions (PCE) - Road 25 and 33 (for whole period)

| | | To | | | |
|---|---|---|---|---|---|
| | | **Road 25-West Leg** | **Realigned Road 33-South Leg** | **Road 25-East Leg** | **Future-North Leg** |
| **From** | **Road 25-West Leg** | 0.00 | 0.12 | 0.88 | 0.00 |
| | **Realigned Road 33-South Leg** | 0.04 | 0.00 | 0.86 | 0.10 |
| | **Road 25-East Leg** | 0.31 | 0.58 | 0.00 | 0.12 |
| | **Future-North Leg** | 0.00 | 0.16 | 0.84 | 0.00 |

# Vehicle Mix

## Average PCE Per Vehicle - Road 25 and 33 (for whole period)

| | | To | | | |
|---|---|---|---|---|---|
| From | | Road 25-West Leg | Realigned Road 33-South Leg | Road 25-East Leg | Future-North Leg |
| | Road 25-West Leg | 1.000 | 1.000 | 1.000 | 1.000 |
| | Realigned Road 33-South Leg | 1.000 | 1.000 | 1.000 | 1.000 |
| | Road 25-East Leg | 1.000 | 1.000 | 1.000 | 1.000 |
| | Future-North Leg | 1.000 | 1.000 | 1.000 | 1.000 |

## Truck Percentages - Road 25 and 33 (for whole period)

| | | To | | | |
|---|---|---|---|---|---|
| From | | Road 25-West Leg | Realigned Road 33-South Leg | Road 25-East Leg | Future-North Leg |
| | Road 25-West Leg | 0.0 | 0.0 | 0.0 | 0.0 |
| | Realigned Road 33-South Leg | 0.0 | 0.0 | 0.0 | 0.0 |
| | Road 25-East Leg | 0.0 | 0.0 | 0.0 | 0.0 |
| | Future-North Leg | 0.0 | 0.0 | 0.0 | 0.0 |

# Results

## Results Summary for whole modelled period

| Name | Max V/C Ratio | Max Delay (s) | Max Queue (PCE) | Max 95th percentile Queue (PCE) | Max LOS |
|---|---|---|---|---|---|
| **Road 25-West Leg** | 0.03 | 1.66 | 0.03 | ~1 | A |
| **Realigned Road 33-South Leg** | 0.05 | 3.16 | 0.05 | ~1 | A |
| **Road 25-East Leg** | 0.10 | 1.65 | 0.11 | ~1 | A |
| **Future-North Leg** | 0.09 | 3.43 | 0.10 | ~1 | A |

# Future 2040, PM

## Data Errors and Warnings

*No errors or warnings*

## Analysis Set Details

| Name | Roundabout Capacity Model | Description | Locked | Network Flow Scaling Factor (%) | Reason For Scaling Factors |
|---|---|---|---|---|---|
|  | ARCADY |  |  | 100.000 |  |

## Demand Set Details

| Name | Scenario Name | Time Period Name | Description | Traffic Profile Type | Model Start Time (HH:mm) | Model Finish Time (HH:mm) | Model Time Period Length (min) | Time Segment Length (min) | Single Time Segment Only | Locked |
|---|---|---|---|---|---|---|---|---|---|---|
| Future 2040, PM | Future 2040 | PM |  | ONE HOUR | 17:00 | 18:30 | 90 | 15 |  |  |

# Intersection Network

## Intersections

| Intersection | Name | Intersection Type | Leg Order | Grade Separated | Large Roundabout | Intersection Delay (s) | Intersection LOS |
|---|---|---|---|---|---|---|---|
| 1-1 | Road 25 and 33 | Roundabout | 1,2,3,4 | | | 2.81 | A |

## Intersection Network Options

| Driving Side | Lighting |
|---|---|
| Right | Normal/unknown |

# Legs

## Legs

| Name | Leg | Name | Description |
|---|---|---|---|
| **Road 25-West Leg** | 1 | Road 25-West Leg | |
| **Realigned Road 33-South Leg** | 2 | Realigned Road 33-South Leg | |
| **Road 25-East Leg** | 3 | Road 25-East Leg | |
| **Future-North Leg** | 4 | Future-North Leg | |

## Capacity Options

| Name | Minimum Capacity (PCE/hr) | Maximum Capacity (PCE/hr) |
|---|---|---|
| **Road 25-West Leg** | 0.00 | 99999.00 |
| **Realigned Road 33-South Leg** | 0.00 | 99999.00 |
| **Road 25-East Leg** | 0.00 | 99999.00 |
| **Future-North Leg** | 0.00 | 99999.00 |

## Roundabout Geometry

| Name | V - Approach road half-width (m) | E - Entry width (m) | l' - Effective flare length (m) | R - Entry radius (m) | D - Inscribed circle diameter (m) | PHI - Conflict (entry) angle (deg) | Exit Only |
|---|---|---|---|---|---|---|---|
| **Road 25-West Leg** | 7.00 | 8.00 | 10.00 | 30.00 | 45.00 | 25.00 | |
| **Realigned Road 33-South Leg** | 3.50 | 4.20 | 10.00 | 30.00 | 45.00 | 25.00 | |
| **Road 25-East Leg** | 7.00 | 8.00 | 10.00 | 30.00 | 45.00 | 25.00 | |
| **Future-North Leg** | 3.50 | 4.20 | 10.00 | 30.00 | 45.00 | 25.00 | |

## Slope / Intercept / Capacity

### Roundabout Slope and Intercept used in model

| Name | Enter slope and intercept directly | Entered slope | Entered intercept (PCE/hr) | Final Slope | Final Intercept (PCE/hr) |
|---|---|---|---|---|---|
| **Road 25-West Leg** | | (calculated) | (calculated) | 0.780 | 2429.641 |
| **Realigned Road 33-South Leg** | | (calculated) | (calculated) | 0.555 | 1275.301 |
| **Road 25-East Leg** | | (calculated) | (calculated) | 0.780 | 2429.641 |
| **Future-North Leg** | | (calculated) | (calculated) | 0.555 | 1275.301 |

*The slope and intercept shown above include any corrections and adjustments.*

# Traffic Flows

## Demand Set Data Options

| Default Vehicle Mix | Vehicle Mix Varies Over Time | Vehicle Mix Varies Over Turn | Vehicle Mix Varies Over Entry | Vehicle Mix Source | PCE Factor for a Truck (PCE) | Default Turning Proportions | Estimate from entry/exit counts | Turning Proportions Vary Over Time | Turning Proportions Vary Over Turn | Turning Proportions Vary Over Entry |
|---|---|---|---|---|---|---|---|---|---|---|
| | | ✓ | ✓ | Truck Percentages | 2.00 | | | | ✓ | ✓ |

# Entry Flows

## General Flows Data

| Name | Profile Type | Use Turning Counts | Average Demand Flow (PCE/hr) | Flow Scaling Factor (%) |
|---|---|---|---|---|
| **Road 25-West Leg** | ONE HOUR | ✓ | 64.00 | 100.000 |
| **Realigned Road 33-South Leg** | ONE HOUR | ✓ | 274.00 | 100.000 |
| **Road 25-East Leg** | ONE HOUR | ✓ | 232.00 | 100.000 |
| **Future-North Leg** | ONE HOUR | ✓ | 61.00 | 100.000 |

# Direct/Resultant Flows

## Direct Flows Data

| Time Segment | Name | Direct Demand Entry Flow (PCE/hr) | DirectDemandEntryFlowInPCE (PCE/hr) | Direct Demand Exit Flow (PCE/hr) | Direct Demand Pedestrian Flow (Ped/hr) |
|---|---|---|---|---|---|
| **17:00-17:15** | **Road 25-West Leg** | 48.18 | 48.18 | | |
| **17:15-17:30** | **Road 25-West Leg** | 57.53 | 57.53 | | |
| **17:30-17:45** | **Road 25-West Leg** | 70.47 | 70.47 | | |
| **17:45-18:00** | **Road 25-West Leg** | 70.47 | 70.47 | | |
| **18:00-18:15** | **Road 25-West Leg** | 57.53 | 57.53 | | |
| **18:15-18:30** | **Road 25-West Leg** | 48.18 | 48.18 | | |
| **17:00-17:15** | **Realigned Road 33-South Leg** | 206.28 | 206.28 | | |

| | | | | | |
|---|---|---|---|---|---|
| **17:15-17:30** | **Realigned Road 33-South Leg** | 246.32 | 246.32 | | |
| **17:30-17:45** | **Realigned Road 33-South Leg** | 301.68 | 301.68 | | |
| **17:45-18:00** | **Realigned Road 33-South Leg** | 301.68 | 301.68 | | |
| **18:00-18:15** | **Realigned Road 33-South Leg** | 246.32 | 246.32 | | |
| **18:15-18:30** | **Realigned Road 33-South Leg** | 206.28 | 206.28 | | |
| **17:00-17:15** | **Road 25-East Leg** | 174.66 | 174.66 | | |
| **17:15-17:30** | **Road 25-East Leg** | 208.56 | 208.56 | | |
| **17:30-17:45** | **Road 25-East Leg** | 255.44 | 255.44 | | |
| **17:45-18:00** | **Road 25-East Leg** | 255.44 | 255.44 | | |
| **18:00-18:15** | **Road 25-East Leg** | 208.56 | 208.56 | | |
| **18:15-18:30** | **Road 25-East Leg** | 174.66 | 174.66 | | |
| **17:00-17:15** | **Future-North Leg** | 45.92 | 45.92 | | |
| **17:15-17:30** | **Future-North Leg** | 54.84 | 54.84 | | |
| **17:30-17:45** | **Future-North Leg** | 67.16 | 67.16 | | |
| **17:45-18:00** | **Future-North Leg** | 67.16 | 67.16 | | |
| **18:00-18:15** | **Future-North Leg** | 54.84 | 54.84 | | |
| **18:15-18:30** | **Future-North Leg** | 45.92 | 45.92 | | |

# Turning Proportions

## Turning Counts / Proportions (PCE/hr) - Road 25 and 33 (for whole period)

| | | **To** | | | |
|---|---|---|---|---|---|
| | | **Road 25-West Leg** | **Realigned Road 33-South Leg** | **Road 25-East Leg** | **Future-North Leg** |
| **From** | **Road 25-West Leg** | 0.000 | 4.000 | 60.000 | 0.000 |
| | **Realigned Road 33-South Leg** | 4.000 | 0.000 | 248.000 | 22.000 |
| | **Road 25-East Leg** | 60.000 | 92.000 | 0.000 | 80.000 |
| | **Future-North Leg** | 0.000 | 14.000 | 47.000 | 0.000 |

## Turning Proportions (PCE) - Road 25 and 33 (for whole period)

| | | **To** | | | |
|---|---|---|---|---|---|
| | | **Road 25-West Leg** | **Realigned Road 33-South Leg** | **Road 25-East Leg** | **Future-North Leg** |
| **From** | **Road 25-West Leg** | 0.00 | 0.06 | 0.94 | 0.00 |
| | **Realigned Road 33-South Leg** | 0.01 | 0.00 | 0.91 | 0.08 |
| | **Road 25-East Leg** | 0.26 | 0.40 | 0.00 | 0.34 |
| | **Future-North Leg** | 0.00 | 0.23 | 0.77 | 0.00 |

# Vehicle Mix

## Average PCE Per Vehicle - Road 25 and 33 (for whole period)

| | **To** | | | | |
|---|---|---|---|---|---|
| **From** | | **Road 25-West Leg** | **Realigned Road 33-South Leg** | **Road 25-East Leg** | **Future-North Leg** |
| | **Road 25-West Leg** | 1.000 | 1.000 | 1.000 | 1.000 |
| | **Realigned Road 33-South Leg** | 1.000 | 1.000 | 1.000 | 1.000 |
| | **Road 25-East Leg** | 1.000 | 1.000 | 1.000 | 1.000 |
| | **Future-North Leg** | 1.000 | 1.000 | 1.000 | 1.000 |

## Truck Percentages - Road 25 and 33 (for whole period)

| | **To** | | | | |
|---|---|---|---|---|---|
| **From** | | **Road 25-West Leg** | **Realigned Road 33-South Leg** | **Road 25-East Leg** | **Future-North Leg** |
| | **Road 25-West Leg** | 0.0 | 0.0 | 0.0 | 0.0 |
| | **Realigned Road 33-South Leg** | 0.0 | 0.0 | 0.0 | 0.0 |
| | **Road 25-East Leg** | 0.0 | 0.0 | 0.0 | 0.0 |
| | **Future-North Leg** | 0.0 | 0.0 | 0.0 | 0.0 |

# Results

## Results Summary for whole modelled period

| Name | Max V/C Ratio | Max Delay (s) | Max Queue (PCE) | Max 95th percentile Queue (PCE) | Max LOS |
|---|---|---|---|---|---|
| **Road 25-West Leg** | 0.03 | 1.61 | 0.03 | ~1 | A |
| **Realigned Road 33-South Leg** | 0.25 | 3.96 | 0.33 | ~1 | A |
| **Road 25-East Leg** | 0.11 | 1.67 | 0.12 | ~1 | A |
| **Future-North Leg** | 0.06 | 3.23 | 0.06 | ~1 | A |

# Appendix D

LCCET

# Organization Information

This sheet provides general project information for reference purposes only.

| Organization Information | |
|---|---|
| **Agency:** | Bruce County |
| **Project Name:** | Bruce County Road 25 & Road 33 Traffic Control Evaluation |
| **Project Reference:** | 192089 |
| **Location:** | Bruce County Road 25 & Road 33 |
| **City:** | Saugeen Shores |
| **State:** | Ontario, Canada |
| **Performing Department or Organization:** | Harbourside Transportation Consultants |
| **Date:** | 2019-12-17 |
| **Analyst:** | F. Allaire |

# Alternatives Master List

This sheet is used to manage the  alternatives

**Add Alternative**

| Alternatives | | | |
|---|---|---|---|
| **Alternative #** | **Short Name** | **Description** | **Notes** |
| Option 0 | TWSC | Two-Way Stop Control | Shared LTR on all approaches |
| Option 1 | TCS 1 | Traffic Control Signal | Shared LTR on all approaches |
| Option 2 | SGL RDBT | Single Lane Roundabout | Single lane entries on all approaches |
| Option 3 | TCS 2 | (Enter description of alternative here) | |
| Option 4 | MULT RDBT | Multilane Roundabout | Two lane entries on R25 and single lane entries on R33 |

## Option 0 - TWSC

**Description:** **Two-Way Stop Control**

A summary of the net present value for this alternative is shown to the right in Column "J"

| | | | |
|---|---|---|---|
| **Planning & construction period** | Begin planning & construction | **2019** | First year of planning & construction |
| **Operating period** | Opening year | **2020** | Travel time/delay and demand forecasts for the opening year *must* be provided. |
| | Interim year 1 | | Travel time/delay and demand forecasts for up to three years between the opening year and the end year *may* be provided. |
| | Interim year 2 | | |
| | Interim year 3 | | |
| | End year | **2040** | Travel time/delay and demand forecasts for the end (horizon) year *must* be provided. |
| **Worksheet setup** | **Setup Worksheet** | | Once you have entered begin planning & construction, opening, and end years, click this button to set up the worksheet. You may enter other inputs at any time. |

| **Net Present Value Summary** | |
|---|---|
| Planning & Construction Costs | $ 515,500 |
| Operating & Maintenance Costs | $ 88,636 |
| Auto Passenger Time | $ 29,492 |
| Auto Passenger Reliability | -- |
| Truck Time | $ 895 |
| Truck Reliability | -- |
| Transit Passenger Time | -- |
| Transit Passenger Reliability | -- |
| Bicyclist Time | -- |
| Pedestrian Time | -- |
| Safety | $ 550,971 |
| Greenhouse Gases | -- |
| Criteria Pollutants | -- |
| **Total Net Present Value** | **$ 1,185,493** |

| **Planning & construction costs** | **Units** | **Planning & construction year(s)** | | | | | **Notes** |
|---|---|---|---|---|---|---|---|
| | | **2019** | **2020** | **2021** | **2022** | **2023** | |
| Planning, design | Dollars | $ 40,000 | | | | | |
| Survey | Dollars | $ - | | | | | |
| Right of way | Dollars | $ - | | | | | |
| Equipment, signs | Dollars | $ - | | | | | |
| Utilities | Dollars | $ - | | | | | |
| Construction | Dollars | $ 475,500 | | | | | |
| Landscaping | Dollars | $ - | | | | | |
| (Other planning & construction costs) | Dollars | | | | | | |
| (Other planning & construction costs) | Dollars | | | | | | |
| (Other planning & construction costs) | Dollars | | | | | | |
| (Other planning & construction costs) | Dollars | | | | | | |
| (Other planning & construction costs) | Dollars | | | | | | |
| (Other planning & construction costs) | Dollars | | | | | | |
| (Other planning & construction costs) | Dollars | | | | | | |
| (Other planning & construction costs) | Dollars | | | | | | |
| (Other planning & construction costs) | Dollars | | | | | | |
| (Other planning & construction costs) | Dollars | | | | | | |

| **Operating & maintenance costs** | **Units** | **Begin year** | **Period (years)** | **Cost** | **Notes** |
|---|---|---|---|---|---|
| Power | Dollars | 2020 | 1 | $ 750 | |
| Inspection | Dollars | | | | |
| Repaving | Dollars | | | | |
| Signing, striping | Dollars | 2020 | 1 | $ 5,000 | |
| (Other O&M costs) | Dollars | | | | |
| (Other O&M costs) | Dollars | | | | |
| (Other O&M costs) | Dollars | | | | |
| (Other O&M costs) | Dollars | | | | |
| (Other O&M costs) | Dollars | | | | |
| (Other O&M costs) | Dollars | | | | |
| (Other O&M costs) | Dollars | | | | |
| (Other O&M costs) | Dollars | | | | |
| (Other O&M costs) | Dollars | | | | |
| (Other O&M costs) | Dollars | | | | |

Calculations can be reviewed within table beginning in cell K133.

## Option 0 - TWSC

**Description:** **Two-Way Stop Control**

| Demand & travel time / delay | Average travel time / delay | | Opening year | Interim year(s) | | | End year | Notes |
|---|---|---|---|---|---|---|---|---|
| | Time Period | Units | 2020 | | | | 2040 | |
| Average vehicle travel time or delay | AM peak | seconds/veh | 3.7 | | | | 6.8 | |
| | PM peak | seconds/veh | 6.1 | | | | 7.6 | |
| | Weekend peak | seconds/veh | | | | | | |
| Standard deviation of vehicle travel time or delay | AM peak | seconds/veh | | | | | | |
| | PM peak | seconds/veh | | | | | | |
| | Weekend peak | seconds/veh | | | | | | |
| Average bicycle travel time or delay | All time periods | seconds/bike | | | | | | |
| Average pedestrian travel time or delay | All time periods | seconds/ped | | | | | | |

| Safety | Crash type | Units | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Fatality, injury, PDO | Fatality crashes | crashes/year | 0.00 | | | | 0.00 | |
| | Injury crashes | crashes/year | 0.03 | | | | 0.19 | |
| | Property damage only crashes | crashes/year | 0.09 | | | | 0.33 | |
| | | | | | | | | |
| | | | | | | | | |

| Emissions | Type | Units | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Greenhouse gases -- Federal method (Exec. Order 12866) | CO2 equivalent | metric tons/year | | | | | | |
| Criteria pollutants -- by type | CO | metric tons/year | | | | | | |
| | NOx | metric tons/year | | | | | | |
| | HC | metric tons/year | | | | | | |
| | PM 2.5 | metric tons/year | | | | | | |

## Option 1 - TCS 1

**Description:** **Traffic Control Signal**

A summary of the net present value for this alternative is shown to the right in Column "J"

| | | | |
|---|---|---|---|
| **Planning & construction period** | Begin planning & construction | **2019** | First year of planning & construction |
| **Operating period** | Opening year | **2020** | Travel time/delay and demand forecasts for the opening year *must* be provided. |
| | Interim year 1 | | Travel time/delay and demand forecasts for up to three years between the opening year and the end year *may* be provided. |
| | Interim year 2 | | |
| | Interim year 3 | | |
| | End year | **2040** | Travel time/delay and demand forecasts for the end (horizon) year *must* be provided. |
| **Worksheet setup** | **Setup Worksheet** | | Once you have entered begin planning & construction, opening, and end years, click this button to set up the worksheet. You may enter other inputs at any time. |

| **Net Present Value Summary** | |
|---|---|
| Planning & Construction Costs | $ 765,500 |
| Operating & Maintenance Costs | $ 178,814 |
| Auto Passenger Time | $ 41,243 |
| Auto Passenger Reliability | -- |
| Truck Time | $ 1,251 |
| Truck Reliability | -- |
| Transit Passenger Time | -- |
| Transit Passenger Reliability | -- |
| Bicyclist Time | -- |
| Pedestrian Time | -- |
| Safety | $ 418,228 |
| Greenhouse Gases | -- |
| Criteria Pollutants | -- |
| **Total Net Present Value** | **$ 1,405,036** |

| **Planning & construction costs** | **Units** | **Planning & construction year(s)** | | | | | **Notes** |
|---|---|---|---|---|---|---|---|
| | | **2019** | **2020** | **2021** | **2022** | **2023** | |
| Planning, design | Dollars | $ 40,000 | | | | | |
| Survey | Dollars | $ - | | | | | |
| Right of way | Dollars | $ - | | | | | |
| Equipment, signs | Dollars | $ 250,000 | | | | | |
| Utilities | Dollars | $ - | | | | | |
| Construction | Dollars | $ 475,500 | | | | | |
| Landscaping | Dollars | | | | | | |
| (Other planning & construction costs) | Dollars | | | | | | |
| (Other planning & construction costs) | Dollars | | | | | | |
| (Other planning & construction costs) | Dollars | | | | | | |
| (Other planning & construction costs) | Dollars | | | | | | |
| (Other planning & construction costs) | Dollars | | | | | | |
| (Other planning & construction costs) | Dollars | | | | | | |
| (Other planning & construction costs) | Dollars | | | | | | |
| (Other planning & construction costs) | Dollars | | | | | | |
| (Other planning & construction costs) | Dollars | | | | | | |
| (Other planning & construction costs) | Dollars | | | | | | |

| **Operating & maintenance costs** | **Units** | **Begin year** | **Period (years)** | **Cost** | **Notes** |
|---|---|---|---|---|---|
| Power | Dollars | 2020 | 1 | $ 1,600 | |
| Inspection | Dollars | 2020 | 1 | $ 5,000 | |
| Repaving | Dollars | | | | |
| Signing, striping | Dollars | 2020 | 1 | $ 5,000 | |
| (Other O&M costs) | Dollars | | | | |
| (Other O&M costs) | Dollars | | | | |
| (Other O&M costs) | Dollars | | | | |
| (Other O&M costs) | Dollars | | | | |
| (Other O&M costs) | Dollars | | | | |
| (Other O&M costs) | Dollars | | | | |
| (Other O&M costs) | Dollars | | | | |
| (Other O&M costs) | Dollars | | | | |
| (Other O&M costs) | Dollars | | | | |
| (Other O&M costs) | Dollars | | | | |

Calculations can be reviewed within table beginning in cell K133.

## Option 1 - TCS 1

**Description:** **Traffic Control Signal**

| Demand & travel time / delay | Average travel time / delay | | Opening year | Interim year(s) | | | End year | Notes |
|---|---|---|---|---|---|---|---|---|
| | Time Period | Units | 2020 | | | | 2040 | |
| Average vehicle travel time or delay | AM peak | seconds/veh | 4.7 | | | | 8.3 | |
| | PM peak | seconds/veh | 11.2 | | | | 11.9 | |
| | Weekend peak | seconds/veh | | | | | | |
| Standard deviation of vehicle travel time or delay | AM peak | seconds/veh | | | | | | |
| | PM peak | seconds/veh | | | | | | |
| | Weekend peak | seconds/veh | | | | | | |
| Average bicycle travel time or delay | All time periods | seconds/bike | | | | | | |
| Average pedestrian travel time or delay | All time periods | seconds/ped | | | | | | |

| Safety | Crash type | Units | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Fatality, injury, PDO | Fatality crashes | crashes/year | 0.00 | | | | 0.00 | |
| | Injury crashes | crashes/year | 0.08 | | | | 0.24 | |
| | Property damage only crashes | crashes/year | 0.48 | | | | 0.90 | |
| | | | | | | | | |
| | | | | | | | | |

| Emissions | Type | Units | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Greenhouse gases -- Federal method (Exec. Order 12866) | CO2 equivalent | metric tons/year | | | | | | |
| Criteria pollutants -- by type | CO | metric tons/year | | | | | | |
| | NOx | metric tons/year | | | | | | |
| | HC | metric tons/year | | | | | | |
| | PM 2.5 | metric tons/year | | | | | | |

## Option 2 - SGL RDBT

**Description:** **Single Lane Roundabout**

A summary of the net present value for this alternative is shown to the right in Column "J"

| | | | |
|---|---|---|---|
| **Planning & construction period** | Begin planning & construction | **2019** | First year of planning & construction |
| **Operating period** | Opening year | **2020** | Travel time/delay and demand forecasts for the opening year *must* be provided. |
| | Interim year 1 | | Travel time/delay and demand forecasts for up to three years between the opening year and the end year *may* be provided. |
| | Interim year 2 | | |
| | Interim year 3 | | |
| | End year | **2040** | Travel time/delay and demand forecasts for the end (horizon) year *must* be provided. |
| **Worksheet setup** | **Setup Worksheet** | | Once you have entered begin planning & construction, opening, and end years, click this button to set up the worksheet. You may enter other inputs at any time. |

| **Planning & construction costs** | **Units** | **Planning & construction year(s)** | | | | | **Notes** |
|---|---|---|---|---|---|---|---|
| | | **2019** | **2020** | **2021** | **2022** | **2023** | |
| Planning, design | Dollars | $ 40,000 | | | | | |
| Survey | Dollars | $ - | | | | | |
| Right of way | Dollars | $ 9,400 | | | | | |
| Equipment, signs | Dollars | $ - | | | | | |
| Utilities | Dollars | $ 31,250 | | | | | |
| Construction | Dollars | $ 722,600 | | | | | |
| Landscaping | Dollars | | | | | | |
| (Other planning & construction costs) | Dollars | | | | | | |
| (Other planning & construction costs) | Dollars | | | | | | |
| (Other planning & construction costs) | Dollars | | | | | | |
| (Other planning & construction costs) | Dollars | | | | | | |
| (Other planning & construction costs) | Dollars | | | | | | |
| (Other planning & construction costs) | Dollars | | | | | | |
| (Other planning & construction costs) | Dollars | | | | | | |
| (Other planning & construction costs) | Dollars | | | | | | |
| (Other planning & construction costs) | Dollars | | | | | | |
| (Other planning & construction costs) | Dollars | | | | | | |

| **Net Present Value Summary** | |
|---|---|
| Planning & Construction Costs | $ 803,250 |
| Operating & Maintenance Costs | $ 100,198 |
| Auto Passenger Time | $ 22,344 |
| Auto Passenger Reliability | -- |
| Truck Time | $ 678 |
| Truck Reliability | -- |
| Transit Passenger Time | -- |
| Transit Passenger Reliability | -- |
| Bicyclist Time | -- |
| Pedestrian Time | -- |
| Safety | $ 142,774 |
| Greenhouse Gases | -- |
| Criteria Pollutants | -- |
| **Total Net Present Value** | **$ 1,069,243** |

| **Operating & maintenance costs** | **Units** | **Begin year** | **Period (years)** | **Cost** | **Notes** |
|---|---|---|---|---|---|
| Power | Dollars | 2020 | 1 | $ 1,500 | |
| Inspection | Dollars | | | | |
| Repaving | Dollars | | | | |
| Signing, striping | Dollars | 2020 | 1 | $ 5,000 | |
| (Other O&M costs) | Dollars | | | | |
| (Other O&M costs) | Dollars | | | | |
| (Other O&M costs) | Dollars | | | | |
| (Other O&M costs) | Dollars | | | | |
| (Other O&M costs) | Dollars | | | | |
| (Other O&M costs) | Dollars | | | | |
| (Other O&M costs) | Dollars | | | | |
| (Other O&M costs) | Dollars | | | | |
| (Other O&M costs) | Dollars | | | | |
| (Other O&M costs) | Dollars | | | | |

Calculations can be reviewed within table beginning in cell K133.

## Option 2 - SGL RDBT

**Description:** **Single Lane Roundabout**

| **Demand & travel time / delay** | **Average travel time / delay** | | **Opening year** | **Interim year(s)** | | | **End year** | **Notes** |
|---|---|---|---|---|---|---|---|---|
| | **Time Period** | **Units** | **2020** | | | | **2040** | |
| Average vehicle travel time or delay | AM peak | seconds/veh | 3.1 | | | | 3.4 | |
| | PM peak | seconds/veh | 3.2 | | | | 3.7 | |
| | Weekend peak | seconds/veh | | | | | | |
| Standard deviation of vehicle travel time or delay | AM peak | seconds/veh | | | | | | |
| | PM peak | seconds/veh | | | | | | |
| | Weekend peak | seconds/veh | | | | | | |
| Average bicycle travel time or delay | All time periods | seconds/bike | | | | | | |
| Average pedestrian travel time or delay | All time periods | seconds/ped | | | | | | |

| **Safety** | **Crash type** | **Units** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Fatality, injury, PDO | Fatality crashes | crashes/year | 0.00 | | | | 0.00 | |
| | Injury crashes | crashes/year | 0.02 | | | | 0.06 | |
| | Property damage only crashes | crashes/year | 0.95 | | | | 1.80 | |
| | | | | | | | | |
| | | | | | | | | |

| **Emissions** | **Type** | **Units** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Greenhouse gases -- Federal method (Exec. Order 12866) | CO2 equivalent | metric tons/year | | | | | | |
| Criteria pollutants -- by type | CO | metric tons/year | | | | | | |
| | NOx | metric tons/year | | | | | | |
| | HC | metric tons/year | | | | | | |
| | PM 2.5 | metric tons/year | | | | | | |

## Option 3 - TCS 2

**Description:** **(Please enter description of alternative on Alternatives worksheet)**

A summary of the net present value for this alternative is shown to the right in Column "J"

| | | | |
|---|---|---|---|
| **Planning & construction period** | Begin planning & construction | **2019** | First year of planning & construction |
| **Operating period** | Opening year | **2020** | Travel time/delay and demand forecasts for the opening year *must* be provided. |
| | Interim year 1 | | Travel time/delay and demand forecasts for up to three years between the opening year and the end year *may* be provided. |
| | Interim year 2 | | |
| | Interim year 3 | | |
| | End year | **2040** | Travel time/delay and demand forecasts for the end (horizon) year *must* be provided. |
| **Worksheet setup** | **Setup Worksheet** | | Once you have entered begin planning & construction, opening, and end years, click this button to set up the worksheet. You may enter other inputs at any time. |

| **Net Present Value Summary** | |
|---|---|
| Planning & Construction Costs | $ 1,552,000 |
| Operating & Maintenance Costs | $ 178,814 |
| Auto Passenger Time | $ 45,383 |
| Auto Passenger Reliability | -- |
| Truck Time | $ 1,377 |
| Truck Reliability | -- |
| Transit Passenger Time | -- |
| Transit Passenger Reliability | -- |
| Bicyclist Time | -- |
| Pedestrian Time | -- |
| Safety | $ 418,228 |
| Greenhouse Gases | -- |
| Criteria Pollutants | -- |
| **Total Net Present Value** | **$ 2,195,802** |

| **Planning & construction costs** | **Units** | **Planning & construction year(s)** | | | | | **Notes** |
|---|---|---|---|---|---|---|---|
| | | **2019** | **2020** | **2021** | **2022** | **2023** | |
| Planning, design | Dollars | $ 75,000 | | | | | |
| Survey | Dollars | $ - | | | | | |
| Right of way | Dollars | $ - | | | | | |
| Equipment, signs | Dollars | $ 375,000 | | | | | |
| Utilities | Dollars | $ - | | | | | |
| Construction | Dollars | $ 1,102,000 | | | | | |
| Landscaping | Dollars | $ - | | | | | |
| (Other planning & construction costs) | Dollars | | | | | | |
| (Other planning & construction costs) | Dollars | | | | | | |
| (Other planning & construction costs) | Dollars | | | | | | |
| (Other planning & construction costs) | Dollars | | | | | | |
| (Other planning & construction costs) | Dollars | | | | | | |
| (Other planning & construction costs) | Dollars | | | | | | |
| (Other planning & construction costs) | Dollars | | | | | | |
| (Other planning & construction costs) | Dollars | | | | | | |
| (Other planning & construction costs) | Dollars | | | | | | |
| (Other planning & construction costs) | Dollars | | | | | | |

| **Operating & maintenance costs** | **Units** | **Begin year** | **Period (years)** | **Cost** | **Notes** |
|---|---|---|---|---|---|
| Power | Dollars | 2020 | 1 | $ 1,600 | |
| Inspection | Dollars | 2020 | 1 | $ 5,000 | |
| Repaving | Dollars | | | | |
| Signing, striping | Dollars | 2020 | 1 | $ 5,000 | |
| (Other O&M costs) | Dollars | | | | |
| (Other O&M costs) | Dollars | | | | |
| (Other O&M costs) | Dollars | | | | |
| (Other O&M costs) | Dollars | | | | |
| (Other O&M costs) | Dollars | | | | |
| (Other O&M costs) | Dollars | | | | |
| (Other O&M costs) | Dollars | | | | |
| (Other O&M costs) | Dollars | | | | |
| (Other O&M costs) | Dollars | | | | |
| (Other O&M costs) | Dollars | | | | |

Calculations can be reviewed within table beginning in cell K133.

## Option 3 - TCS 2

**Description:** **(Please enter description of alternative on Alternatives worksheet)**

| **Demand & travel time / delay** | **Average travel time / delay** | | **Opening year** | **Interim year(s)** | | | **End year** | **Notes** |
|---|---|---|---|---|---|---|---|---|
| | **Time Period** | **Units** | **2020** | | | | **2040** | |
| Average vehicle travel time or delay | AM peak | seconds/veh | 5.3 | | | | 8.2 | |
| | PM peak | seconds/veh | 11.5 | | | | 11.9 | |
| | Weekend peak | seconds/veh | | | | | | |
| Standard deviation of vehicle travel time or delay | AM peak | seconds/veh | | | | | | |
| | PM peak | seconds/veh | | | | | | |
| | Weekend peak | seconds/veh | | | | | | |
| Average bicycle travel time or delay | All time periods | seconds/bike | | | | | | |
| Average pedestrian travel time or delay | All time periods | seconds/ped | | | | | | |

| **Safety** | **Crash type** | **Units** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Fatality, injury, PDO | Fatality crashes | crashes/year | 0.00 | | | | 0.00 | |
| | Injury crashes | crashes/year | 0.08 | | | | 0.24 | |
| | Property damage only crashes | crashes/year | 0.48 | | | | 0.90 | |
| | | | | | | | | |
| | | | | | | | | |

| **Emissions** | **Type** | **Units** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Greenhouse gases -- Federal method (Exec. Order 12866) | CO2 equivalent | metric tons/year | | | | | | |
| Criteria pollutants -- by type | CO | metric tons/year | | | | | | |
| | NOx | metric tons/year | | | | | | |
| | HC | metric tons/year | | | | | | |
| | PM 2.5 | metric tons/year | | | | | | |

## Option 4 - MULT RDBT

**Description:** **Multilane Roundabout**

A summary of the net present value for this alternative is shown to the right in Column "J"

| | | | |
|---|---|---|---|
| **Planning & construction period** | Begin planning & construction | **2019** | First year of planning & construction |
| **Operating period** | Opening year | **2020** | Travel time/delay and demand forecasts for the opening year *must* be provided. |
| | Interim year 1 | | Travel time/delay and demand forecasts for up to three years between the opening year and the end year *may* be provided. |
| | Interim year 2 | | |
| | Interim year 3 | | |
| | End year | **2040** | Travel time/delay and demand forecasts for the end (horizon) year *must* be provided. |
| **Worksheet setup** | **Setup Worksheet** | | Once you have entered begin planning & construction, opening, and end years, click this button to set up the worksheet. You may enter other inputs at any time. |

| **Planning & construction costs** | **Units** | **Planning & construction year(s)** | | | | | **Notes** |
|---|---|---|---|---|---|---|---|
| | | **2019** | **2020** | **2021** | **2022** | **2023** | |
| Planning, design | Dollars | $ 75,000 | | | | | |
| Survey | Dollars | $ - | | | | | |
| Right of way | Dollars | $ 112,500 | | | | | |
| Equipment, signs | Dollars | $ - | | | | | |
| Utilities | Dollars | $ 31,250 | | | | | |
| Construction | Dollars | $ 1,276,500 | | | | | |
| Landscaping | Dollars | $ - | | | | | |
| (Other planning & construction costs) | Dollars | | | | | | |
| (Other planning & construction costs) | Dollars | | | | | | |
| (Other planning & construction costs) | Dollars | | | | | | |
| (Other planning & construction costs) | Dollars | | | | | | |
| (Other planning & construction costs) | Dollars | | | | | | |
| (Other planning & construction costs) | Dollars | | | | | | |
| (Other planning & construction costs) | Dollars | | | | | | |
| (Other planning & construction costs) | Dollars | | | | | | |
| (Other planning & construction costs) | Dollars | | | | | | |
| (Other planning & construction costs) | Dollars | | | | | | |

| **Operating & maintenance costs** | **Units** | **Begin year** | **Period (years)** | **Cost** | **Notes** |
|---|---|---|---|---|---|
| Power | Dollars | 2020 | 1 | $ 1,500 | |
| Inspection | Dollars | | | | |
| Repaving | Dollars | | | | |
| Signing, striping | Dollars | 2020 | 1 | $ 5,000 | |
| (Other O&M costs) | Dollars | | | | |
| (Other O&M costs) | Dollars | | | | |
| (Other O&M costs) | Dollars | | | | |
| (Other O&M costs) | Dollars | | | | |
| (Other O&M costs) | Dollars | | | | |
| (Other O&M costs) | Dollars | | | | |
| (Other O&M costs) | Dollars | | | | |
| (Other O&M costs) | Dollars | | | | |
| (Other O&M costs) | Dollars | | | | |
| (Other O&M costs) | Dollars | | | | |

Calculations can be reviewed within table beginning in cell K133.

| **Net Present Value Summary** | |
|---|---|
| Planning & Construction Costs | $ 1,495,250 |
| Operating & Maintenance Costs | $ 100,198 |
| Auto Passenger Time | $ 13,984 |
| Auto Passenger Reliability | -- |
| Truck Time | $ 424 |
| Truck Reliability | -- |
| Transit Passenger Time | -- |
| Transit Passenger Reliability | -- |
| Bicyclist Time | -- |
| Pedestrian Time | -- |
| Safety | $ 142,774 |
| Greenhouse Gases | -- |
| Criteria Pollutants | -- |
| **Total Net Present Value** | **$ 1,752,629** |

## Option 4 - MULT RDBT

**Description:** **Multilane Roundabout**

| Demand & travel time / delay | Average travel time / delay | | Opening year | Interim year(s) | | | End year | Notes |
|---|---|---|---|---|---|---|---|---|
| | Time Period | Units | 2020 | | | | 2040 | |
| Average vehicle travel time or delay | AM peak | seconds/veh | 1.8 | | | | 2.2 | |
| | PM peak | seconds/veh | 2.6 | | | | 2.8 | |
| | Weekend peak | seconds/veh | | | | | | |
| Standard deviation of vehicle travel time or delay | AM peak | seconds/veh | | | | | | |
| | PM peak | seconds/veh | | | | | | |
| | Weekend peak | seconds/veh | | | | | | |
| Average bicycle travel time or delay | All time periods | seconds/bike | | | | | | |
| Average pedestrian travel time or delay | All time periods | seconds/ped | | | | | | |

| Safety | Crash type | Units | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Fatality, injury, PDO | Fatality crashes | crashes/year | 0.00 | | | | 0.00 | |
| | Injury crashes | crashes/year | 0.02 | | | | 0.06 | |
| | Property damage only crashes | crashes/year | 0.95 | | | | 1.80 | |
| | | | | | | | | |
| | | | | | | | | |

| Emissions | Type | Units | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Greenhouse gases -- Federal method (Exec. Order 12866) | CO2 equivalent | metric tons/year | | | | | | |
| Criteria pollutants -- by type | CO | metric tons/year | | | | | | |
| | NOx | metric tons/year | | | | | | |
| | HC | metric tons/year | | | | | | |
| | PM 2.5 | metric tons/year | | | | | | |

# Outputs

This sheet compiles the data from summary tables in individual alternatives sheets.

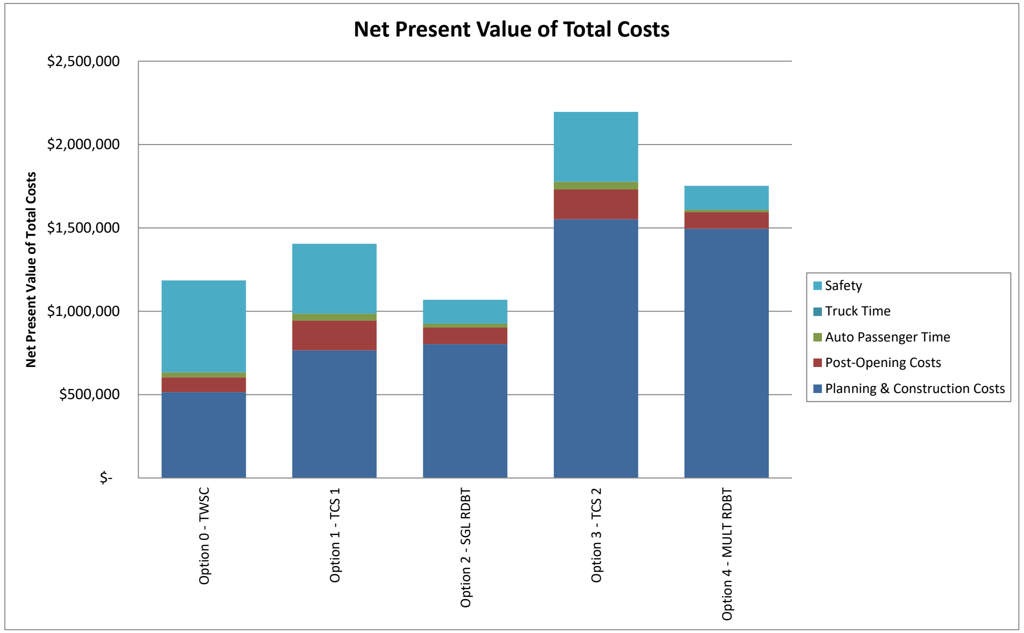
**Analysis Summary**

| Cost Categories | Net Present Value of Costs | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Option 0 - TWSC | Option 1 - TCS 1 | Option 2 - SGL RDBT | Option 3 - TCS 2 | Option 4 - MULT RDBT | | | | | |
| Planning & Construction Costs | $ 515,500 | $ 765,500 | $ 803,250 | $ 1,552,000 | $ 1,495,250 | | | | | |
| Post-Opening Costs | $ 88,636 | $ 178,814 | $ 100,198 | $ 178,814 | $ 100,198 | | | | | |
| Auto Passenger Time | $ 29,492 | $ 41,243 | $ 22,344 | $ 45,383 | $ 13,984 | | | | | |
| Auto Passenger Reliability | -- | -- | -- | -- | -- | | | | | |
| Truck Time | $ 895 | $ 1,251 | $ 678 | $ 1,377 | $ 424 | | | | | |
| Truck Reliability | -- | -- | -- | -- | -- | | | | | |
| Transit Passenger Time | -- | -- | -- | -- | -- | | | | | |
| Transit Passenger Reliability | -- | -- | -- | -- | -- | | | | | |
| Bicyclist Time | -- | -- | -- | -- | -- | | | | | |
| Pedestrian Time | -- | -- | -- | -- | -- | | | | | |
| Safety | $ 550,971 | $ 418,228 | $ 142,774 | $ 418,228 | $ 142,774 | | | | | |
| Greenhouse Gases | -- | -- | -- | -- | -- | | | | | |
| Criteria Pollutants | -- | -- | -- | -- | -- | | | | | |
| **Total cost** | **$1,185,493** | **$1,405,036** | **$1,069,243** | **$2,195,802** | **$1,752,629** | | | | | |

To exclude cost categories from the comparison clear all values in the row. Selecting the "Compile Analysis Summary" button will repopulate all values from the alternatives sheets.

| Benefit Categories | Net Present Value of Benefits Relative to Base Case | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Option 1 - TCS 1 | Option 2 - SGL RDBT | Option 3 - TCS 2 | Option 4 - MULT RDBT | | | | | |
| Auto Passenger Time | | $ (11,751) | $ 7,148 | $ (15,891) | $ 15,508 | | | | | |
| Auto Passenger Reliability | | | | | | | | | | |
| Truck Time | | $ (356) | $ 217 | $ (482) | $ 470 | | | | | |
| Truck Reliability | | | | | | | | | | |
| Transit Passenger Time | | | | | | | | | | |
| Transit Passenger Reliability | | | | | | | | | | |
| Bicyclist Time | | | | | | | | | | |
| Pedestrian Time | | | | | | | | | | |
| Safety | | $ 132,743 | $ 408,197 | $ 132,743 | $ 408,197 | | | | | |
| Greenhouse Gases | | | | | | | | | | |
| Criteria Pollutants | | | | | | | | | | |
| **Net Present Value of Benefits** | | **$ 120,635** | **$ 415,561** | **$ 116,370** | **$ 424,175** | | | | | |
| **Net Present Value of Costs** | | **$ 340,178** | **$ 299,311** | **$ 1,126,678** | **$ 991,311** | | | | | |
| **Present Value of Net Benefits** | | **$ (219,542)** | **$ 116,250** | **$ (1,010,308)** | **$ (567,136)** | | | | | |
| **Benefit-Cost Ratio** | | **0.35** | **1.39** | **0.10** | **0.43** | | | | | |

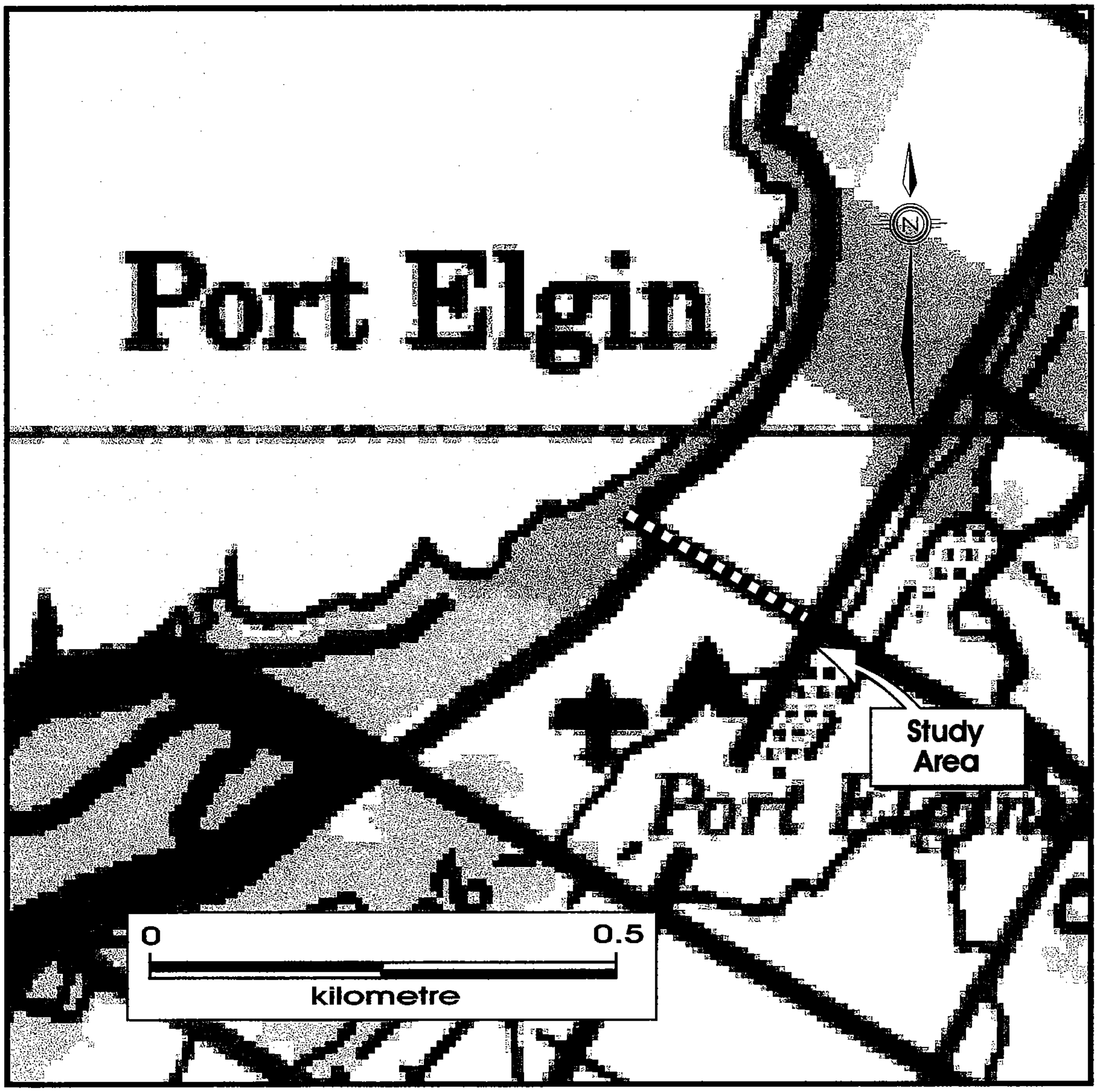
## Outputs


Net Present Value of Total Costs
Net Present Value of Total Costs
$2,500,000
$2,000,000
$1,500,000
$1,000,000
$500,000
$-
Option 0 - TWSC
Option 1 - TCS 1
Option 2 - SGL RDBT
Option 3 - TCS 2
Option 4 - MULT RDBT
Safety
Truck Time
Auto Passenger Time
Post-Opening Costs
Planning & Construction Costs

# APPENDIX E:
# CULTURAL ENVIRONMENT

M-2552

# Archaeological Assessment (Stages 1 and 2)
# Bruce Road 25 Reconstruction
# Town of Saugeen Shores, Bruce County, Ontario



Mayer
Heritage
Consultants Inc.

*Cultural Heritage Assessments and Archaeological Mitigative Excavations*

# Archaeological Assessment (Stages 1 and 2)
# Bruce Road 25 Reconstruction
# Town of Saugeen Shores, Bruce County, Ontario

submitted to

**Gamsby and Mannerow Limited**
**652 Third Avenue East**
**Owen Sound, Ontario**
**N4K 2KI**

and

**The Ontario Ministry of Culture**

Prepared by

Mayer Heritage Consultants Inc.
2509 Main Street, P. O. Box 456 Lambeth Station,
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Archaeological Consulting Licence Number P040
Contract Information Form Number P040-280-2008
Corporate Project Number 08-036

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## Project Personnel

| | |
|---|---|
| Project Manager | Paul J. C. O'Neal |
| Report Preparation | Becky Jones |
| Field Director | Becky Jones |
| Field Assistants | Ashley Bailey<br>Jordana Gonser<br>Kyle Greenwood<br>Danielle Quinney<br>Diane Servos |

## Acknowledgments

Preparation of this report was facilitated by the assistance of the following individuals and their agencies:

- ***John Slocombe,*** Gamsby and Mannerow Limited
- ***Robert von Bitter***, Archaeological Data Co-ordinator, Ontario Ministry of Culture

# Archaeological Assessment (Stages 1 and 2)
# Bruce Road 25 Reconstruction
# Town of Saugeen Shores, Bruce County, Ontario

## Introduction

Among other matters, the *Planning Act R.S.O. 1990*, establishes that the protection of features of archaeological interest is a matter of provincial concern. As such, an archaeological resource assessment (Stage 1 background research and Stage 2 general survey) was conducted as a standard condition of approval for the proposed road widening along both sides of Bruce Road 25 from Lake Huron to Highway 21, in the Town of Port Elgin, Regional Municipality of Bruce County, Ontario (Figure 1).

This assessment was conducted in order to determine if any direct and/or indirect impacts would occur by proposed construction activities on archaeological resources that might be present. Archaeological resources consist of artifacts (Aboriginal stone tools, pottery and subsistence remains as well as Euro-Canadian objects), subsurface settlement patterns and cultural features (post moulds, trash pits, privies, and wells), and sites (temporary camps and special purpose activity areas, plus more permanent settlements such as villages, homesteads, grist mills and industrial structures).

## Stage 1 Background Research

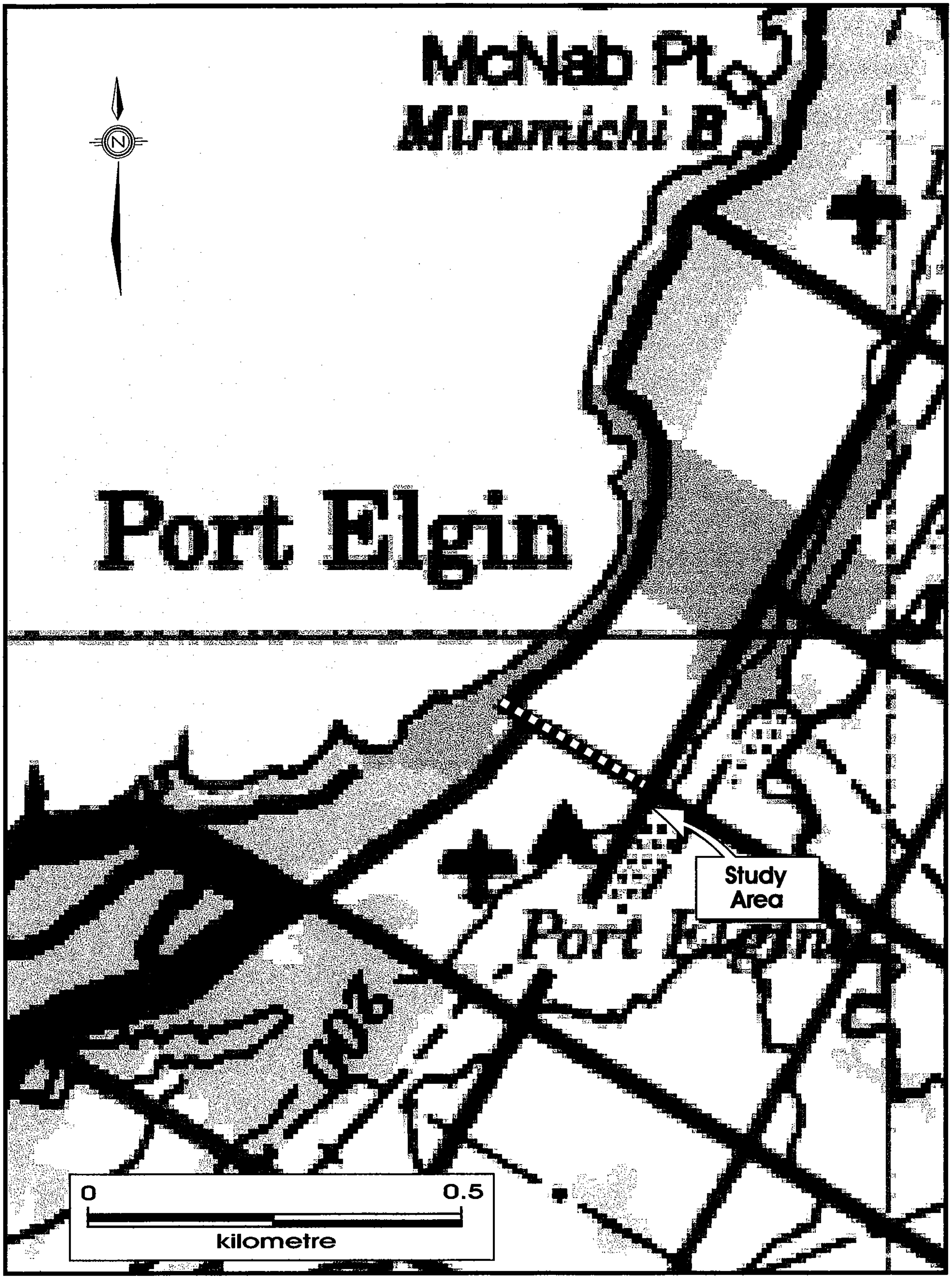
Stage 1 background research was conducted in order to complete the following tasks:

- amass all of the readily available information on any previous archaeological surveys in the area;
- determine the locations of any registered and unregistered sites; and
- develop an historical framework for assigning levels of potential significance to any new sites discovered during fieldwork.

The framework for assigning levels of potential archaeological significance is drawn from provincial guidelines (Weiler 1980). The necessary information includes the identification and evaluation of any feature that has one or more of the following attributes:

- *it has the potential through archaeological exploration, survey or fieldwork to provide answers to substantive questions (i.e. relate to particular times and places) about events and processes that occurred in the past and therefore add to our knowledge and appreciation of history;*
- *it has the potential through archaeological exploration, survey and fieldwork to contribute to testing the validity of general anthropological principles, cultural change and ecological adaptation, and therefore to the understanding and appreciation of our man-made heritage; or*
- *it is probable that various technical, methodological, and theoretical advances are likely to occur during archaeological investigation of a feature, alone or in association with other features, and therefore contribute to the development of better scientific means of understanding and appreciating our man-made heritage (Weiler 1980:8);*

Figure 1: Location of the Study Area



## Natural Environment

The study area is within the Huron Fringe (Chapman and Putnam 1984). The *Soil Survey of Bruce County* (Hoffman and Richards, 1954) indicate the dominant surface soil type of the subject area to be sand to sandy loam over a well-sorted sandy outwash with excessive to imperfect drainage over a smooth, gentle slope. The study area is located just east of Lake Huron.

## Potential for Archaeological Resources

Archaeological potential is defined as the likelihood of finding archaeological sites within a study area. For planning purposes, determining archaeological potential provides a preliminary indication that significant sites might be found within the study area, and consequently, that it may be necessary to allocate time and resources for archaeological survey and mitigation. In predicting the locations of archaeological sites, the *Primer on Archaeology, Land Use Planning and Development in Ontario* (Ministry of Culture 1997:12-13) states that undisturbed lands, or those with minimal disturbance, such as cultivated fields, within 300 metres of a primary water source or 200 metres of a secondary or tertiary water source are considered to have archaeological potential. Other criteria can include location on elevated ground or near distinctive or unusual landforms, and the presence of well-drained sandy soils.

Based upon a published synthesis of Aboriginal cultural occupations (Wright 1968), Table 1 is a general outline of the cultural history of Southwestern Ontario that is applicable to the study area. Ellis and Ferris (1990) provide greater detail of the distinctive characteristics of each time period and cultural group. The Ministry of Culture archaeological database coordinator (von Bitter 2008) indicated that there are three previously registered archaeological sites within 2,000 metres of the study area (Table 2).

**Table 1: General Cultural Chronology for Southwestern Ontario.**

| *PERIOD* | *GROUP* | *TIME RANGE* | *COMMENTS* |
|---|---|---|---|
| Early Paleo-Indian | Fluted Projectiles | 9500 - 8500 B.C. | big game hunters |
| Late Paleo-Indian | Hi-Lo Projectiles | 8500 - 7500 B.C. | small nomadic groups |
| Early Archaic | --- | 7800 - 6000 B.C. | nomadic hunters and gatherers |
| Middle Archaic | Laurentian | 6000 - 2000 B.C. | territorial settlements |
| Late Archaic | Lamoka | 2500 - 1700 B.C. | polished ground stone tools |
| " | Broadpoint | 1800 - 1400 B.C. | --- |
| " | Crawford Knoll | 1500 - 500 B.C. | --- |
| " | Glacial Kame | *circa* 1000 B.C. | burial ceremonialism |
| Early Woodland | Meadowood | 1000 - 400 B.C. | introduction of pottery |
| " | Red Ochre | 1000 - 500 B.C. | --- |
| Middle Woodland | Western Basin/Saugeen | 400 B.C. - A.D. 500 | long distance trade networks |
| " | Princess Point | A.D. 500 - 800 | incipient agriculture |
| Late Woodland | Glen Meyer | A.D. 800 - 1300 | transition to village life |
| " | Uren | A.D. 1300 - 1350 | large villages with palisades |
| " | Middleport | A.D. 1300 - 1400 | wide distribution of ceramic styles |
| " | Neutral/Huron | A.D. 1400 - 1650 | tribal warfare |
| Early Contact | Mississauga plus others | A.D. 1700 - 1875 | tribal displacement |
| Late Contact | Euro-Canadian | A.D. 1800 - present | European settlement |

Figure 2: Study Area, Facing West towards Lake Huron

Figure 3: Crew at Work on North Side of Bruce Road 25, Facing West

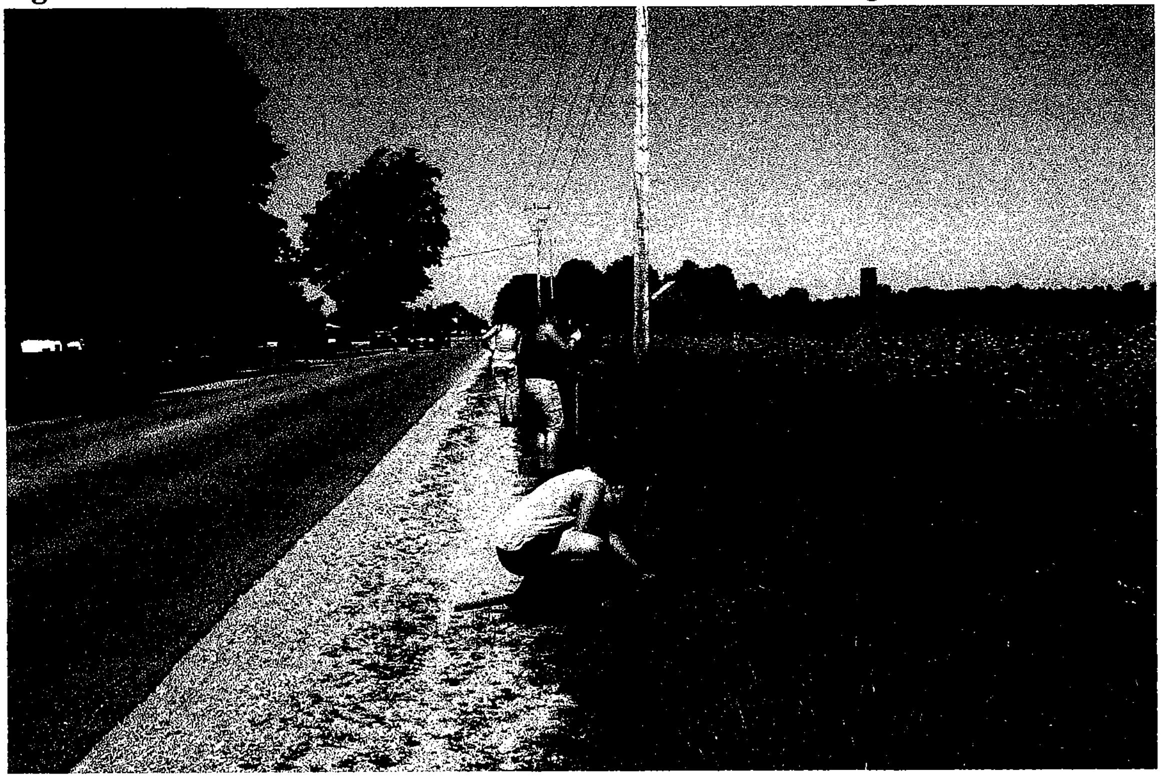
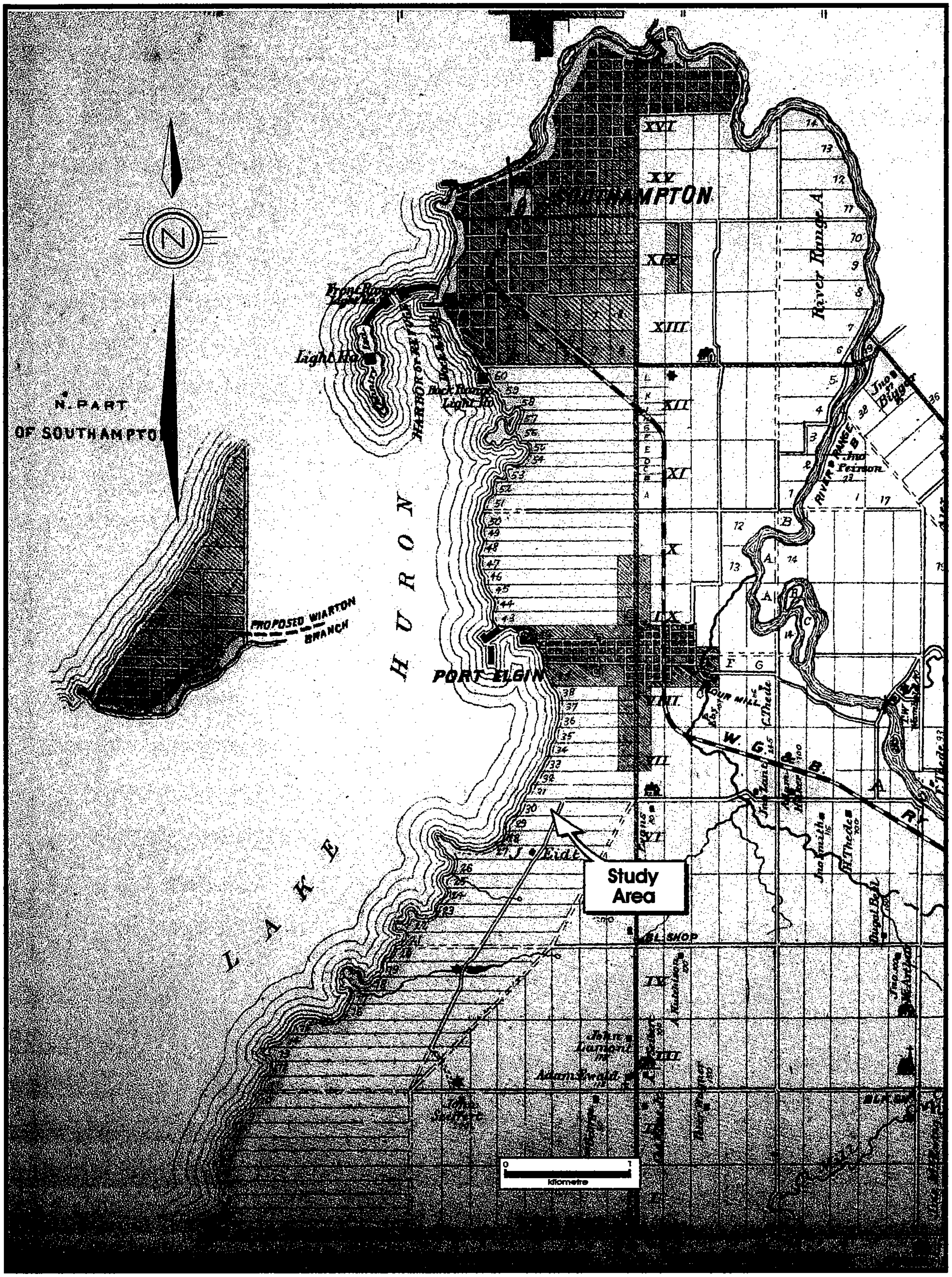


Figure 4: Site Location on Historic Atlas



Over their thousands of years of occupation in the general region, Aboriginal people, have left behind, to a greater or lesser degree, physical evidence of their lifeway activities and settlements at many locations. The earliest possible human occupation was during the Paleo-Indian period (*circa* 9000 to 7000 B.C.) wherein small groups of nomadic peoples hunted big game along the shorelines of glacial lakes. These people were few in number and their small, temporary campsites are relatively rare.

People during the Archaic period (*circa* 7000 to 1000 B.C.) were still primarily nomadic hunters but also established territorial settlements, gathered seasonally available resources, and introduced burial ceremonialism. Late Archaic period sites are more numerous and can be quite large due to repeated annual visits.

Sites of the Woodland period (*circa* 1000 B.C. to A.D. 1650) are usually the most numerous because the population levels in Southwestern Ontario had significantly increased. The manufacture of ceramic pottery vessels for storage and cooking was introduced along with the establishment of long distance trading networks, horticulture, warfare and large palisaded villages.

**Table 2: Registered Archaeological Sites within 2,000 metres of the Study Area.**

| *REGISTRATION #* | *NAME* | *TYPE* | *CULTURAL AFFILIATION* |
|---|---|---|---|
| BcHi-18 | Beaner | Findspot | Pre-Contact |
| BcHi-19 | Port Elgin Cemetery | Cemetery | Undetermined |
| BcHi-3 | Nodwell | Burial, Campsite | Woodland, Late |

Sites of the Contact period (*circa* A.D. 1650 to 1900) include Aboriginal and Euro-Canadian residences and industries. The study area is located in the historic town of Port Elgin and extends from Saugeen Beach Road to Highway 21. On the map of Saugeen Township, in the Illustrated Atlas of the County of Bruce (1880), no ownership of the subject area is indicated, and no structures are shown. The absence of any structures on this map, however, does not necessarily mean that one or more structures were not present at that time, earlier or later.

Based upon the soil and topography suitable for human habitation, the proximity to water and the historic significance of the geographic region, the study area exhibits high potential for the discovery of pre-contact Aboriginal and Euro-Canadian archaeological resources.

Figure 5: Site Map Showing Stage 2 Results

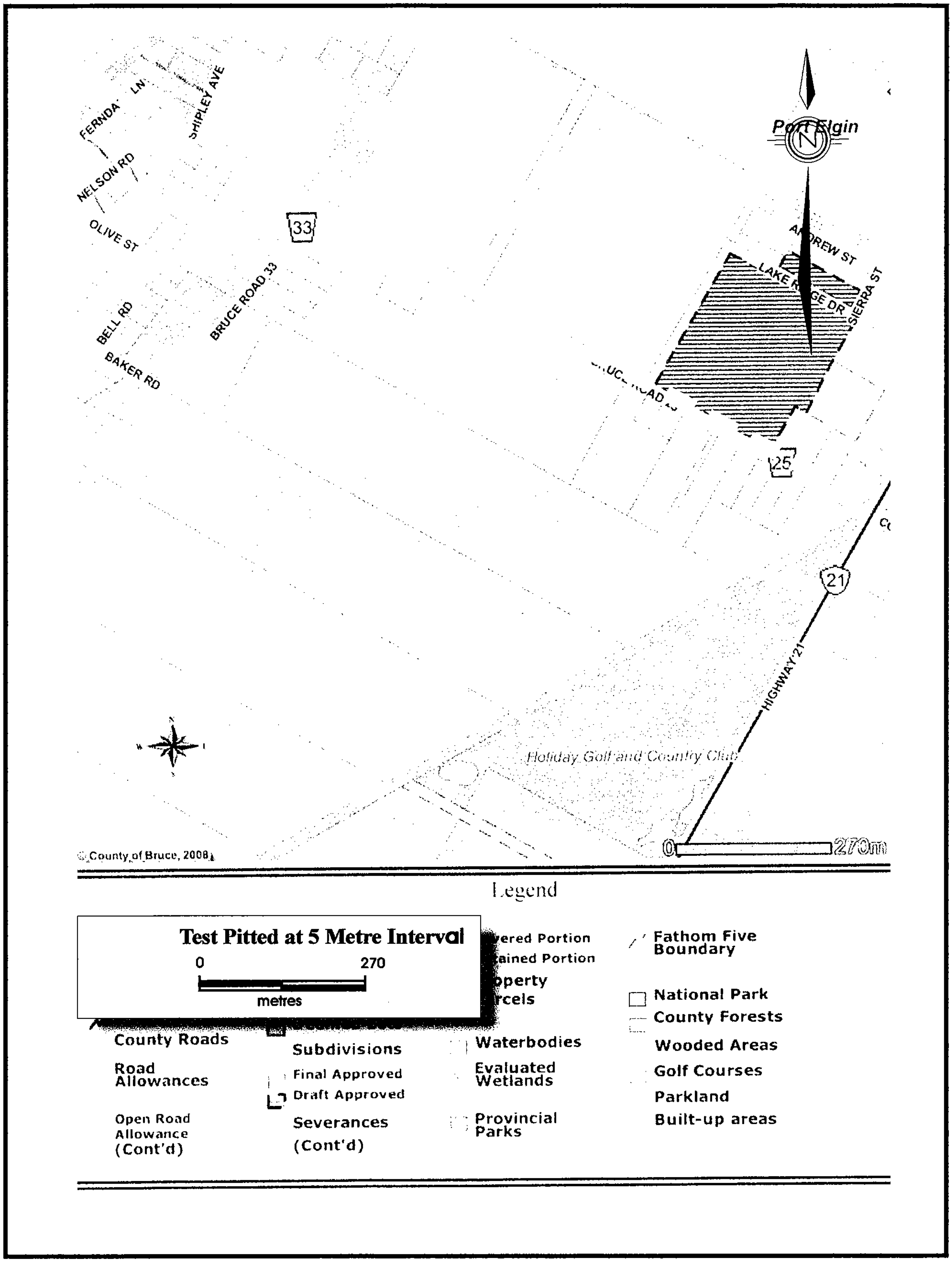
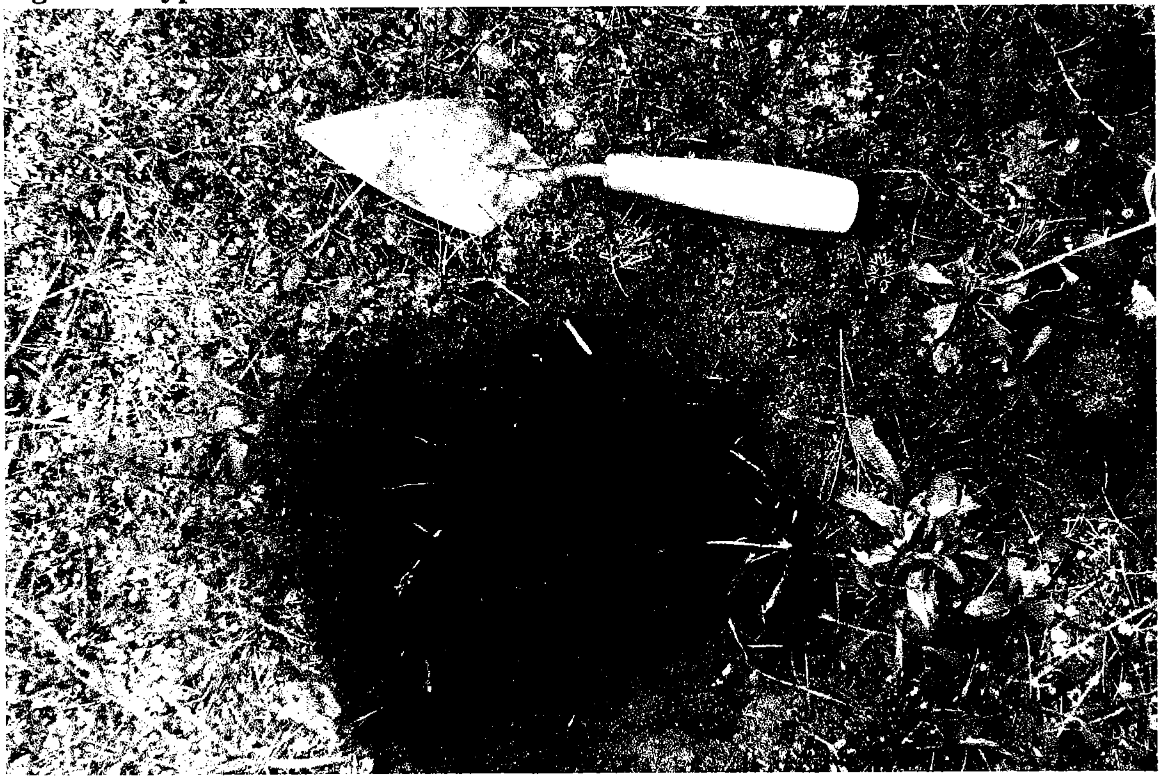


Figure 6: Crew at Work on South Side of Bruce Road 25, Facing Southeast

Figure 7: Typical Test Pit



## Stage 2 General Survey

The Stage 2 general survey employed the shovel test pit method at a five-metre interval across the entire 1.2 kilometre study area. Each test pit was 30 centimetres in diameter and was dug to subsoil, which varied from 15 to 35 centimetres below the surface. All soil was screened through 6-millimetre mesh to maximize the potential for artifact recovery. Any artifacts recovered triggered an intensified survey through additional test pits excavated at the cardinal positions around the original test pit. Appropriate photographic documentation was taken and all test pits were backfilled upon completion. Permission was received to enter on the property and to remove artifacts as necessary. This survey was conducted July 24th, 2008. Weather conditions were warm and sunny.

### Results

No artifacts were encountered during the Stage 2 general survey and no further archaeological assessment is recommended.

## RECOMMENDATIONS

The following recommendations are provided for consideration by Gamsby and Mannerow Limited and by the Ministry of Culture:

1. Additional assessment or mitigative measures are not warranted because no significant archaeological resources were found at these sites. The Ministry of Culture is requested to issue a letter concurring with these recommendations.

2. Although every reasonable effort was made to locate all archaeological resources, it is possible that some remain to be discovered within the study area. Should deeply buried archaeological material be found during construction, the Ministry of Culture in London (519-675-7742) and Mayer Heritage Consultants Inc. in London (519-652-1818 or 800-465-9990) should be immediately notified.

3. As on virtually any property in southern Ontario, it is possible that Aboriginal or Euro-Canadian burials could be present within the study area. In the event that human remains are encountered during construction, the proponent should immediately contact both the Ministry of Culture, and the Cemeteries Regulation Unit of the Ontario Ministry of Consumer and Commercial Relations in Toronto (416-326-8392), as well as the appropriate municipal police, the local coroner, and Mayer Heritage Consultants Inc.

5. The licensee shall keep in safekeeping all artifacts and records of archaeological fieldwork carried out under this licence, except where those artifacts and records are transferred to by the licensee to Her Majesty the Queen in right of Ontario or the licensee is directed to deposit them in a public institution in accordance with subsection 66(1) of the Act.

## References Cited and Consulted

Belden, H. and Co.
1880 *Illustrated Atlas of the County of Bruce*. Reprinted 1970, Ross Cumming, Port Elgin, Ontario.

Chapman, Lyman John and Donald F. Putnam
1984 The Physiography of Southern Ontario (Third Edition). *Ontario Geological Survey Special Volume 2*. Ontario Ministry of Natural Resources, Toronto.

Ellis, Chris & Neal Ferris
1990 The Archaeology of Southern Ontario to A.D. 1650. *Occasional Publication No. 5*. London Chapter, Ontario Archaeological Society Inc.

Government of Ontario
1990 *The Heritage Act, R.S.O. 1990*. Queen's Printer, Toronto.

1990 *The Planning Act, R.S.O. 1990*. Queen's Printer, Toronto.

1993 *Archaeological Assessment Technical Guidelines*. Ministry of Tourism, Culture, and Recreation.

1997 *Primer on Archaeology, Land Use Planning and Development in Ontario.* Ontario Ministry of Tourism, Culture and Recreation.

von Bitter, Robert
2008 E-mail transmission from the Ministry of Culture Archaeological Data Co-ordinator regarding registered archaeological sites within 2,000 metres of the study area.

Weiler, John
1980 *Guidelines on the Man-Made Heritage Component of Environmental Assessments.* Ontario Ministry of Culture and Recreation, Toronto.

Wright James V.
1968 *Ontario Prehistory: an eleven thousand-year archaeological outline*. Archaeological Survey of Canada, National Museums of Canada, Ottawa.

Clear Form Print Form

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
Bruce Road 25 - Goderich Street to Bruce Street

Project or Property Location (upper and lower or single tier municipality)
Town of Saugeen Shores

Proponent Name
County of Bruce

Proponent Contact Information
Kerri Meier

## 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)

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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

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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.

# APPENDIX F:
# NATURAL ENVIRONMENT

AWS

**AWS Environmental Consulting Inc.**
**(Operating as Aquatic and Wildlife Services)**
**242090 Concession Rd. 3 Keppel,**
**R.R. # 1, Shallow Lake, Ontario, Canada, N0H 2K0**

**Office: 519-372-2303, Email: aws@gbtel.ca**
**Web site: www.awsenvironmental.ca**

August 1, 2019

GM BluePlan Engineering Limited
1260-2nd Avenue East
Owen Sound, ON
N4K 2J3

Att: John Slocombe, P. Eng.

Re: Species-At-Risk (SAR) Survey
Bruce County Road 25 Upgrade: Eastern Portion and Hwy 21 Intersection Area
Class Environmental Assessment Process/Reporting: Municipal Infrastructure Project

Dear Mr. Slocombe

This letter report represents the 'Species-At-Risk' (SAR) survey works along the Eastern Portion of Bruce County Road 25, from its intersection at Highway 21 westerly to the 2017 SAR study lands point. To aid in addressing environmental concerns under the Municipal Class Environmental Assessment process, this 'Species-At-Risk' survey, review and impact assessment has been completed in support of that process.

## 1. Introduction

The County of Bruce Highway's department began a review in 2010 for proposed municipal infrastructure works to address drainage and road upgrades to Bruce Road 25, from Highway 21 westerly to Lake Huron. Environmental study works have been ongoing since 2010, following a proposed 'Study-Phasing' for road upgrades, intersection upgrades and hydrology/drainage upgrades. This report reflects the 'eastern' portion to Bruce Road 25 delineated as the road allowance lands fronting portions of Lot 30 and 31, Lake Range in the Geographic Township of Saugeen and the intersection to Highway 21. This final phase Bruce Road 25 study area is shown on the Site Location mapping of Figure 1, with delineation of the 2019 Study Lands shown on Figure 2.

In addition to the 2019 investigations, this review incorporates terrestrial flora and fauna investigations and fisheries habitat assessment of earlier natural heritage reports.

## 2. Study Methodology

Two on-site field investigations were undertaken by AWS Environmental Consulting Inc (AWS) within the subject Study Lands on:

- June 7
  - Survey Time between 0635 to 0655
  - Air temp =12 C, Wind Speed = 7-10 km's/hr, Cloud cover = 10%
  - Breeding Bird survey, Cavity Tree search

- June 22
  - Survey Time between 0730 to 0830
  - Air temp =15 C, Wind Speed = 7-10 km's/hr, Cloud cover = 35%
  - Breeding Bird survey, General Flora & Fauna

Breeding bird surveys followed Bird Studies Canada point count protocols for both survey dates. Roadside vegetation was surveyed for at-risk species and larger trees were assessed for cavities or potential bat roosting habitat. The Study Lands are highly disturbed or altered from past development with adjacent residential dwellings, commercial building or active agricultural cash cropping abutting Bruce Rd 25. The study lands were dominated with grasses and weeds, primarily non-native species, with a few scattered roadside and property line trees.

The abutting private lands were not accessible, though given the open country, roadside observations of local surrounding fauna and flora was undertaken and deemed sufficient for this SAR investigation, as no off-site environmental impacts are anticipated from road upgrade works.

## 3. Background Review

### i. Natural Heritage Features

Figure No. 3, sourced from the Ministry of Natural Resources and Forestry web site, shows no significant Natural Heritage features within the 2019 Study Lands or within 120m to the Study Lands. As such, with low habitat diversity, disturbed lands and no identified significant heritage features on-site, from an impact assessment review concern, the potential for presence or on-site habitat use by SAR within the Study Lands would be considered low to negligible.

### ii. Historical Records

Provided below is a review of noted SAR records within 5 km's to the Study Lands, with provincial habitat criteria, on-site habitat characterization and impact assessment potential provided for each.

- Butternut (_Juglans Cinerea_)
  - Provincial Ranking = S2, Provincial Status = Endangered
  - Last recorded in search coverage area, 2008
  - Provincial Habitat Description: *Butternut usually grows alone or in small groups in deciduous forests. It prefers moist, well-drained soil and is often found along streams. It is also found on well-drained gravel sites and rarely on dry rocky soil.*

  *This species does not do well in the shade, and often grows in sunny openings and near forest edges*.
  - Pockets of scattered suitable habitat were noted within the Study Lands however; on-site flora investigation of 2019 did not identify this species within the Study Lands or within the adjacent lands.
  - No negative impacts from proposed road upgrade works are anticipated.

- Small White Lady's Slipper (*Cypripedium candidum*)
  - Provincial Ranking = S1, Provincial Status= Endangered
  - Last recorded in search coverage area, 1903
  - Provincial Habitat Description: *dry to mesic prairies, marshes, marl fens, and wet grassy meadows*
  - No suitable habitat identified within the Study Lands and on-site flora investigation of 2019 did not identify this species within the Study Lands or within adjacent lands.
  - No negative impacts from proposed road upgrade works are anticipated.

- Bobolink (*Dolichonyx oryzivorus*)
  - Provincial Ranking = S4B, Provincial Status = Threatened
  - Last recorded in the search area 2005
  - Provincial Habitat Description*: large, open expansive grasslands with dense ground cover; hayfields, meadows or fallow fields; marshes; requires tracts of grassland >50 ha*
  - No suitable habitat was identified within the Study Lands, adjacent farm fields could provide suitable habitat depending on the annual crop planting. Detailed investigative works for the Bruce Road 33 Realignment report in 2017 did not identify Bobolink within that study area or its immediate adjacent lands.
  - No negative impacts to the breeding population of Bobolink from proposed road upgrade works are anticipated.

- Eastern Meadowlark (*Sturnella magna*)
  - Provincial Ranking = S4B Provincial Status = Threatened
  - Last recorded in the search area 2002
  - Provincial Habitat Description*: open, grassy meadows, farmland, pastures, hayfields or grasslands with elevated singing perches; cultivated land and weedy areas with trees; old orchards with adjacent, open grassy areas >10 ha in size*
  - No suitable habitat was identified within the Study Lands, adjacent farm fields could provide suitable habitat depending on the annual crop planting. Detailed investigative works for the Bruce Road 33 Realignment report in 2017 did not identify Eastern Meadowlark within that study area or its immediate adjacent lands.
  - No negative impacts to the breeding population of Eastern Meadowlark from proposed road upgrade works are anticipated.

- Gypsy Cuckoo Bumble Bee (*Bombus bohemicus)*
  - Provincial Ranking = S1S2, Provincial Status = Endangered
  - Last recorded in the search area 1993
  - Provincial Habitat Description: *occurs in diverse habitats such as open meadows, agricultural and urban areas, boreal forest and woodlands. In Ontario, the Gypsy Cuckoo Bumble Bee was historically found throughout most of the province; however in recent years it is known only to occur in Pinery Provincial Park.*

  - Suitable habitat identified within the Study Lands. Considered to be low risk given current documented population range area is 100 km's south. This is a parasitic bee species which takes over colonies of other bee species. No bumble bee colonies were observed within the Study Lands.
  - Vegetation clearing should be avoided during the active spring and summer nectar gathering period.

- Bank Swallow (*Riparia ripario*)
  - Provincial Ranking = S4, Provincial Status = Threatened
  - Last recorded in the search area 1999
  - Provincial Habitat Description: *Bank swallows nest in burrows in natural and human-made settings where there are vertical faces in silt and sand deposits. Many nests are on banks of rivers and lakes, but they are also found in active sand and gravel pits or former ones where the banks remain suitable. The birds breed in colonies ranging from several to a few thousand pairs*.
  - No suitable habitat was identified within the Study Lands.
  - No negative impacts to the breeding population of Bank Swallow from proposed road upgrade works are anticipated.

In addition to the noted six SAR there were 11 other unregulated species of provincial concern however; under the Class EA process Municipal Infrastructure works are exempt from natural heritage policies. As a precautionary approach only a brief review and professional opinion of these the 4 fauna and 7 flora in relation to the proposed site works, is provided below:

- Northern Map Turtle (*Graptemys geographica*): No suitable significant habitat identified on-site, 2019 fauna investigations did not record this species. No negative impacts anticipated from proposed road upgrade works.

- Snapping Turtle (*Chelydra serpentine*): No suitable significant habitat identified on-site, 2019 fauna investigations did not record this species. No negative impacts anticipated from proposed road upgrade works.

- Dwarf Lake Iris (*Iris lacustris*): No suitable habitat identified on-site, 2019 flora investigations did not record this species. No negative impacts anticipated from proposed road upgrade works.

- Eastern Ribbonsnake (*Thamnophis sauritus*): No suitable habitat identified on-site, 2019 fauna investigations did not record this species. No negative impacts anticipated from proposed road upgrade works.

- Eastern Milksnake (*Lampropeltis triangulum*): Patches of minor suitable habitat identified on-site, 2019 fauna investigations did not record this species. No negative impacts anticipated from proposed road upgrade works.

- Tuberous Indian-plantain (*Astragalus neglectus*) : No suitable habitat identified on-site, 2019 flora investigations did not record this species. No negative impacts anticipated from proposed road upgrade works.

- Great Lakes Sandreed (*Sporobolus rigidus varimagnus*): No suitable habitat identified on-site, 2019 flora investigations did not record this species. No negative impacts anticipated from proposed road upgrade works.

- Beaked Spikerush (*Eleocharis rostellata*): No suitable habitat identified on-site, 2019 flora investigations did not record this species. No negative impacts anticipated from proposed road upgrade works.

- Stiff Gentian (*Gentianella Quinquefolia*): No suitable habitat identified on-site, 2019 flora investigations did not record this species. No negative impacts anticipated from proposed road upgrade works.

- Low Nutrush (*Scleria verticillata*): No suitable habitat identified on-site, 2019 flora investigations did not record this species. No negative impacts anticipated from proposed road upgrade works.

- Neglected Milk-vetch (*Astragalus neglectus*): No suitable habitat identified on-site, 2019 flora investigations did not record this species. No negative impacts anticipated from proposed road upgrade works.

## 4. 2019 Flora and Fauna Findings

### Flora

No Butternut or any flora species of conservation concern were identified within the Study Lands. The road allowance ditch, field and property lines edges were primarily in grasses with patches of weeds (dominated by non- native species) and scattered common Deciduous and Conifer trees.

### Fauna

No identifiable SAR bird habitat was observed within the Study Lands. No standing snags or large diameter trees with cavities were observed within the Study Lands which could support SAR bat roosting habitat. Common migratory bird species were observed foraging and rearing young within some of the roadside trees/shrubs to the Study Lands.

### Hydrology

No natural watercourses are present within the Study Lands. Roadside ditching provides intermittent surface flows for drainage works.

No natural surface water impoundments for ephemeral or vernal ponds or wetlands are present within the Study Lands. As such, other than seasonal roadside drainage, no natural hydrology functions or features shall be negatively impacts from the proposed road upgrade works.

## 5. Impact Assessment

Though background literature review and on-site investigations of 2019, it has been demonstrated that no At Risk Species occur within the Study Lands or identified functioning habitat. As such, the proposed road construction activities would be in compliance with the Provincial Endangered Species Act and the Federal Species At Risk Act.

## 6. Recommended Mitigation

Tree cutting activities should not be carried out during the active woodland and grassland nesting and rearing period for terrestrial based birds, in accordance to the Federal Migratory Birds Act. Additionally vegetation removal should not occur during the overlapping spring& summer season of nectar gathering period for bumble bees to minimize any negative impacts from road upgrade works, thus it is recommended that:

> No tree or shrub felling should occur from April 1st to August 31st in accordance to the Federal Migratory Birds Act, without further detailed investigation by a qualified person for nesting activity protection measures during the active nesting/rearing period.

Respectfully Submitted

John Morton, President
AWS Environmental Consulting Inc.

cc Bruce County Highway Department

**Attachments**

- Figure 1: Site location
- Figure 2: Study Lands, 2019
- Figure 3: Provincial Features
- Figure 4: County Official Plan-Documented Natural Heritage Constraints
- Figure 5: Town of Saugeen Shores Official Plan-Documented Natural Heritage Constraints & Overlays
- Figure 6: Adjacent Environmental Study Lands, Phasing Report Aspects to Area Road Upgrades

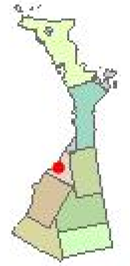
County of Bruce

# Figure 1 : Study Lands Location, East End of Bruce Road 25

1: 10,000

0.5 0 0.25 0.5 Kilometers

NAD_1983_UTM_Zone_17N



Legend

- Provincial Highway
- County Road
- Watercourse
  - Permanent Stream
  - Intermittent Stream

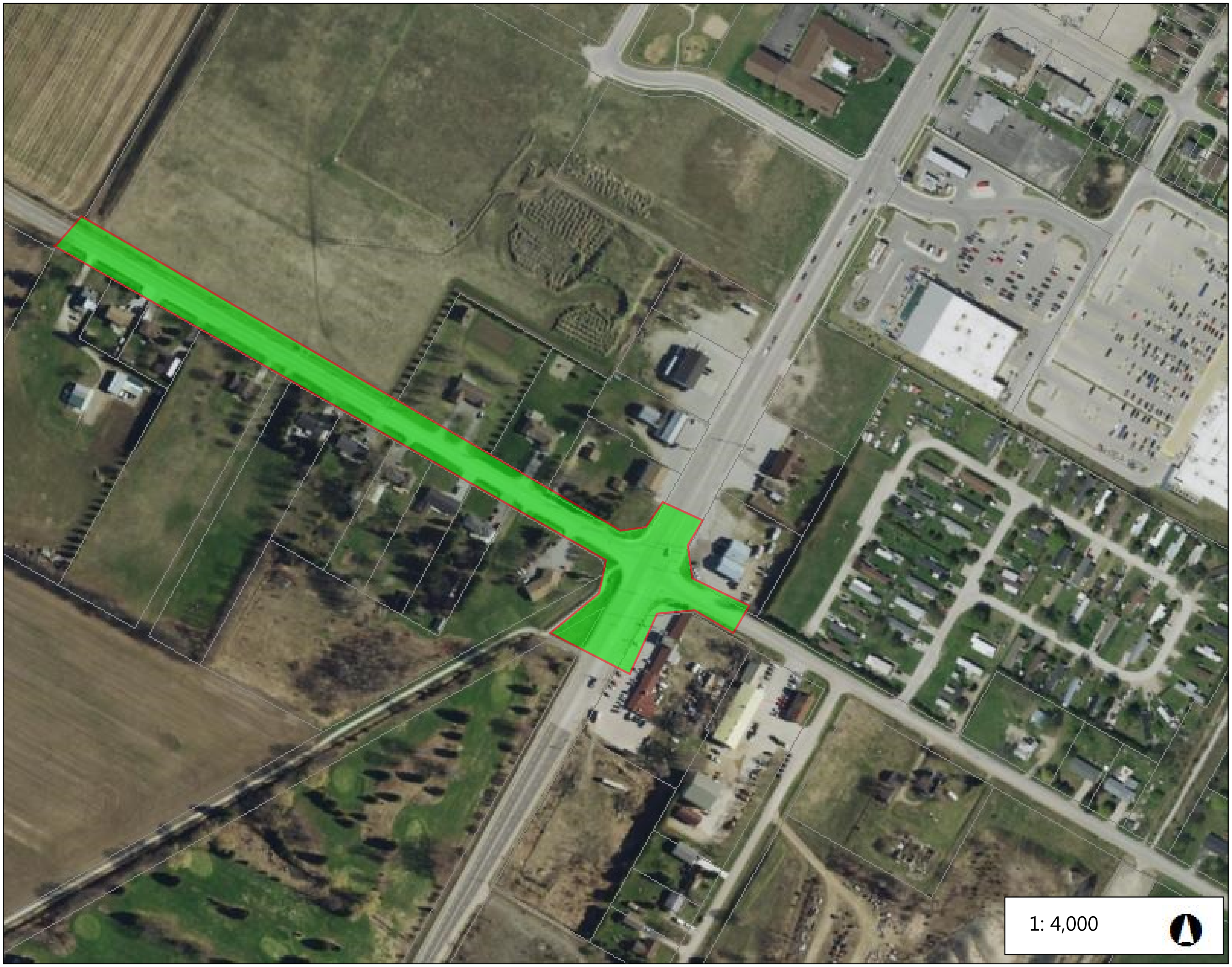
🟩 Study Lands:
East end of Bruce Rd 25

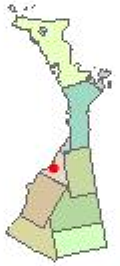
Notes

Road Allowance to
Part Lots 30 & 31
Lake Range, Saugeen

County of Bruce

## Figure 2: Study Lands





Legend

🟩 Study Lands;
Road Allowance Lands
Along East End of
Bruce Road 25

Notes

Part Lots 30 & 31
Lake Range, Saugeen

0.2 0 0.10 0.2 Kilometers

NAD_1983_UTM_Zone_17N

**Ontario** **Ministry of Natural Resources and Forestry**
Make-a-Map: Natural Heritage Areas

# Figure 3: Provincial Features

**Notes:** East end of Bruce Road 25
Part Lots 30 & 31
Lake Range, Saugeen

0.7 0 0.33 0.7 Kilometers

This map should not be relied on as a precise indicator of routes or locations, nor as a guide to navigation. The Ontario Ministry of Natural Resources and Forestry(OMNRF) shall not be liable in any way for the use of, or reliance upon, this map or any information on this map.

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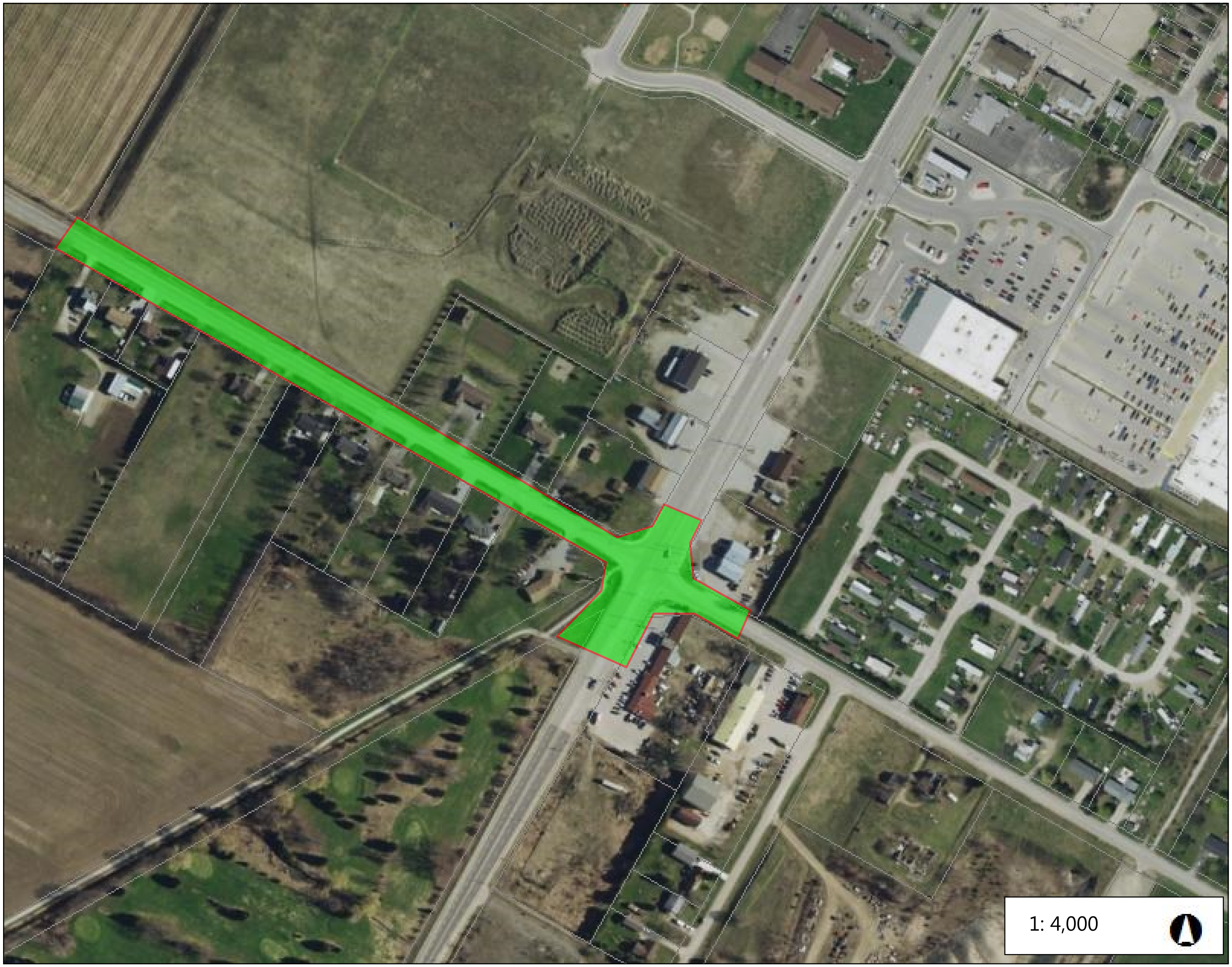
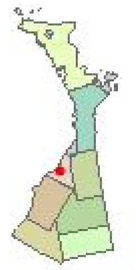
GTA 2005 / SWOOP 2006 / Simcoe-Muskoka-Dufferin © FirstBase Solutions, 2005 / 2006 / 2008

County of Bruce

# Figure 4: Bruce County Official Plan, Part Schedule 'E'
## Natural Heritage Constraints





Legend

**Wellhead Protection Area**
- 🟪 100m Buffer Zone
- 🟧 2 Year Time of Travel
- 🟫 10 Year Time of Travel
- 🟥 25 Year Time of Travel

🟨 Karst

**Significant Wetland**
- ▨ Provincially Significant Wetland
- ▨ Locally Significant Wetland

▨ Area of Natural and Scientific Interest

🟩 Study Lands

No Natural Heritage Constraints Identified within 120m to the Study Lands

Notes

Part Lots 30 & 31
Lake Range, Saugeen

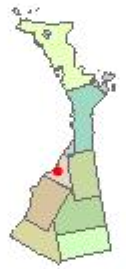
0.2 0 0.10 0.2 Kilometers

NAD_1983_UTM_Zone_17N

County of Bruce

# Figure 5: Town of Saugeen Shores Official Plan Schedule 'A' Natural Heritage Constraints-Overlays

NAD_1983_UTM_Zone_17N



Legend

- ☒ Special Policy Area Overlay
  - ⬚ Methane Buffer
  - ▨ Significant Woodland
- 🟩 Study Lands

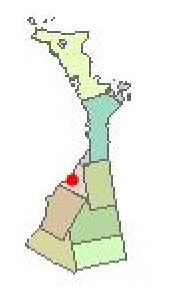
No Natural Heritage Constraints Identified within 120m to the Study Lands

Notes

Part Lots 30 & 31
Lake Range, Saugeen

County of Bruce

# Figure 6: Adjacent Environmental Study Lands, Phasing Aspects to Area Road Upgrades



Legend

- Provincial Highway
- County Road
- Watercourse
  - Permanent Stream
  - Intermittent Stream

🟩 Study Lands:
East end of Bruce Rd 25
August 2019

🟨 Study Area for
West end of Bruce Rd 25
December 2017

▨ Study Area for
North end of Bruce Rd 33
Realignment, July 2017

🟦 Study Area for
Shipley Creek and
Bruce Rd 25 Ditching:
April 2010, March 2018
and May 2019

Notes

Road Allowance to
Part Lots 30 & 31
Lake Range, Saugeen

0.5 0 0.25 0.5 Kilometers

NAD_1983_UTM_Zone_17N

GM BluePlan
ENGINEERING

PEOPLE | ENGINEERING | ENVIRONMENTS

February 25, 2020
Our File: 218428

Via Email: c.seider@waterprotection.ca

Drinking Water Source Protection
c/o Grey Sauble Conservation Authority
Risk Management Office
237897 Inglis Falls Road, RR#4
Owen Sound, ON N4K 5N6

Attention: Mr. Carl Seider

Re: Source Water Protection Consultation
Reconstruction of Bruce Road 25
Goderich Street to Bruce Street
Town of Saugeen Shores
County of Bruce

Dear Carl,

GM BluePlan Engineering has been retained by the County of Bruce, as the proponent, with the Town of Saugeen Shores, as principle partner, to undertake a Schedule 'B' Municipal Class Environmental Assessment (EA) planning process appropriately to plan the re-construction of Bruce Road 25 from the Town's planned alignment of Bruce Street (from the north) to Goderich Street. A Project File (February 2020) has been prepared to address the EA process (Municipal Engineers Association, 2015) and is available on the County and Town websites. The Project File discusses the findings, to date, of Phase 1 and, in part, Phase 2 of the Environmental Assessment process.

As a simplified summary, the project proposes the re-construction of Bruce Road 25 between Goderich Street and the future Bruce Street, where shown on the attached *Notice of Project Initiation*, and will include the installation of watermains and storm and sanitary sewer services, and the extension of an active transportation route along the north side of subject section of road. This will result in road works, potentially outside of the existing rights-of-way, including grading and paving, as well as landscaping of adjacent areas. The creation of lands that would include chemical or fuel storage are not included as part of this plan.

Based on our preliminary review, the Study Area is situated within the Saugeen Valley Source Protection Area. According to the Saugeen-Grey Sauble-Northern Bruce Peninsula Source Protection Plan, the Study Area is not situated within a wellhead protection area (WHPA) or intake protection zone (IPZ) and therefore cannot be considered a significant drinking water threat. Although it does not alter the evaluation of drinking water threats, it is recognized that the site is situated within a significant groundwater recharge area (SGRA) and a highly vulnerable aquifer (HVA), with a vulnerability score of 6.

We have reviewed the recommended Bruce Road 25 re-construction and associated activities in relation to the *Tables for Drinking Water Threats*. Based on the potential scope of the project, it not anticipated that:

i. Any project activities will be considered a prescribed drinking water threat; or
ii. Any activities will change or create new vulnerable areas.

As part of the EA process, we are reviewing the project with respect to requirements under the Clean Water Act. At this time, we are requesting confirmation of the above, as well as whether you are aware of any other potential considerations and policies in the Source Protection Plan that may apply to the project.

Should you have any questions, please feel free to contact our office.

Yours truly,

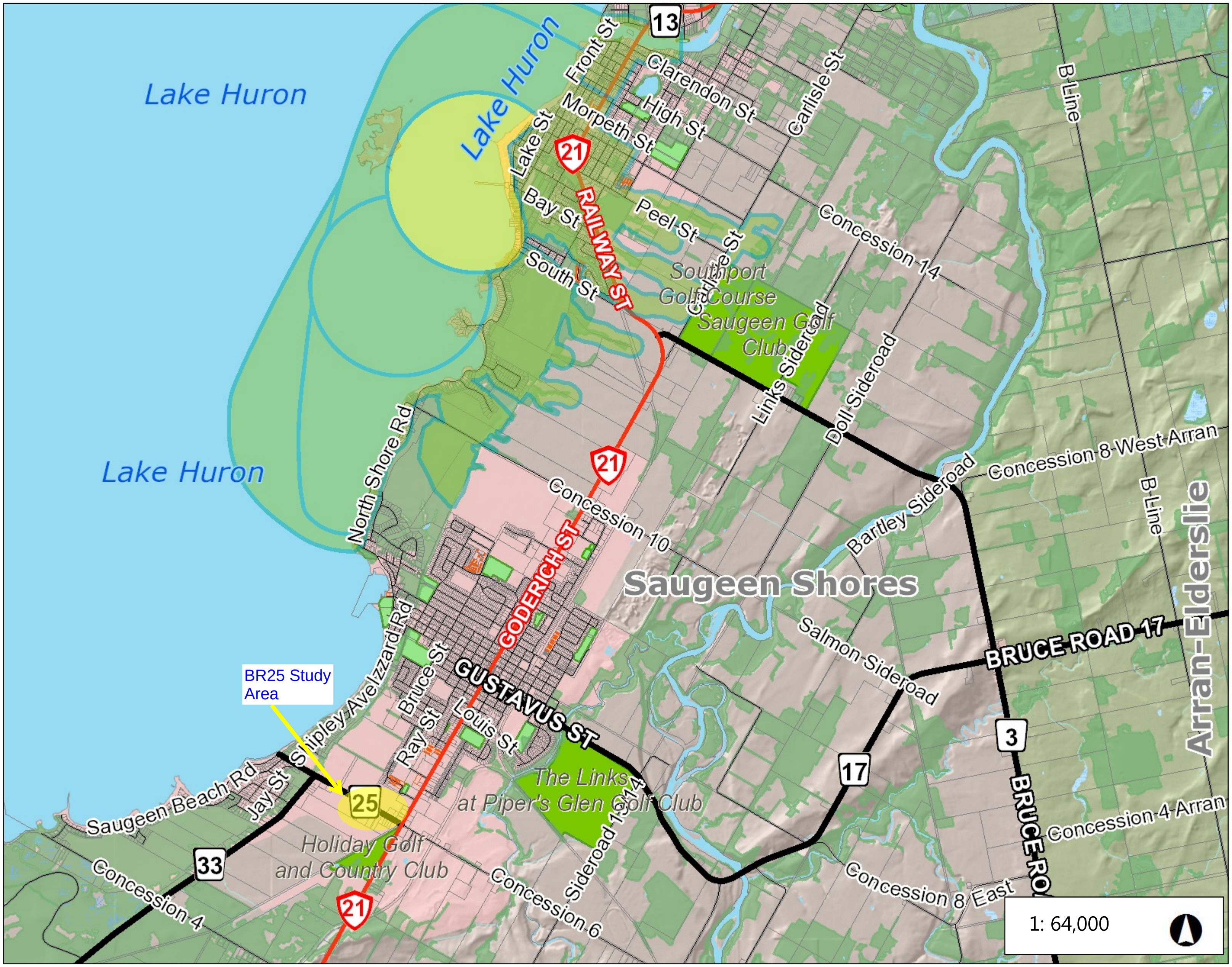
GM BLUEPLAN ENGINEERING LIMITED
Per:

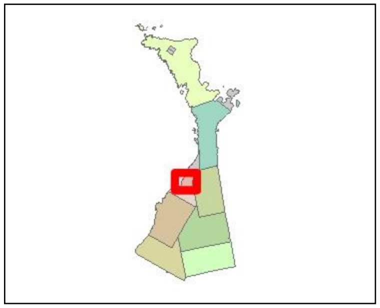
Matthew Nelson, P.Eng., P.Geo.
AN/mr

cc: County of Bruce: Jim Donohoe, via Email – jdonohoe@brucecounty.on.ca
File No. 218428

# County of Bruce

## Bruce County IPZ





Legend

Intake Protection Zone
- 🟩 4 - 5.9
- 🟨 6 - 7.9
- 🟧 8 - 9.9
- 🟥 10

Wellhead Protection Area Boui
- 🟪 Zone A - 100m Buffer
- 🟧 Zone B - 2 yr ToT
- 🟫 Zone C - 10 yr ToT
- 🟫 Zone D - 25 yr ToT

Ferry

Provincial Highway

County Road

Property Parcel
- ☐ Assessment Parcel
- ☐ Condominium Unit or Common Elei
- ☐ First Nation Parcel

🟦 Body of Water

Evaluated Wetland

Fathom Five Boundary

🟩 Fathom Five

National Park Land Tenure
- 🟩 Parks Canada Owned or Managed
- 🟩 Park Unopened Road Allowance or
- ☐ Private Land

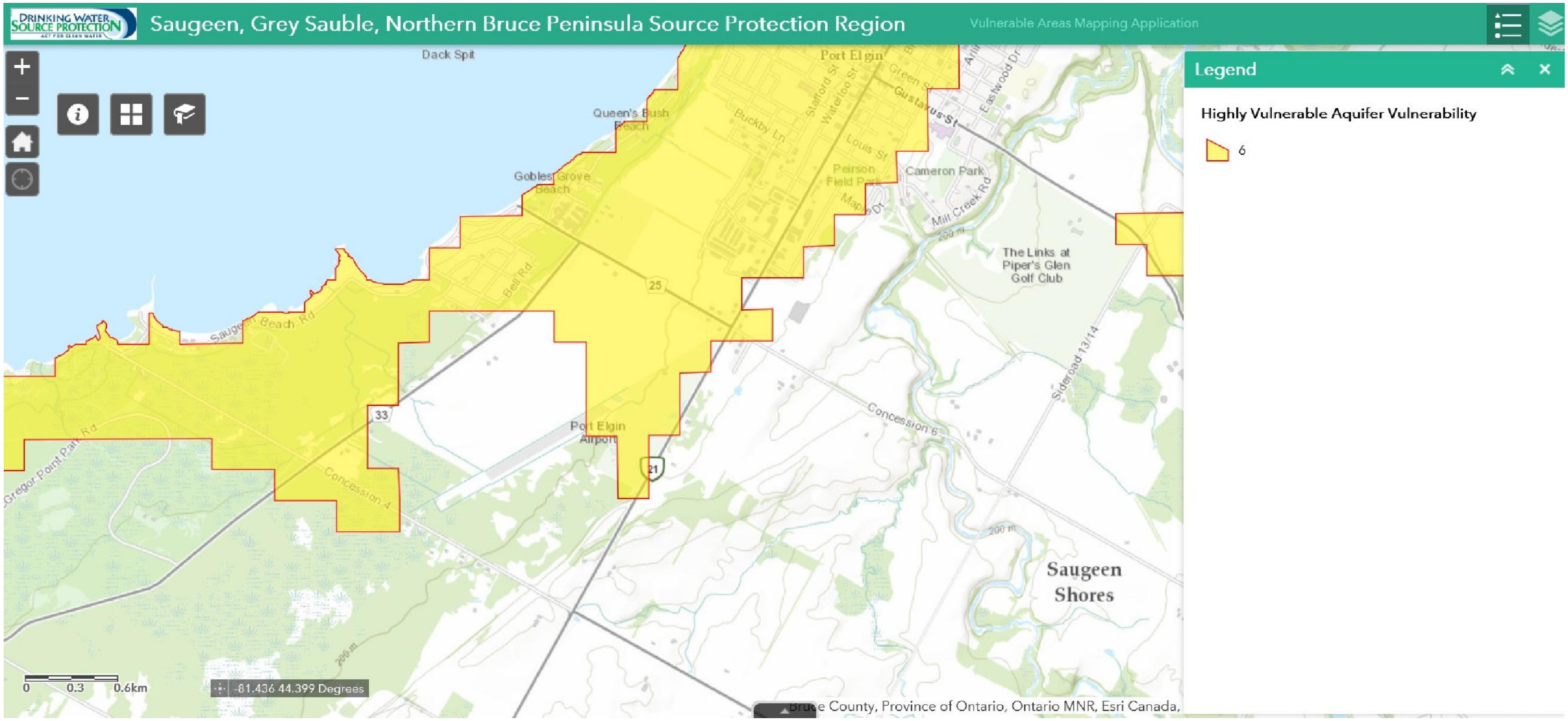
County Forest Boundary

3.3 0 1.63 3.3 Kilometers

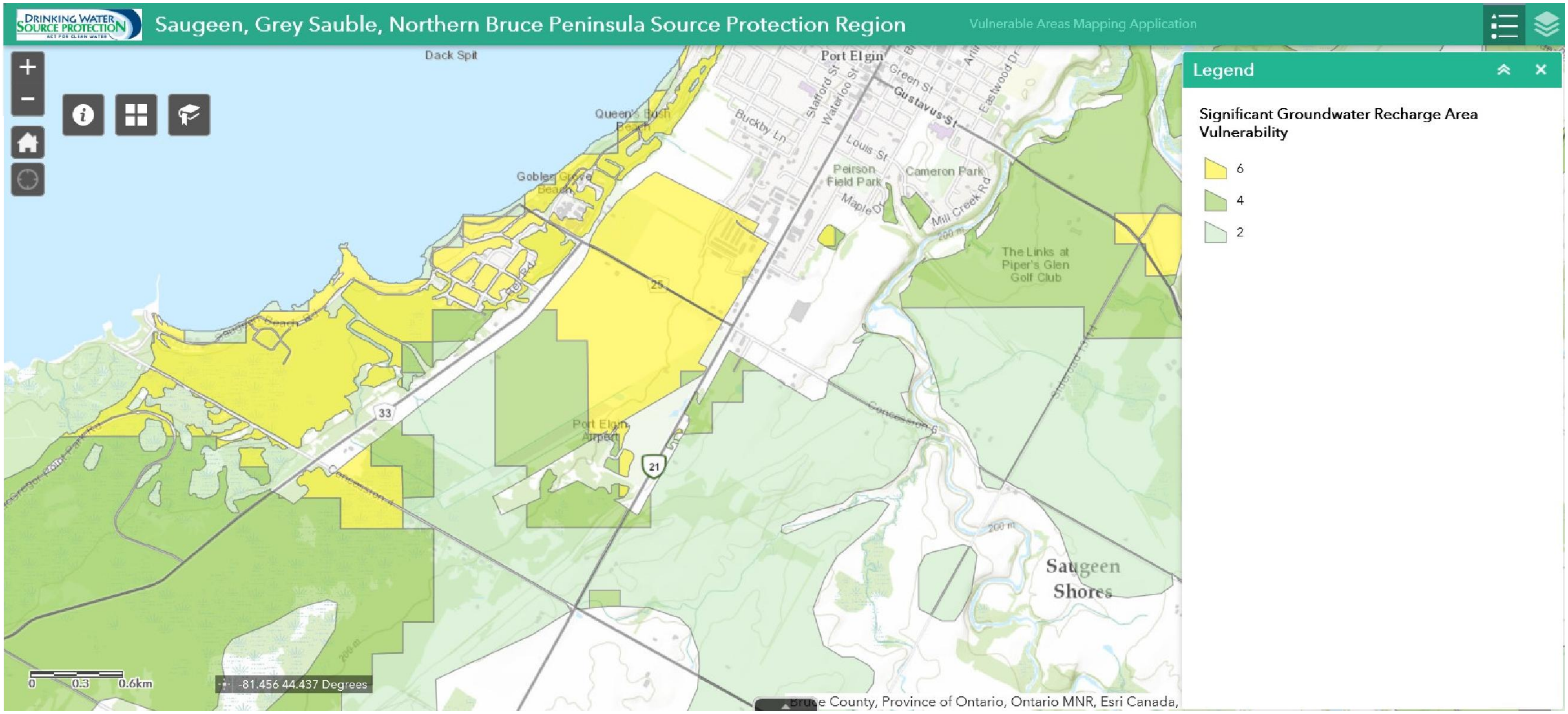
NAD_1983_UTM_Zone_17N

Notes

Intake
Protection
Zone



Drinking Water Source Protection
Saugeen, Grey Sauble, Northern Bruce Peninsula Source Protection Region
Vulnerable Areas Mapping Application
Legend
Highly Vulnerable Aquifer Vulnerability
6
Dack Spit
Port Elgin
Queen's Bush Beach
Gobles Grove Beach
Buckby Ln
Stafford St
Waterloo St
Gustavus St
Louis St
Green St
Eastwood Dr
Peirson Field Park
Cameron Park
Maple Dr
Mill Creek Rd
200 m
The Links at Piper's Glen Golf Club
Bell Rd
25
Saugeen Beach Rd
33
Port Elgin Airport
21
Concession 6
Sideroad 13/14
Gregor Point Park Rd
Concession 4
Saugeen Shores
200 m
0
0.3
0.6km
-81.436 44.399 Degrees
Bruce County, Province of Ontario, Ontario MNR, Esri Canada,



Saugeen, Grey Sauble, Northern Bruce Peninsula Source Protection Region

Vulnerable Areas Mapping Application

Legend

Significant Groundwater Recharge Area Vulnerability

🟨 6
🟩 4
▢ 2

**From:** Carl Seider <c.seider@greysauble.on.ca>
**Sent:** Wednesday, February 26, 2020 11:21 AM
**To:** Drea Nelson - GM BluePlan; Matt Nelson - GM BluePlan
**Cc:** Jim Donohoe; John Slocombe - GM BluePlan; Amanda Froese (amanda.froese@saugeenshores.ca); Kerri Meier; Miguel Pelletier; RMO Mailbox
**Subject:** RE: 218428 Bruce Road 25 Re-Construction: Notice of Project Initiation (Schedule 'B' EA)

Hi Andrea & Matthew,

Thank you for providing a copy of the Project File regarding the re-construction of Bruce Road 25.

As noted in your letter, this project does not fall within a high vulnerable source protection area (wellhead protection area or intake protection zone) where Source Protection Plan policies apply. Furthermore, the Source Protection Plan does not contain any policies directed to activities within significant groundwater recharge areas or highly vulnerable aquifers, therefore Source Protection Plan policies do not apply to the proposed Bruce Road 25 re-construction project.

Furthermore, the proposed project will not change or create new vulnerable areas, as the area is already identified as a Significant Groundwater Recharge Area (SGRA)/Highly Vulnerable Aquifer (HVA) with a vulnerability score of 6 (highest vulnerability score for this category). As noted in your letter, there are currently no Source Protection Plan policies that apply to either SGRA/HVA areas, which are deemed as moderate threat areas.

Based on the location of the project and proposed works, I can confirm that project activities are not considered a prescribed drinking water threat, and that any activities associated with the project will not change or create new vulnerable source protection areas.

If you have any questions related to this email, feel free to contact me directly.

Regards,

**Carl Seider,** Risk Management Official

**Grey Sauble Conservation**
**Risk Management Office**
237897 Inglis Falls Road, RR 4
Owen Sound, Ontario, N4K 5N6
Phone: 519-470-3000 Ext. 201
Toll Free: 877-470-3001
Fax: 519-371-0437
c.seider@greysauble.on.ca

---

**From:** Drea Nelson - GM BluePlan <Drea.Nelson@gmblueplan.ca>
**Sent:** February 25, 2020 9:55 AM
**To:** Carl Seider <c.seider@greysauble.on.ca>; Carl Seider <c.seider@greysauble.on.ca>
**Cc:** Jim Donohoe <JDonohoe@brucecounty.on.ca>; John Slocombe - GM BluePlan <John.Slocombe@gmblueplan.ca>; Amanda Froese (amanda.froese@saugeenshores.ca) <amanda.froese@saugeenshores.ca>; Kerri Meier <kmeier@brucecounty.on.ca>; Miguel Pelletier <MPelletier@brucecounty.on.ca>
**Subject:** 218428 Bruce Road 25 Re-Construction: Notice of Project Initiation (Schedule 'B' EA)

Good Morning,

Please find attached a *Notice of Project Initiation* for the Schedule 'B' Municipal Class Environmental Assessment (EA) for the re-construction of Bruce County Road 25 (BR25), as considered in the Master Plan for Bruce Roads 25 and 33 for Roads and Drainage. Documentation of the development and review of alternatives considered, including a summary of the planning and consultation process, a detailed evaluation and assessment of the alternatives and the rationale for the selection of a *Preliminary Recommended Solution*, is provided in Version 1 of the Bruce County Road 25 Re-Construction Project File, which is available for viewing purposes and can be accessed (and saved) by clicking on the link below. This link will be valid for 20 days.

https://sendafile.gmblueplan.ca/uploads/02-24-20_164752_218428_BR25_Reconstruction_Project_File_(Version_1).pdf

The County of Bruce and the Town of Saugeen Shores also have the Master Plan and the Bruce County Road 25 Re-Construction Project File posted on their websites and available at their offices for viewing purposes.

Further, in support of the EA process for this project, we are consulting you with respect to Source Water Protection. Please find enclosed correspondence describing the project that requests your comment.

Please contact Jim Donohoe, Engineering Manager, Transportation and Environmental Services (Bruce County) at the address listed on the attached *Notice of Project Initiation,* with any questions or comments regarding this project.

Best Regards,
Andrea Nelson

**Andrea Nelson, M.Sc.**
Senior Hydrogeologist / Environmental Planner

**GM BluePlan Engineering Limited**
1260-2nd Avenue East | Owen Sound ON N4K 2J3
t: 519.376.1805 ext. 2219 | c: 519.372.4678
andrea.nelson@gmblueplan.ca | www.gmblueplan.ca

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# APPENDIX G:
# TECHNICAL ENVIRONMENT

**CHUNG & VANDER DOELEN**
**ENGINEERING LTD.**

# GEOTECHNICAL INVESTIGATION
# ROAD RECONSTRUCTION/REALIGNMENT PROJECTS
# BRUCE COUNTY ROADS 25 AND 33
# SAUGEEN SHORES, ONTARIO

**Submitted to:**

GM BluePlan Engineering Limited
1260 - 2nd Avenue East
Owen Sound, Ontario
N4K 2J3

**Attention:**

Mr. John Slocombe, P. Eng.

**FILE NO** / G17496 /January 30, 2018

**CHUNG & VANDER DOELEN**
**ENGINEERING LTD.**

311 VICTORIA STREET NORTH
KITCHENER / ONTARIO / N2H 5E1
519-742-8979

January 30, 2018
**File No.:** G17496

GM BluePlan Engineering Limited
1260 - 2nd Avenue East
Owen Sound, Ontario
N4K 2J3

**Attention:** Mr. John Slocombe, P. Eng.

**Re:** **GEOTECHNICAL INVESTIGATION**
**ROAD RECONSTRUCTION/REALIGNMENT PROJECTS**
**BRUCE COUNTY ROADS 25 AND 33**
**SAUGEEN SHORES, ONTARIO**

We take pleasure in enclosing one (1) copy of our Geotechnical Investigation Report carried out at the above-mentioned location and we will be glad to discuss any questions arising from this work.

Soil samples will be retained for a period of three (3) months and will thereafter be disposed of unless we are otherwise instructed.

We thank you for giving us this opportunity to be of service to you.

Yours truly,
**CHUNG & VANDER DOELEN ENGINEERING LTD.**

Robert Vander Doelen, P. Eng.
Senior Engineer

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## 1.0 INTRODUCTION

CHUNG & VANDER DOELEN ENGINEERING LTD. (CVD) has been retained by GM BluePlan Engineering Limited (GMBP) to conduct a geotechnical investigation for the proposed reconstruction of Bruce County Road 25 and the proposed realignment of Bruce County Road 33 in the Town of Saugeen Shores, Ontario.

It is understood that Bruce County Road 25 will be reconstructed between Highway 21 and Saugeen Beach Road. Bruce County Road 33 will be realigned approximately between Baker Road and the future Bruce Street. The particulars of the project sections are as follows:

- Approximate length of the two roadway sections is 2500± m (1600± m on Bruce County Road 25 and 900± m on Bruce County Road 33)

- Bruce County Road 25 involves the installation of underground sewer and watermain servicing (storm sewer upto 1.5 m diameter) and full reconstruction of the roadway. Servicing depths will be in the order of 4 to 5 m below grade.

- Horizontal direction drilling (HDD) is expected to be utilized at the west end of the project section where a water course crossing exists

- Bruce County Road 33 will be realigned through an existing farm field approximately between Baker Road and the future Bruce Street. The future roadway profile will be raised between 0 and 1± m above existing grades and be constructed with roadside ditching. Municipal servicing (3± m deep) is planned along the new realignment from Bruce County Road 25 to 250± m south of Bruce County Road 25

The purpose of this investigation has been to determine the existing pavement structure and underlying soil and groundwater conditions. Geotechnical recommendations for the following aspects are to be provided:

- Replacement and construction of underground servicing including method of excavation, horizontal directional drilling, groundwater control, trench backfill, compaction requirements, suitability of reuse of existing granular base materials and insitu soils

- Recommendation for design and construction of a suitable flexible pavement structure

- Construction concerns including any required specification and provisions for materials and specialized construction activities, and recommendations for methods of overcoming anticipated construction problems, in particular, those relating to dewatering, classification of soils as per OHSA Reg. 213/91 and the stability of the excavations

- Estimates of percolation rates of the soils encountered between Sta 1+700 and Sta 2+300 on Bruce County Road 25 (approximately between the existing Bruce Road 33 intersection to the proposed Bruce Road 33 intersection)

- Handling of surplus soil materials. Specifically, any potential for encountering contamination during construction, as well as methodology for handling contaminated substances in accordance with current MOE regulations and guidelines, and the implications on the construction of the project will be addressed

## 2.0 FIELD AND LABORATORY WORK

The field work was conducted between November 20 and 23, 2017 and consisted of drilling and sampling twenty-five (25) boreholes extending to depths between 3.51 and 6.55 m below existing grades.

The boreholes were located in the field by CVD staff and their locations are illustrated on Drawing No. 1. The borehole locations and associated ground surface elevations at the borehole locations were surveyed and supplied to CVD by GMBP.

The field work for this project was carried out under the supervision of a member of our engineering team who logged the subsurface conditions encountered in the field, effected the subsurface sampling and testing, and monitored the groundwater conditions. Traffic control was provided during drilling operations where necessary and the underground utilities were located prior to drilling of the boreholes. A road occupancy permit was issued by the County of Bruce for the period of the field investigation program.

The boreholes were advanced to the sampling depths using a power auger drilling rig, equipped with continuous flight augers and standard soil sampling equipment. Standard penetration tests were carried out at frequent intervals of depth and the results are shown on the Borehole Log Sheets as penetration resistance or "N" values. The compactness condition or consistency of the soil strata has been inferred from these test results.

Groundwater conditions were monitored in the boreholes during and following withdrawal of the drilling augers at each borehole location. 50 mm diameter monitoring wells with flush-mount protective covers were installed at Boreholes 2, 7, 11 and 15 under the direction of the GMBP’s hydrogeologist. The groundwater levels were measured on December 5, 2017 by GMBP and provided to CVD.

Samples obtained from the in situ tests were examined in the field and subsequently taken to our laboratory for detailed description and moisture content determinations.

Additional geotechnical laboratory testing included twelve (12) gradational analyses and three (3) Standard Proctor Maximum Dry Density (SPMDD) relationship tests which were conducted on representative soil samples collected during the field work program.

Six (6) soil samples were submitted to ALS Laboratory Group of Waterloo, Ontario for analysis of metals, inorganics (including electrical conductivity and sodium adsorption ratio), petroleum hydrocarbons (PHCs F1-F4), and volatile organic compounds (VOCs). Chemical testing conducted on the soil samples was to assess the environmental quality of excess soil which may potentially be removed off-site during construction.

## 3.0 SITE CONDITION

The two (2) project sections are generally considered as two (2) urban roadways in low density residential, commercial, and agricultural land use settings. It is understood that a former fuel station existed at the northeast corner of Highway 21 and Bruce Road 25.

## 4.0 SUBSURFACE CONDITION

The conditions encountered in the boreholes are detailed on the Borehole Log Sheets, Enclosures 1 to 25 of this report. The following notes are intended to amplify and comment on the subsurface data.

The stratigraphic boundaries shown on the borehole logs are inferred from non-continuous sampling conducted during advancement of the borehole drilling procedures and, therefore, represent transitions between soil types rather than exact planes of geologic change. The subsurface conditions will vary between and beyond the borehole locations.

### 4.1 Pavement

The existing pavement structure components and their associated thicknesses were measured during the advancement of Boreholes 1 to 16 along the existing Bruce County Road 25 project section. The findings are summarized in the table below:

| Borehole No. | Asphaltic Concrete (mm) | Granular Base (mm) | Underlying Subgrade Soil Type |
|---|---|---|---|
| 1 | 110 | 590 | sand, some silt, trace gravel |
| 2 | 110 | - | silty sand fill, trace to some gravel |
| 3 | 100 | - | silty sand fill, trace gravel and clay |
| 4 | 50 | - | sand fill, trace to some silt and gravel |
| 5 | 50 | - | sand fill, trace to some silt and gravel |
| 6 | 50 | - | sand fill, some silt and gravel |
| 7 | 40 | - | sand fill, some silt, trace gravel |
| 8 | 50 | - | sand fill, some silt, some gravel |
| 9 | 50 | - | sand fill, some silt and gravel |
| 10 | 40 | - | sand fill, some silt, trace gravel |
| 11 | 50 | - | sand fill, some silt, trace gravel |
| 12 | 75 | - | sand fill, some silt and gravel |
| 13 | 50 | - | sand fill, some silt , trace to some gravel |
| 14 | 40 | - | sand fill, some silt , trace gravel |
| 15 | 100 | - | sand fill, some silt and gravel |
| 16 | 60 | 330 | sand, some silt |

A grain size distribution analysis was performed on a sample of the granular base collected from Borehole 16 beneath the surficial asphalt and the results are presented graphically on Enclosure 26 of this report. The sample failed the gradational requirements of OPSS Granular “B” Type I with 10.5% passing the #200 sieve (8% maximum is specified).

## 4.2 Fill

The pavement materials at Boreholes 2 to 15 were underlain by brown sand fill with varying percentages of silt and gravel which extended to depths between 0.5 and 2.1 m below existing grades. Four (4) grain size distribution analyses were conducted on representative samples of the sand fill collected from Boreholes 3, 6, 9 and 12 and the results are graphically presented on Enclosures 27 to 30.

Standard penetration testing in the fill at Boreholes 13 and 15 yielded “N”-values between 6 and 47 blows per 300 mm, indicating a variable loose to dense compactness condition. Natural moisture contents were measured between 6 and 13%, indicating a damp to moist moisture condition. Elevated moisture contents may be related to the presence of organics.

## 4.3 Topsoil

The ground surface at Boreholes 17 to 25 and the fill at Boreholes 2 to 11 and 13 to 15 were underlain by topsoil typically measuring between 150 and 600 mm thick.

The buried topsoil at Boreholes 2 to 11, 14 and 15 extended to depths between 0.74 and 1.8 m below existing grades. The buried topsoil (possible fill) at Borehole 13 is 1.7± m thick and extends to a depth of 3.8± m below existing grade.

Standard penetration testing in the topsoil yielded “N”-values between 6 and 25 blows per 300 mm, indicating a variable loose to compact compactness condition.

## 4.4 Native Soil Deposits

The above-described pavement and soil materials were underlain by native deposits of sand and gravel, sand, silty sand, sand and silt, silt and clayey silt. Occasional to frequent lenses/seams of silt and clayey silt were observed within the sand and silty sand deposits while occasional lenses/seams of sand were observed within the finer grained silt and clayey silt deposits. All twenty-five (25) boreholes were terminated within the various native deposits at depths between 3.51 and 6.55 m below existing grades.

Seven (7) grain size distribution analyses were conducted on representative samples of the native deposits collected from Boreholes 1, 2, 8, 12, 15, 18 and 23 and the results are graphically presented on Enclosures 31 to 37.

Standard penetration testing in the native deposits yielded “N”-values generally between 4 and 55 blows per 300 mm, indicating a variable loose to very dense compactness condition. Natural moisture contents were measured between 4 and 27%, indicating variable damp to saturated moisture conditions.

Three (3) laboratory Standard Proctor tests were conducted on bulk samples of the native deposits collected at Boreholes 5, 10 and 21 and the results are presented on Enclosures 38 to 40. The density-moisture relationship test derived maximum dry densities between 1925 and 2090 kg/m$^3$ with corresponding optimum moisture contents of 8.9 and 12.2%.

## 4.5 Groundwater Condition

Groundwater conditions were monitored during advancement of borehole augering and immediately following withdrawal of the drilling augers at each borehole location.

Water levels were measured (and estimated) at depths between 1.8± and 4.7± m below existing grades at Boreholes 1 to 20 at the time of auger withdrawal. Dry borehole cave-in above the groundwater level occurred at Boreholes 9, 10 and 13 following withdrawal of the drilling augers. Boreholes 21 to 25 remained dry and open to their full investigation depths at withdrawal of the drilling augers.

50 mm diameter monitoring wells were installed to depths between 4.4 and 6.1 m below existing grades at Boreholes 2, 7, 11 and 15 to enable measurement of groundwater levels over the long term (if required). The following table provides the water levels measured on November 23 and December 5, 2017 at the four monitoring wells.

| Location | Ground Surface Elevation (m) | Water Depth (m) | | Water Elevation (m) | |
|---|---|---|---|---|---|
| | | Nov 23, 2017 | Dec 5, 2017 | Nov 23, 2017 | Dec 5, 2017 |
| Borehole 2 | 201.80 | 4.02 | 4.34 | 197.78 | 197.46 |
| Borehole 7 | 198.75 | 3.91 | 3.93 | 194.84 | 194.82 |
| Borehole 11 | 196.06 | 4.72 | 4.72 | 191.34 | 191.34 |
| Borehole 15 | 182.20 | 1.47 | 1.46 | 180.73 | 180.74 |

It is noted that the groundwater table will fluctuate seasonally and in response to major weather events.

## 4.6 Soil Chemistry

Six (6) soil samples were submitted to ALS Laboratory Group of Waterloo, Ontario for analysis of metals, inorganics (including electrical conductivity and sodium adsorption ratio), petroleum hydrocarbons (PHCs F1-F4), and volatile organic compounds (VOCs). Chemical testing conducted on the soil samples was to assess the environmental quality of excess soil which may potentially be removed off-site during construction.

The following table presents the location, depth, description and parameters analyzed for each soil sample collected and submitted.

| Sample I.D. | Sample Depth | Sample Description | Parameters Analysed |
|---|---|---|---|
| BH1-SA2 | 0.75 to 1.22 mbeg | sand | metals, inorganics, PHCs (F1-F4), VOCs |
| BH2-SA5 | 3.05 to 3.51 mbeg | silt, some sand and clay | metals, inorganics, PHCs (F1-F4), VOCs |
| BH5-SA1 | 0.15 to 0.30 mbeg | sand fill | metals, inorganics, PHCs (F1-F4), VOCs |
| BH9-SA2 | 0.75 to 1.22 mbeg | sand | metals, inorganics, PHCs (F1-F4), VOCs |
| BH13-SA1 | 0.15 to 0.30 mbeg | sand fill | metals, inorganics, PHCs (F1-F4), VOCs |
| BH16-SA2 | 0.75 to 1.22 mbeg | sand | metals, inorganics, PHCs (F1-F4), VOCs |

The laboratory certificates of chemical analysis and results of the soil samples submitted to ALS Laboratory Group of Waterloo are enclosed in Appendix B.

## 5.0 DISCUSSION AND RECOMMENDATIONS

### 5.1 Pavement

Full roadway reconstruction will occur along the project section of Bruce County Road 25 due to underground infrastructure replacement and construction. Full roadway construction will occur along the project section of Bruce County Road 33 due to the realignment of the roadway.

### 5.1.1 Pavement Structure Consideration

The earth subgrade soil is expected to vary between clayey silt and sand with varying percentages of silt. Using tables in the Pavement Design and Rehabilitation Manual (1990), MTO Granular Base Equivalency (GBE) calculations and subgrade type obtained from the boreholes at the site, traffic loading and judgement and experience, the following flexible pavement structure is considered applicable for urban roadway sections.

| Pavement Component | Component Thickness |
|---|---|
| HL3 Surface Asphaltic Concrete<br>HL8 Binder Asphaltic Concrete | 40 mm<br>60 mm |
| Granular "A" Base Course | 150 mm |
| Granular "B" Type II Sub-base Course[2] | 450 mm |
| Pavement Thickness | 700 mm |
| **Granular Base Equivalency (GBE)**[1] | 650 mm |

**Note:**

1. GBE denotes Granular Base Equivalency which is calculated using factors of 2 for asphaltic concrete, 1 for Granular "A" base and 0.67 for Granular "B" sub-base
2. OPSS Granular "B" Type II

Longitudinal sub-drains with positive drainage outlets are recommended to be installed at the subgrade level along the edges of the roadway reconstruction to enhance the performance of the pavement. Systematic drainage of the granular base materials will promote the longevity of the pavement structure.

Elimination of the recommended sub-drains may be reviewed at the time of reconstruction and should be dependent on inspection of the exposed and underlying subgrade soil condition.

### 5.1.2 Pavement Construction

All topsoil/organic soil should be removed during preparation of the roadway subgrade if exposed at the prepared earth subgrade level or if it lies within 0.6 m of the prepared earth subgrade level. It is anticipated that a sufficient thickness of non-organic sand fill will remain over the thick buried topsoil layer at Borehole 13, however, further investigation of the vertical/lateral extent and stability of the topsoil layer is recommended.

The exposed inorganic earth subgrade should be recompacted from the surface with a minimum 10 tonne vibratory compactor to a density of no less than 95% Standard Proctor Maximum Dry Density (SPMDD) prior to placement of the Granular “B”(OPSS Granular “B” Type II). Any soft or otherwise incompactible areas detected should be removed and replaced with approved granular materials and should also be compacted to no less than 95% SPMDD.

The pavement design considers that road construction will be carried out during the drier time of the year and that the subgrade is stable, not heaving under construction equipment traffic. If the subgrade is wet or unstable, additional granular sub-base may be required.

The Granular “A” and Granular “B” (OPSS Granular “B” Type II) should be compacted to 100% SPMDD. Current testing of the existing granular base materials indicate non-compliance to the gradational requirements of OPSS Granular “B” and, therefore, are not suitable to be reused as Granular “B” sub-base materials. However, a more thorough review and additional sample testing of the existing granular base materials may reveal the potential for reuse of some portion of the existing granular base materials.

The asphaltic concrete should be placed and compacted in accordance with OPSS Form 310 and to at least 92% of the Marshall Density (MRD). Performance Grade Asphalt Cement (PGAC) 58-28 should be utilized in the hot mix asphalt.

The surface course of the asphaltic concrete should be placed at least one (1) year after base course is placed to allow minor settlements of the trench backfill to complete. The incomplete pavement structure may not be capable of supporting the anticipated traffic. Consequently, minor repairs of the sub-base, base and asphaltic concrete may be required prior to paving the surface course asphaltic concrete.

Frequent in situ density testing by this office should be carried out to verify that the specified degree of compaction is being achieved and maintained.

Vibration could be generated from various construction equipment, such as compactors and rollers which could be harmful to surrounding structures and buildings during construction. Peak Particle Velocity (PPV) of ground motion is widely accepted as the best descriptor of potential for vibration damage to structures. The safe vibration limit can be set to 10 to 20 mm/s PPV, depending on the sensitivity of surrounding structures to vibration.

Vibration monitoring can be carried out to measure the PPV of ground motion from vibration generated from typical compaction equipment at the beginning of the project in the potentially critical areas. This will set criteria and establish the type of equipment to be used for this project. It is also recommended that a pre-construction condition survey be conducted to document the condition of the existing structures within the possible zone of influence.

## 5.2 Underground Services Installation

Installation of municipal sewer and watermain servicing (storm sewer upto 1.5 m diameter) is proposed along Bruce County Road 25. Servicing depths will be in the order of 4 to 5 m below grade. Horizontal direction drilling (HDD) is expected to be utilized at the west end of the project section where a water coarse crossing exists.

Municipal servicing is also proposed along the new realignment of Bruce County Road 33 from Bruce County Road 25 to 250± m south of Bruce County Road 25. Servicing depths will be in the order of 3 m below grade.

The following table summarizes the observed groundwater elevations, the proposed deepest sewer invert elevations along Bruce County Road 25 and the 250 m northmost portion of Bruce County Road 33, and the anticipated depth of excavation below the observed groundwater table at each of the relevant boreholes drilled during the investigation.

The proposed service trench invert elevations presented in the table below assume that 300 mm of granular bedding will be provided below the future sewer service.

| Borehole | Observed Groundwater Elevation (m) | Proposed Deepest Service Trench Invert Elevation (m) | Depth of Excavation Below Observed Groundwater Table (m) |
|---|---|---|---|
| 2 | 197.78 | 198.30 | -0.52 |
| 3* | 198.45 | 197.00 | 1.45 |
| 4* | 197.31 | 196.40 | 0.91 |

| Borehole | Observed Groundwater Elevation (m) | Proposed Deepest Service Trench Invert Elevation (m) | Depth of Excavation Below Observed Groundwater Table (m) |
|---|---|---|---|
| 5* | 195.83 | 195.60 | 0.23 |
| 6* | 195.50 | 195.30 | 0.20 |
| 7 | 194.84 | 194.70 | 0.14 |
| 8* | 195.56 | 194.00 | 1.56 |
| 9* | 193.15 | 193.30 | -0.15 |
| 10* | 192.45 | 193.40 | -0.95 |
| 11 | 191.34 | 192.60 | -1.26 |
| 12* | 190.25 | 190.70 | -0.55 |
| 13* | 186.29 | 186.70 | -0.41 |
| 14* | 182.65 | 182.20 | 0.45 |
| 15 | 180.74 | 179.00 | 1.74 |
| 16* | 179.65 | 177.80 | 1.85 |
| 17* | 194.51 | 194.30 | 0.21 |
| 18* | 194.40 | 194.60 | -0.20 |
| 19* | 194.17 | 195.00 | -0.83 |

* denotes borehole without monitoring well and the groundwater elevation presented is based upon the level measured during or following completion of the borehole (i.e., measured groundwater level may not have properly stabilized and may not be accurate)

### 5.2.1 Groundwater Control

The groundwater table will be encountered during the underground servicing installation works. The groundwater levels drop from 198.0± m at Borehole 2 (near Highway 21) to 179.5± m at Borehole 16 (near Saugeen Beach Road) as well as from 194.5± m at Borehole 17 (near Bruce County Road 25) to 194.0± m at Borehole 19 (250 m south of Bruce County Road 25). It should be noted that the groundwater table can be expected to fluctuate seasonally and with major weather events.

***CVD recommends that test pits be dug during the tendering stage of the project, so that the potential contractors can examine the groundwater and soil conditions and arrive at suitable methods of excavation, groundwater control and backfilling based on their experience and plant.***

Where the exposed base subgrade and sidewall soils of the excavation are comprised of saturated granular deposits, it is recommended that groundwater be lowered and controlled to at least 0.6 m below the base of excavations to create and maintain a stable subgrade condition to facilitate pipe laying and backfilling operations, and to ensure cut slope stability.

In general, groundwater is expected to be controllable by pumping from several filtered sump pits (possibly together with intercept ditching) if the water table at the time of construction is located within 0.6 m above the required excavation level. If the water table at the time of construction is located higher than 0.6 m above the required excavation level, it is expected that pre-lowering of the groundwater table will be required prior to excavation. This may require the use of well points or other suitable means.

As the amount of groundwater to be pumped is expected to exceed 50,000 Litres/day, this pumping is considered to be a “water taking” by the Ministry of Environment and Climate Change (MOECC) and is subject to the Ministry’s “Permit To Take Water (PTTW)” requirements. In March 2016, the Ministry provided an exemption from the permitting requirements for “construction-only” water takings that do not exceed 400,000 L/day. For these modest “construction-only” water takings, the water taking must still be “registered” on the MOECC “Environmental Activity and Sector Registry (EASR)”, but nevertheless a quicker and less formal process is now available to allow pumping to proceed. In addition, the Ministry has clarified that surface water from rainfall is not included in the water quantity and there is no time limitation for these regulated water takings, although a qualified person (QP) must still evaluate the water taking for all the same environmental impact issues and then indicate this through the on-line registration procedure. For all other water takings and construction water takings exceeding 400,000 L/day, a PTTW is still required along with a 90-day review process.

A more detailed assessment by a QP is required to determine if the water taking at this site is likely to exceed 400,000 L/day (278 L/min). Thereafter, the need for either EASR registration or a PTTW can be determined.

### 5.2.2 Trenching

The excavations will generally penetrate loose to dense fill and competent native granular and cohesive soil deposits. The fill and native soil deposits will generally provide suitable subgrade support at the pipe founding levels. Any loose, unstable and/or organic soils encountered at the pipe invert should be sub-excavated and replaced with well compacted Granular "A" (or clean crushed gravel wrapped in non-woven geotextile) which should be placed in 150 mm thick layers and compacted to at least 95% Standard Proctor Maximum Dry Density (SPMDD). The support of pipes in these areas can also be achieved with non-shrinkable fill, if poor soil is encountered at the subgrade level and fully removed.

The soil materials are generally considered to be Type 3 Soils in accordance with the latest Occupational Health and Safety Act, provided that groundwater is adequately controlled by suitable means. Trenches can be cut to 1H to 1V throughout provided groundwater is being suitably controlled. Otherwise, the side slopes should be cut to 3H : 1V or flatter. The side slopes should be suitably protected from erosion processes.

The geotechnical engineer should be retained to examine and inspect cut slopes to ensure construction safety.

It may be necessary to provide support for nearby services if they are located within the influence zone of 45 degrees to the vertical.

The use of trench liner box or timber lagging can be considered to support the trench side walls and adjacent foundations, structures or utilities.

### 5.2.3 Bedding

Any unstable soils exposed at the pipe subgrade should be sub-excavated and replaced with imported Granular "A", placed in thin layers and compacted to at least 95% SPMDD, or can be removed and supported on non-shrinkable fill as previously described in Section 5.2.2.

The bedding requirements for the services should be in accordance with Ontario Provincial Standard Drawings OPSD - 802 for flexible and rigid pipes provided that the groundwater table is adequately controlled and the pipe subgrade is stable. The bedding shall be a Class "B" and consist of at least 150 mm (to a maximum of 300 mm) thick Granular "A" or clean crushed gravel wrapped in geotextile compacted to 95% SPMDD.

Clear crushed stone bedding can be used to replace Granular “A” bedding if the subgrade is unstable and saturated, and compacting the Granular “A” bedding layer is not practical. The clear crushed stone will need to be suitably densified and wrapped with a non-woven filter cloth (Terrafix 270R or equivalent) to prevent migration of fine soil particles (silt) into the crushed stone mattress and prevent the loss of subgrade support for the pipes.

Granular "A" or clean crushed gravel wrapped in geotextile should be used to backfill around the pipe to at least 150 mm above the top of the pipe. This backfill should be placed in thin layers and each layer compacted to at least 95% SPMDD. Recycled asphalt will not be allowed to be used in Granular “A” bedding material.

### 5.2.4 Backfill

In general, the excavated soils are considered suitable for reuse as trench backfill. If the excavated materials are allowed to dry too much during summer construction, judicious addition of water may be required to facilitate compaction. Mixing drier and wetter excavated soils may be feasible to arrive at a more compactable moisture content.

The backfill should be placed in thin layers, 300 mm thick or less dependant on the demonstrated success of compaction based on in-situ density test results. Other types of materials such as organic soils, overly wet soils, boulders and frozen materials (if work is carried out in the winter months) should not be used for backfilling. All backfill should be compacted to at least 95% SPMDD.

Backfilling operations should follow closely after excavation so that only a minimal length of trench slope is exposed at any one time so as to minimize potential problems. This will potentially minimize over-wetting of the subgrade material. Particular attention should be given to make sure frozen material is not used as backfill should construction extend into the winter season.

It has been our experience that excavated cohesive soils should be broken into smaller pieces (less than 150 mm diameter) before returning into the trench as backfill. This will eliminate “wedging” problems and reduce long term settlement. Particular attention must be made to backfilling the laterals where the trenches are narrow and against the manholes and catch-basins. Thinner lifts and additional compaction must be applied.

Frequent inspection by experienced geotechnical personnel should be carried out to examine and approve backfill material, to carefully inspect placement, and to verify that the specified degree of compaction has been obtained by in situ density testing.

### 5.2.5 Horizontal Directional Drilling

Horizontal directional drilling techniques are being considered to install 48 m of 750 mm diameter HDPE storm sewer and 45.5 m of 450 mm diameter HDPE storm sewer near the intersection of Bruce County Road 25 and Nelson Road.

The saturated deposit of fine sand encountered at Boreholes 14 and 15 is considered suitable for sewer installation using horizontal directional drilling methods. It should be noted that the Saugeen Shores area has been subjected to glaciation. Although not encountered during the drilling of the boreholes, cobbles or boulders could be present within the various deposits. Consequently, potential obstructions to the advancement of directional drilling may occur.

It is noted that the selection of directional drilling method(s) are normally the responsibility of the contractor.

Bentonite and/or polymer drilling mud slurry is used as a coolant, counteracting fluid pressure and lubricant in the drilling process. The slurry pressure should be controlled so as not to hydraulically fracture the soil which may result in release of slurry to the ground surface.

## 6.0 GEO-ENVIRONMENTAL CONSIDERATIONS

It is our understanding that excess soils may potentially be removed off-site during construction. CVD recommends that a soil management plan be established to manage the quantity, as well as where and how the excess soils can be disposed of off-site.

The analytical results and environmental assessment findings must be disclosed to the receiving site owner(s) and approval by the receiving site owner(s) be obtained prior to exporting/transferring the materials. It is noted that the soils condition may differ between and beyond the sampled locations. If any impacted soils are discovered during construction, CVD should be contacted for further sampling and testing to determine the limit of the impacted soils.

Transportation of excess soils from the source site to the receiving site(s) should be carried out in accordance with the MOECC document entitled “Management of Excess Soil - A Guide for Best Management Practices” dated January 2014. Additional soil sampling and analysis may be required as per the above-noted MOECC document and/or as per the requirement of the receiving site owner(s), depending on the volume of excess soil generated during construction.

Any soils identified during construction to have been environmentally impacted are to be separately stockpiled and analysed to determine the appropriate measures for handling and disposal. Waste characterization testing (TCLP) to classify the material for disposal as prescribed in Ontario Regulation 558 is required.

## 6.1 Applicable Regulatory Standards

The Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act established in accordance with the amended Ontario Regulation 153/04 (April 15, 2011) was consulted in the assessment of the soil at the project site. The analytical results were compared to the following "applicable regulatory standards":

- Table 1 (Full Depth Background Site Condition Standards) for Agricultural or Other Property Use
- Table 1 (Full Depth Background Site Condition Standards) for Residential/Institutional/Parkland/Industrial/Commercial/Community Property Use
- Table 2 (Full Depth Generic Site Condition Standards in a Potable Ground Water Condition) for Residential/Parkland/Institutional Property Use for coarse textured soil
- Table 2 (Full Depth Generic Site Condition Standards in a Potable Ground Water Condition) for Industrial/Commercial/Community Property Use for coarse textured soil

The project site exists as a public transportation corridor. Neighbouring rural properties to the site rely on groundwater as a source of potable water. The site is not located within 30 m of an area of natural significance and is not a shallow soil property. The soil results were therefore compared to the Ministry of the Environment & Climate Change (MOECC) Table 2, Full Depth Generic Site Condition Standards in a Potable Ground Water Condition for Industrial/Commercial/Community Property Use for coarse textured soil.

Table 1 for Full Depth Background Standards for Agricultural or Other Property Use and Residential/Institutional/Parkland/Industrial/Commercial/Community Use would apply for off site disposal of soil and reuse with no environmental restrictions.

## 6.2 Analytical Results and Considerations

Six (6) soil samples were submitted to ALS Laboratory Group of Waterloo, Ontario for analysis of metals, inorganics (including electrical conductivity and sodium adsorption ratio), petroleum hydrocarbons (PHCs F1-F4), and volatile organic compounds (VOCs). The chemical testing was conducted to assess the environmental quality of excess soil which may potentially be removed off-site during construction. The laboratory certificates of chemical analysis and results provided by ALS Laboratory Group of Waterloo are enclosed in Appendix B. A comparison of the soil chemistry results to the applicable regulatory standards is enclosed in Appendix C.

The SAR and EC parameter values from five (5) of the six (6) samples submitted have concentrations above Table 1 standards. The SAR values from two (2) of the six (6) samples submitted exceed Table 2 standards for Industrial/Commercial/Community Property Use. Since the elevated SAR values are related to salt use for pavement de-icing purposes, it is not considered to be an exceedance to the site regulatory standard in accordance with Regulation 153/04. The excavated soil can be removed to a similar municipally owned road site where continued de-icing salt application will likely occur. Alternatively, the excess soil may be received by a holder of an appropriate certificate of approval.

The analytical results from the soil samples selected for metals analysis indicate that all analysed metals parameters were below all four applicable regulatory standards.

The analytical results from the soil samples selected for petroleum hydrocarbons analysis (PHCs, F1-F4) indicate that four (4) of six (6) samples tested have concentrations exceeding Table 1 (Full Depth Background Site Condition Standards) for Residential/Institutional/Parkland/Industrial/Commercial/Community Property Use , however, the results were below both Table 2 standards for Residential/Parkland/Institutional Property Use and Industrial/Commercial/Community Property Use.

The analytical results from the soil samples selected for VOCs analysis indicate that all analysed parameters were below all four applicable regulatory standards.

Further sampling and testing to determine the limit of impacted soil within the project work area is recommended. Impacted soil is to be separately stockpiled and analysed to determine the appropriate measures for handling and disposal.

## 7.0 CLOSURE

The Limitations of Report, as quoted in Appendix "A", is an integral part of this report.

We trust that the information presented in this report is complete within our terms of reference. If there are any further questions concerning this report, please do not hesitate to contact our office.

Yours truly,
**CHUNG & VANDER DOELEN ENGINEERING LTD.**

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Robert Vander Doelen, P. Eng.
Senior Engineer

Eric Y. Chung, M. Eng., P. Eng.
Principal Engineer

# APPENDIX “A”

## Limitations of Report

# APPENDIX "A"

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## LIMITATIONS OF REPORT

The conclusions and recommendations given in this report are based on information determined at the testhole locations. Subsurface and groundwater conditions between and beyond the testholes may differ from those encountered at the testhole locations, and conditions may become apparent during construction which could not be detected or anticipated at the time of the site investigation. It is recommended practice that the Soils Engineer be retained during construction to confirm that the subsurface conditions throughout the site do not deviate materially from those encountered in the testholes.

The comments made in this report on potential construction problems and possible methods are intended only for the guidance of the designer. The number of testholes may not be sufficient to determine all the factors that may affect construction methods and costs. For example, the thickness of surficial topsoil or fill layers may vary markedly and unpredictably. The contractors bidding on this project or undertaking the construction should, therefore, make their own interpretation of the factual information presented and draw their own conclusion as to how the subsurface conditions may affect their work.

The benchmark and elevations mentioned in this report were obtained strictly for use in the geotechnical design of the project and by this office only, and should not be used by any other parties for any other purposes.

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. CHUNG & VANDER DOELEN ENGINEERING LIMITED accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

This report does not reflect the environmental issues or concerns unless otherwise stated in the report. The design recommendations given in this report are applicable only to the project described in the text and then only if constructed substantially in accordance with the details stated in this report. Since all details of the design may not be known, we recommend that we be retained during the final design stage to verify that the design is consistent with our recommendations, and that assumptions made in our analysis are valid.

# APPENDIX “B”

## Soil Chemistry Results

CHUNG AND VANDER DOELEN
ATTN: JOE VANDERZALM
311 VICTORIA ST. N.
KITCHENER ON N2H 5E1

Date Received: 01-DEC-17
Report Date: 30-JAN-18 07:48 (MT)
Version: FINAL REV. 2

Client Phone: 519-742-8979

# Certificate of Analysis

Lab Work Order #: L2030089
Project P.O. #: NOT SUBMITTED
Job Reference: G17496
C of C Numbers: 14-460142
Legal Site Desc:

Mary-Lynn Pike
Client Services Supervisor

L2030089-1 BH1-SA2
Sampled By: Client on 20-NOV-17
Matrix: SOIL

| Sample Details Grouping | Analyte | Result | Qualifier | D.L. | Units | Analyzed | Guideline Limits #1 | #2 | #3 | #4 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Physical Tests** | | | | | | | | | | |
| | Conductivity | 0.266 | | 0.0040 | mS/cm | 07-DEC-17 | 0.47 | 0.57 | 1.4 | 0.7 |
| | % Moisture | 16.1 | | 0.10 | % | 04-DEC-17 | | | | |
| | pH | 7.63 | | 0.10 | pH units | 05-DEC-17 | | | | |
| **Cyanides** | | | | | | | | | | |
| | Cyanide, Weak Acid Diss | <0.050 | | 0.050 | ug/g | 05-DEC-17 | 0.051 | 0.051 | 0.051 | 0.051 |
| **Saturated Paste Extractables** | | | | | | | | | | |
| | SAR | 1.78 | | 0.10 | SAR | 07-DEC-17 | *1 | 2.4 | 12 | 5 |
| | Calcium (Ca) | 9.0 | | 1.0 | mg/L | 07-DEC-17 | | | | |
| | Magnesium (Mg) | 1.5 | | 1.0 | mg/L | 07-DEC-17 | | | | |
| | Sodium (Na) | 21.9 | | 1.0 | mg/L | 07-DEC-17 | | | | |
| **Metals** | | | | | | | | | | |
| | Antimony (Sb) | <1.0 | | 1.0 | ug/g | 07-DEC-17 | 1 | 1.3 | 40 | 7.5 |
| | Arsenic (As) | 3.1 | | 1.0 | ug/g | 07-DEC-17 | 11 | 18 | 18 | 18 |
| | Barium (Ba) | 16.8 | | 1.0 | ug/g | 07-DEC-17 | 210 | 220 | 670 | 390 |
| | Beryllium (Be) | <0.50 | | 0.50 | ug/g | 07-DEC-17 | 2.5 | 2.5 | 8 | 4 |
| | Boron (B) | 5.3 | | 5.0 | ug/g | 07-DEC-17 | 36 | 36 | 120 | 120 |
| | Boron (B), Hot Water Ext. | 0.25 | | 0.10 | ug/g | 08-DEC-17 | 36 | 36 | 2 | 1.5 |
| | Cadmium (Cd) | <0.50 | | 0.50 | ug/g | 07-DEC-17 | 1 | 1.2 | 1.9 | 1.2 |
| | Chromium (Cr) | 16.0 | | 1.0 | ug/g | 07-DEC-17 | 67 | 70 | 160 | 160 |
| | Cobalt (Co) | 3.3 | | 1.0 | ug/g | 07-DEC-17 | 19 | 21 | 80 | 22 |
| | Copper (Cu) | 6.9 | | 1.0 | ug/g | 07-DEC-17 | 62 | 92 | 230 | 140 |
| | Lead (Pb) | 13.6 | | 1.0 | ug/g | 07-DEC-17 | 45 | 120 | 120 | 120 |
| | Mercury (Hg) | 0.0371 | | 0.0050 | ug/g | 07-DEC-17 | 0.16 | 0.27 | 3.9 | 0.27 |
| | Molybdenum (Mo) | <1.0 | | 1.0 | ug/g | 07-DEC-17 | 2 | 2 | 40 | 6.9 |
| | Nickel (Ni) | 6.7 | | 1.0 | ug/g | 07-DEC-17 | 37 | 82 | 270 | 100 |
| | Selenium (Se) | <1.0 | | 1.0 | ug/g | 07-DEC-17 | 1.2 | 1.5 | 5.5 | 2.4 |
| | Silver (Ag) | <0.20 | | 0.20 | ug/g | 07-DEC-17 | 0.5 | 0.5 | 40 | 20 |
| | Thallium (Tl) | <0.50 | | 0.50 | ug/g | 07-DEC-17 | 1 | 1 | 3.3 | 1 |
| | Uranium (U) | <1.0 | | 1.0 | ug/g | 07-DEC-17 | 1.9 | 2.5 | 33 | 23 |
| | Vanadium (V) | 27.9 | | 1.0 | ug/g | 07-DEC-17 | 86 | 86 | 86 | 86 |
| | Zinc (Zn) | 29.2 | | 5.0 | ug/g | 07-DEC-17 | 290 | 290 | 340 | 340 |
| **Speciated Metals** | | | | | | | | | | |
| | Chromium, Hexavalent | 0.21 | | 0.20 | ug/g | 07-DEC-17 | 0.66 | 0.66 | 8 | 8 |
| **Volatile Organic Compounds** | | | | | | | | | | |
| | Acetone | <0.50 | VOCJ | 0.50 | ug/g | 06-DEC-17 | 0.5 | 0.5 | 16 | 16 |
| | Benzene | <0.0068 | VOCJ | 0.0068 | ug/g | 06-DEC-17 | 0.02 | 0.02 | 0.32 | 0.21 |
| | Bromodichloromethane | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 1.5 | 1.5 |
| | Bromoform | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 0.61 | 0.27 |
| | Bromomethane | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 0.05 | 0.05 |
| | Carbon tetrachloride | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 0.21 | 0.05 |
| | Chlorobenzene | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 2.4 | 2.4 |
| | Dibromochloromethane | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 2.3 | 2.3 |
| | Chloroform | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 0.47 | 0.05 |
| | 1,2-Dibromoethane | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 0.05 | 0.05 |
| | 1,2-Dichlorobenzene | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 1.2 | 1.2 |

** Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
* Analytical result for this parameter exceeds Guideline Limit listed on this report. Guideline Limits applied:

**Ontario Regulation 153/04 - April 15, 2011 Standards = [Suite] - ON-511-T1/T2-SOIL-AG+RPIICC/RPI-ICC-C**

**#1: T1-Soil-Agricultural or Other Property Use**
**#2: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use**
**#3: T2-Soil-Ind/Com/Commu Property Use (Coarse)**
**#4: T2-Soil-Res/Park/Inst. Property Use (Coarse)**

# ANALYTICAL GUIDELINE REPORT

G17496

L2030089-1 BH1-SA2
Sampled By: Client on 20-NOV-17
Matrix: SOIL

| Sample Details Grouping | Analyte | Result | Qualifier | D.L. | Units | Analyzed | Guideline Limits #1 | #2 | #3 | #4 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Volatile Organic Compounds** | | | | | | | | | | |
| | 1,3-Dichlorobenzene | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 9.6 | 4.8 |
| | 1,4-Dichlorobenzene | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 0.2 | 0.083 |
| | Dichlorodifluoromethane | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 16 | 16 |
| | 1,1-Dichloroethane | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 0.47 | 0.47 |
| | 1,2-Dichloroethane | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 0.05 | 0.05 |
| | 1,1-Dichloroethylene | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 0.064 | 0.05 |
| | cis-1,2-Dichloroethylene | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 1.9 | 1.9 |
| | trans-1,2-Dichloroethylene | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 1.3 | 0.084 |
| | Methylene Chloride | <1.0 | RRR | 1.0 | ug/g | 06-DEC-17 | **0.05 | **0.05 | 1.6 | **0.1 |
| | 1,2-Dichloropropane | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 0.16 | 0.05 |
| | cis-1,3-Dichloropropene | <0.030 | VOCJ | 0.030 | ug/g | 06-DEC-17 | | | | |
| | trans-1,3-Dichloropropene | <0.030 | VOCJ | 0.030 | ug/g | 06-DEC-17 | | | | |
| | 1,3-Dichloropropene (cis & trans) | <0.042 | | 0.042 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 0.059 | 0.05 |
| | Ethylbenzene | <0.018 | VOCJ | 0.018 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 1.1 | 1.1 |
| | n-Hexane | <0.10 | RRR | 0.10 | ug/g | 06-DEC-17 | **0.05 | **0.05 | 46 | 2.8 |
| | Methyl Ethyl Ketone | <0.50 | VOCJ | 0.50 | ug/g | 06-DEC-17 | 0.5 | 0.5 | 70 | 16 |
| | Methyl Isobutyl Ketone | <0.50 | VOCJ | 0.50 | ug/g | 06-DEC-17 | 0.5 | 0.5 | 31 | 1.7 |
| | MTBE | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 1.6 | 0.75 |
| | Styrene | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 34 | 0.7 |
| | 1,1,1,2-Tetrachloroethane | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 0.087 | 0.058 |
| | 1,1,2,2-Tetrachloroethane | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 0.05 | 0.05 |
| | Tetrachloroethylene | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 1.9 | 0.28 |
| | Toluene | <0.080 | VOCJ | 0.080 | ug/g | 06-DEC-17 | 0.2 | 0.2 | 6.4 | 2.3 |
| | 1,1,1-Trichloroethane | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 6.1 | 0.38 |
| | 1,1,2-Trichloroethane | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 0.05 | 0.05 |
| | Trichloroethylene | <0.010 | VOCJ | 0.010 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 0.55 | 0.061 |
| | Trichlorofluoromethane | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.25 | 4 | 4 |
| | Vinyl chloride | <0.020 | VOCJ | 0.020 | ug/g | 06-DEC-17 | 0.02 | 0.02 | 0.032 | 0.02 |
| | o-Xylene | <0.020 | VOCJ | 0.020 | ug/g | 06-DEC-17 | | | | |
| | m+p-Xylenes | <0.030 | VOCJ | 0.030 | ug/g | 06-DEC-17 | | | | |
| | Xylenes (Total) | <0.050 | | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 26 | 3.1 |
| | Surrogate: 4-Bromofluorobenzene | 103.4 | | 50-140 | % | 06-DEC-17 | | | | |
| | Surrogate: 1,4-Difluorobenzene | 105.4 | | 50-140 | % | 06-DEC-17 | | | | |
| **Hydrocarbons** | | | | | | | | | | |
| | F1 (C6-C10) | <5.0 | VOCJ | 5.0 | ug/g | 06-DEC-17 | 17 | 25 | 55 | 55 |
| | F1-BTEX | <5.0 | | 5.0 | ug/g | 11-DEC-17 | 17 | 25 | 55 | 55 |
| | F2 (C10-C16) | <10 | | 10 | ug/g | 11-DEC-17 | 10 | 10 | 230 | 98 |
| | F3 (C16-C34) | 71 | | 50 | ug/g | 11-DEC-17 | 240 | 240 | 1700 | 300 |
| | F4 (C34-C50) | 121 | | 50 | ug/g | 11-DEC-17 | *120 | *120 | 3300 | 2800 |
| | Total Hydrocarbons (C6-C50) | 192 | | 72 | ug/g | 11-DEC-17 | | | | |
| | Chrom. to baseline at nC50 | YES | | | No Unit | 11-DEC-17 | | | | |
| | Surrogate: 2-Bromobenzotrifluoride | 82.9 | | 60-140 | % | 11-DEC-17 | | | | |
| | Surrogate: 3,4-Dichlorotoluene | 76.8 | | 60-140 | % | 06-DEC-17 | | | | |

** Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
* Analytical result for this parameter exceeds Guideline Limit listed on this report. Guideline Limits applied:

**Ontario Regulation 153/04 - April 15, 2011 Standards = [Suite] - ON-511-T1/T2-SOIL-AG+RPIICC/RPI-ICC-C**

**#1: T1-Soil-Agricultural or Other Property Use**

**#2: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use**

**#3: T2-Soil-Ind/Com/Commu Property Use (Coarse)**

**#4: T2-Soil-Res/Park/Inst. Property Use (Coarse)**

# ANALYTICAL GUIDELINE REPORT

| Sample Details Grouping | Analyte | Result | Qualifier | D.L. | Units | Analyzed | Guideline Limits #1 | #2 | #3 | #4 |
|---|---|---|---|---|---|---|---|---|---|---|
| L2030089-2 | BH2-SA5 | | | | | | | | | |
| Sampled By: | Client on 20-NOV-17 | | | | | | | | | |
| Matrix: | SOIL | | | | | | | | | |
| **Physical Tests** | | | | | | | | | | |
| | Conductivity | 0.843 | | 0.0040 | mS/cm | 07-DEC-17 | *0.47 | *0.57 | 1.4 | *0.7 |
| | % Moisture | 16.9 | | 0.10 | % | 04-DEC-17 | | | | |
| | pH | 7.78 | | 0.10 | pH units | 05-DEC-17 | | | | |
| **Cyanides** | | | | | | | | | | |
| | Cyanide, Weak Acid Diss | <0.050 | | 0.050 | ug/g | 05-DEC-17 | 0.051 | 0.051 | 0.051 | 0.051 |
| **Saturated Paste Extractables** | | | | | | | | | | |
| | SAR | 17.6 | SAR:M | 0.10 | SAR | 07-DEC-17 | *1 | *2.4 | *12 | *5 |
| | Calcium (Ca) | 5.4 | | 1.0 | mg/L | 07-DEC-17 | | | | |
| | Magnesium (Mg) | <1.0 | | 1.0 | mg/L | 07-DEC-17 | | | | |
| | Sodium (Na) | 148 | | 1.0 | mg/L | 07-DEC-17 | | | | |
| **Metals** | | | | | | | | | | |
| | Antimony (Sb) | <1.0 | | 1.0 | ug/g | 07-DEC-17 | 1 | 1.3 | 40 | 7.5 |
| | Arsenic (As) | 1.9 | | 1.0 | ug/g | 07-DEC-17 | 11 | 18 | 18 | 18 |
| | Barium (Ba) | 15.6 | | 1.0 | ug/g | 07-DEC-17 | 210 | 220 | 670 | 390 |
| | Beryllium (Be) | <0.50 | | 0.50 | ug/g | 07-DEC-17 | 2.5 | 2.5 | 8 | 4 |
| | Boron (B) | 8.6 | | 5.0 | ug/g | 07-DEC-17 | 36 | 36 | 120 | 120 |
| | Boron (B), Hot Water Ext. | <0.10 | | 0.10 | ug/g | 08-DEC-17 | 36 | 36 | 2 | 1.5 |
| | Cadmium (Cd) | <0.50 | | 0.50 | ug/g | 07-DEC-17 | 1 | 1.2 | 1.9 | 1.2 |
| | Chromium (Cr) | 8.5 | | 1.0 | ug/g | 07-DEC-17 | 67 | 70 | 160 | 160 |
| | Cobalt (Co) | 3.0 | | 1.0 | ug/g | 07-DEC-17 | 19 | 21 | 80 | 22 |
| | Copper (Cu) | 7.7 | | 1.0 | ug/g | 07-DEC-17 | 62 | 92 | 230 | 140 |
| | Lead (Pb) | 2.5 | | 1.0 | ug/g | 07-DEC-17 | 45 | 120 | 120 | 120 |
| | Mercury (Hg) | <0.0050 | | 0.0050 | ug/g | 07-DEC-17 | 0.16 | 0.27 | 3.9 | 0.27 |
| | Molybdenum (Mo) | <1.0 | | 1.0 | ug/g | 07-DEC-17 | 2 | 2 | 40 | 6.9 |
| | Nickel (Ni) | 6.2 | | 1.0 | ug/g | 07-DEC-17 | 37 | 82 | 270 | 100 |
| | Selenium (Se) | <1.0 | | 1.0 | ug/g | 07-DEC-17 | 1.2 | 1.5 | 5.5 | 2.4 |
| | Silver (Ag) | <0.20 | | 0.20 | ug/g | 07-DEC-17 | 0.5 | 0.5 | 40 | 20 |
| | Thallium (Tl) | <0.50 | | 0.50 | ug/g | 07-DEC-17 | 1 | 1 | 3.3 | 1 |
| | Uranium (U) | <1.0 | | 1.0 | ug/g | 07-DEC-17 | 1.9 | 2.5 | 33 | 23 |
| | Vanadium (V) | 12.5 | | 1.0 | ug/g | 07-DEC-17 | 86 | 86 | 86 | 86 |
| | Zinc (Zn) | 13.3 | | 5.0 | ug/g | 07-DEC-17 | 290 | 290 | 340 | 340 |
| **Speciated Metals** | | | | | | | | | | |
| | Chromium, Hexavalent | <0.20 | | 0.20 | ug/g | 07-DEC-17 | 0.66 | 0.66 | 8 | 8 |
| **Volatile Organic Compounds** | | | | | | | | | | |
| | Acetone | <0.50 | VOCJ | 0.50 | ug/g | 06-DEC-17 | 0.5 | 0.5 | 16 | 16 |
| | Benzene | <0.0068 | VOCJ | 0.0068 | ug/g | 06-DEC-17 | 0.02 | 0.02 | 0.32 | 0.21 |
| | Bromodichloromethane | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 1.5 | 1.5 |
| | Bromoform | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 0.61 | 0.27 |
| | Bromomethane | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 0.05 | 0.05 |
| | Carbon tetrachloride | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 0.21 | 0.05 |
| | Chlorobenzene | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 2.4 | 2.4 |
| | Dibromochloromethane | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 2.3 | 2.3 |
| | Chloroform | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 0.47 | 0.05 |
| | 1,2-Dibromoethane | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 0.05 | 0.05 |
| | 1,2-Dichlorobenzene | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 1.2 | 1.2 |

** Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.

* Analytical result for this parameter exceeds Guideline Limit listed on this report. Guideline Limits applied:

**Ontario Regulation 153/04 - April 15, 2011 Standards = [Suite] - ON-511-T1/T2-SOIL-AG+RPIICC/RPI-ICC-C**

**#1: T1-Soil-Agricultural or Other Property Use**

**#2: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use**

**#3: T2-Soil-Ind/Com/Commu Property Use (Coarse)**

**#4: T2-Soil-Res/Park/Inst. Property Use (Coarse)**

# ANALYTICAL GUIDELINE REPORT

| Sample Details Grouping | Analyte | Result | Qualifier | D.L. | Units | Analyzed | Guideline Limits #1 | #2 | #3 | #4 |
|---|---|---|---|---|---|---|---|---|---|---|
| L2030089-2 | BH2-SA5 | | | | | | | | | |
| Sampled By: | Client on 20-NOV-17 | | | | | | | | | |
| Matrix: | SOIL | | | | | | | | | |
| **Volatile Organic Compounds** | | | | | | | | | | |
| | 1,3-Dichlorobenzene | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 9.6 | 4.8 |
| | 1,4-Dichlorobenzene | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 0.2 | 0.083 |
| | Dichlorodifluoromethane | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 16 | 16 |
| | 1,1-Dichloroethane | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 0.47 | 0.47 |
| | 1,2-Dichloroethane | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 0.05 | 0.05 |
| | 1,1-Dichloroethylene | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 0.064 | 0.05 |
| | cis-1,2-Dichloroethylene | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 1.9 | 1.9 |
| | trans-1,2-Dichloroethylene | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 1.3 | 0.084 |
| | Methylene Chloride | <2.0 | RRR | 2.0 | ug/g | 06-DEC-17 | **0.05 | **0.05 | **1.6 | **0.1 |
| | 1,2-Dichloropropane | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 0.16 | 0.05 |
| | cis-1,3-Dichloropropene | <0.030 | VOCJ | 0.030 | ug/g | 06-DEC-17 | | | | |
| | trans-1,3-Dichloropropene | <0.030 | VOCJ | 0.030 | ug/g | 06-DEC-17 | | | | |
| | 1,3-Dichloropropene (cis & trans) | <0.042 | | 0.042 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 0.059 | 0.05 |
| | Ethylbenzene | <0.018 | VOCJ | 0.018 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 1.1 | 1.1 |
| | n-Hexane | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 46 | 2.8 |
| | Methyl Ethyl Ketone | <0.50 | VOCJ | 0.50 | ug/g | 06-DEC-17 | 0.5 | 0.5 | 70 | 16 |
| | Methyl Isobutyl Ketone | <0.50 | VOCJ | 0.50 | ug/g | 06-DEC-17 | 0.5 | 0.5 | 31 | 1.7 |
| | MTBE | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 1.6 | 0.75 |
| | Styrene | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 34 | 0.7 |
| | 1,1,1,2-Tetrachloroethane | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 0.087 | 0.058 |
| | 1,1,2,2-Tetrachloroethane | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 0.05 | 0.05 |
| | Tetrachloroethylene | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 1.9 | 0.28 |
| | Toluene | <0.080 | VOCJ | 0.080 | ug/g | 06-DEC-17 | 0.2 | 0.2 | 6.4 | 2.3 |
| | 1,1,1-Trichloroethane | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 6.1 | 0.38 |
| | 1,1,2-Trichloroethane | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 0.05 | 0.05 |
| | Trichloroethylene | <0.010 | VOCJ | 0.010 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 0.55 | 0.061 |
| | Trichlorofluoromethane | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.25 | 4 | 4 |
| | Vinyl chloride | <0.020 | VOCJ | 0.020 | ug/g | 06-DEC-17 | 0.02 | 0.02 | 0.032 | 0.02 |
| | o-Xylene | <0.020 | VOCJ | 0.020 | ug/g | 06-DEC-17 | | | | |
| | m+p-Xylenes | <0.030 | VOCJ | 0.030 | ug/g | 06-DEC-17 | | | | |
| | Xylenes (Total) | <0.050 | | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 26 | 3.1 |
| | Surrogate: 4-Bromofluorobenzene | 99.6 | | 50-140 | % | 06-DEC-17 | | | | |
| | Surrogate: 1,4-Difluorobenzene | 101.2 | | 50-140 | % | 06-DEC-17 | | | | |
| **Hydrocarbons** | | | | | | | | | | |
| | F1 (C6-C10) | <5.0 | VOCJ | 5.0 | ug/g | 06-DEC-17 | 17 | 25 | 55 | 55 |
| | F1-BTEX | <5.0 | | 5.0 | ug/g | 08-DEC-17 | 17 | 25 | 55 | 55 |
| | F2 (C10-C16) | <10 | | 10 | ug/g | 08-DEC-17 | 10 | 10 | 230 | 98 |
| | F3 (C16-C34) | <50 | | 50 | ug/g | 08-DEC-17 | 240 | 240 | 1700 | 300 |
| | F4 (C34-C50) | <50 | | 50 | ug/g | 08-DEC-17 | 120 | 120 | 3300 | 2800 |
| | Total Hydrocarbons (C6-C50) | <72 | | 72 | ug/g | 08-DEC-17 | | | | |
| | Chrom. to baseline at nC50 | YES | | | No Unit | 08-DEC-17 | | | | |
| | Surrogate: 2-Bromobenzotrifluoride | 84.9 | | 60-140 | % | 08-DEC-17 | | | | |
| | Surrogate: 3,4-Dichlorotoluene | 69.4 | | 60-140 | % | 06-DEC-17 | | | | |

** Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.

* Analytical result for this parameter exceeds Guideline Limit listed on this report. Guideline Limits applied:

**Ontario Regulation 153/04 - April 15, 2011 Standards = [Suite] - ON-511-T1/T2-SOIL-AG+RPIICC/RPI-ICC-C**

**#1: T1-Soil-Agricultural or Other Property Use**

**#2: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use**

**#3: T2-Soil-Ind/Com/Commu Property Use (Coarse)**

**#4: T2-Soil-Res/Park/Inst. Property Use (Coarse)**

# ANALYTICAL GUIDELINE REPORT

G17496

| Sample Details Grouping | Analyte | Result | Qualifier | D.L. | Units | Analyzed | Guideline Limits | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | #1 | #2 | #3 | #4 |
| L2030089-3 | BH5-SA1 | | | | | | | | | |
| Sampled By: | Client on 21-NOV-17 | | | | | | | | | |
| Matrix: | SOIL | | | | | | | | | |
| **Physical Tests** | | | | | | | | | | |
| | Conductivity | 0.361 | | 0.0040 | mS/cm | 07-DEC-17 | 0.47 | 0.57 | 1.4 | 0.7 |
| | % Moisture | 6.52 | | 0.10 | % | 04-DEC-17 | | | | |
| | pH | 8.16 | | 0.10 | pH units | 05-DEC-17 | | | | |
| **Cyanides** | | | | | | | | | | |
| | Cyanide, Weak Acid Diss | <0.050 | | 0.050 | ug/g | 06-DEC-17 | 0.051 | 0.051 | 0.051 | 0.051 |
| **Saturated Paste Extractables** | | | | | | | | | | |
| | SAR | 7.49 | | 0.10 | SAR | 07-DEC-17 | *1 | *2.4 | 12 | *5 |
| | Calcium (Ca) | 2.2 | | 1.0 | mg/L | 07-DEC-17 | | | | |
| | Magnesium (Mg) | 1.5 | | 1.0 | mg/L | 07-DEC-17 | | | | |
| | Sodium (Na) | 59.2 | | 1.0 | mg/L | 07-DEC-17 | | | | |
| **Metals** | | | | | | | | | | |
| | Antimony (Sb) | <1.0 | | 1.0 | ug/g | 07-DEC-17 | 1 | 1.3 | 40 | 7.5 |
| | Arsenic (As) | 1.9 | | 1.0 | ug/g | 07-DEC-17 | 11 | 18 | 18 | 18 |
| | Barium (Ba) | 8.0 | | 1.0 | ug/g | 07-DEC-17 | 210 | 220 | 670 | 390 |
| | Beryllium (Be) | <0.50 | | 0.50 | ug/g | 07-DEC-17 | 2.5 | 2.5 | 8 | 4 |
| | Boron (B) | 6.9 | | 5.0 | ug/g | 07-DEC-17 | 36 | 36 | 120 | 120 |
| | Boron (B), Hot Water Ext. | <0.10 | | 0.10 | ug/g | 08-DEC-17 | 36 | 36 | 2 | 1.5 |
| | Cadmium (Cd) | <0.50 | | 0.50 | ug/g | 07-DEC-17 | 1 | 1.2 | 1.9 | 1.2 |
| | Chromium (Cr) | 6.2 | | 1.0 | ug/g | 07-DEC-17 | 67 | 70 | 160 | 160 |
| | Cobalt (Co) | 2.0 | | 1.0 | ug/g | 07-DEC-17 | 19 | 21 | 80 | 22 |
| | Copper (Cu) | 6.3 | | 1.0 | ug/g | 07-DEC-17 | 62 | 92 | 230 | 140 |
| | Lead (Pb) | 2.2 | | 1.0 | ug/g | 07-DEC-17 | 45 | 120 | 120 | 120 |
| | Mercury (Hg) | 0.0056 | | 0.0050 | ug/g | 07-DEC-17 | 0.16 | 0.27 | 3.9 | 0.27 |
| | Molybdenum (Mo) | <1.0 | | 1.0 | ug/g | 07-DEC-17 | 2 | 2 | 40 | 6.9 |
| | Nickel (Ni) | 4.1 | | 1.0 | ug/g | 07-DEC-17 | 37 | 82 | 270 | 100 |
| | Selenium (Se) | <1.0 | | 1.0 | ug/g | 07-DEC-17 | 1.2 | 1.5 | 5.5 | 2.4 |
| | Silver (Ag) | <0.20 | | 0.20 | ug/g | 07-DEC-17 | 0.5 | 0.5 | 40 | 20 |
| | Thallium (Tl) | <0.50 | | 0.50 | ug/g | 07-DEC-17 | 1 | 1 | 3.3 | 1 |
| | Uranium (U) | <1.0 | | 1.0 | ug/g | 07-DEC-17 | 1.9 | 2.5 | 33 | 23 |
| | Vanadium (V) | 11.1 | | 1.0 | ug/g | 07-DEC-17 | 86 | 86 | 86 | 86 |
| | Zinc (Zn) | 11.7 | | 5.0 | ug/g | 07-DEC-17 | 290 | 290 | 340 | 340 |
| **Speciated Metals** | | | | | | | | | | |
| | Chromium, Hexavalent | <0.20 | | 0.20 | ug/g | 07-DEC-17 | 0.66 | 0.66 | 8 | 8 |
| **Volatile Organic Compounds** | | | | | | | | | | |
| | Acetone | <0.50 | VOCJ | 0.50 | ug/g | 06-DEC-17 | 0.5 | 0.5 | 16 | 16 |
| | Benzene | <0.0068 | VOCJ | 0.0068 | ug/g | 06-DEC-17 | 0.02 | 0.02 | 0.32 | 0.21 |
| | Bromodichloromethane | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 1.5 | 1.5 |
| | Bromoform | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 0.61 | 0.27 |
| | Bromomethane | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 0.05 | 0.05 |
| | Carbon tetrachloride | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 0.21 | 0.05 |
| | Chlorobenzene | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 2.4 | 2.4 |
| | Dibromochloromethane | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 2.3 | 2.3 |
| | Chloroform | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 0.47 | 0.05 |
| | 1,2-Dibromoethane | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 0.05 | 0.05 |
| | 1,2-Dichlorobenzene | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 1.2 | 1.2 |

** Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
* Analytical result for this parameter exceeds Guideline Limit listed on this report. Guideline Limits applied:

**Ontario Regulation 153/04 - April 15, 2011 Standards = [Suite] - ON-511-T1/T2-SOIL-AG+RPIICC/RPI-ICC-C**

**#1: T1-Soil-Agricultural or Other Property Use**

**#2: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use**

**#3: T2-Soil-Ind/Com/Commu Property Use (Coarse)**

**#4: T2-Soil-Res/Park/Inst. Property Use (Coarse)**

# ANALYTICAL GUIDELINE REPORT

G17496

| Sample Details<br>Grouping | Analyte | Result | Qualifier | D.L. | Units | Analyzed | Guideline Limits | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| L2030089-3 | BH5-SA1 | | | | | | | | | |
| Sampled By: | Client on 21-NOV-17 | | | | | | | | | |
| Matrix: | SOIL | | | | | | #1 | #2 | #3 | #4 |
| **Volatile Organic Compounds** | | | | | | | | | | |
| | 1,3-Dichlorobenzene | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 9.6 | 4.8 |
| | 1,4-Dichlorobenzene | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 0.2 | 0.083 |
| | Dichlorodifluoromethane | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 16 | 16 |
| | 1,1-Dichloroethane | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 0.47 | 0.47 |
| | 1,2-Dichloroethane | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 0.05 | 0.05 |
| | 1,1-Dichloroethylene | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 0.064 | 0.05 |
| | cis-1,2-Dichloroethylene | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 1.9 | 1.9 |
| | trans-1,2-Dichloroethylene | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 1.3 | 0.084 |
| | Methylene Chloride | <0.50 | RRR | 0.50 | ug/g | 06-DEC-17 | **0.05 | **0.05 | 1.6 | **0.1 |
| | 1,2-Dichloropropane | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 0.16 | 0.05 |
| | cis-1,3-Dichloropropene | <0.030 | VOCJ | 0.030 | ug/g | 06-DEC-17 | | | | |
| | trans-1,3-Dichloropropene | <0.030 | VOCJ | 0.030 | ug/g | 06-DEC-17 | | | | |
| | 1,3-Dichloropropene (cis & trans) | <0.042 | | 0.042 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 0.059 | 0.05 |
| | Ethylbenzene | <0.018 | VOCJ | 0.018 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 1.1 | 1.1 |
| | n-Hexane | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 46 | 2.8 |
| | Methyl Ethyl Ketone | <0.50 | VOCJ | 0.50 | ug/g | 06-DEC-17 | 0.5 | 0.5 | 70 | 16 |
| | Methyl Isobutyl Ketone | <0.50 | VOCJ | 0.50 | ug/g | 06-DEC-17 | 0.5 | 0.5 | 31 | 1.7 |
| | MTBE | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 1.6 | 0.75 |
| | Styrene | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 34 | 0.7 |
| | 1,1,1,2-Tetrachloroethane | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 0.087 | 0.058 |
| | 1,1,2,2-Tetrachloroethane | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 0.05 | 0.05 |
| | Tetrachloroethylene | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 1.9 | 0.28 |
| | Toluene | <0.080 | VOCJ | 0.080 | ug/g | 06-DEC-17 | 0.2 | 0.2 | 6.4 | 2.3 |
| | 1,1,1-Trichloroethane | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 6.1 | 0.38 |
| | 1,1,2-Trichloroethane | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 0.05 | 0.05 |
| | Trichloroethylene | <0.010 | VOCJ | 0.010 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 0.55 | 0.061 |
| | Trichlorofluoromethane | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.25 | 4 | 4 |
| | Vinyl chloride | <0.020 | VOCJ | 0.020 | ug/g | 06-DEC-17 | 0.02 | 0.02 | 0.032 | 0.02 |
| | o-Xylene | <0.020 | VOCJ | 0.020 | ug/g | 06-DEC-17 | | | | |
| | m+p-Xylenes | <0.030 | VOCJ | 0.030 | ug/g | 06-DEC-17 | | | | |
| | Xylenes (Total) | <0.050 | | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 26 | 3.1 |
| | Surrogate: 4-Bromofluorobenzene | 103.9 | | 50-140 | % | 06-DEC-17 | | | | |
| | Surrogate: 1,4-Difluorobenzene | 106.4 | | 50-140 | % | 06-DEC-17 | | | | |
| **Hydrocarbons** | | | | | | | | | | |
| | F1 (C6-C10) | <5.0 | VOCJ | 5.0 | ug/g | 06-DEC-17 | 17 | 25 | 55 | 55 |
| | F1-BTEX | <5.0 | | 5.0 | ug/g | 13-DEC-17 | 17 | 25 | 55 | 55 |
| | F2 (C10-C16) | <20 | DLM | 20 | ug/g | 12-DEC-17 | **10 | **10 | 230 | 98 |
| | F3 (C16-C34) | 300 | DLM | 100 | ug/g | 12-DEC-17 | *240 | *240 | 1700 | 300 |
| | F4 (C34-C50) | 340 | DLM | 100 | ug/g | 12-DEC-17 | *120 | *120 | 3300 | 2800 |
| | F4G-SG (GHH-Silica) | 1420 | | 250 | ug/g | 08-DEC-17 | *120 | *120 | 3300 | 2800 |
| | Total Hydrocarbons (C6-C50) | 640 | | 140 | ug/g | 13-DEC-17 | | | | |
| | Chrom. to baseline at nC50 | NO | | | No Unit | 12-DEC-17 | | | | |
| | Surrogate: 2-Bromobenzotrifluoride | 90.9 | | 60-140 | % | 12-DEC-17 | | | | |
| | Surrogate: 3,4-Dichlorotoluene | 69.5 | | 60-140 | % | 06-DEC-17 | | | | |

** Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.

* Analytical result for this parameter exceeds Guideline Limit listed on this report. Guideline Limits applied:

**Ontario Regulation 153/04 - April 15, 2011 Standards = [Suite] - ON-511-T1/T2-SOIL-AG+RPIICC/RPI-ICC-C**

**#1: T1-Soil-Agricultural or Other Property Use**

**#2: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use**

**#3: T2-Soil-Ind/Com/Commu Property Use (Coarse)**

**#4: T2-Soil-Res/Park/Inst. Property Use (Coarse)**

# ANALYTICAL GUIDELINE REPORT

G17496

| Sample Details Grouping | Analyte | Result | Qualifier | D.L. | Units | Analyzed | Guideline Limits | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| L2030089-4 | BH9-SA2 | | | | | | | | | |
| Sampled By: | Client on 21-NOV-17 | | | | | | | | | |
| Matrix: | SOIL | | | | | | #1 | #2 | #3 | #4 |
| **Physical Tests** | | | | | | | | | | |
| | Conductivity | 0.337 | | 0.0040 | mS/cm | 07-DEC-17 | 0.47 | 0.57 | 1.4 | 0.7 |
| | % Moisture | 6.43 | | 0.10 | % | 04-DEC-17 | | | | |
| | pH | 7.66 | | 0.10 | pH units | 05-DEC-17 | | | | |
| **Cyanides** | | | | | | | | | | |
| | Cyanide, Weak Acid Diss | <0.050 | | 0.050 | ug/g | 06-DEC-17 | 0.051 | 0.051 | 0.051 | 0.051 |
| **Saturated Paste Extractables** | | | | | | | | | | |
| | SAR | 8.19 | SAR:M | 0.10 | SAR | 07-DEC-17 | *1 | *2.4 | 12 | *5 |
| | Calcium (Ca) | 3.5 | | 1.0 | mg/L | 07-DEC-17 | | | | |
| | Magnesium (Mg) | <1.0 | | 1.0 | mg/L | 07-DEC-17 | | | | |
| | Sodium (Na) | 55.3 | | 1.0 | mg/L | 07-DEC-17 | | | | |
| **Metals** | | | | | | | | | | |
| | Antimony (Sb) | <1.0 | | 1.0 | ug/g | 07-DEC-17 | 1 | 1.3 | 40 | 7.5 |
| | Arsenic (As) | 2.1 | | 1.0 | ug/g | 07-DEC-17 | 11 | 18 | 18 | 18 |
| | Barium (Ba) | 14.0 | | 1.0 | ug/g | 07-DEC-17 | 210 | 220 | 670 | 390 |
| | Beryllium (Be) | <0.50 | | 0.50 | ug/g | 07-DEC-17 | 2.5 | 2.5 | 8 | 4 |
| | Boron (B) | <5.0 | | 5.0 | ug/g | 07-DEC-17 | 36 | 36 | 120 | 120 |
| | Boron (B), Hot Water Ext. | <0.10 | | 0.10 | ug/g | 11-DEC-17 | 36 | 36 | 2 | 1.5 |
| | Cadmium (Cd) | <0.50 | | 0.50 | ug/g | 07-DEC-17 | 1 | 1.2 | 1.9 | 1.2 |
| | Chromium (Cr) | 12.2 | | 1.0 | ug/g | 07-DEC-17 | 67 | 70 | 160 | 160 |
| | Cobalt (Co) | 2.9 | | 1.0 | ug/g | 07-DEC-17 | 19 | 21 | 80 | 22 |
| | Copper (Cu) | 5.4 | | 1.0 | ug/g | 07-DEC-17 | 62 | 92 | 230 | 140 |
| | Lead (Pb) | 2.5 | | 1.0 | ug/g | 07-DEC-17 | 45 | 120 | 120 | 120 |
| | Mercury (Hg) | 0.0277 | | 0.0050 | ug/g | 07-DEC-17 | 0.16 | 0.27 | 3.9 | 0.27 |
| | Molybdenum (Mo) | <1.0 | | 1.0 | ug/g | 07-DEC-17 | 2 | 2 | 40 | 6.9 |
| | Nickel (Ni) | 5.6 | | 1.0 | ug/g | 07-DEC-17 | 37 | 82 | 270 | 100 |
| | Selenium (Se) | <1.0 | | 1.0 | ug/g | 07-DEC-17 | 1.2 | 1.5 | 5.5 | 2.4 |
| | Silver (Ag) | <0.20 | | 0.20 | ug/g | 07-DEC-17 | 0.5 | 0.5 | 40 | 20 |
| | Thallium (Tl) | <0.50 | | 0.50 | ug/g | 07-DEC-17 | 1 | 1 | 3.3 | 1 |
| | Uranium (U) | <1.0 | | 1.0 | ug/g | 07-DEC-17 | 1.9 | 2.5 | 33 | 23 |
| | Vanadium (V) | 21.0 | | 1.0 | ug/g | 07-DEC-17 | 86 | 86 | 86 | 86 |
| | Zinc (Zn) | 12.3 | | 5.0 | ug/g | 07-DEC-17 | 290 | 290 | 340 | 340 |
| **Speciated Metals** | | | | | | | | | | |
| | Chromium, Hexavalent | 0.48 | | 0.20 | ug/g | 07-DEC-17 | 0.66 | 0.66 | 8 | 8 |
| **Volatile Organic Compounds** | | | | | | | | | | |
| | Acetone | <0.50 | VOCJ | 0.50 | ug/g | 07-DEC-17 | 0.5 | 0.5 | 16 | 16 |
| | Benzene | <0.0068 | VOCJ | 0.0068 | ug/g | 07-DEC-17 | 0.02 | 0.02 | 0.32 | 0.21 |
| | Bromodichloromethane | <0.050 | VOCJ | 0.050 | ug/g | 07-DEC-17 | 0.05 | 0.05 | 1.5 | 1.5 |
| | Bromoform | <0.050 | VOCJ | 0.050 | ug/g | 07-DEC-17 | 0.05 | 0.05 | 0.61 | 0.27 |
| | Bromomethane | <0.050 | VOCJ | 0.050 | ug/g | 07-DEC-17 | 0.05 | 0.05 | 0.05 | 0.05 |
| | Carbon tetrachloride | <0.050 | VOCJ | 0.050 | ug/g | 07-DEC-17 | 0.05 | 0.05 | 0.21 | 0.05 |
| | Chlorobenzene | <0.050 | VOCJ | 0.050 | ug/g | 07-DEC-17 | 0.05 | 0.05 | 2.4 | 2.4 |
| | Dibromochloromethane | <0.050 | VOCJ | 0.050 | ug/g | 07-DEC-17 | 0.05 | 0.05 | 2.3 | 2.3 |
| | Chloroform | <0.050 | VOCJ | 0.050 | ug/g | 07-DEC-17 | 0.05 | 0.05 | 0.47 | 0.05 |
| | 1,2-Dibromoethane | <0.050 | VOCJ | 0.050 | ug/g | 07-DEC-17 | 0.05 | 0.05 | 0.05 | 0.05 |
| | 1,2-Dichlorobenzene | <0.050 | VOCJ | 0.050 | ug/g | 07-DEC-17 | 0.05 | 0.05 | 1.2 | 1.2 |

** Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
* Analytical result for this parameter exceeds Guideline Limit listed on this report. Guideline Limits applied:

**Ontario Regulation 153/04 - April 15, 2011 Standards = [Suite] - ON-511-T1/T2-SOIL-AG+RPIICC/RPI-ICC-C**

**#1: T1-Soil-Agricultural or Other Property Use**
**#2: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use**
**#3: T2-Soil-Ind/Com/Commu Property Use (Coarse)**
**#4: T2-Soil-Res/Park/Inst. Property Use (Coarse)**

# ANALYTICAL GUIDELINE REPORT

| Sample Details<br>Grouping | Analyte | Result | Qualifier | D.L. | Units | Analyzed | Guideline Limits | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| L2030089-4 | BH9-SA2 | | | | | | | | | |
| Sampled By: | Client on 21-NOV-17 | | | | | | | | | |
| Matrix: | SOIL | | | | | | #1 | #2 | #3 | #4 |
| **Volatile Organic Compounds** | | | | | | | | | | |
| | 1,3-Dichlorobenzene | <0.050 | VOCJ | 0.050 | ug/g | 07-DEC-17 | 0.05 | 0.05 | 9.6 | 4.8 |
| | 1,4-Dichlorobenzene | <0.050 | VOCJ | 0.050 | ug/g | 07-DEC-17 | 0.05 | 0.05 | 0.2 | 0.083 |
| | Dichlorodifluoromethane | <0.050 | VOCJ | 0.050 | ug/g | 07-DEC-17 | 0.05 | 0.05 | 16 | 16 |
| | 1,1-Dichloroethane | <0.050 | VOCJ | 0.050 | ug/g | 07-DEC-17 | 0.05 | 0.05 | 0.47 | 0.47 |
| | 1,2-Dichloroethane | <0.050 | VOCJ | 0.050 | ug/g | 07-DEC-17 | 0.05 | 0.05 | 0.05 | 0.05 |
| | 1,1-Dichloroethylene | <0.050 | VOCJ | 0.050 | ug/g | 07-DEC-17 | 0.05 | 0.05 | 0.064 | 0.05 |
| | cis-1,2-Dichloroethylene | <0.050 | VOCJ | 0.050 | ug/g | 07-DEC-17 | 0.05 | 0.05 | 1.9 | 1.9 |
| | trans-1,2-Dichloroethylene | <0.050 | VOCJ | 0.050 | ug/g | 07-DEC-17 | 0.05 | 0.05 | 1.3 | 0.084 |
| | Methylene Chloride | <0.050 | VOCJ | 0.050 | ug/g | 07-DEC-17 | 0.05 | 0.05 | 1.6 | 0.1 |
| | 1,2-Dichloropropane | <0.050 | VOCJ | 0.050 | ug/g | 07-DEC-17 | 0.05 | 0.05 | 0.16 | 0.05 |
| | cis-1,3-Dichloropropene | <0.030 | VOCJ | 0.030 | ug/g | 07-DEC-17 | | | | |
| | trans-1,3-Dichloropropene | <0.030 | VOCJ | 0.030 | ug/g | 07-DEC-17 | | | | |
| | 1,3-Dichloropropene (cis & trans) | <0.042 | | 0.042 | ug/g | 07-DEC-17 | 0.05 | 0.05 | 0.059 | 0.05 |
| | Ethylbenzene | <0.018 | VOCJ | 0.018 | ug/g | 07-DEC-17 | 0.05 | 0.05 | 1.1 | 1.1 |
| | n-Hexane | <0.050 | VOCJ | 0.050 | ug/g | 07-DEC-17 | 0.05 | 0.05 | 46 | 2.8 |
| | Methyl Ethyl Ketone | <0.50 | VOCJ | 0.50 | ug/g | 07-DEC-17 | 0.5 | 0.5 | 70 | 16 |
| | Methyl Isobutyl Ketone | <0.50 | VOCJ | 0.50 | ug/g | 07-DEC-17 | 0.5 | 0.5 | 31 | 1.7 |
| | MTBE | <0.050 | VOCJ | 0.050 | ug/g | 07-DEC-17 | 0.05 | 0.05 | 1.6 | 0.75 |
| | Styrene | <0.050 | VOCJ | 0.050 | ug/g | 07-DEC-17 | 0.05 | 0.05 | 34 | 0.7 |
| | 1,1,1,2-Tetrachloroethane | <0.050 | VOCJ | 0.050 | ug/g | 07-DEC-17 | 0.05 | 0.05 | 0.087 | 0.058 |
| | 1,1,2,2-Tetrachloroethane | <0.050 | VOCJ | 0.050 | ug/g | 07-DEC-17 | 0.05 | 0.05 | 0.05 | 0.05 |
| | Tetrachloroethylene | <0.050 | VOCJ | 0.050 | ug/g | 07-DEC-17 | 0.05 | 0.05 | 1.9 | 0.28 |
| | Toluene | <0.080 | VOCJ | 0.080 | ug/g | 07-DEC-17 | 0.2 | 0.2 | 6.4 | 2.3 |
| | 1,1,1-Trichloroethane | <0.050 | VOCJ | 0.050 | ug/g | 07-DEC-17 | 0.05 | 0.05 | 6.1 | 0.38 |
| | 1,1,2-Trichloroethane | <0.050 | VOCJ | 0.050 | ug/g | 07-DEC-17 | 0.05 | 0.05 | 0.05 | 0.05 |
| | Trichloroethylene | <0.010 | VOCJ | 0.010 | ug/g | 07-DEC-17 | 0.05 | 0.05 | 0.55 | 0.061 |
| | Trichlorofluoromethane | <0.050 | VOCJ | 0.050 | ug/g | 07-DEC-17 | 0.05 | 0.25 | 4 | 4 |
| | Vinyl chloride | <0.020 | VOCJ | 0.020 | ug/g | 07-DEC-17 | 0.02 | 0.02 | 0.032 | 0.02 |
| | o-Xylene | <0.020 | VOCJ | 0.020 | ug/g | 07-DEC-17 | | | | |
| | m+p-Xylenes | <0.030 | VOCJ | 0.030 | ug/g | 07-DEC-17 | | | | |
| | Xylenes (Total) | <0.050 | | 0.050 | ug/g | 07-DEC-17 | 0.05 | 0.05 | 26 | 3.1 |
| | Surrogate: 4-Bromofluorobenzene | 104.1 | | 50-140 | % | 07-DEC-17 | | | | |
| | Surrogate: 1,4-Difluorobenzene | 109.7 | | 50-140 | % | 07-DEC-17 | | | | |
| **Hydrocarbons** | | | | | | | | | | |
| | F1 (C6-C10) | <5.0 | VOCJ | 5.0 | ug/g | 07-DEC-17 | 17 | 25 | 55 | 55 |
| | F1-BTEX | <5.0 | | 5.0 | ug/g | 13-DEC-17 | 17 | 25 | 55 | 55 |
| | F2 (C10-C16) | 15 | | 10 | ug/g | 12-DEC-17 | *10 | *10 | 230 | 98 |
| | F3 (C16-C34) | 194 | | 50 | ug/g | 12-DEC-17 | 240 | 240 | 1700 | 300 |
| | F4 (C34-C50) | 53 | | 50 | ug/g | 12-DEC-17 | 120 | 120 | 3300 | 2800 |
| | F4G-SG (GHH-Silica) | 270 | | 250 | ug/g | 08-DEC-17 | *120 | *120 | 3300 | 2800 |
| | Total Hydrocarbons (C6-C50) | 263 | | 72 | ug/g | 13-DEC-17 | | | | |
| | Chrom. to baseline at nC50 | NO | | | No Unit | 12-DEC-17 | | | | |
| | Surrogate: 2-Bromobenzotrifluoride | 90.2 | | 60-140 | % | 12-DEC-17 | | | | |
| | Surrogate: 3,4-Dichlorotoluene | 93.7 | | 60-140 | % | 07-DEC-17 | | | | |

** Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.

* Analytical result for this parameter exceeds Guideline Limit listed on this report. Guideline Limits applied:

**Ontario Regulation 153/04 - April 15, 2011 Standards = [Suite] - ON-511-T1/T2-SOIL-AG+RPIICC/RPI-ICC-C**

**#1: T1-Soil-Agricultural or Other Property Use**

**#2: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use**

**#3: T2-Soil-Ind/Com/Commu Property Use (Coarse)**

**#4: T2-Soil-Res/Park/Inst. Property Use (Coarse)**

# ANALYTICAL GUIDELINE REPORT

| Sample Details Grouping | Analyte | Result | Qualifier | D.L. | Units | Analyzed | Guideline Limits | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| L2030089-5 | BH13-SA1 | | | | | | | | | |
| Sampled By: | Client on 22-NOV-17 | | | | | | | | | |
| Matrix: | SOIL | | | | | | #1 | #2 | #3 | #4 |
| **Physical Tests** | | | | | | | | | | |
| | Conductivity | 0.340 | | 0.0040 | mS/cm | 07-DEC-17 | 0.47 | 0.57 | 1.4 | 0.7 |
| | % Moisture | 5.00 | | 0.10 | % | 05-DEC-17 | | | | |
| | pH | 8.13 | | 0.10 | pH units | 05-DEC-17 | | | | |
| **Cyanides** | | | | | | | | | | |
| | Cyanide, Weak Acid Diss | <0.050 | | 0.050 | ug/g | 06-DEC-17 | 0.051 | 0.051 | 0.051 | 0.051 |
| **Saturated Paste Extractables** | | | | | | | | | | |
| | SAR | 5.48 | | 0.10 | SAR | 07-DEC-17 | *1 | *2.4 | 12 | *5 |
| | Calcium (Ca) | 3.4 | | 1.0 | mg/L | 07-DEC-17 | | | | |
| | Magnesium (Mg) | 2.8 | | 1.0 | mg/L | 07-DEC-17 | | | | |
| | Sodium (Na) | 56.4 | | 1.0 | mg/L | 07-DEC-17 | | | | |
| **Metals** | | | | | | | | | | |
| | Antimony (Sb) | <1.0 | | 1.0 | ug/g | 07-DEC-17 | 1 | 1.3 | 40 | 7.5 |
| | Arsenic (As) | 1.8 | | 1.0 | ug/g | 07-DEC-17 | 11 | 18 | 18 | 18 |
| | Barium (Ba) | 7.8 | | 1.0 | ug/g | 07-DEC-17 | 210 | 220 | 670 | 390 |
| | Beryllium (Be) | <0.50 | | 0.50 | ug/g | 07-DEC-17 | 2.5 | 2.5 | 8 | 4 |
| | Boron (B) | 5.2 | | 5.0 | ug/g | 07-DEC-17 | 36 | 36 | 120 | 120 |
| | Boron (B), Hot Water Ext. | <0.10 | | 0.10 | ug/g | 11-DEC-17 | 36 | 36 | 2 | 1.5 |
| | Cadmium (Cd) | <0.50 | | 0.50 | ug/g | 07-DEC-17 | 1 | 1.2 | 1.9 | 1.2 |
| | Chromium (Cr) | 5.8 | | 1.0 | ug/g | 07-DEC-17 | 67 | 70 | 160 | 160 |
| | Cobalt (Co) | 1.8 | | 1.0 | ug/g | 07-DEC-17 | 19 | 21 | 80 | 22 |
| | Copper (Cu) | 5.8 | | 1.0 | ug/g | 07-DEC-17 | 62 | 92 | 230 | 140 |
| | Lead (Pb) | 2.0 | | 1.0 | ug/g | 07-DEC-17 | 45 | 120 | 120 | 120 |
| | Mercury (Hg) | 0.0056 | | 0.0050 | ug/g | 07-DEC-17 | 0.16 | 0.27 | 3.9 | 0.27 |
| | Molybdenum (Mo) | <1.0 | | 1.0 | ug/g | 07-DEC-17 | 2 | 2 | 40 | 6.9 |
| | Nickel (Ni) | 3.8 | | 1.0 | ug/g | 07-DEC-17 | 37 | 82 | 270 | 100 |
| | Selenium (Se) | <1.0 | | 1.0 | ug/g | 07-DEC-17 | 1.2 | 1.5 | 5.5 | 2.4 |
| | Silver (Ag) | <0.20 | | 0.20 | ug/g | 07-DEC-17 | 0.5 | 0.5 | 40 | 20 |
| | Thallium (Tl) | <0.50 | | 0.50 | ug/g | 07-DEC-17 | 1 | 1 | 3.3 | 1 |
| | Uranium (U) | <1.0 | | 1.0 | ug/g | 07-DEC-17 | 1.9 | 2.5 | 33 | 23 |
| | Vanadium (V) | 9.8 | | 1.0 | ug/g | 07-DEC-17 | 86 | 86 | 86 | 86 |
| | Zinc (Zn) | 9.8 | | 5.0 | ug/g | 07-DEC-17 | 290 | 290 | 340 | 340 |
| **Speciated Metals** | | | | | | | | | | |
| | Chromium, Hexavalent | <0.20 | | 0.20 | ug/g | 07-DEC-17 | 0.66 | 0.66 | 8 | 8 |
| **Volatile Organic Compounds** | | | | | | | | | | |
| | Acetone | <0.50 | VOCJ | 0.50 | ug/g | 06-DEC-17 | 0.5 | 0.5 | 16 | 16 |
| | Benzene | <0.0068 | VOCJ | 0.0068 | ug/g | 06-DEC-17 | 0.02 | 0.02 | 0.32 | 0.21 |
| | Bromodichloromethane | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 1.5 | 1.5 |
| | Bromoform | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 0.61 | 0.27 |
| | Bromomethane | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 0.05 | 0.05 |
| | Carbon tetrachloride | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 0.21 | 0.05 |
| | Chlorobenzene | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 2.4 | 2.4 |
| | Dibromochloromethane | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 2.3 | 2.3 |
| | Chloroform | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 0.47 | 0.05 |
| | 1,2-Dibromoethane | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 0.05 | 0.05 |
| | 1,2-Dichlorobenzene | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 1.2 | 1.2 |

** Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.

* Analytical result for this parameter exceeds Guideline Limit listed on this report. Guideline Limits applied:

**Ontario Regulation 153/04 - April 15, 2011 Standards = [Suite] - ON-511-T1/T2-SOIL-AG+RPIICC/RPI-ICC-C**

**#1: T1-Soil-Agricultural or Other Property Use**

**#2: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use**

**#3: T2-Soil-Ind/Com/Commu Property Use (Coarse)**

**#4: T2-Soil-Res/Park/Inst. Property Use (Coarse)**

| Sample Details Grouping | Analyte | Result | Qualifier | D.L. | Units | Analyzed | Guideline Limits | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| L2030089-5 | BH13-SA1 | | | | | | | | | |
| Sampled By: | Client on 22-NOV-17 | | | | | | | | | |
| Matrix: | SOIL | | | | | | #1 | #2 | #3 | #4 |
| **Volatile Organic Compounds** | | | | | | | | | | |
| | 1,3-Dichlorobenzene | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 9.6 | 4.8 |
| | 1,4-Dichlorobenzene | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 0.2 | 0.083 |
| | Dichlorodifluoromethane | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 16 | 16 |
| | 1,1-Dichloroethane | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 0.47 | 0.47 |
| | 1,2-Dichloroethane | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 0.05 | 0.05 |
| | 1,1-Dichloroethylene | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 0.064 | 0.05 |
| | cis-1,2-Dichloroethylene | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 1.9 | 1.9 |
| | trans-1,2-Dichloroethylene | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 1.3 | 0.084 |
| | Methylene Chloride | <0.50 | RRR | 0.50 | ug/g | 06-DEC-17 | **0.05 | **0.05 | 1.6 | **0.1 |
| | 1,2-Dichloropropane | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 0.16 | 0.05 |
| | cis-1,3-Dichloropropene | <0.030 | VOCJ | 0.030 | ug/g | 06-DEC-17 | | | | |
| | trans-1,3-Dichloropropene | <0.030 | VOCJ | 0.030 | ug/g | 06-DEC-17 | | | | |
| | 1,3-Dichloropropene (cis & trans) | <0.042 | | 0.042 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 0.059 | 0.05 |
| | Ethylbenzene | <0.018 | VOCJ | 0.018 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 1.1 | 1.1 |
| | n-Hexane | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 46 | 2.8 |
| | Methyl Ethyl Ketone | <0.50 | VOCJ | 0.50 | ug/g | 06-DEC-17 | 0.5 | 0.5 | 70 | 16 |
| | Methyl Isobutyl Ketone | <0.50 | VOCJ | 0.50 | ug/g | 06-DEC-17 | 0.5 | 0.5 | 31 | 1.7 |
| | MTBE | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 1.6 | 0.75 |
| | Styrene | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 34 | 0.7 |
| | 1,1,1,2-Tetrachloroethane | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 0.087 | 0.058 |
| | 1,1,2,2-Tetrachloroethane | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 0.05 | 0.05 |
| | Tetrachloroethylene | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 1.9 | 0.28 |
| | Toluene | <0.080 | VOCJ | 0.080 | ug/g | 06-DEC-17 | 0.2 | 0.2 | 6.4 | 2.3 |
| | 1,1,1-Trichloroethane | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 6.1 | 0.38 |
| | 1,1,2-Trichloroethane | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 0.05 | 0.05 |
| | Trichloroethylene | <0.010 | VOCJ | 0.010 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 0.55 | 0.061 |
| | Trichlorofluoromethane | <0.050 | VOCJ | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.25 | 4 | 4 |
| | Vinyl chloride | <0.020 | VOCJ | 0.020 | ug/g | 06-DEC-17 | 0.02 | 0.02 | 0.032 | 0.02 |
| | o-Xylene | <0.020 | VOCJ | 0.020 | ug/g | 06-DEC-17 | | | | |
| | m+p-Xylenes | <0.030 | VOCJ | 0.030 | ug/g | 06-DEC-17 | | | | |
| | Xylenes (Total) | <0.050 | | 0.050 | ug/g | 06-DEC-17 | 0.05 | 0.05 | 26 | 3.1 |
| | Surrogate: 4-Bromofluorobenzene | 107.9 | | 50-140 | % | 06-DEC-17 | | | | |
| | Surrogate: 1,4-Difluorobenzene | 108.9 | | 50-140 | % | 06-DEC-17 | | | | |
| **Hydrocarbons** | | | | | | | | | | |
| | F1 (C6-C10) | <5.0 | VOCJ | 5.0 | ug/g | 06-DEC-17 | 17 | 25 | 55 | 55 |
| | F1-BTEX | <5.0 | | 5.0 | ug/g | 12-DEC-17 | 17 | 25 | 55 | 55 |
| | F2 (C10-C16) | <10 | | 10 | ug/g | 11-DEC-17 | 10 | 10 | 230 | 98 |
| | F3 (C16-C34) | 55 | | 50 | ug/g | 11-DEC-17 | 240 | 240 | 1700 | 300 |
| | F4 (C34-C50) | 82 | | 50 | ug/g | 11-DEC-17 | 120 | 120 | 3300 | 2800 |
| | Total Hydrocarbons (C6-C50) | 137 | | 72 | ug/g | 12-DEC-17 | | | | |
| | Chrom. to baseline at nC50 | YES | | | No Unit | 11-DEC-17 | | | | |
| | Surrogate: 2-Bromobenzotrifluoride | 71.5 | | 60-140 | % | 11-DEC-17 | | | | |
| | Surrogate: 3,4-Dichlorotoluene | 73.3 | | 60-140 | % | 06-DEC-17 | | | | |

** Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.

* Analytical result for this parameter exceeds Guideline Limit listed on this report. Guideline Limits applied:

**Ontario Regulation 153/04 - April 15, 2011 Standards = [Suite] - ON-511-T1/T2-SOIL-AG+RPIICC/RPI-ICC-C**

**#1: T1-Soil-Agricultural or Other Property Use**

**#2: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use**

**#3: T2-Soil-Ind/Com/Commu Property Use (Coarse)**

**#4: T2-Soil-Res/Park/Inst. Property Use (Coarse)**

# ANALYTICAL GUIDELINE REPORT

| Sample Details<br>Grouping | Analyte | Result | Qualifier | D.L. | Units | Analyzed | Guideline Limits | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| L2030089-7 | BH16-SA2 | | | | | | | | | |
| Sampled By: | Client on 22-NOV-17 | | | | | | | | | |
| Matrix: | SOIL | | | | | | #1 | #2 | #3 | #4 |
| **Physical Tests** | | | | | | | | | | |
| | Conductivity | 0.588 | | 0.0040 | mS/cm | 07-DEC-17 | *0.47 | *0.57 | 1.4 | 0.7 |
| | % Moisture | 3.96 | | 0.10 | % | 05-DEC-17 | | | | |
| | pH | 8.27 | | 0.10 | pH units | 05-DEC-17 | | | | |
| **Cyanides** | | | | | | | | | | |
| | Cyanide, Weak Acid Diss | <0.050 | | 0.050 | ug/g | 06-DEC-17 | 0.051 | 0.051 | 0.051 | 0.051 |
| **Saturated Paste Extractables** | | | | | | | | | | |
| | SAR | 13.7 | | 0.10 | SAR | 07-DEC-17 | *1 | *2.4 | *12 | *5 |
| | Calcium (Ca) | 2.6 | | 1.0 | mg/L | 07-DEC-17 | | | | |
| | Magnesium (Mg) | 1.0 | | 1.0 | mg/L | 07-DEC-17 | | | | |
| | Sodium (Na) | 103 | | 1.0 | mg/L | 07-DEC-17 | | | | |
| **Metals** | | | | | | | | | | |
| | Antimony (Sb) | <1.0 | | 1.0 | ug/g | 07-DEC-17 | 1 | 1.3 | 40 | 7.5 |
| | Arsenic (As) | 1.1 | | 1.0 | ug/g | 07-DEC-17 | 11 | 18 | 18 | 18 |
| | Barium (Ba) | 4.2 | | 1.0 | ug/g | 07-DEC-17 | 210 | 220 | 670 | 390 |
| | Beryllium (Be) | <0.50 | | 0.50 | ug/g | 07-DEC-17 | 2.5 | 2.5 | 8 | 4 |
| | Boron (B) | <5.0 | | 5.0 | ug/g | 07-DEC-17 | 36 | 36 | 120 | 120 |
| | Boron (B), Hot Water Ext. | <0.10 | | 0.10 | ug/g | 11-DEC-17 | 36 | 36 | 2 | 1.5 |
| | Cadmium (Cd) | <0.50 | | 0.50 | ug/g | 07-DEC-17 | 1 | 1.2 | 1.9 | 1.2 |
| | Chromium (Cr) | 5.1 | | 1.0 | ug/g | 07-DEC-17 | 67 | 70 | 160 | 160 |
| | Cobalt (Co) | 1.2 | | 1.0 | ug/g | 07-DEC-17 | 19 | 21 | 80 | 22 |
| | Copper (Cu) | 1.1 | | 1.0 | ug/g | 07-DEC-17 | 62 | 92 | 230 | 140 |
| | Lead (Pb) | <1.0 | | 1.0 | ug/g | 07-DEC-17 | 45 | 120 | 120 | 120 |
| | Mercury (Hg) | <0.0050 | | 0.0050 | ug/g | 07-DEC-17 | 0.16 | 0.27 | 3.9 | 0.27 |
| | Molybdenum (Mo) | <1.0 | | 1.0 | ug/g | 07-DEC-17 | 2 | 2 | 40 | 6.9 |
| | Nickel (Ni) | 2.5 | | 1.0 | ug/g | 07-DEC-17 | 37 | 82 | 270 | 100 |
| | Selenium (Se) | <1.0 | | 1.0 | ug/g | 07-DEC-17 | 1.2 | 1.5 | 5.5 | 2.4 |
| | Silver (Ag) | <0.20 | | 0.20 | ug/g | 07-DEC-17 | 0.5 | 0.5 | 40 | 20 |
| | Thallium (Tl) | <0.50 | | 0.50 | ug/g | 07-DEC-17 | 1 | 1 | 3.3 | 1 |
| | Uranium (U) | <1.0 | | 1.0 | ug/g | 07-DEC-17 | 1.9 | 2.5 | 33 | 23 |
| | Vanadium (V) | 7.2 | | 1.0 | ug/g | 07-DEC-17 | 86 | 86 | 86 | 86 |
| | Zinc (Zn) | 5.3 | | 5.0 | ug/g | 07-DEC-17 | 290 | 290 | 340 | 340 |
| **Speciated Metals** | | | | | | | | | | |
| | Chromium, Hexavalent | <0.20 | | 0.20 | ug/g | 07-DEC-17 | 0.66 | 0.66 | 8 | 8 |
| **Volatile Organic Compounds** | | | | | | | | | | |
| | Acetone | <0.50 | VOCJ | 0.50 | ug/g | 07-DEC-17 | 0.5 | 0.5 | 16 | 16 |
| | Benzene | <0.0068 | VOCJ | 0.0068 | ug/g | 07-DEC-17 | 0.02 | 0.02 | 0.32 | 0.21 |
| | Bromodichloromethane | <0.050 | VOCJ | 0.050 | ug/g | 07-DEC-17 | 0.05 | 0.05 | 1.5 | 1.5 |
| | Bromoform | <0.050 | VOCJ | 0.050 | ug/g | 07-DEC-17 | 0.05 | 0.05 | 0.61 | 0.27 |
| | Bromomethane | <0.050 | VOCJ | 0.050 | ug/g | 07-DEC-17 | 0.05 | 0.05 | 0.05 | 0.05 |
| | Carbon tetrachloride | <0.050 | VOCJ | 0.050 | ug/g | 07-DEC-17 | 0.05 | 0.05 | 0.21 | 0.05 |
| | Chlorobenzene | <0.050 | VOCJ | 0.050 | ug/g | 07-DEC-17 | 0.05 | 0.05 | 2.4 | 2.4 |
| | Dibromochloromethane | <0.050 | VOCJ | 0.050 | ug/g | 07-DEC-17 | 0.05 | 0.05 | 2.3 | 2.3 |
| | Chloroform | <0.050 | VOCJ | 0.050 | ug/g | 07-DEC-17 | 0.05 | 0.05 | 0.47 | 0.05 |
| | 1,2-Dibromoethane | <0.050 | VOCJ | 0.050 | ug/g | 07-DEC-17 | 0.05 | 0.05 | 0.05 | 0.05 |
| | 1,2-Dichlorobenzene | <0.050 | VOCJ | 0.050 | ug/g | 07-DEC-17 | 0.05 | 0.05 | 1.2 | 1.2 |

** Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.
* Analytical result for this parameter exceeds Guideline Limit listed on this report. Guideline Limits applied:

**Ontario Regulation 153/04 - April 15, 2011 Standards = [Suite] - ON-511-T1/T2-SOIL-AG+RPIICC/RPI-ICC-C**

**#1: T1-Soil-Agricultural or Other Property Use**

**#2: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use**

**#3: T2-Soil-Ind/Com/Commu Property Use (Coarse)**

**#4: T2-Soil-Res/Park/Inst. Property Use (Coarse)**

# ANALYTICAL GUIDELINE REPORT

| Sample Details Grouping | Analyte | Result | Qualifier | D.L. | Units | Analyzed | Guideline Limits #1 | #2 | #3 | #4 |
|---|---|---|---|---|---|---|---|---|---|---|
| L2030089-7 | BH16-SA2 | | | | | | | | | |
| Sampled By: | Client on 22-NOV-17 | | | | | | | | | |
| Matrix: | SOIL | | | | | | | | | |
| **Volatile Organic Compounds** | | | | | | | | | | |
| | 1,3-Dichlorobenzene | <0.050 | VOCJ | 0.050 | ug/g | 07-DEC-17 | 0.05 | 0.05 | 9.6 | 4.8 |
| | 1,4-Dichlorobenzene | <0.050 | VOCJ | 0.050 | ug/g | 07-DEC-17 | 0.05 | 0.05 | 0.2 | 0.083 |
| | Dichlorodifluoromethane | <0.050 | VOCJ | 0.050 | ug/g | 07-DEC-17 | 0.05 | 0.05 | 16 | 16 |
| | 1,1-Dichloroethane | <0.050 | VOCJ | 0.050 | ug/g | 07-DEC-17 | 0.05 | 0.05 | 0.47 | 0.47 |
| | 1,2-Dichloroethane | <0.050 | VOCJ | 0.050 | ug/g | 07-DEC-17 | 0.05 | 0.05 | 0.05 | 0.05 |
| | 1,1-Dichloroethylene | <0.050 | VOCJ | 0.050 | ug/g | 07-DEC-17 | 0.05 | 0.05 | 0.064 | 0.05 |
| | cis-1,2-Dichloroethylene | <0.050 | VOCJ | 0.050 | ug/g | 07-DEC-17 | 0.05 | 0.05 | 1.9 | 1.9 |
| | trans-1,2-Dichloroethylene | <0.050 | VOCJ | 0.050 | ug/g | 07-DEC-17 | 0.05 | 0.05 | 1.3 | 0.084 |
| | Methylene Chloride | <0.15 | RRR | 0.15 | ug/g | 07-DEC-17 | **0.05 | **0.05 | 1.6 | **0.1 |
| | 1,2-Dichloropropane | <0.050 | VOCJ | 0.050 | ug/g | 07-DEC-17 | 0.05 | 0.05 | 0.16 | 0.05 |
| | cis-1,3-Dichloropropene | <0.030 | VOCJ | 0.030 | ug/g | 07-DEC-17 | | | | |
| | trans-1,3-Dichloropropene | <0.030 | VOCJ | 0.030 | ug/g | 07-DEC-17 | | | | |
| | 1,3-Dichloropropene (cis & trans) | <0.042 | | 0.042 | ug/g | 07-DEC-17 | 0.05 | 0.05 | 0.059 | 0.05 |
| | Ethylbenzene | <0.018 | VOCJ | 0.018 | ug/g | 07-DEC-17 | 0.05 | 0.05 | 1.1 | 1.1 |
| | n-Hexane | <0.050 | VOCJ | 0.050 | ug/g | 07-DEC-17 | 0.05 | 0.05 | 46 | 2.8 |
| | Methyl Ethyl Ketone | <0.50 | VOCJ | 0.50 | ug/g | 07-DEC-17 | 0.5 | 0.5 | 70 | 16 |
| | Methyl Isobutyl Ketone | <0.50 | VOCJ | 0.50 | ug/g | 07-DEC-17 | 0.5 | 0.5 | 31 | 1.7 |
| | MTBE | <0.050 | VOCJ | 0.050 | ug/g | 07-DEC-17 | 0.05 | 0.05 | 1.6 | 0.75 |
| | Styrene | <0.050 | VOCJ | 0.050 | ug/g | 07-DEC-17 | 0.05 | 0.05 | 34 | 0.7 |
| | 1,1,1,2-Tetrachloroethane | <0.050 | VOCJ | 0.050 | ug/g | 07-DEC-17 | 0.05 | 0.05 | 0.087 | 0.058 |
| | 1,1,2,2-Tetrachloroethane | <0.050 | VOCJ | 0.050 | ug/g | 07-DEC-17 | 0.05 | 0.05 | 0.05 | 0.05 |
| | Tetrachloroethylene | <0.050 | VOCJ | 0.050 | ug/g | 07-DEC-17 | 0.05 | 0.05 | 1.9 | 0.28 |
| | Toluene | <0.080 | VOCJ | 0.080 | ug/g | 07-DEC-17 | 0.2 | 0.2 | 6.4 | 2.3 |
| | 1,1,1-Trichloroethane | <0.050 | VOCJ | 0.050 | ug/g | 07-DEC-17 | 0.05 | 0.05 | 6.1 | 0.38 |
| | 1,1,2-Trichloroethane | <0.050 | VOCJ | 0.050 | ug/g | 07-DEC-17 | 0.05 | 0.05 | 0.05 | 0.05 |
| | Trichloroethylene | <0.010 | VOCJ | 0.010 | ug/g | 07-DEC-17 | 0.05 | 0.05 | 0.55 | 0.061 |
| | Trichlorofluoromethane | <0.050 | VOCJ | 0.050 | ug/g | 07-DEC-17 | 0.05 | 0.25 | 4 | 4 |
| | Vinyl chloride | <0.020 | VOCJ | 0.020 | ug/g | 07-DEC-17 | 0.02 | 0.02 | 0.032 | 0.02 |
| | o-Xylene | <0.020 | VOCJ | 0.020 | ug/g | 07-DEC-17 | | | | |
| | m+p-Xylenes | <0.030 | VOCJ | 0.030 | ug/g | 07-DEC-17 | | | | |
| | Xylenes (Total) | <0.050 | | 0.050 | ug/g | 07-DEC-17 | 0.05 | 0.05 | 26 | 3.1 |
| | Surrogate: 4-Bromofluorobenzene | 104.2 | | 50-140 | % | 07-DEC-17 | | | | |
| | Surrogate: 1,4-Difluorobenzene | 106.3 | | 50-140 | % | 07-DEC-17 | | | | |
| **Hydrocarbons** | | | | | | | | | | |
| | F1 (C6-C10) | <5.0 | VOCJ | 5.0 | ug/g | 07-DEC-17 | 17 | 25 | 55 | 55 |
| | F1-BTEX | <5.0 | | 5.0 | ug/g | 12-DEC-17 | 17 | 25 | 55 | 55 |
| | F2 (C10-C16) | <10 | | 10 | ug/g | 12-DEC-17 | 10 | 10 | 230 | 98 |
| | F3 (C16-C34) | 56 | | 50 | ug/g | 12-DEC-17 | 240 | 240 | 1700 | 300 |
| | F4 (C34-C50) | 129 | | 50 | ug/g | 12-DEC-17 | *120 | *120 | 3300 | 2800 |
| | F4G-SG (GHH-Silica) | 510 | | 250 | ug/g | 07-DEC-17 | *120 | *120 | 3300 | 2800 |
| | Total Hydrocarbons (C6-C50) | 186 | | 72 | ug/g | 12-DEC-17 | | | | |
| | Chrom. to baseline at nC50 | NO | | | No Unit | 12-DEC-17 | | | | |
| | Surrogate: 2-Bromobenzotrifluoride | 70.7 | | 60-140 | % | 12-DEC-17 | | | | |
| | Surrogate: 3,4-Dichlorotoluene | 74.2 | | 60-140 | % | 07-DEC-17 | | | | |

** Detection Limit for result exceeds Guideline Limit. Assessment against Guideline Limit cannot be made.

* Analytical result for this parameter exceeds Guideline Limit listed on this report. Guideline Limits applied:

**Ontario Regulation 153/04 - April 15, 2011 Standards = [Suite] - ON-511-T1/T2-SOIL-AG+RPIICC/RPI-ICC-C**

**#1: T1-Soil-Agricultural or Other Property Use**

**#2: T1-Soil-Res/Park/Inst/Ind/Com/Commu Property Use**

**#3: T2-Soil-Ind/Com/Commu Property Use (Coarse)**

**#4: T2-Soil-Res/Park/Inst. Property Use (Coarse)**

# Reference Information

**Qualifiers for Sample Submission Listed:**

| Qualifier | Description |
|---|---|
| VOCC | Soil jar was submitted as VOC sample container. VOC results may be biased low, and do not meet federal (CCME) or provincial requirements (for BC, AB-Tier1, MB, ON, SK). |

**Sample Parameter Qualifier key listed:**

| Qualifier | Description |
|---|---|
| SAR:M | Reported SAR represents a maximum value. Actual SAR may be lower if both Ca and Mg were detectable. |
| G | QC result did not meet ALS DQO. Refer to narrative comments for further information. |
| VOCJ | Soil jar was submitted as VOC sample container. VOC results may be biased low, and do not meet federal (CCME) or provincial requirements (for BC, AB-Tier1, MB, ON, SK). |
| DLM | Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity). |
| RRR | Refer to Report Remarks for issues regarding this analysis |

**Methods Listed (if applicable):**

| ALS Test Code | Matrix | Test Description | Method Reference*** |
|---|---|---|---|
| B-HWS-R511-WT | Soil | Boron-HWE-O.Reg 153/04 (July 2011) | HW EXTR, EPA 6010B |

A dried solid sample is extracted with calcium chloride, the sample undergoes a heating process. After cooling the sample is filtered and analyzed by ICP/OES.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

| ALS Test Code | Matrix | Test Description | Method Reference*** |
|---|---|---|---|
| CN-WAD-R511-WT | Soil | Cyanide (WAD)-O.Reg 153/04 (July 2011) | MOE 3015/APHA 4500CN I-WAD |

The sample is extracted with a strong base for 16 hours, and then filtered. The filtrate is then distilled where the cyanide is converted to cyanogen chloride by reacting with chloramine-T, the cyanogen chloride then reacts with a combination of barbituric acid and isonicotinic acid to form a highly colored complex.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

| ALS Test Code | Matrix | Test Description | Method Reference*** |
|---|---|---|---|
| CR-CR6-IC-WT | Soil | Hexavalent Chromium in Soil | SW846 3060A/7199 |

This analysis is carried out using procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846, Method 7199, published by the United States Environmental Protection Agency (EPA). The procedure involves analysis for chromium (VI) by ion chromatography using diphenylcarbazide in a sulphuric acid solution.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

| ALS Test Code | Matrix | Test Description | Method Reference*** |
|---|---|---|---|
| EC-WT | Soil | Conductivity (EC) | MOEE E3138 |

A representative subsample is tumbled with de-ionized (DI) water. The ratio of water to soil is 2:1 v/w. After tumbling the sample is then analyzed by a conductivity meter.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

# Reference Information

| | | | |
|---|---|---|---|
| F1-F4-511-CALC-WT | Soil | F1-F4 Hydrocarbon Calculated Parameters | CCME CWS-PHC, Pub #1310, Dec 2001-S |

Analytical methods used for analysis of CCME Petroleum Hydrocarbons have been validated and comply with the Reference Method for the CWS PHC.

Hydrocarbon results are expressed on a dry weight basis.

In cases where results for both F4 and F4G are reported, the greater of the two results must be used in any application of the CWS PHC guidelines and the gravimetric heavy hydrocarbons cannot be added to the C6 to C50 hydrocarbons.
In samples where BTEX and F1 were analyzed , F1-BTEX represents a value where the sum of Benzene, Toluene, Ethylbenzene and total Xylenes has been subtracted from F1.

In samples where PAHs, F2 and F3 were analyzed, F2-Naphth represents the result where Naphthalene has been subtracted from F2. F3-PAH represents a result where the sum of Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Dibenzo(a,h)anthracene, Fluoranthene, Indeno(1,2,3-cd)pyrene, Phenanthrene, and Pyrene has been subtracted from F3.

Unless otherwise qualified, the following quality control criteria have been met for the F1 hydrocarbon range:
1. All extraction and analysis holding times were met.
2. Instrument performance showing response factors for C6 and C10 within 30% of the response factor for toluene.
3. Linearity of gasoline response within 15% throughout the calibration range.

Unless otherwise qualified, the following quality control criteria have been met for the F2-F4 hydrocarbon ranges:
1. All extraction and analysis holding times were met.
2. Instrument performance showing C10, C16 and C34 response factors within 10% of their average.
3. Instrument performance showing the C50 response factor within 30% of the average of the C10, C16 and C34 response factors.
4. Linearity of diesel or motor oil response within 15% throughout the calibration range.

| | | | |
|---|---|---|---|
| F1-HS-511-WT | Soil | F1-O.Reg 153/04 (July 2011) | E3398/CCME TIER 1-HS |

Fraction F1 is determined by extracting a soil or sediment sample as received with methanol, then analyzing by headspace-GC/FID.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011), unless a subset of the Analytical Test Group (ATG) has been requested (the Protocol states that all analytes in an ATG must be reported).

| | | | |
|---|---|---|---|
| F2-F4-511-WT | Soil | F2-F4-O.Reg 153/04 (July 2011) | CCME Tier 1 |

Petroleum Hydrocarbons (F2-F4 fractions) are extracted from soil with 1:1 hexane:acetone using a rotary extractor. Extracts are treated with silica gel to remove polar organic interferences. F2, F3, & F4 are analyzed by GC-FID. F4G-sg is analyzed gravimetrically.

Notes:
1. F2 (C10-C16): Sum of all hydrocarbons that elute between nC10 and nC16.
2. F3 (C16-C34): Sum of all hydrocarbons that elute between nC16 and nC34.
3. F4 (C34-C50): Sum of all hydrocarbons that elute between nC34 and nC50.
4. F4G: Gravimetric Heavy Hydrocarbons
5. F4G-sg: Gravimetric Heavy Hydrocarbons (F4G) after silica gel treatment.
6. Where both F4 (C34-C50) and F4G-sg are reported for a sample, the larger of the two values is used for comparison against the relevant CCME guideline for F4.
7. F4G-sg cannot be added to the C6 to C50 hydrocarbon results to obtain an estimate of total extractable hydrocarbons.
8. This method is validated for use.
9. Data from analysis of validation and quality control samples is available upon request.
10. Reported results are expressed as milligrams per dry kilogram, unless otherwise indicated.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011), unless a subset of the Analytical Test Group (ATG) has been requested (the Protocol states that all analytes in an ATG must be reported).

| | | | |
|---|---|---|---|
| F4G-ADD-511-WT | Soil | F4G SG-O.Reg 153/04 (July 2011) | MOE DECPH-E3398/CCME TIER 1 |

F4G, gravimetric analysis, is determined if the chromatogram does not return to baseline at or before C50. A soil sample is extracted with a solvent mix, the solvent is evaporated and the weight of the residue is determined.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

| | | | |
|---|---|---|---|
| HG-200.2-CVAA-WT | Soil | Mercury in Soil by CVAAS | EPA 200.2/1631E (mod) |

Soil samples are digested with nitric and hydrochloric acids, followed by analysis by CVAAS.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

# Reference Information

| | | | |
|---|---|---|---|
| MET-200.2-CCMS-WT | Soil | Metals in Soil by CRC ICPMS | EPA 200.2/6020A (mod) |

This method uses a heated strong acid digestion with HNO3 and HCl and is intended to liberate metals that may be environmentally available. Silicate minerals are not solubilized. Dependent on sample matrix, some metals may be only partially recovered, including Al, Ba, Be, Cr, Sr, Ti, Tl, V, W, and Zr. Volatile forms of sulfur (including sulfide) may not be captured, as they may be lost during sampling, storage, or digestion. Analysis is by Collision/Reaction Cell ICPMS.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011), unless a subset of the Analytical Test Group (ATG) has been requested (the Protocol states that all analytes in an ATG must be reported).

| | | | |
|---|---|---|---|
| MOISTURE-WT | Soil | % Moisture | Gravimetric: Oven Dried |
| PH-WT | Soil | pH | MOEE E3137A |

A minimum 10g portion of the sample is extracted with 20mL of 0.01M calcium chloride solution by shaking for at least 30 minutes. The aqueous layer is separated from the soil and then analyzed using a pH meter and electrode.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

| | | | |
|---|---|---|---|
| SAR-R511-WT | Soil | SAR-O.Reg 153/04 (July 2011) | SW846 6010C |

A dried, disaggregated solid sample is extracted with deionized water, the aqueous extract is separated from the solid, acidified and then analyzed using a ICP/OES. The concentrations of Na, Ca and Mg are reported as per CALA requirements for calculated parameters. These individual parameters are not for comparison to any guideline.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

| | | | |
|---|---|---|---|
| VOC-1,3-DCP-CALC-WT | Soil | Regulation 153 VOCs | SW8260B/SW8270C |
| VOC-511-HS-WT | Soil | VOC-O.Reg 153/04 (July 2011) | SW846 8260 (511) |

Soil and sediment samples are extracted in methanol and analyzed by headspace-GC/MS.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011), unless a subset of the Analytical Test Group (ATG) has been requested (the Protocol states that all analytes in an ATG must be reported).

| | | | |
|---|---|---|---|
| XYLENES-SUM-CALC-WT | Soil | Sum of Xylene Isomer Concentrations | CALCULATION |

Total xylenes represents the sum of o-xylene and m&p-xylene.

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*** ALS test methods may incorporate modifications from specified reference methods to improve performance.

Chain of Custody numbers:

14-460142

*The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:*

| Laboratory Definition Code | Laboratory Location | Laboratory Definition Code | Laboratory Location |
|---|---|---|---|
| WT | ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA | | |

# Reference Information

## GLOSSARY OF REPORT TERMS

*Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.*
*mg/kg - milligrams per kilogram based on dry weight of sample*
*mg/kg wwt - milligrams per kilogram based on wet weight of sample*
*mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight*
*mg/L - unit of concentration based on volume, parts per million.*
*< - Less than.*
*D.L. - The reporting limit.*
*N/A - Result not available. Refer to qualifier code and definition for explanation.*

*Test results reported relate only to the samples as received by the laboratory.*
*UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.*
*Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.*

ALS Environmental

# Quality Control Report

Workorder: L2030089 Report Date: 30-JAN-18

Client: CHUNG AND VANDER DOELEN
311 VICTORIA ST. N.
KITCHENER ON N2H 5E1
Contact: JOE VANDERZALM

| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **B-HWS-R511-WT** | **Soil** | | | | | | | |
| **Batch R3907291** | | | | | | | | |
| **WG2680136-4 DUP** | | **L2029486-16** | | | | | | |
| Boron (B), Hot Water Ext. | | <0.10 | <0.10 | RPD-NA | ug/g | N/A | 30 | 08-DEC-17 |
| **WG2680136-2 IRM** | | **HOTB-SAL_SOIL5** | | | | | | |
| Boron (B), Hot Water Ext. | | | 112.7 | | % | | 70-130 | 08-DEC-17 |
| **WG2680136-3 LCS** | | | | | | | | |
| Boron (B), Hot Water Ext. | | | 98.9 | | % | | 70-130 | 08-DEC-17 |
| **WG2680136-1 MB** | | | | | | | | |
| Boron (B), Hot Water Ext. | | | <0.10 | | ug/g | | 0.1 | 08-DEC-17 |
| **Batch R3909311** | | | | | | | | |
| **WG2681347-4 DUP** | | **L2031924-14** | | | | | | |
| Boron (B), Hot Water Ext. | | 0.27 | 0.29 | | ug/g | 5.3 | 30 | 11-DEC-17 |
| **WG2681347-2 IRM** | | **HOTB-SAL_SOIL5** | | | | | | |
| Boron (B), Hot Water Ext. | | | 91.5 | | % | | 70-130 | 11-DEC-17 |
| **WG2681347-3 LCS** | | | | | | | | |
| Boron (B), Hot Water Ext. | | | 112.5 | | % | | 70-130 | 11-DEC-17 |
| **WG2681347-1 MB** | | | | | | | | |
| Boron (B), Hot Water Ext. | | | <0.10 | | ug/g | | 0.1 | 11-DEC-17 |
| **Batch R3909327** | | | | | | | | |
| **WG2681348-4 DUP** | | **L2027735-1** | | | | | | |
| Boron (B), Hot Water Ext. | | <0.10 | <0.10 | RPD-NA | ug/g | N/A | 30 | 11-DEC-17 |
| **WG2681348-2 IRM** | | **HOTB-SAL_SOIL5** | | | | | | |
| Boron (B), Hot Water Ext. | | | 123.1 | | % | | 70-130 | 11-DEC-17 |
| **WG2681348-3 LCS** | | | | | | | | |
| Boron (B), Hot Water Ext. | | | 106.8 | | % | | 70-130 | 11-DEC-17 |
| **WG2681348-1 MB** | | | | | | | | |
| Boron (B), Hot Water Ext. | | | <0.10 | | ug/g | | 0.1 | 11-DEC-17 |
| **CN-WAD-R511-WT** | **Soil** | | | | | | | |
| **Batch R3905832** | | | | | | | | |
| **WG2677409-3 DUP** | | **L2030089-1** | | | | | | |
| Cyanide, Weak Acid Diss | | <0.050 | <0.050 | RPD-NA | ug/g | N/A | 35 | 05-DEC-17 |
| **WG2677409-2 LCS** | | | | | | | | |
| Cyanide, Weak Acid Diss | | | 97.1 | | % | | 80-120 | 05-DEC-17 |
| **WG2677409-1 MB** | | | | | | | | |
| Cyanide, Weak Acid Diss | | | <0.050 | | ug/g | | 0.05 | 05-DEC-17 |
| **WG2677409-4 MS** | | **L2030089-1** | | | | | | |
| Cyanide, Weak Acid Diss | | | 95.0 | | % | | 70-130 | 05-DEC-17 |

# Quality Control Report

Client: CHUNG AND VANDER DOELEN
311 VICTORIA ST. N.
KITCHENER ON N2H 5E1
Contact: JOE VANDERZALM

| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **CN-WAD-R511-WT** | **Soil** | | | | | | | |
| **Batch R3906332** | | | | | | | | |
| **WG2678088-3 DUP** | | **L2030089-3** | | | | | | |
| Cyanide, Weak Acid Diss | | <0.050 | <0.050 | RPD-NA | ug/g | N/A | 35 | 06-DEC-17 |
| **WG2678088-2 LCS** | | | | | | | | |
| Cyanide, Weak Acid Diss | | | 94.1 | | % | | 80-120 | 06-DEC-17 |
| **WG2678088-1 MB** | | | | | | | | |
| Cyanide, Weak Acid Diss | | | <0.050 | | ug/g | | 0.05 | 06-DEC-17 |
| **WG2678088-4 MS** | | **L2030089-3** | | | | | | |
| Cyanide, Weak Acid Diss | | | 103.1 | | % | | 70-130 | 06-DEC-17 |
| **CR-CR6-IC-WT** | **Soil** | | | | | | | |
| **Batch R3907033** | | | | | | | | |
| **WG2678498-3 CRM** | | **WT-SQC012** | | | | | | |
| Chromium, Hexavalent | | | 88.8 | | % | | 70-130 | 07-DEC-17 |
| **WG2678498-4 DUP** | | **L2029486-12** | | | | | | |
| Chromium, Hexavalent | | 0.28 | 0.27 | | ug/g | 4.4 | 35 | 07-DEC-17 |
| **WG2678498-2 LCS** | | | | | | | | |
| Chromium, Hexavalent | | | 102.1 | | % | | 80-120 | 07-DEC-17 |
| **WG2678498-1 MB** | | | | | | | | |
| Chromium, Hexavalent | | | <0.20 | | ug/g | | 0.2 | 07-DEC-17 |
| **Batch R3907034** | | | | | | | | |
| **WG2678681-4 CRM** | | **WT-SQC012** | | | | | | |
| Chromium, Hexavalent | | | 83.3 | | % | | 70-130 | 07-DEC-17 |
| **WG2678681-3 DUP** | | **L2022851-1** | | | | | | |
| Chromium, Hexavalent | | <0.20 | <0.20 | RPD-NA | ug/g | N/A | 35 | 07-DEC-17 |
| **WG2678681-2 LCS** | | | | | | | | |
| Chromium, Hexavalent | | | 92.9 | | % | | 80-120 | 07-DEC-17 |
| **WG2678681-1 MB** | | | | | | | | |
| Chromium, Hexavalent | | | <0.20 | | ug/g | | 0.2 | 07-DEC-17 |
| **EC-WT** | **Soil** | | | | | | | |
| **Batch R3906797** | | | | | | | | |
| **WG2678814-14 DUP** | | **L2029656-1** | | | | | | |
| Conductivity | | 0.233 | 0.224 | | mS/cm | 3.9 | 20 | 07-DEC-17 |
| **WG2679610-2 LCS** | | | | | | | | |
| Conductivity | | | 99.6 | | % | | 90-110 | 07-DEC-17 |
| **WG2678814-13 MB** | | | | | | | | |
| Conductivity | | | <0.0040 | | mS/cm | | 0.004 | 07-DEC-17 |
| **F1-HS-511-WT** | **Soil** | | | | | | | |

# Quality Control Report

Workorder: L2030089 Report Date: 30-JAN-18

Client: CHUNG AND VANDER DOELEN
311 VICTORIA ST. N.
KITCHENER ON N2H 5E1
Contact: JOE VANDERZALM

| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **F1-HS-511-WT** | **Soil** | | | | | | | |
| **Batch R3905063** | | | | | | | | |
| **WG2676849-4 DUP** | | **WG2676849-3** | | | | | | |
| F1 (C6-C10) | | <5.0 | <5.0 | RPD-NA | ug/g | N/A | 30 | 06-DEC-17 |
| **WG2676849-2 LCS** | | | | | | | | |
| F1 (C6-C10) | | | 96.5 | | % | | 80-120 | 05-DEC-17 |
| **WG2676849-1 MB** | | | | | | | | |
| F1 (C6-C10) | | | <5.0 | | ug/g | | 5 | 05-DEC-17 |
| Surrogate: 3,4-Dichlorotoluene | | | 86.8 | | % | | 60-140 | 05-DEC-17 |
| **WG2676849-7 MS** | | **WG2676849-6** | | | | | | |
| F1 (C6-C10) | | | 93.9 | | % | | 60-140 | 05-DEC-17 |
| **F2-F4-511-WT** | **Soil** | | | | | | | |
| **Batch R3907630** | | | | | | | | |
| **WG2677118-4 DUP** | | **WG2677118-3** | | | | | | |
| F2 (C10-C16) | | <10 | <10 | RPD-NA | ug/g | N/A | 30 | 08-DEC-17 |
| F3 (C16-C34) | | <50 | <50 | RPD-NA | ug/g | N/A | 30 | 08-DEC-17 |
| F4 (C34-C50) | | <50 | <50 | RPD-NA | ug/g | N/A | 30 | 08-DEC-17 |
| **WG2677118-2 LCS** | | | | | | | | |
| F2 (C10-C16) | | | 143.3 | LCS-H | % | | 80-120 | 08-DEC-17 |
| F3 (C16-C34) | | | 139.0 | LCS-H | % | | 80-120 | 08-DEC-17 |
| F4 (C34-C50) | | | 139.8 | LCS-H | % | | 80-120 | 08-DEC-17 |
| **WG2677118-1 MB** | | | | | | | | |
| F2 (C10-C16) | | | <10 | | ug/g | | 10 | 08-DEC-17 |
| F3 (C16-C34) | | | <50 | | ug/g | | 50 | 08-DEC-17 |
| F4 (C34-C50) | | | <50 | | ug/g | | 50 | 08-DEC-17 |
| Surrogate: 2-Bromobenzotrifluoride | | | 36.8 | MBS | % | | 60-140 | 08-DEC-17 |
| **WG2677118-5 MS** | | **WG2677118-3** | | | | | | |
| F2 (C10-C16) | | | 110.7 | | % | | 60-140 | 08-DEC-17 |
| F3 (C16-C34) | | | 109.3 | | % | | 60-140 | 08-DEC-17 |
| F4 (C34-C50) | | | 110.1 | | % | | 60-140 | 08-DEC-17 |
| **Batch R3909909** | | | | | | | | |
| **WG2680759-4 DUP** | | **WG2680759-3** | | | | | | |
| F2 (C10-C16) | | <10 | <10 | RPD-NA | ug/g | N/A | 30 | 11-DEC-17 |
| F3 (C16-C34) | | 70 | 52 | J | ug/g | 19 | 100 | 11-DEC-17 |
| F4 (C34-C50) | | 67 | <50 | RPD-NA | ug/g | N/A | 30 | 11-DEC-17 |
| **WG2680759-2 LCS** | | | | | | | | |
| F2 (C10-C16) | | | 106.1 | | % | | 80-120 | 11-DEC-17 |
| F3 (C16-C34) | | | 102.8 | | % | | 80-120 | 11-DEC-17 |

| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **F2-F4-511-WT** | **Soil** | | | | | | | |
| **Batch R3909909** | | | | | | | | |
| **WG2680759-2 LCS** | | | | | | | | |
| F4 (C34-C50) | | | 103.1 | | % | | 80-120 | 11-DEC-17 |
| **WG2680759-1 MB** | | | | | | | | |
| F2 (C10-C16) | | | <10 | | ug/g | | 10 | 11-DEC-17 |
| F3 (C16-C34) | | | <50 | | ug/g | | 50 | 11-DEC-17 |
| F4 (C34-C50) | | | <50 | | ug/g | | 50 | 11-DEC-17 |
| Surrogate: 2-Bromobenzotrifluoride | | | 88.3 | | % | | 60-140 | 11-DEC-17 |
| **WG2680759-5 MS** | | **WG2680759-3** | | | | | | |
| F2 (C10-C16) | | | 92.7 | | % | | 60-140 | 11-DEC-17 |
| F3 (C16-C34) | | | 92.3 | | % | | 60-140 | 11-DEC-17 |
| F4 (C34-C50) | | | 95.7 | | % | | 60-140 | 11-DEC-17 |
| **Batch R3911651** | | | | | | | | |
| **WG2678636-4 DUP** | | **WG2678636-3** | | | | | | |
| F2 (C10-C16) | | <10 | <10 | RPD-NA | ug/g | N/A | 30 | 11-DEC-17 |
| F3 (C16-C34) | | <50 | <50 | RPD-NA | ug/g | N/A | 30 | 11-DEC-17 |
| F4 (C34-C50) | | <50 | <50 | RPD-NA | ug/g | N/A | 30 | 11-DEC-17 |
| COMMENTS: Surrogate recovery marginally exceeded ALS DQO. Reported non-detect results for associated samples were deemed to be unaffected. | | | | | | | | |
| **WG2678636-2 LCS** | | | | | | | | |
| F2 (C10-C16) | | | 116.2 | | % | | 80-120 | 11-DEC-17 |
| F3 (C16-C34) | | | 113.7 | | % | | 80-120 | 11-DEC-17 |
| F4 (C34-C50) | | | 113.4 | | % | | 80-120 | 11-DEC-17 |
| **WG2678636-1 MB** | | | | | | | | |
| F2 (C10-C16) | | | <10 | | ug/g | | 10 | 12-DEC-17 |
| F3 (C16-C34) | | | <50 | | ug/g | | 50 | 12-DEC-17 |
| F4 (C34-C50) | | | <50 | | ug/g | | 50 | 12-DEC-17 |
| Surrogate: 2-Bromobenzotrifluoride | | | 41.3 | MBS | % | | 60-140 | 12-DEC-17 |
| **WG2678636-5 MS** | | **WG2678636-3** | | | | | | |
| F2 (C10-C16) | | | 106.5 | | % | | 60-140 | 11-DEC-17 |
| F3 (C16-C34) | | | 110.8 | | % | | 60-140 | 11-DEC-17 |
| F4 (C34-C50) | | | 112.1 | | % | | 60-140 | 11-DEC-17 |
| **Batch R3912368** | | | | | | | | |
| **WG2682137-4 DUP** | | **WG2682137-3** | | | | | | |
| F2 (C10-C16) | | <20 | <20 | RPD-NA | ug/g | N/A | 30 | 12-DEC-17 |
| F3 (C16-C34) | | 300 | 280 | | ug/g | 7.0 | 30 | 12-DEC-17 |
| F4 (C34-C50) | | 340 | 320 | | ug/g | 4.7 | 30 | 12-DEC-17 |
| **WG2682137-2 LCS** | | | | | | | | |

| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **F2-F4-511-WT** | **Soil** | | | | | | | |
| **Batch R3912368** | | | | | | | | |
| **WG2682137-2 LCS** | | | | | | | | |
| F2 (C10-C16) | | | 111.4 | | % | | 80-120 | 12-DEC-17 |
| F3 (C16-C34) | | | 101.9 | | % | | 80-120 | 12-DEC-17 |
| F4 (C34-C50) | | | 105.2 | | % | | 80-120 | 12-DEC-17 |
| **WG2682137-1 MB** | | | | | | | | |
| F2 (C10-C16) | | | <10 | | ug/g | | 10 | 12-DEC-17 |
| F3 (C16-C34) | | | <50 | | ug/g | | 50 | 12-DEC-17 |
| F4 (C34-C50) | | | <50 | | ug/g | | 50 | 12-DEC-17 |
| Surrogate: 2-Bromobenzotrifluoride | | | 101.9 | | % | | 60-140 | 12-DEC-17 |
| **WG2682137-5 MS** | | **WG2682137-3** | | | | | | |
| F2 (C10-C16) | | | 101.6 | | % | | 60-140 | 12-DEC-17 |
| F3 (C16-C34) | | | 113.2 | | % | | 60-140 | 12-DEC-17 |
| F4 (C34-C50) | | | N/A | MS-B | % | | - | 12-DEC-17 |
| **F4G-ADD-511-WT** | **Soil** | | | | | | | |
| **Batch R3912041** | | | | | | | | |
| **WG2682950-2 LCS** | | | | | | | | |
| F4G-SG (GHH-Silica) | | | 104.0 | | % | | 60-140 | 07-DEC-17 |
| **WG2682950-1 MB** | | | | | | | | |
| F4G-SG (GHH-Silica) | | | <250 | | ug/g | | 250 | 07-DEC-17 |
| **Batch R3912660** | | | | | | | | |
| **WG2683652-3 DUP** | | **L2030089-3** | | | | | | |
| F4G-SG (GHH-Silica) | | 1420 | 990 | | ug/g | 36 | 40 | 08-DEC-17 |
| **WG2683652-2 LCS** | | | | | | | | |
| F4G-SG (GHH-Silica) | | | 83.0 | | % | | 60-140 | 08-DEC-17 |
| **WG2683652-1 MB** | | | | | | | | |
| F4G-SG (GHH-Silica) | | | <250 | | ug/g | | 250 | 08-DEC-17 |
| **HG-200.2-CVAA-WT** | **Soil** | | | | | | | |
| **Batch R3906456** | | | | | | | | |
| **WG2679203-2 CRM** | | **WT-CANMET-TILL1** | | | | | | |
| Mercury (Hg) | | | 111.5 | | % | | 70-130 | 07-DEC-17 |
| **WG2679203-6 DUP** | | **WG2679203-5** | | | | | | |
| Mercury (Hg) | | 0.0114 | 0.0115 | | ug/g | 1.2 | 40 | 07-DEC-17 |
| **WG2679203-3 LCS** | | | | | | | | |
| Mercury (Hg) | | | 113.5 | | % | | 80-120 | 07-DEC-17 |
| **WG2679203-1 MB** | | | | | | | | |
| Mercury (Hg) | | | <0.0050 | | mg/kg | | 0.005 | 07-DEC-17 |
| **MET-200.2-CCMS-WT** | **Soil** | | | | | | | |

| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **MET-200.2-CCMS-WT** | **Soil** | | | | | | | |
| **Batch R3907089** | | | | | | | | |
| **WG2679203-2 CRM** | | **WT-CANMET-TILL1** | | | | | | |
| Antimony (Sb) | | | 92.5 | | % | | 70-130 | 07-DEC-17 |
| Arsenic (As) | | | 114.6 | | % | | 70-130 | 07-DEC-17 |
| Barium (Ba) | | | 117.6 | | % | | 70-130 | 07-DEC-17 |
| Beryllium (Be) | | | 111.6 | | % | | 70-130 | 07-DEC-17 |
| Boron (B) | | | 4.0 | | mg/kg | | 0-8.2 | 07-DEC-17 |
| Cadmium (Cd) | | | 108.8 | | % | | 70-130 | 07-DEC-17 |
| Chromium (Cr) | | | 114.3 | | % | | 70-130 | 07-DEC-17 |
| Cobalt (Co) | | | 112.8 | | % | | 70-130 | 07-DEC-17 |
| Copper (Cu) | | | 114.2 | | % | | 70-130 | 07-DEC-17 |
| Lead (Pb) | | | 102.7 | | % | | 70-130 | 07-DEC-17 |
| Molybdenum (Mo) | | | 106.0 | | % | | 70-130 | 07-DEC-17 |
| Nickel (Ni) | | | 111.5 | | % | | 70-130 | 07-DEC-17 |
| Selenium (Se) | | | 0.34 | | mg/kg | | 0.11-0.51 | 07-DEC-17 |
| Silver (Ag) | | | 0.22 | | mg/kg | | 0.13-0.33 | 07-DEC-17 |
| Thallium (Tl) | | | 0.120 | | mg/kg | | 0.077-0.18 | 07-DEC-17 |
| Uranium (U) | | | 101.9 | | % | | 70-130 | 07-DEC-17 |
| Vanadium (V) | | | 112.9 | | % | | 70-130 | 07-DEC-17 |
| Zinc (Zn) | | | 111.5 | | % | | 70-130 | 07-DEC-17 |
| **WG2679203-6 DUP** | | **WG2679203-5** | | | | | | |
| Antimony (Sb) | | <0.10 | <0.10 | RPD-NA | ug/g | N/A | 30 | 07-DEC-17 |
| Arsenic (As) | | 2.57 | 2.56 | | ug/g | 0.3 | 30 | 07-DEC-17 |
| Barium (Ba) | | 71.1 | 75.0 | | ug/g | 5.3 | 40 | 07-DEC-17 |
| Beryllium (Be) | | 0.49 | 0.51 | | ug/g | 3.0 | 30 | 07-DEC-17 |
| Boron (B) | | 12.9 | 13.6 | | ug/g | 5.6 | 30 | 07-DEC-17 |
| Cadmium (Cd) | | 0.119 | 0.115 | | ug/g | 3.4 | 30 | 07-DEC-17 |
| Chromium (Cr) | | 18.3 | 18.9 | | ug/g | 3.2 | 30 | 07-DEC-17 |
| Cobalt (Co) | | 6.68 | 6.74 | | ug/g | 0.9 | 30 | 07-DEC-17 |
| Copper (Cu) | | 17.0 | 17.0 | | ug/g | 0.3 | 30 | 07-DEC-17 |
| Lead (Pb) | | 11.4 | 11.4 | | ug/g | 0.3 | 40 | 07-DEC-17 |
| Molybdenum (Mo) | | 0.20 | 0.19 | | ug/g | 5.7 | 40 | 07-DEC-17 |
| Nickel (Ni) | | 15.1 | 15.1 | | ug/g | 0.1 | 30 | 07-DEC-17 |
| Selenium (Se) | | <0.20 | <0.20 | RPD-NA | ug/g | N/A | 30 | 07-DEC-17 |
| Silver (Ag) | | <0.10 | <0.10 | RPD-NA | ug/g | N/A | 40 | 07-DEC-17 |

# Quality Control Report

Workorder: L2030089 Report Date: 30-JAN-18

Client: CHUNG AND VANDER DOELEN
311 VICTORIA ST. N.
KITCHENER ON N2H 5E1
Contact: JOE VANDERZALM

| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **MET-200.2-CCMS-WT** | **Soil** | | | | | | | |
| **Batch R3907089** | | | | | | | | |
| **WG2679203-6 DUP** | | **WG2679203-5** | | | | | | |
| Thallium (Tl) | | 0.096 | 0.094 | | ug/g | 1.7 | 30 | 07-DEC-17 |
| Uranium (U) | | 0.462 | 0.478 | | ug/g | 3.4 | 30 | 07-DEC-17 |
| Vanadium (V) | | 28.4 | 28.5 | | ug/g | 0.4 | 30 | 07-DEC-17 |
| Zinc (Zn) | | 53.9 | 53.4 | | ug/g | 1.0 | 30 | 07-DEC-17 |
| **WG2679203-4 LCS** | | | | | | | | |
| Antimony (Sb) | | | 99.1 | | % | | 80-120 | 07-DEC-17 |
| Arsenic (As) | | | 109.2 | | % | | 80-120 | 07-DEC-17 |
| Barium (Ba) | | | 109.4 | | % | | 80-120 | 07-DEC-17 |
| Beryllium (Be) | | | 99.9 | | % | | 80-120 | 07-DEC-17 |
| Boron (B) | | | 97.4 | | % | | 80-120 | 07-DEC-17 |
| Cadmium (Cd) | | | 100.7 | | % | | 80-120 | 07-DEC-17 |
| Chromium (Cr) | | | 107.9 | | % | | 80-120 | 07-DEC-17 |
| Cobalt (Co) | | | 105.7 | | % | | 80-120 | 07-DEC-17 |
| Copper (Cu) | | | 104.0 | | % | | 80-120 | 07-DEC-17 |
| Lead (Pb) | | | 104.4 | | % | | 80-120 | 07-DEC-17 |
| Molybdenum (Mo) | | | 101.5 | | % | | 80-120 | 07-DEC-17 |
| Nickel (Ni) | | | 105.2 | | % | | 80-120 | 07-DEC-17 |
| Selenium (Se) | | | 101.6 | | % | | 80-120 | 07-DEC-17 |
| Silver (Ag) | | | 97.1 | | % | | 80-120 | 07-DEC-17 |
| Thallium (Tl) | | | 107.8 | | % | | 80-120 | 07-DEC-17 |
| Uranium (U) | | | 98.6 | | % | | 80-120 | 07-DEC-17 |
| Vanadium (V) | | | 109.2 | | % | | 80-120 | 07-DEC-17 |
| Zinc (Zn) | | | 99.8 | | % | | 80-120 | 07-DEC-17 |
| **WG2679203-1 MB** | | | | | | | | |
| Antimony (Sb) | | | <0.10 | | mg/kg | | 0.1 | 07-DEC-17 |
| Arsenic (As) | | | <0.10 | | mg/kg | | 0.1 | 07-DEC-17 |
| Barium (Ba) | | | <0.50 | | mg/kg | | 0.5 | 07-DEC-17 |
| Beryllium (Be) | | | <0.10 | | mg/kg | | 0.1 | 07-DEC-17 |
| Boron (B) | | | <5.0 | | mg/kg | | 5 | 07-DEC-17 |
| Cadmium (Cd) | | | <0.020 | | mg/kg | | 0.02 | 07-DEC-17 |
| Chromium (Cr) | | | <0.50 | | mg/kg | | 0.5 | 07-DEC-17 |
| Cobalt (Co) | | | <0.10 | | mg/kg | | 0.1 | 07-DEC-17 |
| Copper (Cu) | | | <0.50 | | mg/kg | | 0.5 | 07-DEC-17 |
| Lead (Pb) | | | <0.50 | | mg/kg | | 0.5 | 07-DEC-17 |

| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **MET-200.2-CCMS-WT** | **Soil** | | | | | | | |
| **Batch R3907089** | | | | | | | | |
| **WG2679203-1 MB** | | | | | | | | |
| Molybdenum (Mo) | | | <0.10 | | mg/kg | | 0.1 | 07-DEC-17 |
| Nickel (Ni) | | | <0.50 | | mg/kg | | 0.5 | 07-DEC-17 |
| Selenium (Se) | | | <0.20 | | mg/kg | | 0.2 | 07-DEC-17 |
| Silver (Ag) | | | <0.10 | | mg/kg | | 0.1 | 07-DEC-17 |
| Thallium (Tl) | | | <0.050 | | mg/kg | | 0.05 | 07-DEC-17 |
| Uranium (U) | | | <0.050 | | mg/kg | | 0.05 | 07-DEC-17 |
| Vanadium (V) | | | <0.20 | | mg/kg | | 0.2 | 07-DEC-17 |
| Zinc (Zn) | | | <2.0 | | mg/kg | | 2 | 07-DEC-17 |
| **MOISTURE-WT** | **Soil** | | | | | | | |
| **Batch R3903852** | | | | | | | | |
| **WG2677077-3 DUP** | | **L2029712-1** | | | | | | |
| % Moisture | | 9.98 | 9.79 | | % | 1.9 | 20 | 04-DEC-17 |
| **WG2677077-2 LCS** | | | | | | | | |
| % Moisture | | | 98.6 | | % | | 90-110 | 04-DEC-17 |
| **WG2677077-1 MB** | | | | | | | | |
| % Moisture | | | <0.10 | | % | | 0.1 | 04-DEC-17 |
| **Batch R3903853** | | | | | | | | |
| **WG2677376-3 DUP** | | **L2029551-1** | | | | | | |
| % Moisture | | 10.7 | 11.2 | | % | 4.9 | 20 | 04-DEC-17 |
| **WG2677376-2 LCS** | | | | | | | | |
| % Moisture | | | 100.0 | | % | | 90-110 | 04-DEC-17 |
| **WG2677376-1 MB** | | | | | | | | |
| % Moisture | | | <0.10 | | % | | 0.1 | 04-DEC-17 |
| **Batch R3903856** | | | | | | | | |
| **WG2677306-3 DUP** | | **L2028950-3** | | | | | | |
| % Moisture | | 8.55 | 8.41 | | % | 1.7 | 20 | 04-DEC-17 |
| **WG2677306-2 LCS** | | | | | | | | |
| % Moisture | | | 100.2 | | % | | 90-110 | 04-DEC-17 |
| **WG2677306-1 MB** | | | | | | | | |
| % Moisture | | | <0.10 | | % | | 0.1 | 04-DEC-17 |
| **Batch R3905456** | | | | | | | | |
| **WG2677828-3 DUP** | | **L2030089-5** | | | | | | |
| % Moisture | | 5.00 | 4.99 | | % | 0.2 | 20 | 05-DEC-17 |
| **WG2677828-2 LCS** | | | | | | | | |
| % Moisture | | | 99.7 | | % | | 90-110 | 05-DEC-17 |
| **WG2677828-1 MB** | | | | | | | | |

| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **MOISTURE-WT** | **Soil** | | | | | | | |
| **Batch R3905456** | | | | | | | | |
| **WG2677828-1 MB** | | | | | | | | |
| % Moisture | | | <0.10 | | % | | 0.1 | 05-DEC-17 |
| **Batch R3905464** | | | | | | | | |
| **WG2677928-3 DUP** | | **L2030089-7** | | | | | | |
| % Moisture | | 3.96 | 4.03 | | % | 1.7 | 20 | 05-DEC-17 |
| **WG2677928-2 LCS** | | | | | | | | |
| % Moisture | | | 99.6 | | % | | 90-110 | 05-DEC-17 |
| **WG2677928-1 MB** | | | | | | | | |
| % Moisture | | | <0.10 | | % | | 0.1 | 05-DEC-17 |
| **PH-WT** | **Soil** | | | | | | | |
| **Batch R3905378** | | | | | | | | |
| **WG2677412-1 DUP** | | **L2030089-1** | | | | | | |
| pH | | 7.63 | 7.60 | J | pH units | 0.03 | 0.3 | 05-DEC-17 |
| **WG2677776-1 LCS** | | | | | | | | |
| pH | | | 6.98 | | pH units | | 6.9-7.1 | 05-DEC-17 |
| **SAR-R511-WT** | **Soil** | | | | | | | |
| **Batch R3907103** | | | | | | | | |
| **WG2678814-14 DUP** | | **L2029656-1** | | | | | | |
| Calcium (Ca) | | 11.0 | 10.8 | | mg/L | 1.8 | 30 | 07-DEC-17 |
| Sodium (Na) | | 7.8 | 7.6 | | mg/L | 2.8 | 30 | 07-DEC-17 |
| Magnesium (Mg) | | 2.7 | 2.6 | | mg/L | 1.6 | 30 | 07-DEC-17 |
| **WG2678814-15 IRM** | | **WT SAR1** | | | | | | |
| Calcium (Ca) | | | 98.8 | | % | | 70-130 | 07-DEC-17 |
| Sodium (Na) | | | 113.4 | | % | | 70-130 | 07-DEC-17 |
| Magnesium (Mg) | | | 101.8 | | % | | 70-130 | 07-DEC-17 |
| **WG2678814-13 MB** | | | | | | | | |
| Calcium (Ca) | | | <1.0 | | mg/L | | 1 | 07-DEC-17 |
| Sodium (Na) | | | <1.0 | | mg/L | | 1 | 07-DEC-17 |
| Magnesium (Mg) | | | <1.0 | | mg/L | | 1 | 07-DEC-17 |
| **VOC-511-HS-WT** | **Soil** | | | | | | | |
| **Batch R3905063** | | | | | | | | |
| **WG2676849-4 DUP** | | **WG2676849-3** | | | | | | |
| 1,1,1,2-Tetrachloroethane | | <0.050 | <0.050 | RPD-NA | ug/g | N/A | 40 | 06-DEC-17 |
| 1,1,2,2-Tetrachloroethane | | <0.050 | <0.050 | RPD-NA | ug/g | N/A | 40 | 06-DEC-17 |
| 1,1,1-Trichloroethane | | <0.050 | <0.050 | RPD-NA | ug/g | N/A | 40 | 06-DEC-17 |

| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **VOC-511-HS-WT** | **Soil** | | | | | | | |
| **Batch R3905063** | | | | | | | | |
| **WG2676849-4 DUP** | | **WG2676849-3** | | | | | | |
| 1,1,2-Trichloroethane | | <0.050 | <0.050 | RPD-NA | ug/g | N/A | 40 | 06-DEC-17 |
| 1,1-Dichloroethane | | <0.050 | <0.050 | RPD-NA | ug/g | N/A | 40 | 06-DEC-17 |
| 1,1-Dichloroethylene | | <0.050 | <0.050 | RPD-NA | ug/g | N/A | 40 | 06-DEC-17 |
| 1,2-Dibromoethane | | <0.050 | <0.050 | RPD-NA | ug/g | N/A | 40 | 06-DEC-17 |
| 1,2-Dichlorobenzene | | <0.050 | <0.050 | RPD-NA | ug/g | N/A | 40 | 06-DEC-17 |
| 1,2-Dichloroethane | | <0.050 | <0.050 | RPD-NA | ug/g | N/A | 40 | 06-DEC-17 |
| 1,2-Dichloropropane | | <0.050 | <0.050 | RPD-NA | ug/g | N/A | 40 | 06-DEC-17 |
| 1,3-Dichlorobenzene | | <0.050 | <0.050 | RPD-NA | ug/g | N/A | 40 | 06-DEC-17 |
| 1,4-Dichlorobenzene | | <0.050 | <0.050 | RPD-NA | ug/g | N/A | 40 | 06-DEC-17 |
| Acetone | | <0.50 | <0.50 | RPD-NA | ug/g | N/A | 40 | 06-DEC-17 |
| Benzene | | <0.0068 | <0.0068 | RPD-NA | ug/g | N/A | 40 | 06-DEC-17 |
| Bromodichloromethane | | <0.050 | <0.050 | RPD-NA | ug/g | N/A | 40 | 06-DEC-17 |
| Bromoform | | <0.050 | <0.050 | RPD-NA | ug/g | N/A | 40 | 06-DEC-17 |
| Bromomethane | | <0.050 | <0.050 | RPD-NA | ug/g | N/A | 40 | 06-DEC-17 |
| Carbon tetrachloride | | <0.050 | <0.050 | RPD-NA | ug/g | N/A | 40 | 06-DEC-17 |
| Chlorobenzene | | <0.050 | <0.050 | RPD-NA | ug/g | N/A | 40 | 06-DEC-17 |
| Chloroform | | <0.050 | <0.050 | RPD-NA | ug/g | N/A | 40 | 06-DEC-17 |
| cis-1,2-Dichloroethylene | | <0.050 | <0.050 | RPD-NA | ug/g | N/A | 40 | 06-DEC-17 |
| cis-1,3-Dichloropropene | | <0.030 | <0.030 | RPD-NA | ug/g | N/A | 40 | 06-DEC-17 |
| Dibromochloromethane | | <0.050 | <0.050 | RPD-NA | ug/g | N/A | 40 | 06-DEC-17 |
| Dichlorodifluoromethane | | <0.050 | <0.050 | RPD-NA | ug/g | N/A | 40 | 06-DEC-17 |
| Ethylbenzene | | <0.018 | <0.018 | RPD-NA | ug/g | N/A | 40 | 06-DEC-17 |
| n-Hexane | | <0.050 | <0.050 | RPD-NA | ug/g | N/A | 40 | 06-DEC-17 |
| Methylene Chloride | | <0.050 | <0.050 | RPD-NA | ug/g | N/A | 40 | 06-DEC-17 |
| MTBE | | <0.050 | <0.050 | RPD-NA | ug/g | N/A | 40 | 06-DEC-17 |
| m+p-Xylenes | | <0.030 | <0.030 | RPD-NA | ug/g | N/A | 40 | 06-DEC-17 |
| Methyl Ethyl Ketone | | <0.50 | <0.50 | RPD-NA | ug/g | N/A | 40 | 06-DEC-17 |
| Methyl Isobutyl Ketone | | <0.50 | <0.50 | RPD-NA | ug/g | N/A | 40 | 06-DEC-17 |
| o-Xylene | | <0.020 | <0.020 | RPD-NA | ug/g | N/A | 40 | 06-DEC-17 |
| Styrene | | <0.050 | <0.050 | RPD-NA | ug/g | N/A | 40 | 06-DEC-17 |
| Tetrachloroethylene | | <0.050 | <0.050 | RPD-NA | ug/g | N/A | 40 | 06-DEC-17 |
| Toluene | | <0.080 | <0.080 | RPD-NA | ug/g | N/A | 40 | 06-DEC-17 |
| trans-1,2-Dichloroethylene | | <0.050 | <0.050 | | ug/g | | | 06-DEC-17 |

# Quality Control Report

Client: CHUNG AND VANDER DOELEN
311 VICTORIA ST. N.
KITCHENER ON N2H 5E1
Contact: JOE VANDERZALM

| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **VOC-511-HS-WT** | **Soil** | | | | | | | |
| **Batch R3905063** | | | | | | | | |
| **WG2676849-4 DUP** | | **WG2676849-3** | | | | | | |
| trans-1,2-Dichloroethylene | | <0.050 | <0.050 | RPD-NA | ug/g | N/A | 40 | 06-DEC-17 |
| trans-1,3-Dichloropropene | | <0.030 | <0.030 | RPD-NA | ug/g | N/A | 40 | 06-DEC-17 |
| Trichloroethylene | | <0.010 | <0.010 | RPD-NA | ug/g | N/A | 40 | 06-DEC-17 |
| Trichlorofluoromethane | | <0.050 | <0.050 | RPD-NA | ug/g | N/A | 40 | 06-DEC-17 |
| Vinyl chloride | | <0.020 | <0.020 | RPD-NA | ug/g | N/A | 40 | 06-DEC-17 |
| **WG2676849-2 LCS** | | | | | | | | |
| 1,1,1,2-Tetrachloroethane | | | 101.0 | | % | | 60-130 | 05-DEC-17 |
| 1,1,2,2-Tetrachloroethane | | | 98.9 | | % | | 60-130 | 05-DEC-17 |
| 1,1,1-Trichloroethane | | | 102.2 | | % | | 60-130 | 05-DEC-17 |
| 1,1,2-Trichloroethane | | | 102.1 | | % | | 60-130 | 05-DEC-17 |
| 1,1-Dichloroethane | | | 109.7 | | % | | 60-130 | 05-DEC-17 |
| 1,1-Dichloroethylene | | | 89.0 | | % | | 60-130 | 05-DEC-17 |
| 1,2-Dibromoethane | | | 101.6 | | % | | 70-130 | 05-DEC-17 |
| 1,2-Dichlorobenzene | | | 104.2 | | % | | 70-130 | 05-DEC-17 |
| 1,2-Dichloroethane | | | 101.0 | | % | | 60-130 | 05-DEC-17 |
| 1,2-Dichloropropane | | | 101.9 | | % | | 70-130 | 05-DEC-17 |
| 1,3-Dichlorobenzene | | | 103.4 | | % | | 70-130 | 05-DEC-17 |
| 1,4-Dichlorobenzene | | | 105.4 | | % | | 70-130 | 05-DEC-17 |
| Acetone | | | 108.5 | | % | | 60-140 | 05-DEC-17 |
| Benzene | | | 103.6 | | % | | 70-130 | 05-DEC-17 |
| Bromodichloromethane | | | 99.96 | | % | | 50-140 | 05-DEC-17 |
| Bromoform | | | 93.8 | | % | | 70-130 | 05-DEC-17 |
| Bromomethane | | | 93.7 | | % | | 50-140 | 05-DEC-17 |
| Carbon tetrachloride | | | 101.5 | | % | | 70-130 | 05-DEC-17 |
| Chlorobenzene | | | 104.1 | | % | | 70-130 | 05-DEC-17 |
| Chloroform | | | 104.7 | | % | | 70-130 | 05-DEC-17 |
| cis-1,2-Dichloroethylene | | | 107.0 | | % | | 70-130 | 05-DEC-17 |
| cis-1,3-Dichloropropene | | | 101.4 | | % | | 70-130 | 05-DEC-17 |
| Dibromochloromethane | | | 101.6 | | % | | 60-130 | 05-DEC-17 |
| Dichlorodifluoromethane | | | 49.8 | MES | % | | 50-140 | 05-DEC-17 |
| Ethylbenzene | | | 98.3 | | % | | 70-130 | 05-DEC-17 |
| n-Hexane | | | 76.2 | | % | | 70-130 | 05-DEC-17 |
| Methylene Chloride | | | 110.3 | | % | | 70-130 | 05-DEC-17 |

| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **VOC-511-HS-WT** | **Soil** | | | | | | | |
| **Batch R3905063** | | | | | | | | |
| **WG2676849-2 LCS** | | | | | | | | |
| MTBE | | | 104.7 | | % | | 70-130 | 05-DEC-17 |
| m+p-Xylenes | | | 98.1 | | % | | 70-130 | 05-DEC-17 |
| Methyl Ethyl Ketone | | | 104.3 | | % | | 60-140 | 05-DEC-17 |
| Methyl Isobutyl Ketone | | | 94.8 | | % | | 60-140 | 05-DEC-17 |
| o-Xylene | | | 97.5 | | % | | 70-130 | 05-DEC-17 |
| Styrene | | | 97.5 | | % | | 70-130 | 05-DEC-17 |
| Tetrachloroethylene | | | 103.9 | | % | | 60-130 | 05-DEC-17 |
| Toluene | | | 100.7 | | % | | 70-130 | 05-DEC-17 |
| trans-1,2-Dichloroethylene | | | 101.9 | | % | | 60-130 | 05-DEC-17 |
| trans-1,3-Dichloropropene | | | 94.9 | | % | | 70-130 | 05-DEC-17 |
| Trichloroethylene | | | 109.7 | | % | | 60-130 | 05-DEC-17 |
| Trichlorofluoromethane | | | 95.1 | | % | | 50-140 | 05-DEC-17 |
| Vinyl chloride | | | 81.6 | | % | | 60-140 | 05-DEC-17 |
| **WG2676849-1 MB** | | | | | | | | |
| 1,1,1,2-Tetrachloroethane | | | <0.050 | | ug/g | | 0.05 | 05-DEC-17 |
| 1,1,2,2-Tetrachloroethane | | | <0.050 | | ug/g | | 0.05 | 05-DEC-17 |
| 1,1,1-Trichloroethane | | | <0.050 | | ug/g | | 0.05 | 05-DEC-17 |
| 1,1,2-Trichloroethane | | | <0.050 | | ug/g | | 0.05 | 05-DEC-17 |
| 1,1-Dichloroethane | | | <0.050 | | ug/g | | 0.05 | 05-DEC-17 |
| 1,1-Dichloroethylene | | | <0.050 | | ug/g | | 0.05 | 05-DEC-17 |
| 1,2-Dibromoethane | | | <0.050 | | ug/g | | 0.05 | 05-DEC-17 |
| 1,2-Dichlorobenzene | | | <0.050 | | ug/g | | 0.05 | 05-DEC-17 |
| 1,2-Dichloroethane | | | <0.050 | | ug/g | | 0.05 | 05-DEC-17 |
| 1,2-Dichloropropane | | | <0.050 | | ug/g | | 0.05 | 05-DEC-17 |
| 1,3-Dichlorobenzene | | | <0.050 | | ug/g | | 0.05 | 05-DEC-17 |
| 1,4-Dichlorobenzene | | | <0.050 | | ug/g | | 0.05 | 05-DEC-17 |
| Acetone | | | <0.50 | | ug/g | | 0.5 | 05-DEC-17 |
| Benzene | | | <0.0068 | | ug/g | | 0.0068 | 05-DEC-17 |
| Bromodichloromethane | | | <0.050 | | ug/g | | 0.05 | 05-DEC-17 |
| Bromoform | | | <0.050 | | ug/g | | 0.05 | 05-DEC-17 |
| Bromomethane | | | <0.050 | | ug/g | | 0.05 | 05-DEC-17 |
| Carbon tetrachloride | | | <0.050 | | ug/g | | 0.05 | 05-DEC-17 |
| Chlorobenzene | | | <0.050 | | ug/g | | 0.05 | 05-DEC-17 |
| Chloroform | | | <0.050 | | ug/g | | 0.05 | 05-DEC-17 |

# Quality Control Report

Client: CHUNG AND VANDER DOELEN
311 VICTORIA ST. N.
KITCHENER ON N2H 5E1
Contact: JOE VANDERZALM

| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **VOC-511-HS-WT** | **Soil** | | | | | | | |
| **Batch R3905063** | | | | | | | | |
| **WG2676849-1 MB** | | | | | | | | |
| cis-1,2-Dichloroethylene | | | <0.050 | | ug/g | | 0.05 | 05-DEC-17 |
| cis-1,3-Dichloropropene | | | <0.030 | | ug/g | | 0.03 | 05-DEC-17 |
| Dibromochloromethane | | | <0.050 | | ug/g | | 0.05 | 05-DEC-17 |
| Dichlorodifluoromethane | | | <0.050 | | ug/g | | 0.05 | 05-DEC-17 |
| Ethylbenzene | | | <0.018 | | ug/g | | 0.018 | 05-DEC-17 |
| n-Hexane | | | <0.050 | | ug/g | | 0.05 | 05-DEC-17 |
| Methylene Chloride | | | <0.050 | | ug/g | | 0.05 | 05-DEC-17 |
| MTBE | | | <0.050 | | ug/g | | 0.05 | 05-DEC-17 |
| m+p-Xylenes | | | <0.030 | | ug/g | | 0.03 | 05-DEC-17 |
| Methyl Ethyl Ketone | | | <0.50 | | ug/g | | 0.5 | 05-DEC-17 |
| Methyl Isobutyl Ketone | | | <0.50 | | ug/g | | 0.5 | 05-DEC-17 |
| o-Xylene | | | <0.020 | | ug/g | | 0.02 | 05-DEC-17 |
| Styrene | | | <0.050 | | ug/g | | 0.05 | 05-DEC-17 |
| Tetrachloroethylene | | | <0.050 | | ug/g | | 0.05 | 05-DEC-17 |
| Toluene | | | <0.080 | | ug/g | | 0.08 | 05-DEC-17 |
| trans-1,2-Dichloroethylene | | | <0.050 | | ug/g | | 0.05 | 05-DEC-17 |
| trans-1,3-Dichloropropene | | | <0.030 | | ug/g | | 0.03 | 05-DEC-17 |
| Trichloroethylene | | | <0.010 | | ug/g | | 0.01 | 05-DEC-17 |
| Trichlorofluoromethane | | | <0.050 | | ug/g | | 0.05 | 05-DEC-17 |
| Vinyl chloride | | | <0.020 | | ug/g | | 0.02 | 05-DEC-17 |
| Surrogate: 1,4-Difluorobenzene | | | 107.4 | | % | | 50-140 | 05-DEC-17 |
| Surrogate: 4-Bromofluorobenzene | | | 106.3 | | % | | 50-140 | 05-DEC-17 |
| **WG2676849-5 MS** | | **WG2676849-3** | | | | | | |
| 1,1,1,2-Tetrachloroethane | | | 103.1 | | % | | 50-140 | 06-DEC-17 |
| 1,1,2,2-Tetrachloroethane | | | 99.97 | | % | | 50-140 | 06-DEC-17 |
| 1,1,1-Trichloroethane | | | 103.7 | | % | | 50-140 | 06-DEC-17 |
| 1,1,2-Trichloroethane | | | 106.3 | | % | | 50-140 | 06-DEC-17 |
| 1,1-Dichloroethane | | | 113.7 | | % | | 50-140 | 06-DEC-17 |
| 1,1-Dichloroethylene | | | 91.0 | | % | | 50-140 | 06-DEC-17 |
| 1,2-Dibromoethane | | | 106.2 | | % | | 50-140 | 06-DEC-17 |
| 1,2-Dichlorobenzene | | | 107.0 | | % | | 50-140 | 06-DEC-17 |
| 1,2-Dichloroethane | | | 105.3 | | % | | 50-140 | 06-DEC-17 |
| 1,2-Dichloropropane | | | 104.7 | | % | | 50-140 | 06-DEC-17 |
| 1,3-Dichlorobenzene | | | 104.8 | | % | | 50-140 | 06-DEC-17 |

# Quality Control Report

Workorder: L2030089 Report Date: 30-JAN-18

Client: CHUNG AND VANDER DOELEN
311 VICTORIA ST. N.
KITCHENER ON N2H 5E1
Contact: JOE VANDERZALM

| Test | Matrix | Reference | Result | Qualifier | Units | RPD | Limit | Analyzed |
|---|---|---|---|---|---|---|---|---|
| **VOC-511-HS-WT** | **Soil** | | | | | | | |
| **Batch R3905063** | | | | | | | | |
| **WG2676849-5 MS** | | **WG2676849-3** | | | | | | |
| 1,4-Dichlorobenzene | | | 106.8 | | % | | 50-140 | 06-DEC-17 |
| Acetone | | | 111.5 | | % | | 50-140 | 06-DEC-17 |
| Benzene | | | 105.5 | | % | | 50-140 | 06-DEC-17 |
| Bromodichloromethane | | | 102.1 | | % | | 50-140 | 06-DEC-17 |
| Bromoform | | | 95.8 | | % | | 50-140 | 06-DEC-17 |
| Bromomethane | | | 96.8 | | % | | 50-140 | 06-DEC-17 |
| Carbon tetrachloride | | | 103.1 | | % | | 50-140 | 06-DEC-17 |
| Chlorobenzene | | | 105.7 | | % | | 50-140 | 06-DEC-17 |
| Chloroform | | | 107.7 | | % | | 50-140 | 06-DEC-17 |
| cis-1,2-Dichloroethylene | | | 110.0 | | % | | 50-140 | 06-DEC-17 |
| cis-1,3-Dichloropropene | | | 99.7 | | % | | 50-140 | 06-DEC-17 |
| Dibromochloromethane | | | 104.4 | | % | | 50-140 | 06-DEC-17 |
| Dichlorodifluoromethane | | | 54.0 | | % | | 50-140 | 06-DEC-17 |
| Ethylbenzene | | | 99.2 | | % | | 50-140 | 06-DEC-17 |
| n-Hexane | | | 78.5 | | % | | 50-140 | 06-DEC-17 |
| Methylene Chloride | | | 114.3 | | % | | 50-140 | 06-DEC-17 |
| MTBE | | | 106.1 | | % | | 50-140 | 06-DEC-17 |
| m+p-Xylenes | | | 98.6 | | % | | 50-140 | 06-DEC-17 |
| Methyl Ethyl Ketone | | | 109.1 | | % | | 50-140 | 06-DEC-17 |
| Methyl Isobutyl Ketone | | | 93.6 | | % | | 50-140 | 06-DEC-17 |
| o-Xylene | | | 98.7 | | % | | 50-140 | 06-DEC-17 |
| Styrene | | | 98.0 | | % | | 50-140 | 06-DEC-17 |
| Tetrachloroethylene | | | 105.5 | | % | | 50-140 | 06-DEC-17 |
| Toluene | | | 102.7 | | % | | 50-140 | 06-DEC-17 |
| trans-1,2-Dichloroethylene | | | 102.2 | | % | | 50-140 | 06-DEC-17 |
| trans-1,3-Dichloropropene | | | 94.2 | | % | | 50-140 | 06-DEC-17 |
| Trichloroethylene | | | 110.7 | | % | | 50-140 | 06-DEC-17 |
| Trichlorofluoromethane | | | 98.3 | | % | | 50-140 | 06-DEC-17 |
| Vinyl chloride | | | 83.3 | | % | | 50-140 | 06-DEC-17 |

**Legend:**

| | |
|---|---|
| Limit | ALS Control Limit (Data Quality Objectives) |
| DUP | Duplicate |
| RPD | Relative Percent Difference |
| N/A | Not Available |
| LCS | Laboratory Control Sample |
| SRM | Standard Reference Material |
| MS | Matrix Spike |
| MSD | Matrix Spike Duplicate |
| ADE | Average Desorption Efficiency |
| MB | Method Blank |
| IRM | Internal Reference Material |
| CRM | Certified Reference Material |
| CCV | Continuing Calibration Verification |
| CVS | Calibration Verification Standard |
| LCSD | Laboratory Control Sample Duplicate |

**Sample Parameter Qualifier Definitions:**

| Qualifier | Description |
|---|---|
| DLM | Detection Limit Adjusted due to sample matrix effects (e.g. chemical interference, colour, turbidity). |
| J | Duplicate results and limits are expressed in terms of absolute difference. |
| LCS-H | Lab Control Sample recovery was above ALS DQO. Non-detected sample results are considered reliable. Other results, if reported, have been qualified. |
| MBS | Surrogate recovery in Method Blank was outside ALS DQO. Moderately low-biased results in the MB do not significantly affect its purpose. |
| MES | Data Quality Objective was marginally exceeded (by < 10% absolute) for < 10% of analytes in a Multi-Element Scan / Multi-Parameter Scan (considered acceptable as per OMOE & CCME). |
| MS-B | Matrix Spike recovery could not be accurately calculated due to high analyte background in sample. |
| RPD-NA | Relative Percent Difference Not Available due to result(s) being less than detection limit. |

**Hold Time Exceedances:**

All test results reported with this submission were conducted within ALS recommended hold times.

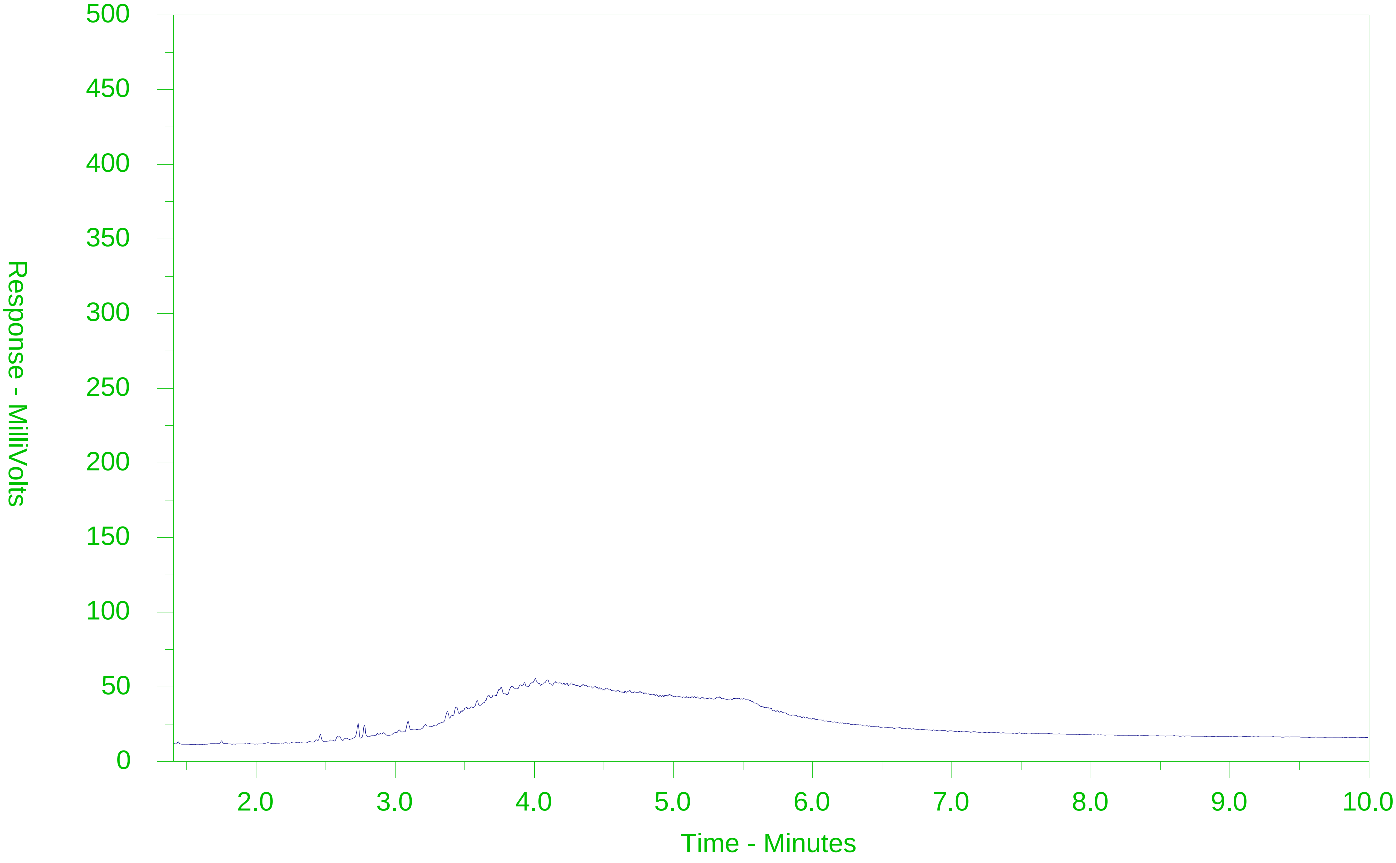
ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

# CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT

| | |
|---|---|
| ALS Sample ID: | L2030089-1 |
| Client Sample ID: | BH1-SA2 |



| | | | |
|---|---|---|---|
| ←F2→ | ←F3→ | | ←F4→ |
| nC10 | nC16 | nC34 | nC50 |
| 174°C | 287°C | 481°C | 575°C |
| 346°F | 549°F | 898°F | 1067°F |
| Gasoline → | | ← Motor Oils/Lube Oils/Grease → | |
| ← Diesel/Jet Fuels → | | | |

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

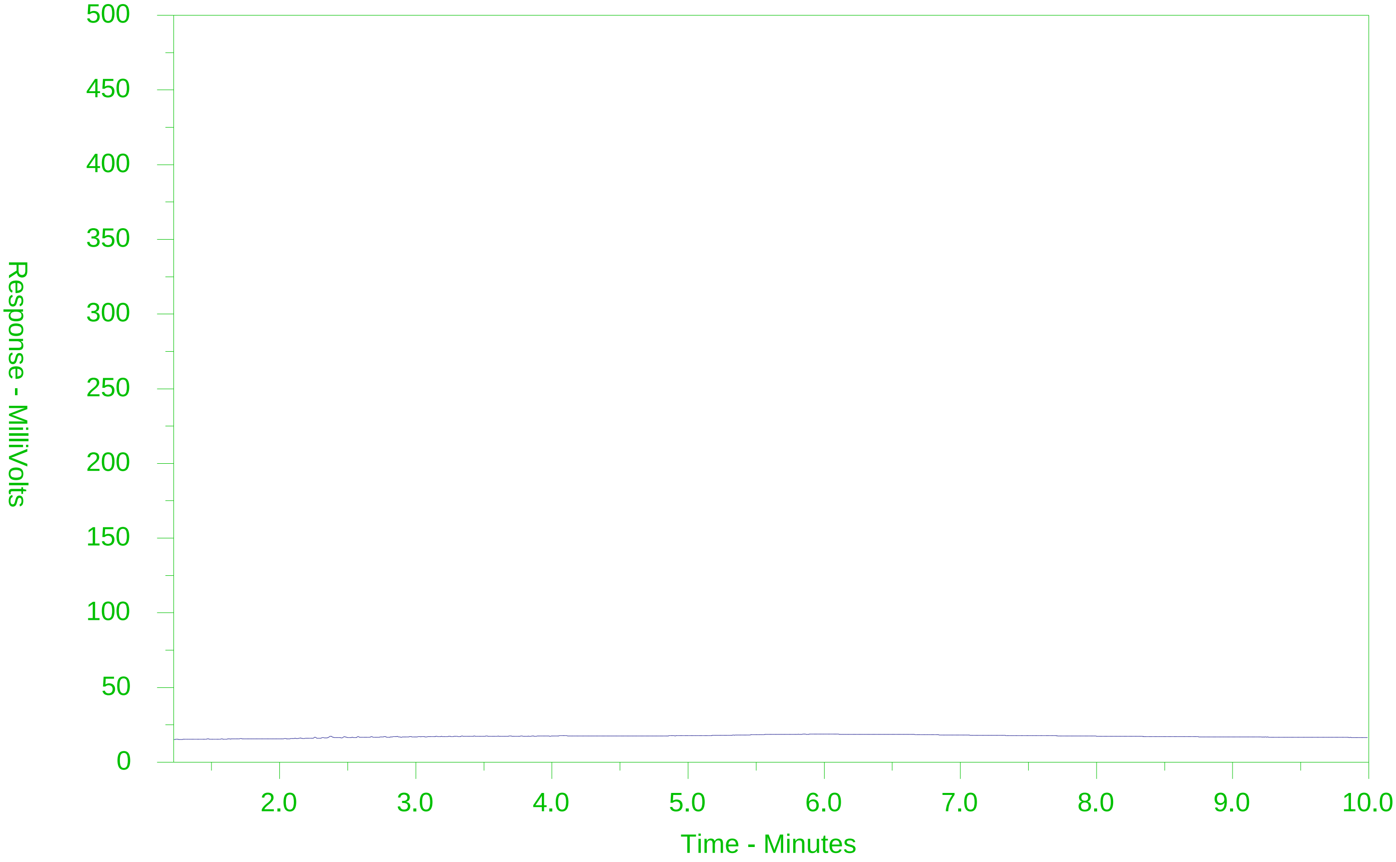
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor and the scale at the left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR Library can be found at www.alsglobal.com.

# CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2030089-2
Client Sample ID: BH2-SA5



| ←F2→ | ←F3→ | | ←F4→ |
|---|---|---|---|
| nC10 | nC16 | nC34 | nC50 |
| 174°C<br>346°F | 287°C<br>549°F | 481°C<br>898°F | 575°C<br>1067°F |
| Gasoline → | | ← Motor Oils/Lube Oils/Grease → | |
| ← Diesel/Jet Fuels → | | | |

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

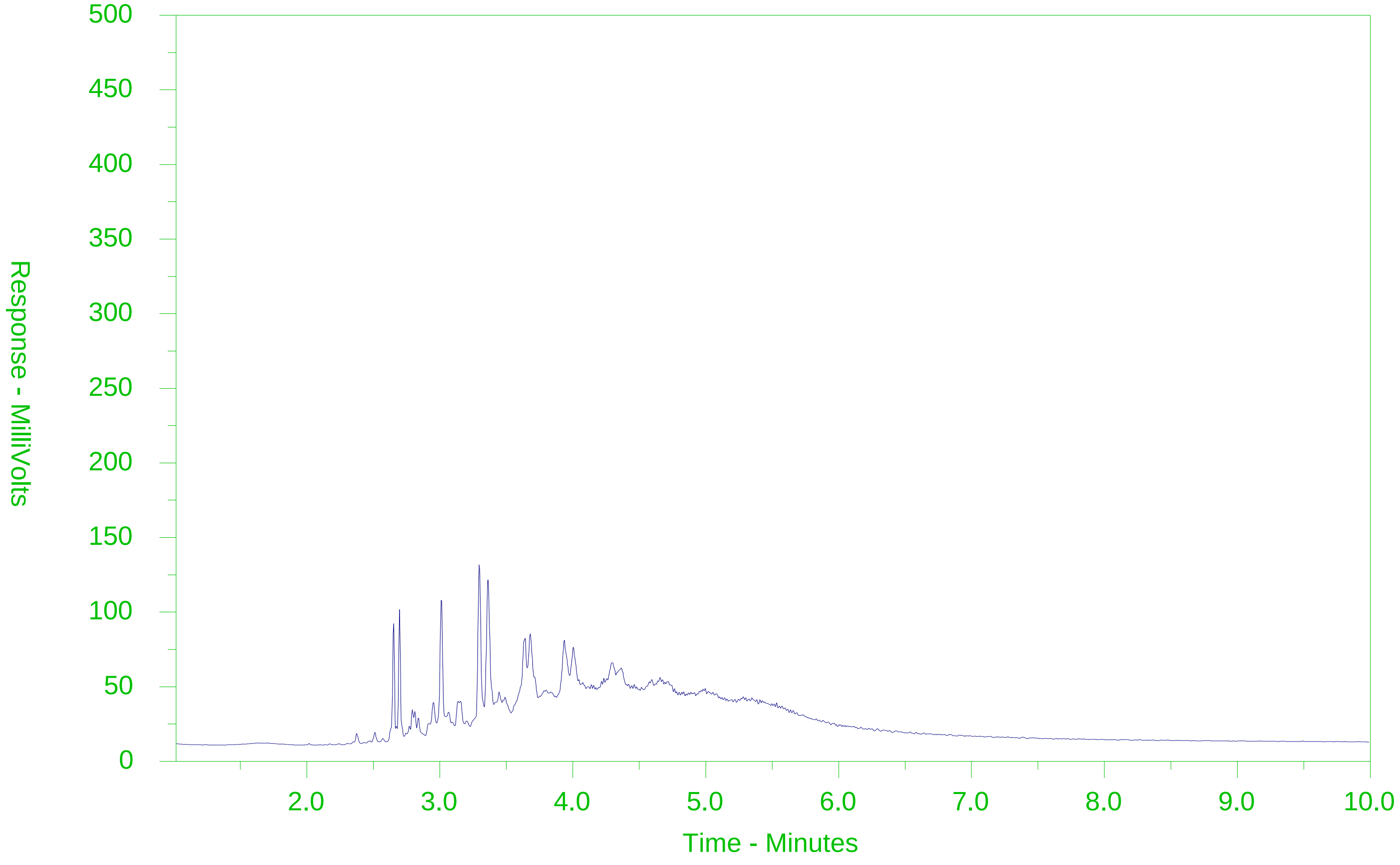
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor and the scale at the left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR Library can be found at www.alsglobal.com.

# CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2030089-3
Client Sample ID: BH5-SA1



| | | | |
|---|---|---|---|
| ←F2→ | ←F3→ | ←F4→ | |
| nC10 | nC16 | nC34 | nC50 |
| 174°C | 287°C | 481°C | 575°C |
| 346°F | 549°F | 898°F | 1067°F |
| Gasoline → | | ← Motor Oils/Lube Oils/Grease → | |
| ← Diesel/Jet Fuels → | | | |

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor and the scale at the left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR Library can be found at www.alsglobal.com.

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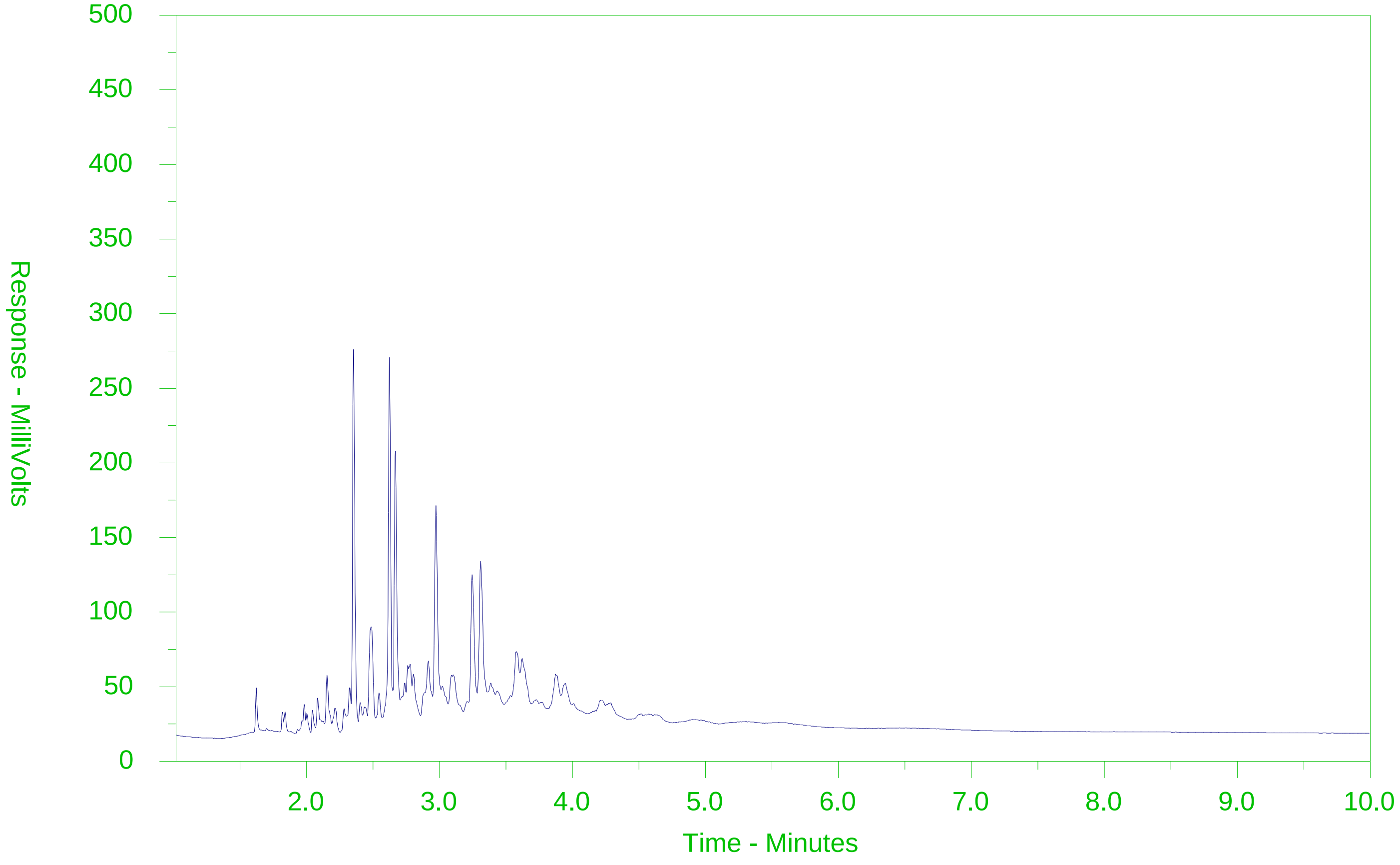
# CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2030089-4
Client Sample ID: BH9-SA2



| | | | |
|---|---|---|---|
| ←F2→ | ←F3→ | ←F4→ | |
| nC10 | nC16 | nC34 | nC50 |
| 174°C | 287°C | 481°C | 575°C |
| 346°F | 549°F | 898°F | 1067°F |
| Gasoline → | | ← Motor Oils/Lube Oils/Grease → | |
| ← Diesel/Jet Fuels → | | | |

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

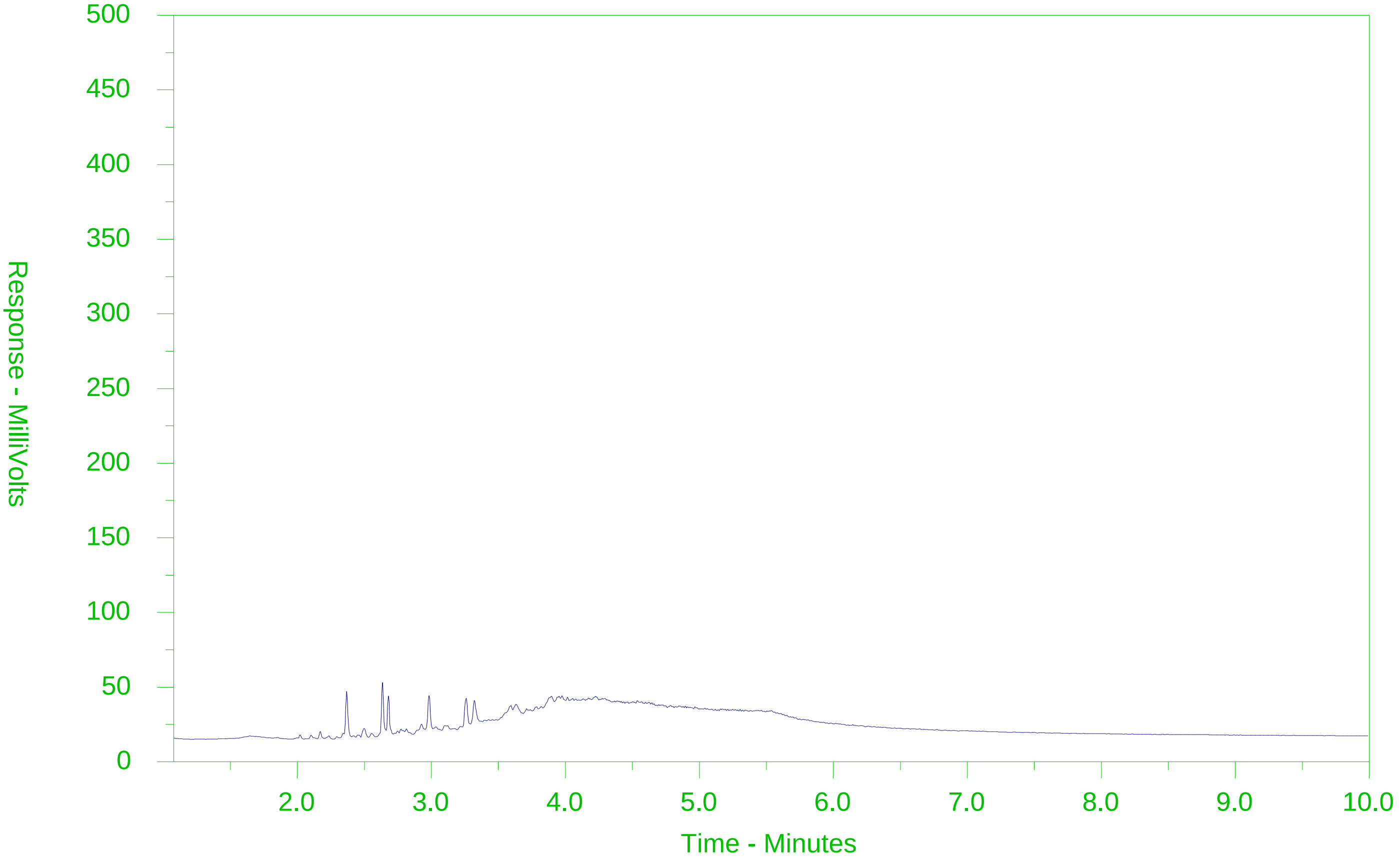
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor and the scale at the left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR Library can be found at www.alsglobal.com.

# CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT

ALS Sample ID: L2030089-5
Client Sample ID: BH13-SA1



| | | | |
|---|---|---|---|
| ←F2→ | ←F3→ | | ←F4→ |
| nC10 | nC16 | nC34 | nC50 |
| 174°C | 287°C | 481°C | 575°C |
| 346°F | 549°F | 898°F | 1067°F |
| Gasoline → | | ← Motor Oils/Lube Oils/Grease → | |
| ← Diesel/Jet Fuels → | | | |

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

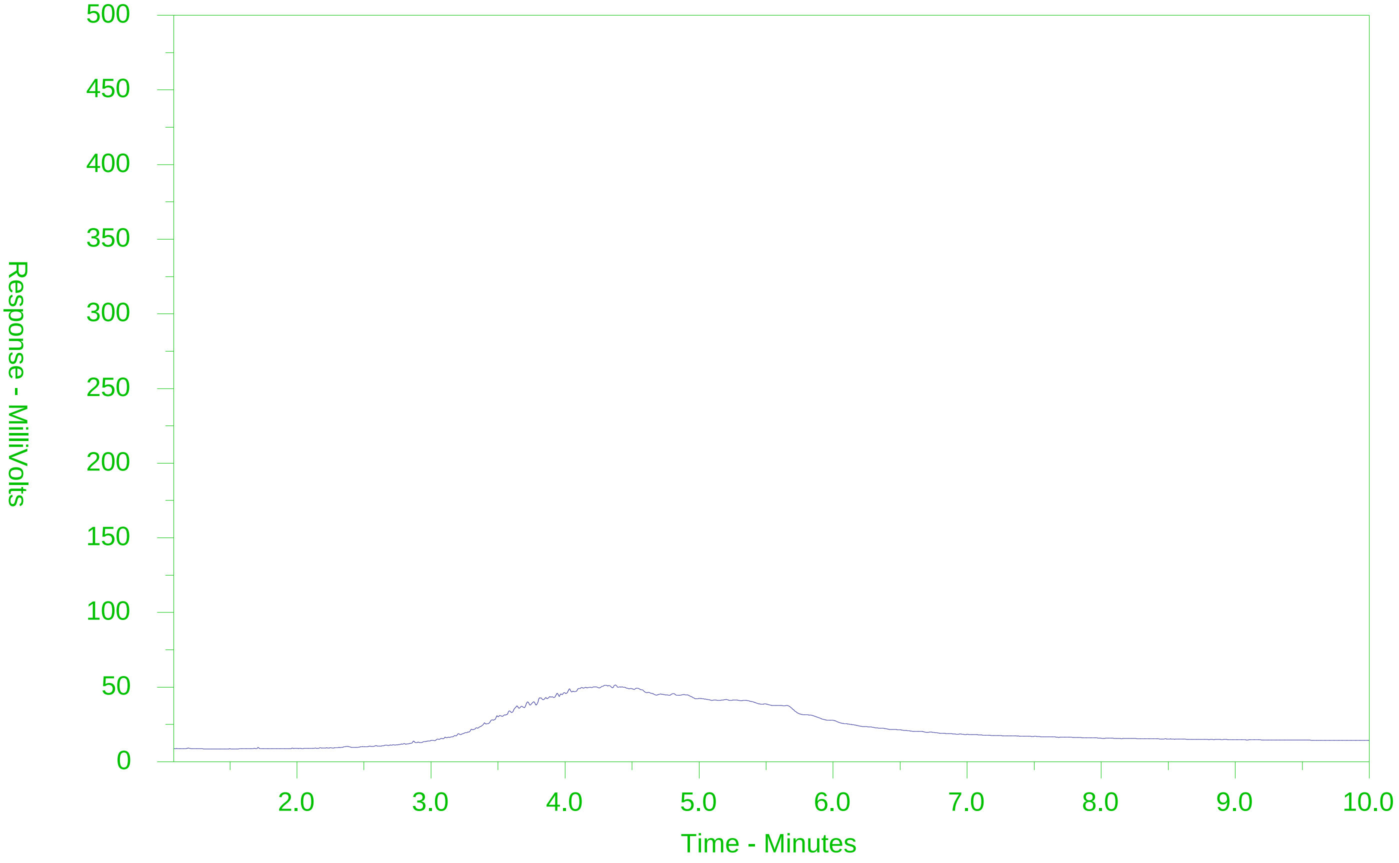
The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor and the scale at the left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR Library can be found at www.alsglobal.com.

# CCME F2-F4 HYDROCARBON DISTRIBUTION REPORT

| | |
|---|---|
| ALS Sample ID: | L2030089-7 |
| Client Sample ID: | BH16-SA2 |



| | | | |
|---|---|---|---|
| ←F2→ | ←F3→ | ←F4→ | |
| nC10 | nC16 | nC34 | nC50 |
| 174°C | 287°C | 481°C | 575°C |
| 346°F | 549°F | 898°F | 1067°F |

Gasoline →

← Motor Oils/Lube Oils/Grease →

← Diesel/Jet Fuels →

The CCME F2-F4 Hydrocarbon Distribution Report (HDR) is intended to assist you in characterizing hydrocarbon products that may be present in your sample.

The scale at the bottom of the chromatogram indicates the approximate retention times of common petroleum products and four n-alkane hydrocarbon marker compounds. Retention times may vary between samples, but general patterns and distributions will remain similar.

Peak heights in this report are a function of the sample concentration, the sample amount extracted, the sample dilution factor and the scale at the left.

Note: This chromatogram was produced using GC conditions that are specific to ALS Canada CCME F2-F4 method. Refer to the ALS Canada CCME F2-F4 Hydrocarbon Library for a collection of chromatograms from common reference samples (fuels, oils, etc.). The HDR Library can be found at www.alsglobal.com.

**ALS Environmental**
www.alsglobal.com

# Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L2030089-COFC

COC Number: 14 - 460142

Page 1 of 1

**Report To**
Company: CVD ENGINEERING
Contact: JOE VANDERZALM
Address: 311 Victoria St. N, KITCHENER
Phone:

**Report Format / Distribution**
Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)
Quality Control (QC) Report with Report ☑ Yes ☐ No
☑ Criteria on Report - provide details below if box checked
Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax joe.vanderzalm@cvdengineering.com
Email 2

**Select Service Level Below (Rush Turnaround Time (TAT) is not available for all tests)**
R ☑ Regular (Standard TAT if received by 3pm)
P ☐ Priority (2-4 business days if received by 3pm)
E ☐ Emergency (1-2 business days if received by 3pm)
E2 ☐ Same day or weekend emergency if received by 10am – contact ALS for surcharge.
Specify Date Required for E2,E or P:

**Invoice To** Same as Report To ☑ Yes ☐ No
Copy of Invoice with Report ☑ Yes ☐ No
Company:
Contact:

**Invoice Distribution**
Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax
Email 2

**Project Information**
ALS Quote #:
Job #: 617496
PO / AFE:
LSD:

**Oil and Gas Required Fields (client use)**
Approver ID:
Cost Center:
GL Account:
Routing Code:
Activity Code:
Location:

ALS Lab Work Order # (lab use only) L2030089 Dec02B
ALS Contact: ML
Sampler: JV

**Analysis Request**

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

| ALS Sample # (lab use only) | Sample Identification and/or Coordinates (This description will appear on the report) | Date (dd-mmm-yy) | Time (hh:mm) | Sample Type | METALS | INORGANICS | ELECTRICAL CONDUCTIVITY | SAR | PHC (F1 - F4) | VOLATILE ORGANIC COMPOUNDS | | | | | | | | Number of Containers |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | BH 1 - SA 2 | 20-NOV-17 | | SOIL | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | |
| 2 | BH 2 - SA5 | 20-NOV-17 | | SOIL | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | |
| 3 | BH 5 - SA 1 | 21-NOV-17 | | SOIL | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | |
| 4 | BH 9 - SA2 | 21-NOV-17 | | SOIL | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | |
| 5 | BH 13 - SA1 | 22-NOV-17 | | SOIL | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | |
| 6 | BH 16 - SA2 | 22-NOV-17 | | SOIL | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |

**Drinking Water (DW) Samples[1] (client use)**
Are samples taken from a Regulated DW System?
☐ Yes ☑ No
Are samples for human drinking water use?
☐ Yes ☑ No

**Special Instructions / Specify Criteria to add on report (client Use)**
O-REG 153-04 > BOTH TABLE 2
BOTH TABLE 2 (COARSE)

**SAMPLE CONDITION AS RECEIVED (lab use only)**
Frozen ☐ SIF Observations Yes ☐ No ☐
Ice packs Yes ☐ No ☐ Custody seal intact Yes ☐ No ☐
Cooling Initiated ☐

| INITIAL COOLER TEMPERATURES °C | | | FINAL COOLER TEMPERATURES °C | | |
|---|---|---|---|---|---|
| | | | 2.3 | | |

**SHIPMENT RELEASE (client use)**
Released by:
Date: Dec.1/17
Time: 12:30

**INITIAL SHIPMENT RECEPTION (lab use only)**
Received by:
Date:
Time:

**FINAL SHIPMENT RECEPTION (lab use only)**
Received by: 491
Date: 1-DEC-17
Time: 12:30

DA

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

NA-FM-0326e v08 Front/03 October 2013

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

[1] If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

3.1F

# APPENDIX “C”

## Comparison of the Soil Chemistry Results to the Applicable Regulatory Criteria

# ANALYTICAL RESULTS FOR SOIL

## MOE Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act, April 15, 2011

| | | *Table 1 Agricultural or Other Property Use Standard* | *Table 1 Residential/ Parkland/ Institutional/ Industrial/ Comerical/ Community Property Use Standard* | *Table 2 Residential/ Parkland/ Institutional Property Use Standard (Coarse)* | *Table 2 Industrial/ Commercial/ Community Property Use Standard (Coarse)* | BH 1 - SA 2 | BH 2 - SA 5 | BH 5 - SA 1 | BH 9 - SA 2 | BH 13 - SA 1 | BH 16 - SA 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Metals & Inorganics*** | Conductivity | *0.47* | *0.57* | *0.7* | *1.4* | 0.266 | 0.843 | 0.361 | 0.337 | 0.34 | 0.588 |
| | % Moisture | - | - | - | - | 16.1 | 16.9 | 6.52 | 6.43 | 5 | 3.96 |
| | pH | - | - | - | - | 7.63 | 7.78 | 8.16 | 7.66 | 8.13 | 8.27 |
| | SAR | *1* | *2.4* | *5* | *12* | 1.78 | 17.6 | 7.49 | 8.19 | 5.48 | 13.7 |
| | Calcium (Ca) | - | - | - | - | 9 | 5.4 | 2.2 | 3.5 | 3.4 | 2.6 |
| | Magnesium (Mg) | - | - | - | - | 1.5 | <1.0 | 1.5 | <1.0 | 2.8 | 1 |
| | Sodium (Na) | - | - | - | - | 21.9 | 148 | 59.2 | 55.3 | 56.4 | 103 |
| | Antimony (Sb) | *1* | *1.3* | *7.5* | *40* | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Arsenic (As) | *11* | *18* | *18* | *18* | 3.1 | 1.9 | 1.9 | 2.1 | 1.8 | 1.1 |
| | Barium (Ba) | *210* | *220* | *390* | *670* | 16.8 | 15.6 | 8 | 14 | 7.8 | 4.2 |
| | Beryllium (Be) | *2.5* | *2.5* | *4* | *8* | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| | Boron (B) | *36* | *36* | *120* | *120* | 5.3 | 8.6 | 6.9 | <5.0 | 5.2 | <5.0 |
| | Boron (B), Hot Water Ext. Available | *36* | *36* | *1.5* | *2* | 0.25 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 |
| | Cadmium (Cd) | *1* | *1.2* | *1.2* | *1.9* | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| | Chromium (Cr) | *67* | *70* | *160* | *160* | 16 | 8.5 | 6.2 | 12.2 | 5.8 | 5.1 |
| | Cobalt (Co) | *19* | *21* | *22* | *80* | 3.3 | 3 | 2 | 2.9 | 1.8 | 1.2 |
| | Copper (Cu) | *62* | *92* | *140* | *230* | 6.9 | 7.7 | 6.3 | 5.4 | 5.8 | 1.1 |
| | Lead (Pb) | *45* | *120* | *120* | *120* | 13.6 | 2.5 | 2.2 | 2.5 | 2 | <1.0 |
| | Mercury (Hg) | *0.16* | *0.27* | *0.27* | *3.9* | 0.0371 | <0.0050 | 0.0056 | 0.0277 | 0.0056 | <0.0050 |
| | Molybdenum (Mo) | *2* | *2* | *6.9* | *40* | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Nickel (Ni) | *37* | *82* | *100* | *270* | 6.7 | 6.2 | 4.1 | 5.6 | 3.8 | 2.5 |
| | Selenium (Se) | *1.2* | *1.5* | *2.4* | *5.5* | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Silver (Ag) | *0.5* | *0.5* | *20* | *40* | <0.20 | <0.20 | <0.20 | <0.20 | <0.20 | <0.20 |
| | Thallium (Tl) | *1* | *1* | *1* | *3.3* | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| | Uranium (U) | *1.9* | *2.5* | *23* | *33* | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| | Vanadium (V) | *86* | *86* | *86* | *86* | 27.9 | 12.5 | 11.1 | 21 | 9.8 | 7.2 |
| | Zinc (Zn) | *290* | *290* | *340* | *340* | 29.2 | 13.3 | 11.7 | 12.3 | 9.8 | 5.3 |
| | Chromium, Hexavalent | *0.66* | *0.66* | *8* | *8* | 0.21 | <0.20 | <0.20 | 0.48 | <0.20 | <0.20 |
| ***Petroleum Hydrocarbons F2-F4*** | F1 (C6-C10) | *17* | *25* | *55* | *55* | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 |
| | F1-BTEX | *17* | *25* | *55* | *55* | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 | <5.0 |
| | F2 (C10-C16) | *10* | *10* | *98* | *230* | <10 | <10 | <20 | 15 | <10 | <10 |
| | F3 (C16-C34) | *240* | *240* | *300* | *1700* | 71 | <50 | 300 | 194 | 55 | 56 |
| | F4 (C34-C50) | *120* | *120* | *2800* | *3300* | 121 | <50 | 340 | 53 | 82 | 129 |
| | F4G-SG (GHH-Silica) | *120* | *120* | *2800* | *3300* | - | - | 1420 | 270 | - | 510 |
| ***Volatile Organic Compounds (VOC's)*** | Acetone | *0.5* | *0.5* | *16* | *16* | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| | Benzene | *0.02* | *0.02* | *0.21* | *0.32* | <0.0068 | <0.0068 | <0.0068 | <0.0068 | <0.0068 | <0.0068 |
| | Bromodichloromethane | *0.05* | *0.05* | *1.5* | *1.5* | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| | Bromoform | *0.05* | *0.05* | *0.27* | *0.61* | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| | Bromomethane | *0.05* | *0.05* | *0.05* | *0.05* | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| | Carbon tetrachloride | *0.05* | *0.05* | *0.05* | *0.21* | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| | Chlorobenzene | *0.05* | *0.05* | *2.4* | *2.4* | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| | Dibromochloromethane | *0.05* | *0.05* | *2.3* | *2.3* | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| | Chloroform | *0.05* | *0.05* | *0.05* | *0.47* | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| | 1,2-Dibromoethane | *0.05* | *0.05* | *0.05* | *0.05* | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| | 1,2-Dichlorobenzene | *0.05* | *0.05* | *1.2* | *1.2* | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| | 1,3-Dichlorobenzene | *0.05* | *0.05* | *4.8* | *9.6* | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| | 1,4-Dichlorobenzene | *0.05* | *0.05* | *0.083* | *0.2* | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| | Dichlorodifluoromethane | *0.05* | *0.05* | *16* | *16* | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| | 1,1-Dichloroethane | *0.05* | *0.05* | *0.47* | *0.47* | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| | 1,2-Dichloroethane | *0.05* | *0.05* | *0.05* | *0.05* | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| | 1,1-Dichloroethylene | *0.05* | *0.05* | *0.05* | *0.064* | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| | cis-1,2-Dichloroethylene | *0.05* | *0.05* | *1.9* | *1.9* | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| | trans-1,2-Dichloroethylene | *0.05* | *0.05* | *0.084* | *1.3* | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| | Methylene Chloride | *0.05* | *0.05* | *0.1* | *1.6* | <1.0 | <2.0 | <0.50 | <0.050 | <0.50 | <0.15 |
| | 1,2-Dichloropropane | *0.05* | *0.05* | *0.05* | *0.16* | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| | 1,3-Dichloropropene (cis & trans) | *0.05* | *0.05* | *0.05* | *0.059* | <0.042 | <0.042 | <0.042 | <0.042 | <0.042 | <0.042 |
| | Ethylbenzene | *0.05* | *0.05* | *1.1* | *1.1* | <0.018 | <0.018 | <0.018 | <0.018 | <0.018 | <0.018 |
| | n-Hexane | *0.05* | *0.05* | *2.8* | *46* | <0.10 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| | Methyl Ethyl Ketone | *0.5* | *0.5* | *16* | *70* | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| | Methyl Isobutyl Ketone | *0.5* | *0.5* | *1.7* | *31* | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 | <0.50 |
| | MTBE | *0.05* | *0.05* | *0.75* | *1.6* | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| | Styrene | *0.05* | *0.05* | *0.7* | *34* | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| | 1,1,1,2-Tetrachloroethane | *0.05* | *0.05* | *0.058* | *0.087* | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| | 1,1,2,2-Tetrachloroethane | *0.05* | *0.05* | *0.05* | *0.05* | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| | Tetrachloroethylene | *0.05* | *0.05* | *0.28* | *1.9* | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| | Toluene | *0.2* | *0.2* | *2.3* | *6.4* | <0.080 | <0.080 | <0.080 | <0.080 | <0.080 | <0.080 |
| | 1,1,1-Trichloroethane | *0.05* | *0.05* | *0.38* | *6.1* | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| | 1,1,2-Trichloroethane | *0.05* | *0.05* | *0.05* | *0.05* | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| | Trichloroethylene | *0.05* | *0.05* | *0.061* | *0.55* | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 | <0.010 |
| | Trichlorofluoromethane | *0.05* | *0.25* | *4* | *4* | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |
| | Vinyl chloride | *0.02* | *0.02* | *0.02* | *0.032* | <0.020 | <0.020 | <0.020 | <0.020 | <0.020 | <0.020 |
| | Xylenes (Total) | *0.05* | *0.05* | *3.1* | *26* | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 | <0.050 |

***NOTES:***

1. Units = ug/g
2. "-" - Paramater not included in chemical analysis
3. "nv" - no value
4. Test results shown in **bold and highlighted text** exceed the Table 1 Standard for Agricultural Other Property Use
5. Test results shown in **bold and highlighted text** exceed the Table 1 Standard for Residential/Parkland/Institutional/Industrial/Comercial/Community Property Use
6. Test results shown in **bold and highlighted text** exceed the Table 2 Standard for Residential/Parkland/Institutional Property Use (Coarse)
7. Test results shown in **bold and highlighted text** exceed the Table 2 Standard for Industrial/Commercial/Community Property Use (Coarse)

# ENCLOSURES

Enclosure No.: 1
Sheet 1 of 1

# FILE No: G17496

# BOREHOLE No. 1

Client: **GM BluePlan Engineering Limited**

Project: **Road Reconstruction / Realignment Projects**

Location: **Bruce County Roads 25 and 33, Saugeen Shores, Ontario**

EQUIPMENT DATA

Machine: **D50T**
Method: **Hollow Stem Auger**
Size: **107 mm I.D.**
Date: **Nov 20 / 17** TO **Nov 20 / 17**

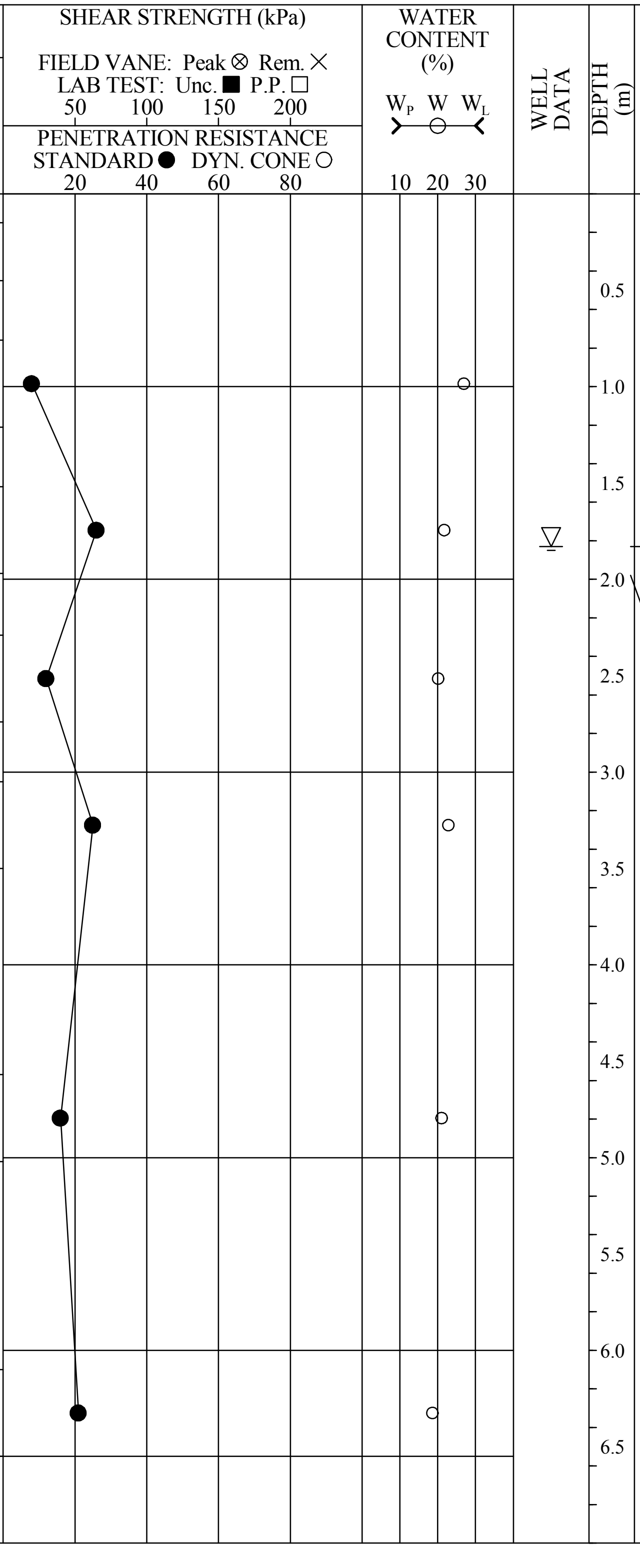
## SOIL LITHOLOGY

Ground Elevation: **202.91 m**

| ELEV./ DEPTH (m) | DESCRIPTION |
|---|---|
| 202.80<br>0.11 | 110 mm ASPHALT |
| | Granular Base<br>some silt |
| 202.21<br>0.70 | loose to compact<br>brown<br>SAND<br>some silt<br>trace gravel<br>occ. to frequent silt and clayey silt lenses/seams<br>moist to saturated |
| 198.03<br>4.88 | compact, grey<br>SILT<br>some sand<br>trace clay<br>occ. sand seams<br>saturated |
| 196.36<br>6.55 | End of Borehole |

## SAMPLE

| SAMPLE ID | TYPE | N-VALUE |
|---|---|---|
| 1 | AS | |
| 2 | SS | 8 |
| 3 | SS | 26 |
| 4 | SS | 12 |
| 5 | SS | 25 |
| 6 | SS | 16 |
| 7 | SS | 21 |



REMARKS

water level at a depth of 1.83 m bgs upon completion of drilling
cave-in to a depth of 1.98 m bgs upon completion of drilling

PROJECT MANAGER: **RVD**

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Enclosure No.: 2
Sheet 1 of 1

# FILE No: G17496

# BOREHOLE No. 2

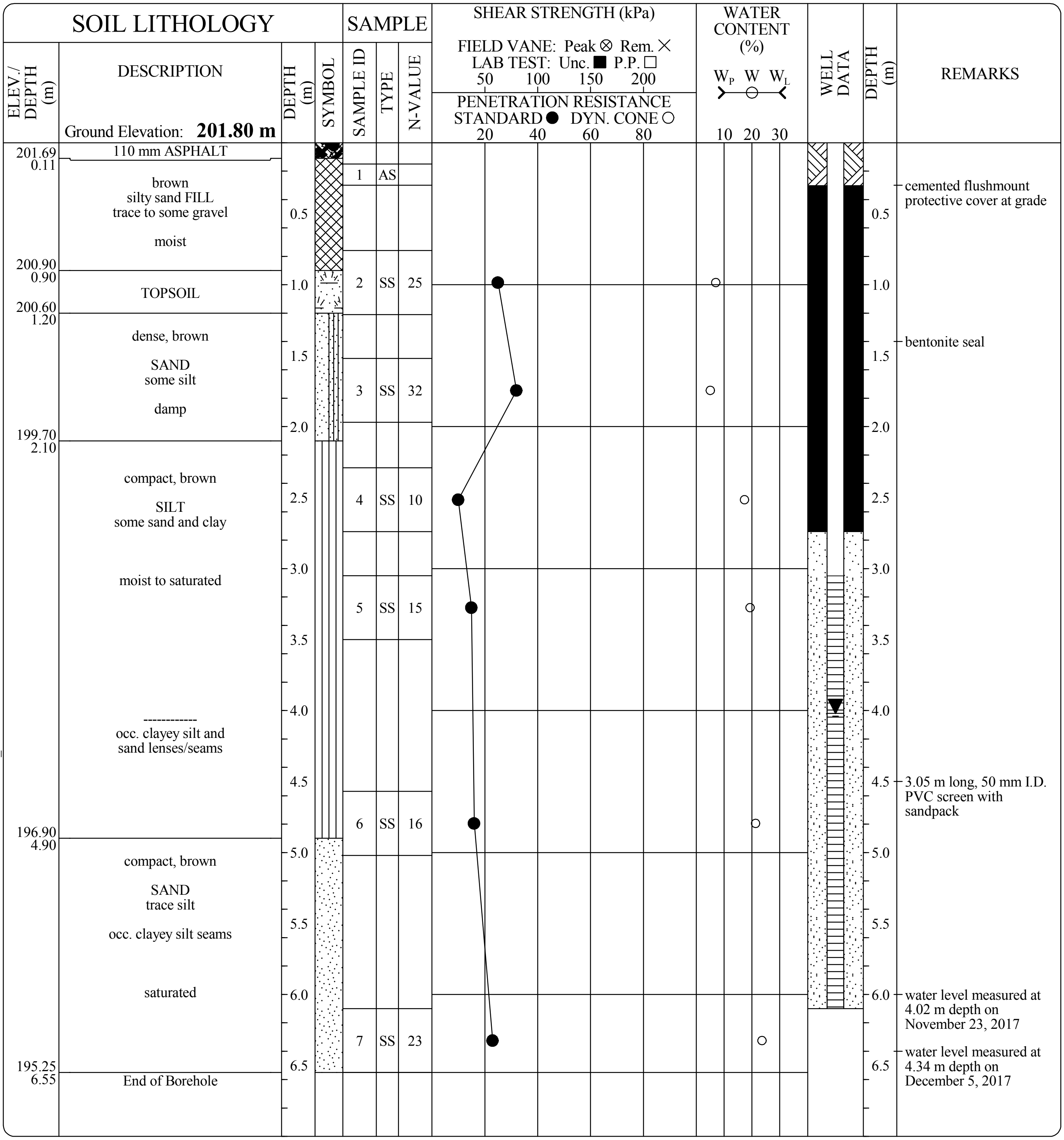
Client: **GM BluePlan Engineering Limited**

Project: **Road Reconstruction / Realignment Projects**

Location: **Bruce County Roads 25 and 33, Saugeen Shores, Ontario**

EQUIPMENT DATA

Machine: **D50T**
Method: **Hollow Stem Auger**
Size: **107 mm I.D.**
Date: **Nov 20 / 17** TO **Nov 20 / 17**



Ground Elevation: **201.80 m**

| ELEV./ DEPTH (m) | DESCRIPTION |
|---|---|
| | 110 mm ASPHALT |
| 201.69<br>0.11 | brown<br>silty sand FILL<br>trace to some gravel<br>moist |
| 200.90<br>0.90 | TOPSOIL |
| 200.60<br>1.20 | dense, brown<br>SAND<br>some silt<br>damp |
| 199.70<br>2.10 | compact, brown<br>SILT<br>some sand and clay<br>moist to saturated<br>------------<br>occ. clayey silt and sand lenses/seams |
| 196.90<br>4.90 | compact, brown<br>SAND<br>trace silt<br>occ. clayey silt seams<br>saturated |
| 195.25<br>6.55 | End of Borehole |

| SAMPLE ID | TYPE | N-VALUE |
|---|---|---|
| 1 | AS | |
| 2 | SS | 25 |
| 3 | SS | 32 |
| 4 | SS | 10 |
| 5 | SS | 15 |
| 6 | SS | 16 |
| 7 | SS | 23 |

| DEPTH (m) | REMARKS |
|---|---|
| | cemented flushmount protective cover at grade |
| | bentonite seal |
| 4.5 | 3.05 m long, 50 mm I.D. PVC screen with sandpack |
| 6.0 | water level measured at 4.02 m depth on November 23, 2017 |
| | water level measured at 4.34 m depth on December 5, 2017 |

CVD BOREHOLE (2017) G17496 BRUCE COUNTY RDS 25 & 33 SAUGEEN SHORE.GPJ CVD_ENG.GDT 6/2/18

PROJECT MANAGER: **RVD**

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Enclosure No.: 3
Sheet 1 of 1

# FILE No: G17496

# BOREHOLE No. 3

Client: **GM BluePlan Engineering Limited**

Project: **Road Reconstruction / Realignment Projects**

Location: **Bruce County Roads 25 and 33, Saugeen Shores, Ontario**

EQUIPMENT DATA

Machine: **D50T**
Method: **Hollow Stem Auger**
Size: **107 mm I.D.**
Date: **Nov 20 / 17** TO **Nov 20 / 17**

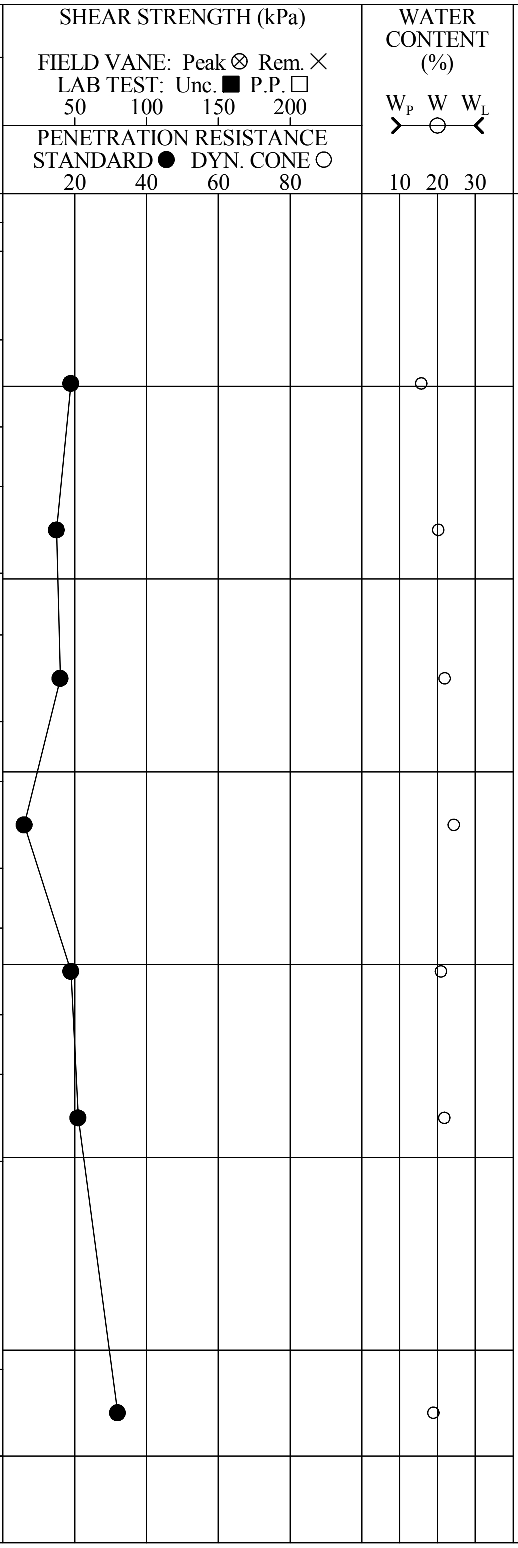
## SOIL LITHOLOGY

Ground Elevation: **200.89 m**

| ELEV./ DEPTH (m) | DESCRIPTION |
|---|---|
| 200.79<br>0.10 | 100 mm ASPHALT |
| 200.05<br>0.84 | brown<br>silty sand FILL<br>trace gravel and clay<br>moist |
| 199.82<br>1.07 | TOPSOIL |
| 198.79<br>2.10 | compact<br>orangy brown to brown<br>SAND AND SILT<br>trace clay and organics<br>moist to wet |
| 197.99<br>2.90 | compact, brown<br>SAND<br>some silt<br>wet to saturated |
| 196.89<br>4.00 | loose brown<br>SILT<br>some sand<br>occ. clayey seams<br>saturated |
| 194.34<br>6.55 | compact to dense<br>brown<br>SAND<br>some silt<br>occ. to frequent silt and clayey silt lenses/seams<br>saturated |
|  | End of Borehole |

## SAMPLE

| SAMPLE ID | TYPE | N-VALUE |
|---|---|---|
| 1 | AS |  |
| 2 | SS | 19 |
| 3 | SS | 15 |
| 4 | SS | 16 |
| 5 | SS | 6 |
| 6 | SS | 19 |
| 7 | SS | 21 |
| 8 | SS | 32 |



WELL DATA: ∇

| DEPTH (m) | REMARKS |
|---|---|
| 2.44 | water level at a depth of 2.44 m bgs upon completion of drilling |
| 2.90 | cave-in to a depth of 2.90 m bgs upon completion of drilling |

PROJECT MANAGER: **RVD**

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Enclosure No.: 4
Sheet 1 of 1

# FILE No: G17496

# BOREHOLE No. 4

Client: **GM BluePlan Engineering Limited**

Project: **Road Reconstruction / Realignment Projects**

Location: **Bruce County Roads 25 and 33, Saugeen Shores, Ontario**

## EQUIPMENT DATA

Machine: **D50T**
Method: **Hollow Stem Auger**
Size: **107 mm I.D.**
Date: **Nov 20 / 17** TO **Nov 20 / 17**

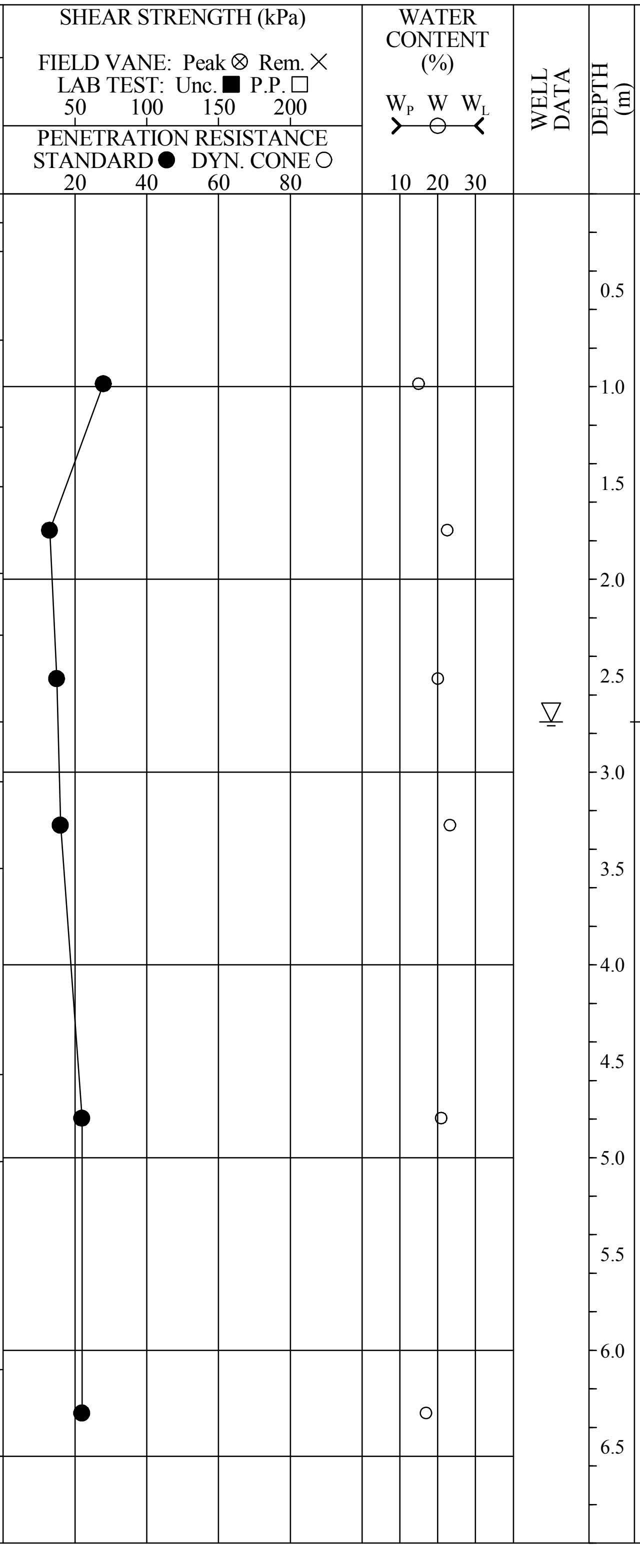
## SOIL LITHOLOGY

Ground Elevation: **200.05 m**

| ELEV./ DEPTH (m) | DESCRIPTION |
|---|---|
| 200.00<br>0.05 | 50 mm ASPHALT |
|  | brown<br>sand FILL<br>trace to some silt and gravel<br>moist |
| 199.21<br>0.84 | TOPSOIL |
| 198.98<br>1.07 | compact, brown<br>SAND<br>some silt<br>occ. clayey silt/silt seams<br>moist to wet |
| 197.95<br>2.10 | compact, brown<br>SAND AND SILT<br>trace clay<br>moist to saturated |
| 196.05<br>4.00 | compact, brown<br>SAND<br>trace silt<br>occ. silt seams<br>saturated |
| 193.50<br>6.55 | End of Borehole |

## SAMPLE

| SAMPLE ID | TYPE | N-VALUE |
|---|---|---|
| 1 | AS |  |
| 2 | SS | 28 |
| 3 | SS | 13 |
| 4 | SS | 15 |
| 5 | SS | 16 |
| 6 | SS | 22 |
| 7 | SS | 22 |



REMARKS: water level and cave-in to a depth of 2.74 m bgs upon completion of drilling

PROJECT MANAGER: **RVD**

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CVD BOREHOLE (2017) G17496 BRUCE COUNTY RDS 25 & 33 SAUGEEN SHORE.GPJ CVD_ENG.GDT 6/2/18

Enclosure No.: 5
Sheet 1 of 1

# FILE No: G17496 BOREHOLE No. 5

Client: **GM BluePlan Engineering Limited**

Project: **Road Reconstruction / Realignment Projects**

Location: **Bruce County Roads 25 and 33, Saugeen Shores, Ontario**

EQUIPMENT DATA

Machine: **D50T**
Method: **Hollow Stem Auger**
Size: **107 mm I.D.**
Date: **Nov 21 / 17** TO **Nov 21 / 17**

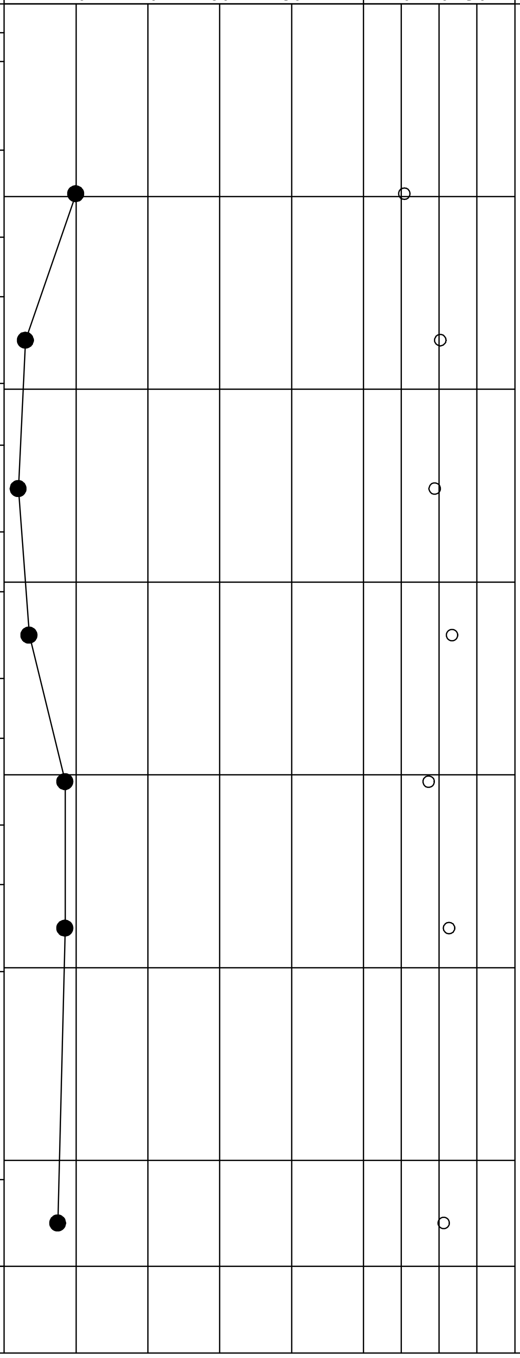
SOIL LITHOLOGY

Ground Elevation: **199.49 m**

| ELEV./ DEPTH (m) | DESCRIPTION |
|---|---|
| 199.44<br>0.05 | 50 mm ASPHALT |
| 198.65<br>0.84 | brown sand FILL trace to some silt and gravel moist |
| 198.35<br>1.14 | TOPSOIL |
| 197.79<br>1.70 | loose, orangy brown SAND AND SILT moist |
| 196.99<br>2.50 | firm, brown CLAYEY SILT moist |
| 192.94<br>6.55 | loose to compact brown SAND trace to some silt occ. clayey silt seams moist to saturated |
| | End of Borehole |

SAMPLE

| SAMPLE ID | TYPE | N-VALUE |
|---|---|---|
| 1 | AS | |
| 2 | SS | 20 |
| 3 | SS | 6 |
| 4 | SS | 4 |
| 5 | SS | 7 |
| 6 | SS | 17 |
| 7 | SS | 17 |
| 8 | SS | 15 |



WELL DATA: ∇ at 3.66 m

REMARKS

- 2.0 – bulk sample taken
- water level and cave-in to a depth of 3.66 m bgs upon completion of drilling

PROJECT MANAGER: **RVD**

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# FILE No: G17496

# BOREHOLE No. 6

Client: **GM BluePlan Engineering Limited**

Project: **Road Reconstruction / Realignment Projects**

Location: **Bruce County Roads 25 and 33, Saugeen Shores, Ontario**

## EQUIPMENT DATA

Machine: **D50T**
Method: **Hollow Stem Auger**
Size: **107 mm I.D.**
Date: **Nov 21 / 17** TO **Nov 21 / 17**

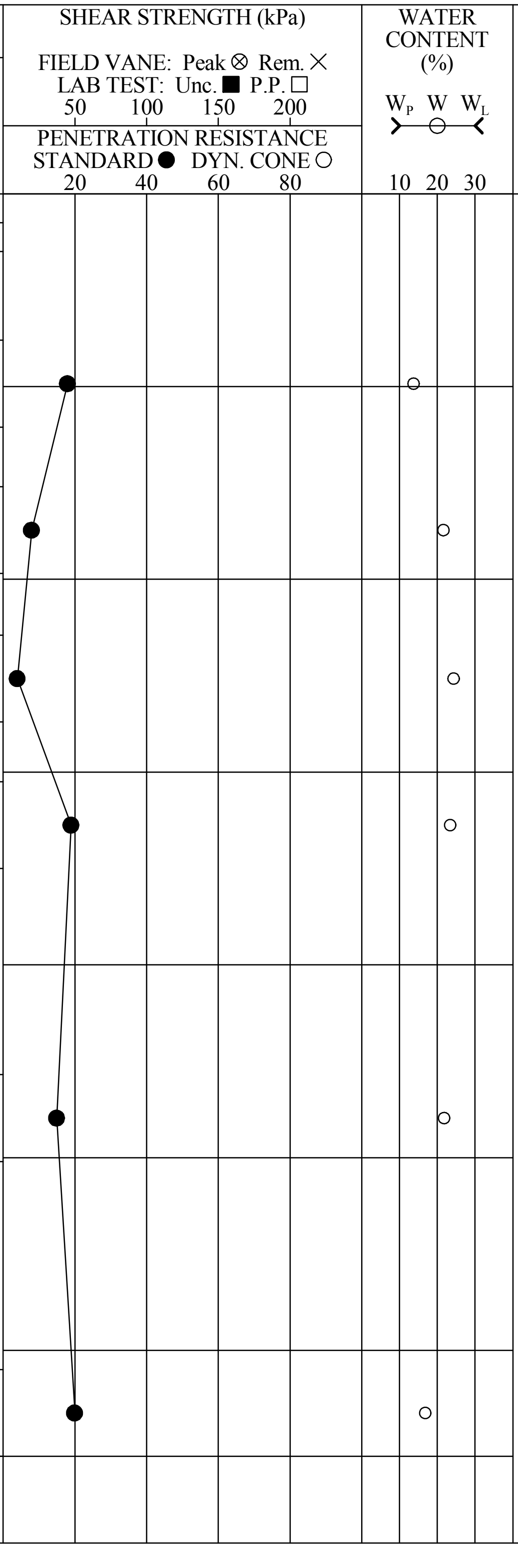
## SOIL LITHOLOGY

Ground Elevation: **199.16 m**

| ELEV./ DEPTH (m) | DESCRIPTION |
|---|---|
| 199.11<br>0.05 | 50 mm ASPHALT |
|  | brown<br>sand FILL<br>some silt and gravel<br>moist |
| 198.26<br>0.90 | TOPSOIL |
| 197.36<br>1.80 | loose, orangy brown<br>SAND AND SILT<br>trace clay<br>moist |
| 196.26<br>2.90 | compact, brown<br>SAND<br>trace to some silt<br>occ. to frequent silt and clayey silt lenses/seams<br>moist to saturated |
| 192.61<br>6.55 | End of Borehole |

## SAMPLE

| SAMPLE ID | TYPE | N-VALUE |
|---|---|---|
| 1 | AS |  |
| 2 | SS | 18 |
| 3 | SS | 8 |
| 4 | SS | 4 |
| 5 | SS | 19 |
| 6 | SS | 15 |
| 7 | SS | 20 |



WELL DATA: ▽ at 3.66 m

REMARKS: water level and cave-in to a depth of 3.66 m bgs upon completion of drilling

PROJECT MANAGER: **RVD**

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# FILE No: G17496

# BOREHOLE No. 7

Client: **GM BluePlan Engineering Limited**
Project: **Road Reconstruction / Realignment Projects**
Location: **Bruce County Roads 25 and 33, Saugeen Shores, Ontario**

EQUIPMENT DATA
Machine: **D50T**
Method: **Hollow Stem Auger**
Size: **107 mm I.D.**
Date: **Nov 21 / 17** TO **Nov 21 / 17**

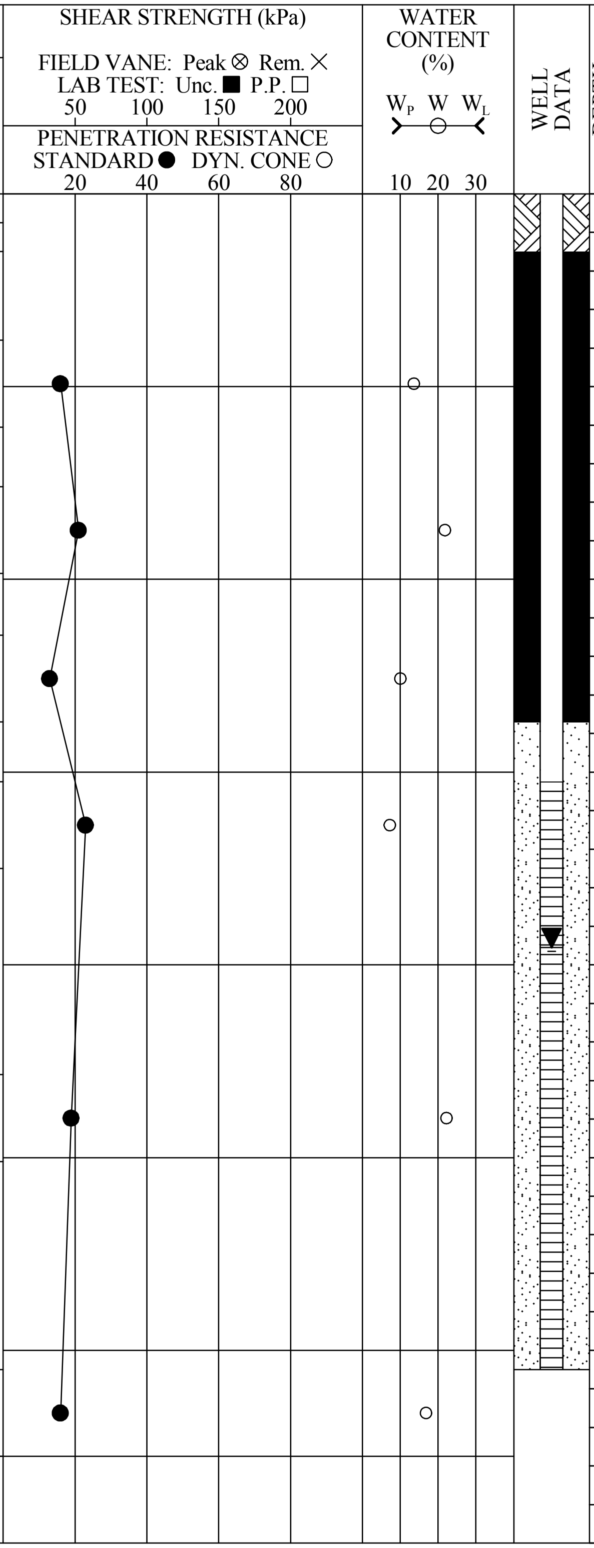
## SOIL LITHOLOGY

Ground Elevation: **198.75 m**

| ELEV./ DEPTH (m) | DESCRIPTION |
|---|---|
| 198.71<br>0.04 | 40 mm ASPHALT |
|  | brown<br>sand FILL<br>some silt, trace gravel<br>moist |
| 197.99<br>0.76 | TOPSOIL |
| 197.37<br>1.38 | compact, brown<br>SAND AND SILT<br>trace clay<br>moist |
| 196.25<br>2.50 | compact, brown<br>SAND<br>trace to some silt<br>occ. silt seams<br>moist to saturated |
| 192.20<br>6.55 | End of Borehole |

## SAMPLE

| SAMPLE ID | TYPE | N-VALUE |
|---|---|---|
| 1 | AS | |
| 2 | SS | 16 |
| 3 | SS | 21 |
| 4 | SS | 13 |
| 5 | SS | 23 |
| 6 | SS | 19 |
| 7 | SS | 16 |



| DEPTH (m) | REMARKS |
|---|---|
| | cemented flushmount protective cover at grade |
| | bentonite seal |
| 4.5 | 3.05 m long, 50 mm I.D. PVC screen with sandpack |
| 6.0 | water level measured at 3.91 m depth on November 23, 2017 |
| | water level measured at 3.93 m depth on December 5, 2017 |

CVD BOREHOLE (2017) G17496 BRUCE COUNTY RDS 25 & 33 SAUGEEN SHORE.GPJ CVD_ENG.GDT 6/2/18

PROJECT MANAGER: **RVD**

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Enclosure No.: 8
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# FILE No: G17496

# BOREHOLE No. 8

Client: **GM BluePlan Engineering Limited**

Project: **Road Reconstruction / Realignment Projects**

Location: **Bruce County Roads 25 and 33, Saugeen Shores, Ontario**

EQUIPMENT DATA

Machine: **D50T**
Method: **Hollow Stem Auger**
Size: **107 mm I.D.**
Date: **Nov 21 / 17** TO **Nov 21 / 17**

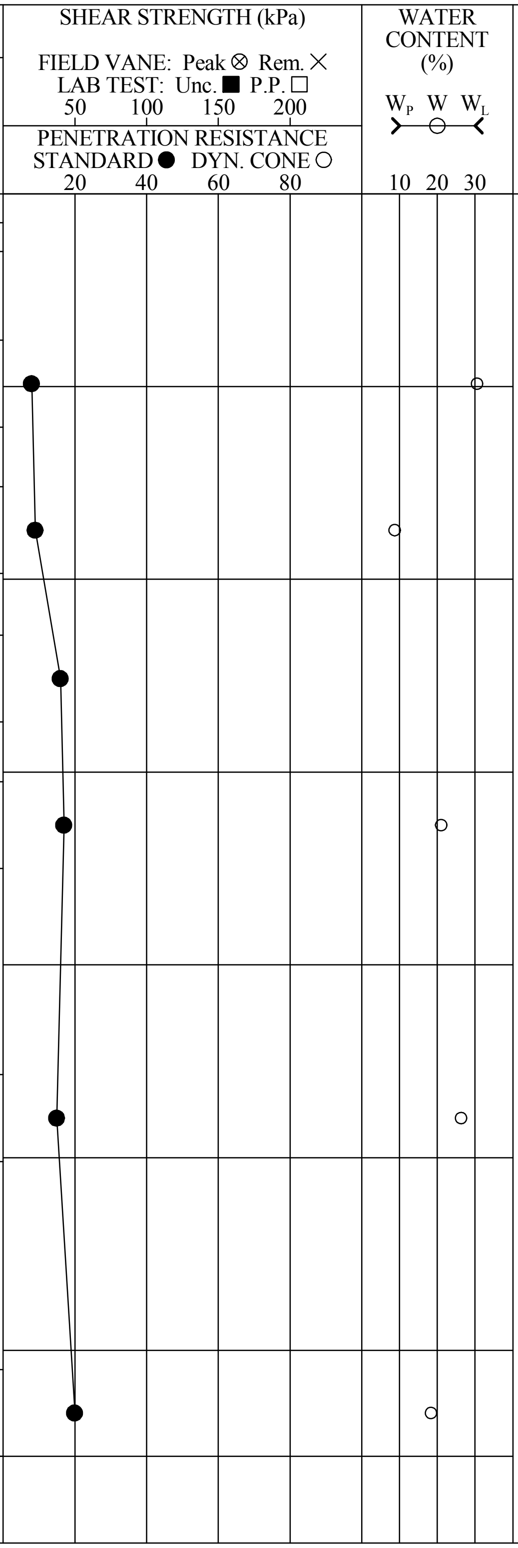
## SOIL LITHOLOGY

Ground Elevation: **198.00 m**

| ELEV./ DEPTH (m) | DESCRIPTION |
|---|---|
| 197.95<br>0.05 | 50 mm ASPHALT |
| 197.50<br>0.50 | brown<br>sand FILL<br>some gravel, some silt<br>moist |
| 196.93<br>1.07 | TOPSOIL |
| 195.90<br>2.10 | loose, orangy brown<br>SILTY SAND<br>damp |
| 191.45<br>6.55 | loose to compact<br>brown<br>SAND<br>some silt to silty<br>trace gravel<br>occ. silt seams<br>moist to saturated<br>----<br>trace to some gravel |
| | End of Borehole |

## SAMPLE

| SAMPLE ID | TYPE | N-VALUE |
|---|---|---|
| 1 | AS | |
| 2 | SS | 8 |
| 3 | SS | 9 |
| 4 | SS | 16 |
| 5 | SS | 17 |
| 6 | SS | 15 |
| 7 | SS | 20 |



WELL DATA: ▽ (approx. 2.44 m)

REMARKS

- water level at a depth of 2.44 m bgs upon completion of drilling
- cave-in to a depth of 2.74 m bgs upon completion of drilling

PROJECT MANAGER: **RVD**

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CVD BOREHOLE (2017) G17496 BRUCE COUNTY RDS 25 & 33 SAUGEEN SHORE.GPJ CVD_ENG.GDT 6/2/18

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# FILE No: G17496

# BOREHOLE No. 9

Client: **GM BluePlan Engineering Limited**

Project: **Road Reconstruction / Realignment Projects**

Location: **Bruce County Roads 25 and 33, Saugeen Shores, Ontario**

EQUIPMENT DATA

Machine: **D50T**
Method: **Hollow Stem Auger**
Size: **107 mm I.D.**
Date: **Nov 21 / 17** TO **Nov 21 / 17**

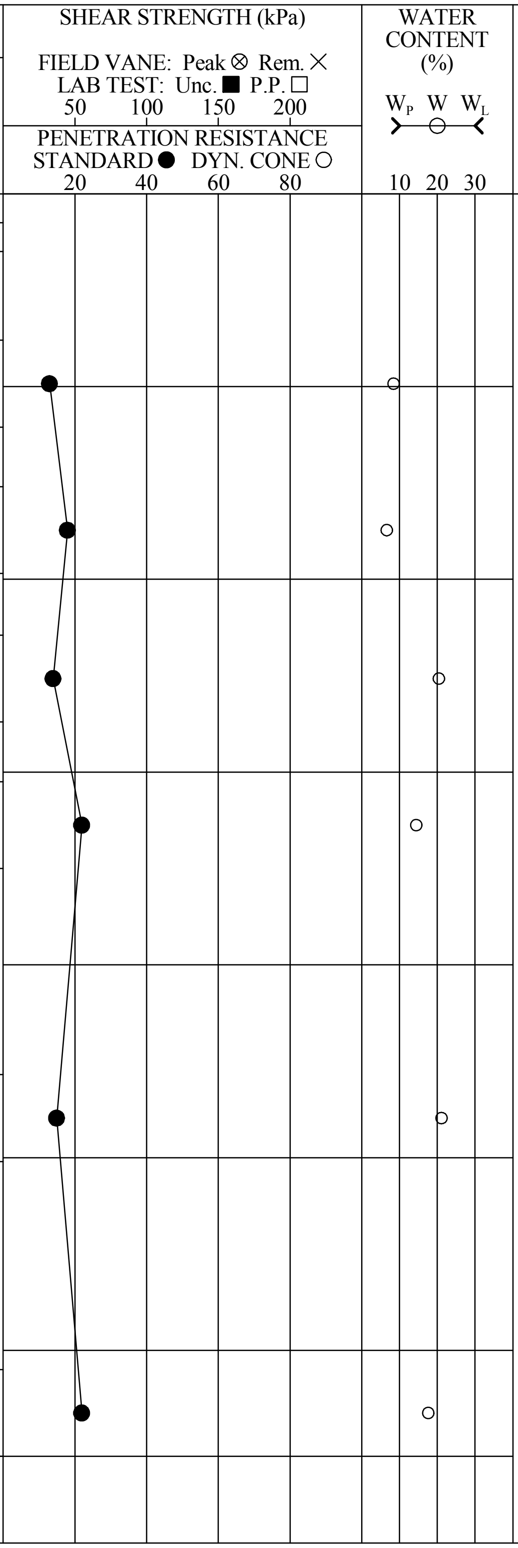
## SOIL LITHOLOGY

Ground Elevation: **197.42 m**

| ELEV./ DEPTH (m) | DESCRIPTION |
|---|---|
| 197.37<br>0.05 | 50 mm ASPHALT |
|  | brown<br>sand FILL<br>some silt and gravel |
| 196.96<br>0.46 | TOPSOIL |
| 196.68<br>0.74 | compact, brown<br>SAND<br>trace to some silt<br>trace gravel<br>occ. to frequent silt and clayey silt lenses/seams<br>damp to saturated |
| 190.87<br>6.55 | End of Borehole |

## SAMPLE

| SAMPLE ID | TYPE | N-VALUE |
|---|---|---|
| 1 | AS |  |
| 2 | SS | 13 |
| 3 | SS | 18 |
| 4 | SS | 14 |
| 5 | SS | 22 |
| 6 | SS | 15 |
| 7 | SS | 22 |



WELL DATA

| DEPTH (m) | REMARKS |
|---|---|
| 4.27 | cave-in and dry to a depth of 4.27 m bgs upon completion of drilling |

PROJECT MANAGER: **RVD**

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# FILE No: G17496 BOREHOLE No. 10

Client: **GM BluePlan Engineering Limited**
Project: **Road Reconstruction / Realignment Projects**
Location: **Bruce County Roads 25 and 33, Saugeen Shores, Ontario**

EQUIPMENT DATA
Machine: **D50T**
Method: **Hollow Stem Auger**
Size: **107 mm I.D.**
Date: **Nov 21 / 17** TO **Nov 21 / 17**

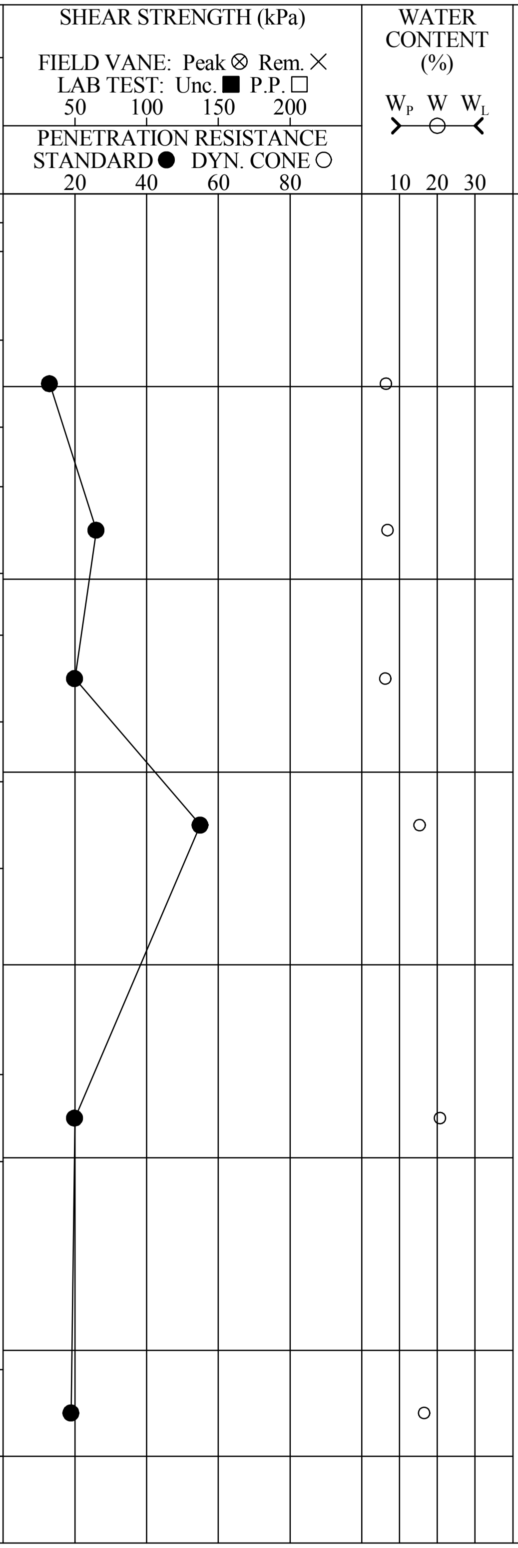
SOIL LITHOLOGY

Ground Elevation: **196.72 m**

| ELEV./ DEPTH (m) | DESCRIPTION |
|---|---|
| 196.68<br>0.04 | 40 mm ASPHALT |
| | brown<br>sand FILL<br>some silt, trace gravel |
| 196.26<br>0.46 | TOPSOIL |
| 195.98<br>0.74 | compact to very dense<br>brown<br>SAND<br>trace to some silt<br>trace gravel<br>occ. silt seams<br>moist to saturated<br>-sand and gravel layer |
| 190.17<br>6.55 | End of Borehole |

SAMPLE

| SAMPLE ID | TYPE | N-VALUE |
|---|---|---|
| 1 | AS | |
| 2 | SS | 13 |
| 3 | SS | 26 |
| 4 | SS | 20 |
| 5 | SS | 55 |
| 6 | SS | 20 |
| 7 | SS | 19 |



WELL DATA

REMARKS

| DEPTH (m) | REMARKS |
|---|---|
| 2.0 | bulk sample taken |
| | cave-in and dry to a depth of 4.27 m bgs upon completion of drilling |

PROJECT MANAGER: **RVD**

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# FILE No: G17496

# BOREHOLE No. 11

Client: **GM BluePlan Engineering Limited**

Project: **Road Reconstruction / Realignment Projects**

Location: **Bruce County Roads 25 and 33, Saugeen Shores, Ontario**

EQUIPMENT DATA

Machine: **D50T**
Method: **Hollow Stem Auger**
Size: **107 mm I.D.**
Date: **Nov 22 / 17** TO **Nov 22 / 17**

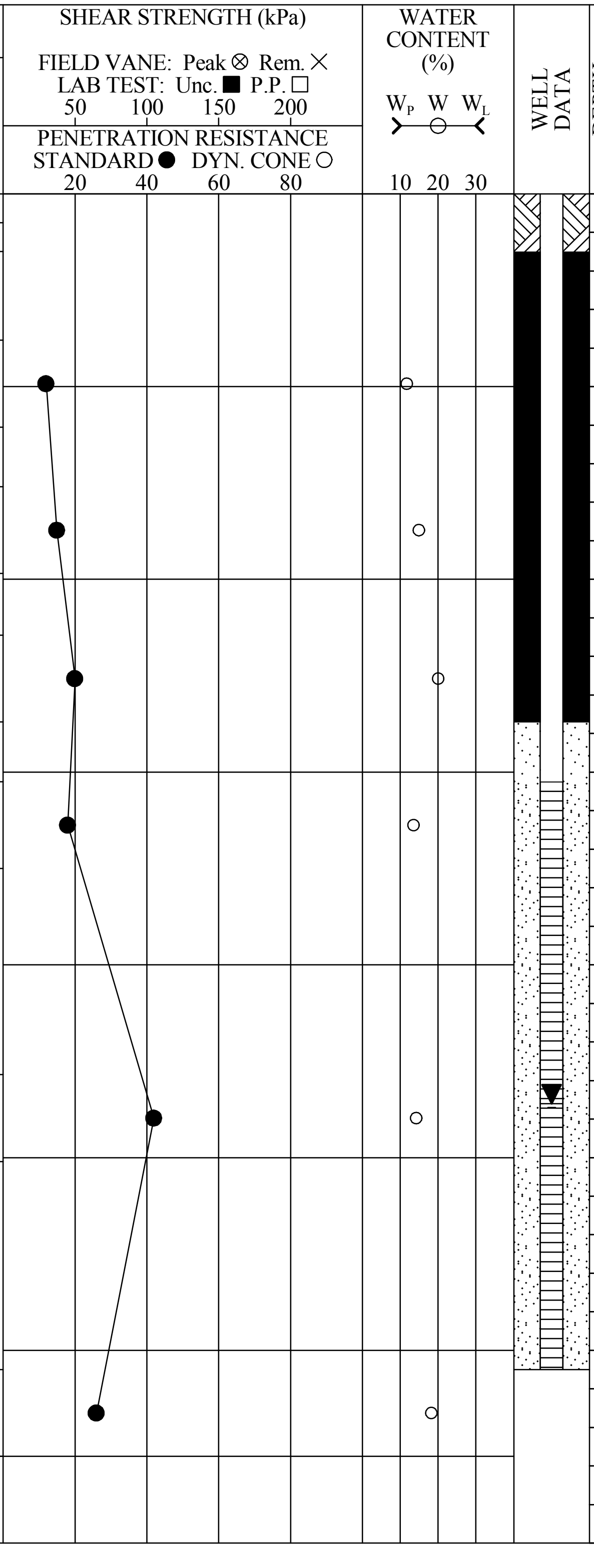
## SOIL LITHOLOGY

Ground Elevation: **196.06 m**

| ELEV./ DEPTH (m) | DESCRIPTION |
|---|---|
| 196.01<br>0.05 | 50 mm ASPHALT |
| | brown<br>sand FILL<br>some silt, trace gravel |
| 195.60<br>0.46 | TOPSOIL |
| 195.32<br>0.74 | compact, brown<br>SAND<br>some silt to Silty<br>trace gravel<br>occ.to frequent silt and clayey silt lenses/seams<br>damp to saturated<br>-----<br>trace silt |
| 189.51<br>6.55 | End of Borehole |

## SAMPLE

| SAMPLE ID | TYPE | N-VALUE |
|---|---|---|
| 1 | AS | |
| 2 | SS | 12 |
| 3 | SS | 15 |
| 4 | SS | 20 |
| 5 | SS | 18 |
| 6 | SS | 42 |
| 7 | SS | 26 |



REMARKS

- cemented flushmount protective cover at grade
- bentonite seal
- 3.05 m long, 50 mm I.D. PVC screen with sandpack
- water level measured at 4.72 m depth on November 23 and December 5, 2017

PROJECT MANAGER: **RVD**

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# BOREHOLE No. 12

Client: **GM BluePlan Engineering Limited**

Project: **Road Reconstruction / Realignment Projects**

Location: **Bruce County Roads 25 and 33, Saugeen Shores, Ontario**

## EQUIPMENT DATA

Machine: **D50T**
Method: **Hollow Stem Auger**
Size: **107 mm I.D.**
Date: **Nov 22 / 17** TO **Nov 22 / 17**

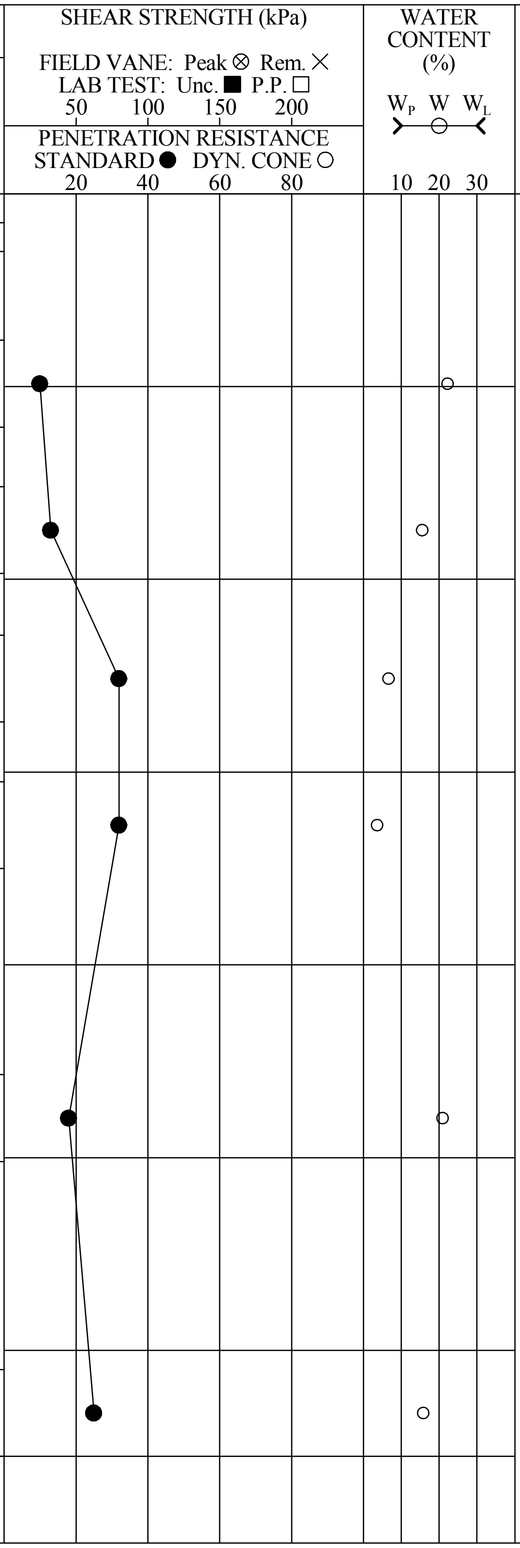
## SOIL LITHOLOGY

Ground Elevation: **194.82 m**

| ELEV./ DEPTH (m) | DESCRIPTION |
|---|---|
| 194.74<br>0.08 | 75 mm ASPHALT |
| | brown<br>sand FILL<br>some silt and gravel<br>moist |
| 193.92<br>0.90 | stiff, brown<br>CLAYEY SILT<br>occ. sand lenses/seams<br>moist |
| 192.72<br>2.10 | compact to dense<br>brown<br>SAND<br>some silt<br>trace gravel<br>damp to saturated |
| 188.27<br>6.55 | End of Borehole |

## SAMPLE

| SAMPLE ID | TYPE | N-VALUE |
|---|---|---|
| 1 | AS | |
| 2 | SS | 10 |
| 3 | SS | 13 |
| 4 | SS | 32 |
| 5 | SS | 32 |
| 6 | SS | 18 |
| 7 | SS | 25 |



WELL DATA: ∇ (4.57 m)

REMARKS: water level and cave-in to a depth of 4.57 m bgs upon completion of drilling

PROJECT MANAGER: **RVD**

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CVD BOREHOLE (2017) G17496 BRUCE COUNTY RDS 25 & 33 SAUGEEN SHORE.GPJ CVD_ENG.GDT 6/2/18

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# BOREHOLE No. 13

Client: **GM BluePlan Engineering Limited**

Project: **Road Reconstruction / Realignment Projects**

Location: **Bruce County Roads 25 and 33, Saugeen Shores, Ontario**

EQUIPMENT DATA

Machine: **D50T**
Method: **Hollow Stem Auger**
Size: **107 mm I.D.**
Date: **Nov 22 / 17** TO **Nov 22 / 17**

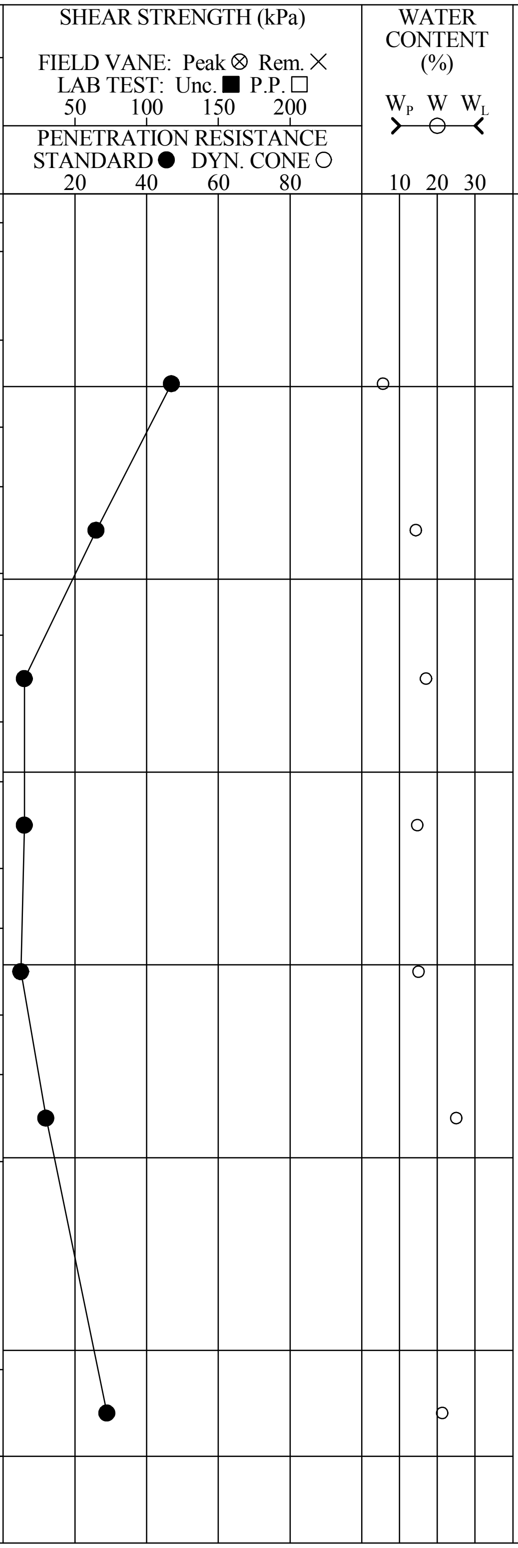
SOIL LITHOLOGY

Ground Elevation: **188.69 m**

| ELEV./ DEPTH (m) | DESCRIPTION |
|---|---|
| 188.64<br>0.05 | 50 mm ASPHALT |
| | compact to dense brown<br>sand FILL some silt trace to some gravel<br>damp to moist |
| 186.59<br>2.10 | loose<br>TOPSOIL (possible Fill) |
| 184.84<br>3.85 | loose, orangy brown<br>SILTY SAND<br>moist |
| 184.19<br>4.50 | compact, brown<br>SAND trace to some silt<br>saturated |
| 182.14<br>6.55 | End of Borehole |

SAMPLE

| SAMPLE ID | TYPE | N-VALUE |
|---|---|---|
| 1 | AS | |
| 2 | SS | 47 |
| 3 | SS | 26 |
| 4 | SS | 6 |
| 5 | SS | 6 |
| 6 | SS | 5 |
| 7 | SS | 12 |
| 8 | SS | 29 |



WELL DATA

DEPTH (m): 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5

REMARKS

2.5 – cave-in and wet to a depth of 2.44 m bgs upon completion of drilling

CVD BOREHOLE (2017) G17496 BRUCE COUNTY RDS 25 & 33 SAUGEEN SHORE.GPJ CVD_ENG.GDT 6/2/18

PROJECT MANAGER: **RVD**

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# BOREHOLE No. 14

Client: **GM BluePlan Engineering Limited**

Project: **Road Reconstruction / Realignment Projects**

Location: **Bruce County Roads 25 and 33, Saugeen Shores, Ontario**

EQUIPMENT DATA

Machine: **D50T**
Method: **Hollow Stem Auger**
Size: **107 mm I.D.**
Date: **Nov 22 / 17** TO **Nov 22 / 17**

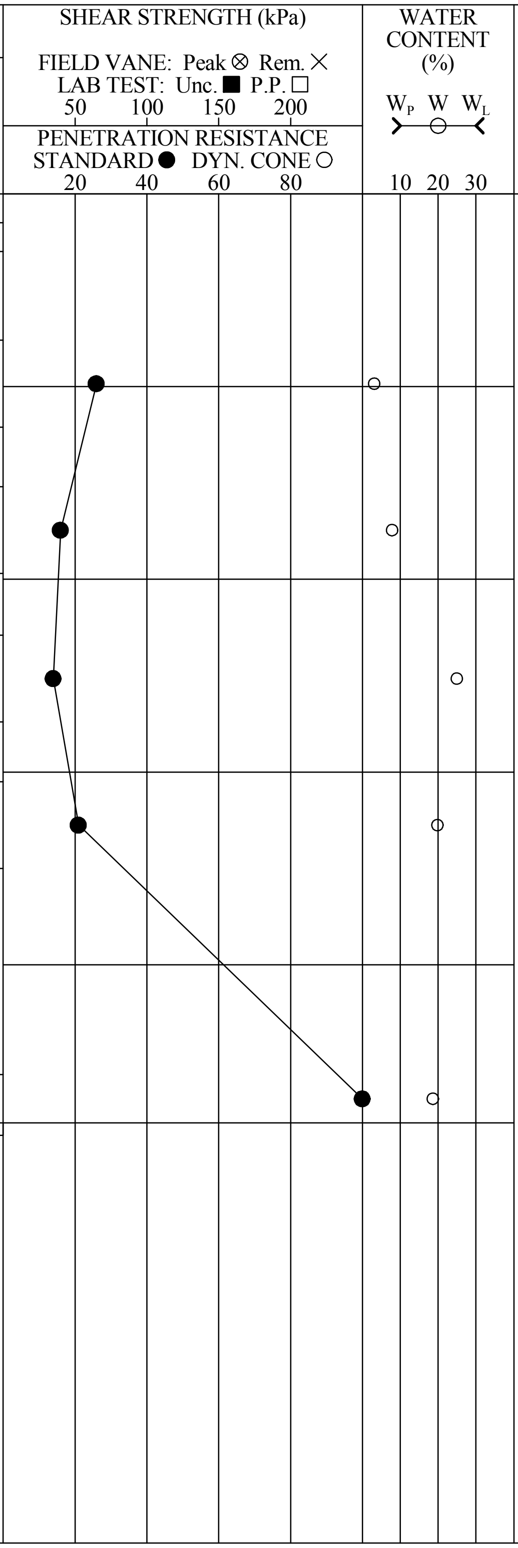
## SOIL LITHOLOGY

Ground Elevation: **184.78 m**

| ELEV./ DEPTH (m) | DESCRIPTION |
|---|---|
| 184.74<br>0.04 | 40 mm ASPHALT |
| 184.32<br>0.46 | brown sand FILL some silt, trace gravel |
| 184.02<br>0.76 | TOPSOIL |
| 180.48<br>4.30 | compact, brown SAND trace silt<br>damp to saturated |
| 179.96<br>4.82 | very dense, brown SAND and GRAVEL saturated |
| | Auger Refusal on suspect boulder |

## SAMPLE

| SAMPLE ID | TYPE | N-VALUE |
|---|---|---|
| 1 | AS | |
| 2 | SS | 26 |
| 3 | SS | 16 |
| 4 | SS | 14 |
| 5 | SS | 21 |
| 6 | SS | 50/ 100 mm |



WELL DATA: ∇

REMARKS: water level and cave-in to a depth of 2.13 m bgs upon completion of drilling

PROJECT MANAGER: **RVD**

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CVD BOREHOLE (2017) G17496 BRUCE COUNTY RDS 25 & 33 SAUGEEN SHORE.GPJ CVD_ENG.GDT 6/2/18

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# BOREHOLE No. 15

| | |
|---|---|
| Client: | **GM BluePlan Engineering Limited** |
| Project: | **Road Reconstruction / Realignment Projects** |
| Location: | **Bruce County Roads 25 and 33, Saugeen Shores, Ontario** |

EQUIPMENT DATA

| | |
|---|---|
| Machine: | **D50T** |
| Method: | **Hollow Stem Auger** |
| Size: | **107 mm I.D.** |
| Date: | **Nov 22 / 17** TO **Nov 22 / 17** |

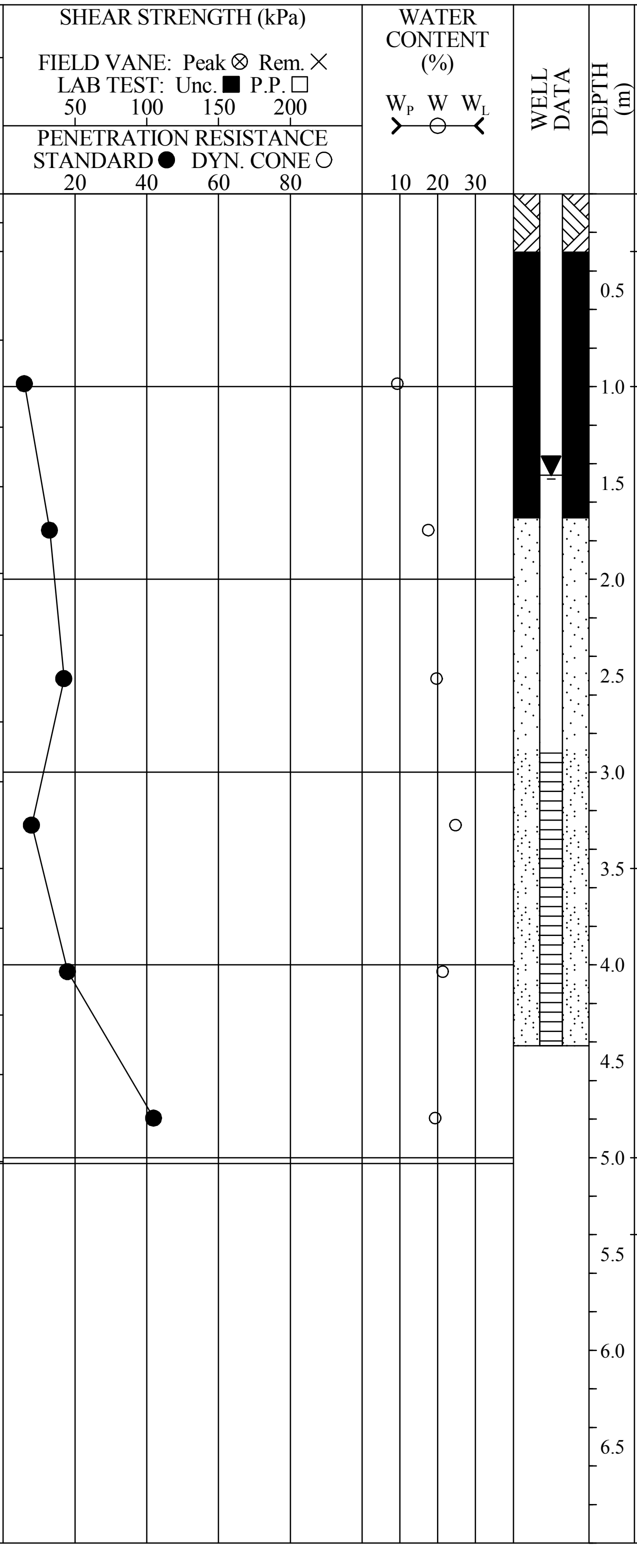
SOIL LITHOLOGY

Ground Elevation: **182.20 m**

| ELEV./ DEPTH (m) | DESCRIPTION |
|---|---|
| 182.10<br>0.10 | 100 mm ASPHALT |
| | loose<br>brown to dark brown<br>sand FILL<br>some silt and gravel<br>moist to wet |
| 180.83<br>1.37 | TOPSOIL |
| 180.40<br>1.80 | loose to dense<br>brown<br>SAND<br>trace silt<br>saturated |
| 177.17<br>5.03 | End of Borehole |

SAMPLE

| SAMPLE ID | TYPE | N-VALUE |
|---|---|---|
| 1 | AS | |
| 2 | SS | 6 |
| 3 | SS | 13 |
| 4 | SS | 17 |
| 5 | SS | 8 |
| 6 | SS | 18 |
| 7 | SS | 42 |



| DEPTH (m) | REMARKS |
|---|---|
| | cemented flushmount protective cover at grade |
| 1.0 | bentonite seal |
| 3.5 | 3.05 m long, 50 mm I.D. PVC screen with sandpack |
| 5.0 | water level measured at 1.47 m depth on November 23, 2017 |
| | water level measured at 1.46 m depth on December 5, 2017 |

PROJECT MANAGER: **RVD**

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Enclosure No.: 16
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# FILE No: G17496

# BOREHOLE No. 16

Client: **GM BluePlan Engineering Limited**

Project: **Road Reconstruction / Realignment Projects**

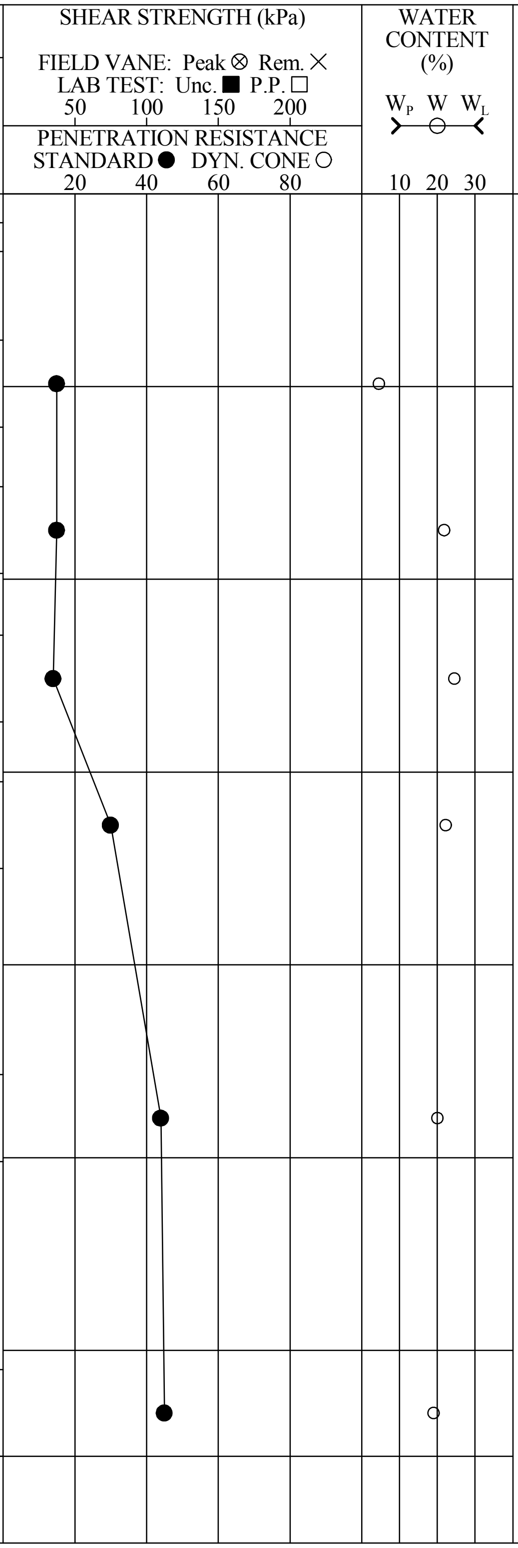
Location: **Bruce County Roads 25 and 33, Saugeen Shores, Ontario**

EQUIPMENT DATA

Machine: **D50T**
Method: **Hollow Stem Auger**
Size: **107 mm I.D.**
Date: **Nov 22 / 17** TO **Nov 22 / 17**

Ground Elevation: **181.78 m**

| ELEV./ DEPTH (m) | DESCRIPTION | SAMPLE ID | TYPE | N-VALUE | WELL DATA | REMARKS |
|---|---|---|---|---|---|---|
| 181.72<br>0.06 | 60 mm ASPHALT | | | | | |
| | Granular Base<br>some silt | 1 | AS | | | |
| 181.39<br>0.39 | compact to dense<br>brown<br>SAND<br>trace silt<br>damp to saturated | 2 | SS | 15 | | |
| | | 3 | SS | 15 | | |
| | | | | | ∇ | water level and cave-in to a depth of 2.13 m bgs upon completion of drilling |
| | | 4 | SS | 14 | | |
| | | 5 | SS | 30 | | |
| | | 6 | SS | 44 | | |
| | | 7 | SS | 45 | | |
| 175.23<br>6.55 | End of Borehole | | | | | |



DEPTH (m): 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5

PROJECT MANAGER: **RVD**

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CVD BOREHOLE (2017) G17496 BRUCE COUNTY RDS 25 & 33 SAUGEEN SHORE.GPJ CVD_ENG.GDT 6/2/18

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# BOREHOLE No. 17

Client: **GM BluePlan Engineering Limited**

Project: **Road Reconstruction / Realignment Projects**

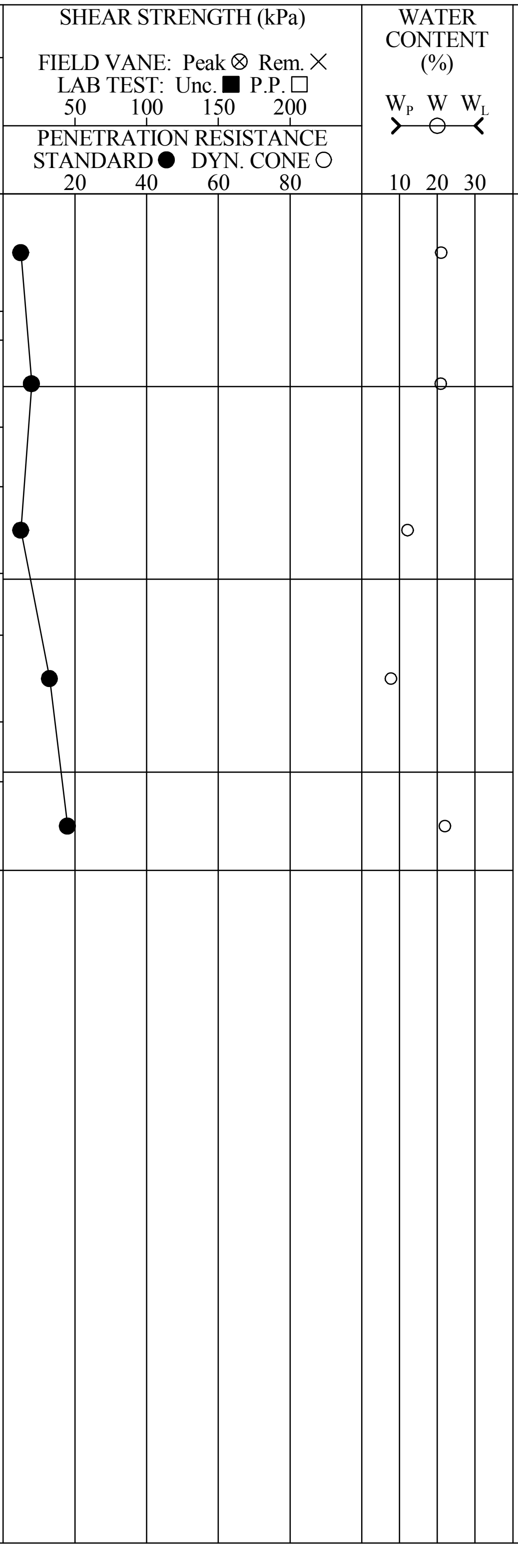
Location: **Bruce County Roads 25 and 33, Saugeen Shores, Ontario**

EQUIPMENT DATA

Machine: **D50T**
Method: **Solid Stem Auger**
Size: **150 mm O.D.**
Date: **Nov 23 / 17** TO **Nov 23 / 17**

Ground Elevation: **197.71 m**

| ELEV./ DEPTH (m) | DESCRIPTION | SAMPLE ID | TYPE | N-VALUE | REMARKS |
|---|---|---|---|---|---|
| | 330 mm TOPSOIL | 1 | SS | 5 | |
| 197.38<br>0.33 | loose, brown<br>SAND AND SILT<br>trace clay<br>moist to wet | 2 | SS | 8 | |
| | | 3 | SS | 5 | |
| 195.61<br>2.10 | compact, brown<br>SAND<br>trace to some silt<br>occ. to frequent silt and clayey silt lenses/seams<br>moist to saturated | 4 | SS | 13 | |
| | | 5 | SS | 18 | water level and cave-in to a depth of 3.20 m bgs upon completion of drilling |
| 194.20<br>3.51 | End of Borehole | | | | |



PROJECT MANAGER: **RVD**

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# FILE No: G17496

# BOREHOLE No. 18

Client: **GM BluePlan Engineering Limited**

Project: **Road Reconstruction / Realignment Projects**

Location: **Bruce County Roads 25 and 33, Saugeen Shores, Ontario**

EQUIPMENT DATA

Machine: **D50T**
Method: **Solid Stem Auger**
Size: **150 mm O.D.**
Date: **Nov 23 / 17** TO **Nov 23 / 17**

## SOIL LITHOLOGY

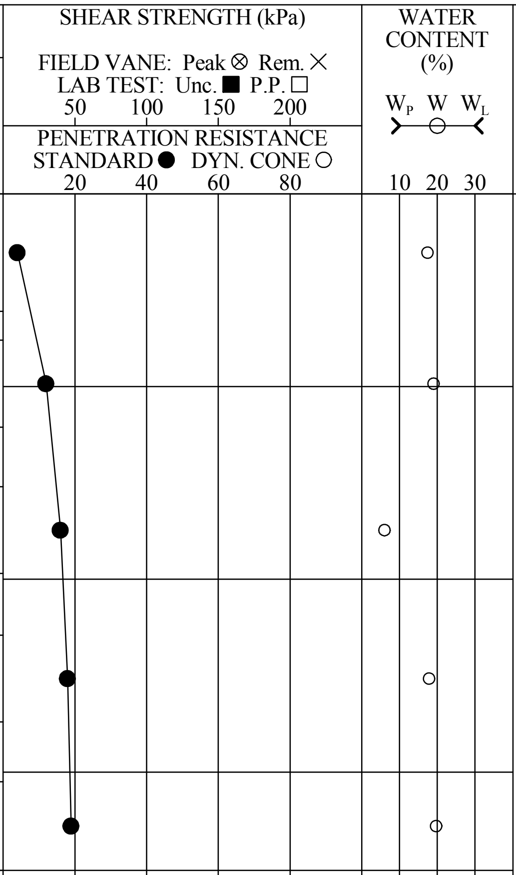
Ground Elevation: **197.30 m**

| ELEV./ DEPTH (m) | DESCRIPTION | SAMPLE ID | TYPE | N-VALUE | WELL DATA | REMARKS |
|---|---|---|---|---|---|---|
| | 180 mm TOPSOIL | | | | | |
| 197.12<br>0.18 | compact<br>orangy brown to brown<br>SAND<br>some silt to Silty<br>occ. to frequent silt and clayey silt lenses/seams<br>moist to saturated | 1 | SS | 4 | | |
| | | 2 | SS | 12 | | |
| | | 3 | SS | 16 | | |
| | | 4 | SS | 18 | ▽ | water level and cave-in to a depth of 2.90 m bgs upon completion of drilling |
| | | 5 | SS | 19 | | |
| 193.79<br>3.51 | End of Borehole | | | | | |

SHEAR STRENGTH (kPa)
FIELD VANE: Peak ⊗ Rem. ×
LAB TEST: Unc. ■ P.P. □

PENETRATION RESISTANCE
STANDARD ● DYN. CONE ○

WATER CONTENT (%)



PROJECT MANAGER: **RVD**

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Enclosure No.: 19
Sheet 1 of 1

# FILE No: G17496

# BOREHOLE No. 19

Client: **GM BluePlan Engineering Limited**

Project: **Road Reconstruction / Realignment Projects**

Location: **Bruce County Roads 25 and 33, Saugeen Shores, Ontario**

EQUIPMENT DATA

Machine: **D50T**
Method: **Solid Stem Auger**
Size: **150 mm O.D.**
Date: **Nov 23 / 17** TO **Nov 23 / 17**

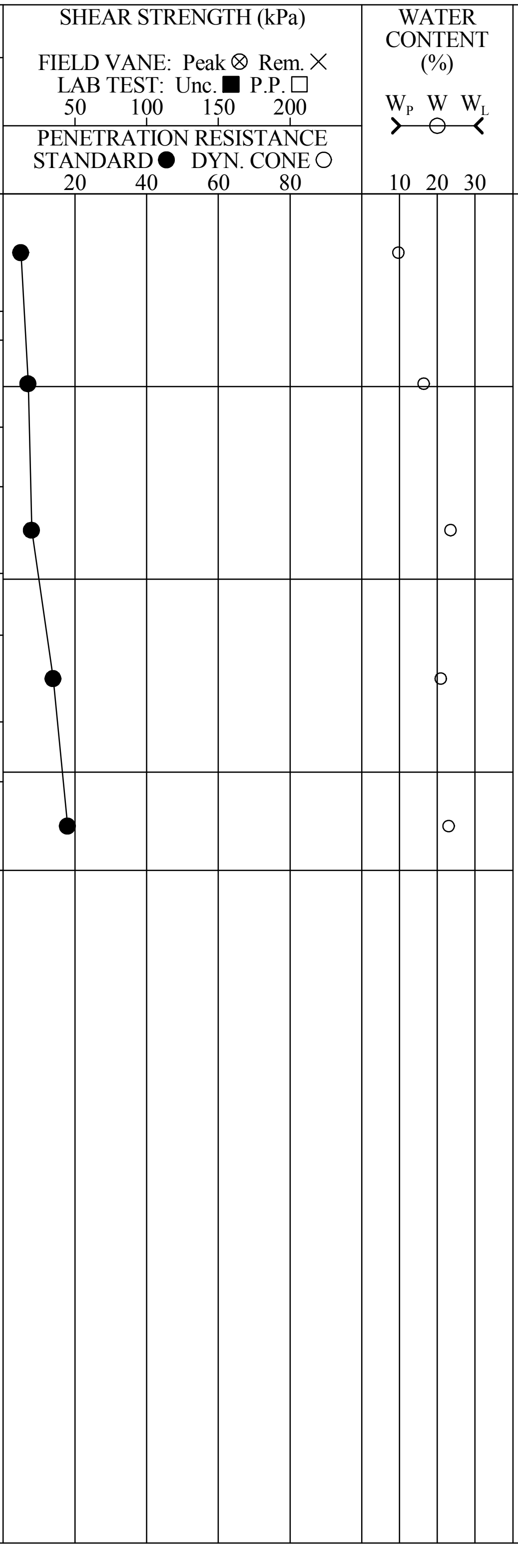
SOIL LITHOLOGY

Ground Elevation: **196.91 m**

| ELEV./ DEPTH (m) | DESCRIPTION | SYMBOL |
|---|---|---|
| 196.76<br>0.15 | 150 mm TOPSOIL | |
| 193.40<br>3.51 | loose to compact<br>brown<br>SAND<br>some silt to Silty<br>occ. to frequent silt and clayey silt lenses/seams<br>moist to saturated | |
| | End of Borehole | |

SAMPLE

| SAMPLE ID | TYPE | N-VALUE |
|---|---|---|
| 1 | SS | 5 |
| 2 | SS | 7 |
| 3 | SS | 8 |
| 4 | SS | 14 |
| 5 | SS | 18 |



WELL DATA: ∇

REMARKS

- water level at a depth of 2.74 m bgs upon completion of drilling
- cave-in to a depth of 3.05 m bgs upon completion of drilling

CVD BOREHOLE (2017) G17496 BRUCE COUNTY RDS 25 & 33 SAUGEEN SHORE.GPJ CVD_ENG.GDT 6/2/18

PROJECT MANAGER: **RVD**

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Enclosure No.: 20
Sheet 1 of 1

# FILE No: G17496

# BOREHOLE No. 20

Client: **GM BluePlan Engineering Limited**

Project: **Road Reconstruction / Realignment Projects**

Location: **Bruce County Roads 25 and 33, Saugeen Shores, Ontario**

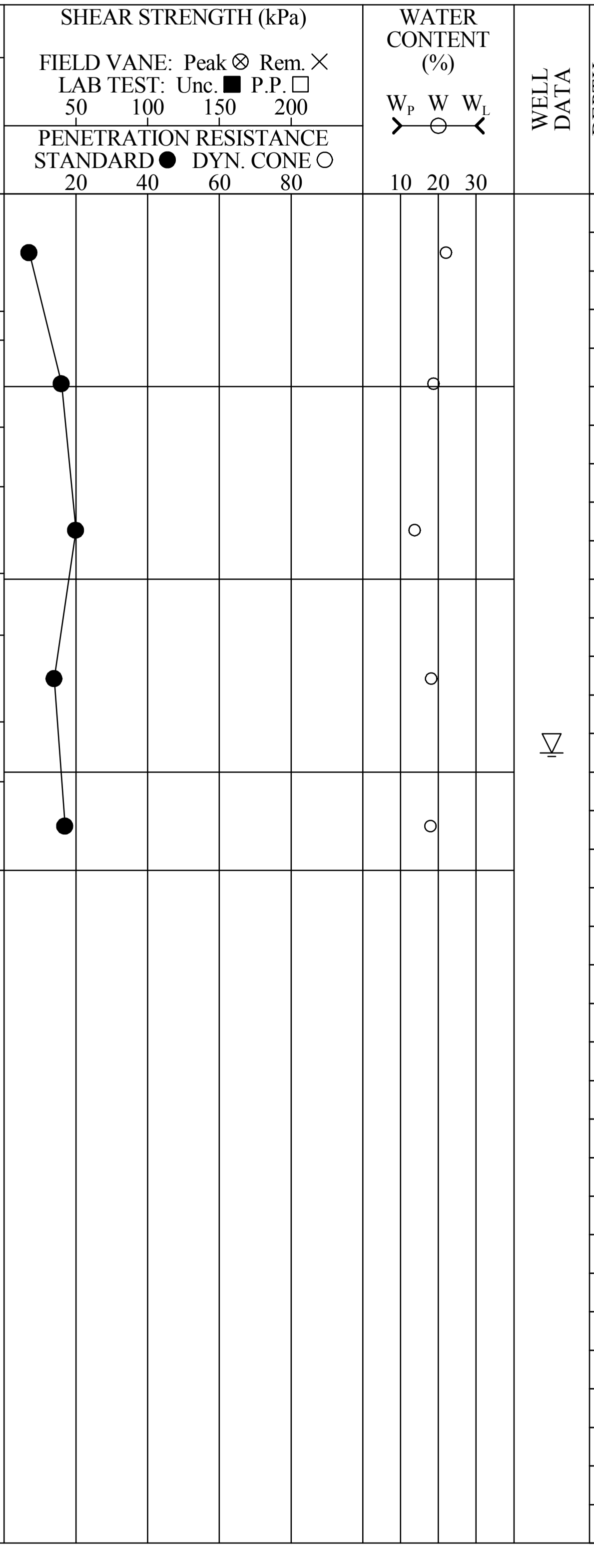
EQUIPMENT DATA

Machine: **D50T**
Method: **Solid Stem Auger**
Size: **150 mm O.D.**
Date: **Nov 23 / 17** TO **Nov 23 / 17**

SOIL LITHOLOGY

Ground Elevation: **196.53 m**

| ELEV./ DEPTH (m) | DESCRIPTION | SAMPLE ID | TYPE | N-VALUE | REMARKS |
|---|---|---|---|---|---|
| | 200 mm TOPSOIL | | | | |
| 196.33<br>0.20 | loose to compact<br>brown<br>SAND<br>some silt to Silty<br>occ. to frequent silt and clayey silt lenses/seams<br>moist to saturated | 1 | SS | 7 | |
| | | 2 | SS | 16 | |
| | | 3 | SS | 20 | |
| | | 4 | SS | 14 | |
| | | 5 | SS | 17 | water level at a depth of 2.90 m bgs upon completion of drilling |
| 193.02<br>3.51 | End of Borehole | | | | open to a depth of 3.51 m bgs upon completion of drilling |



DEPTH (m): 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5

PROJECT MANAGER: **RVD**

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# FILE No: G17496

# BOREHOLE No. 21

Client: **GM BluePlan Engineering Limited**

Project: **Road Reconstruction / Realignment Projects**

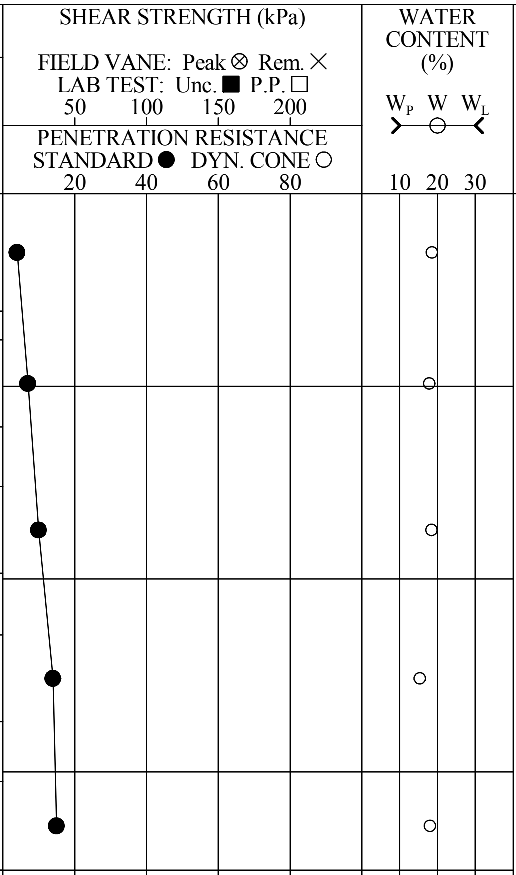
Location: **Bruce County Roads 25 and 33, Saugeen Shores, Ontario**

EQUIPMENT DATA

Machine: **D50T**
Method: **Solid Stem Auger**
Size: **150 mm O.D.**
Date: **Nov 23 / 17** TO **Nov 23 / 17**

Ground Elevation: **196.40 m**

| ELEV./ DEPTH (m) | SOIL LITHOLOGY DESCRIPTION | DEPTH (m) | SAMPLE ID | TYPE | N-VALUE | REMARKS |
|---|---|---|---|---|---|---|
| | 200 mm TOPSOIL | | | | | |
| 196.20<br>0.20 | loose to compact<br>brown<br>SAND<br>some silt to Silty<br>occ. to frequent silt and clayey silt lenses/seams<br>moist to saturated | | 1 | SS | 4 | |
| | | 1.0 | 2 | SS | 7 | |
| | | | 3 | SS | 10 | |
| | | 2.0 | | | | bulk sample taken |
| | | 2.5 | 4 | SS | 14 | |
| | | | 5 | SS | 15 | |
| 192.89<br>3.51 | End of Borehole | 3.5 | | | | open and dry to a depth of 3.51 m bgs upon completion of drilling |



WELL DATA

PROJECT MANAGER: **RVD**

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Enclosure No.: 22
Sheet 1 of 1

# FILE No: G17496

# BOREHOLE No. 22

Client: **GM BluePlan Engineering Limited**

Project: **Road Reconstruction / Realignment Projects**

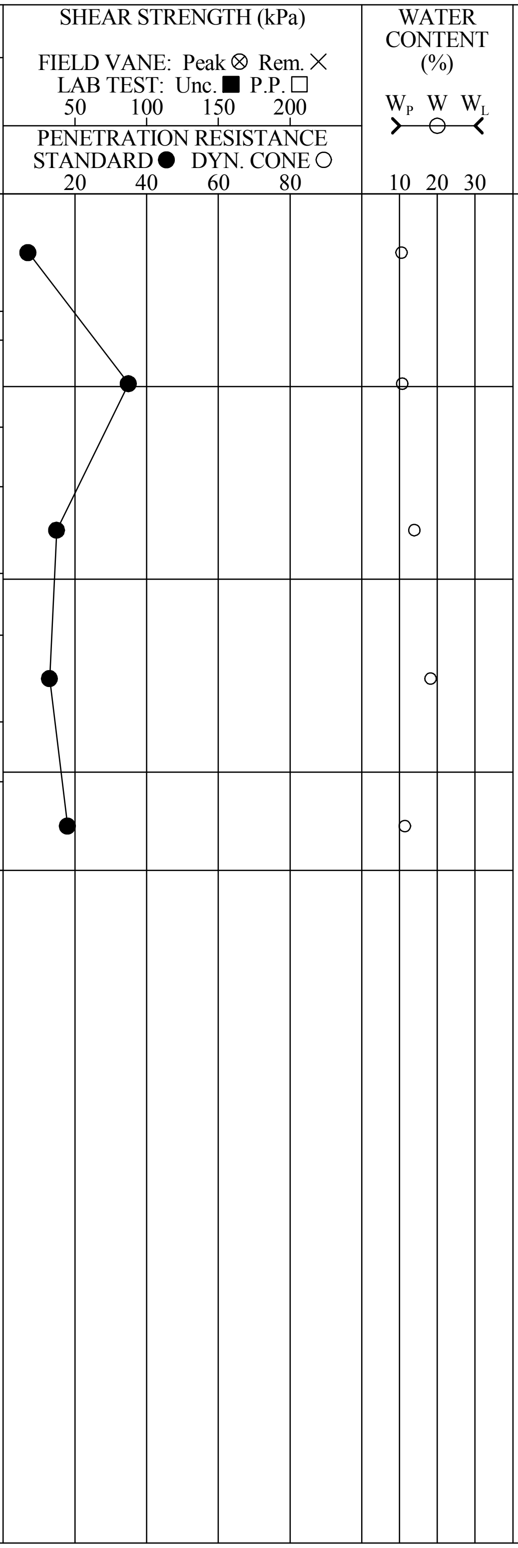
Location: **Bruce County Roads 25 and 33, Saugeen Shores, Ontario**

EQUIPMENT DATA

Machine: **D50T**
Method: **Solid Stem Auger**
Size: **150 mm O.D.**
Date: **Nov 23 / 17** TO **Nov 23 / 17**

Ground Elevation: **196.08 m**

| ELEV./ DEPTH (m) | DESCRIPTION | SAMPLE ID | TYPE | N-VALUE | REMARKS |
|---|---|---|---|---|---|
| | 250 mm TOPSOIL | | | | |
| 195.83<br>0.25 | loose to dense<br>brown<br>SILT<br>some sand to Sandy<br>occ. clayey silt and sand lenses/seams<br>moist | 1 | SS | 7 | |
| | | 2 | SS | 35 | |
| | | 3 | SS | 15 | |
| | | 4 | SS | 13 | |
| 193.18<br>2.90 | End of Borehole | 5 | SS | 18 | open and dry to a depth of 3.51 m bgs upon completion of drilling |



PROJECT MANAGER: **RVD**

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CVD BOREHOLE (2017) G17496 BRUCE COUNTY RDS 25 & 33 SAUGEEN SHORE.GPJ CVD_ENG.GDT 6/2/18

Enclosure No.: 23
Sheet 1 of 1

# FILE No: G17496

# BOREHOLE No. 23

Client: **GM BluePlan Engineering Limited**

Project: **Road Reconstruction / Realignment Projects**

Location: **Bruce County Roads 25 and 33, Saugeen Shores, Ontario**

EQUIPMENT DATA

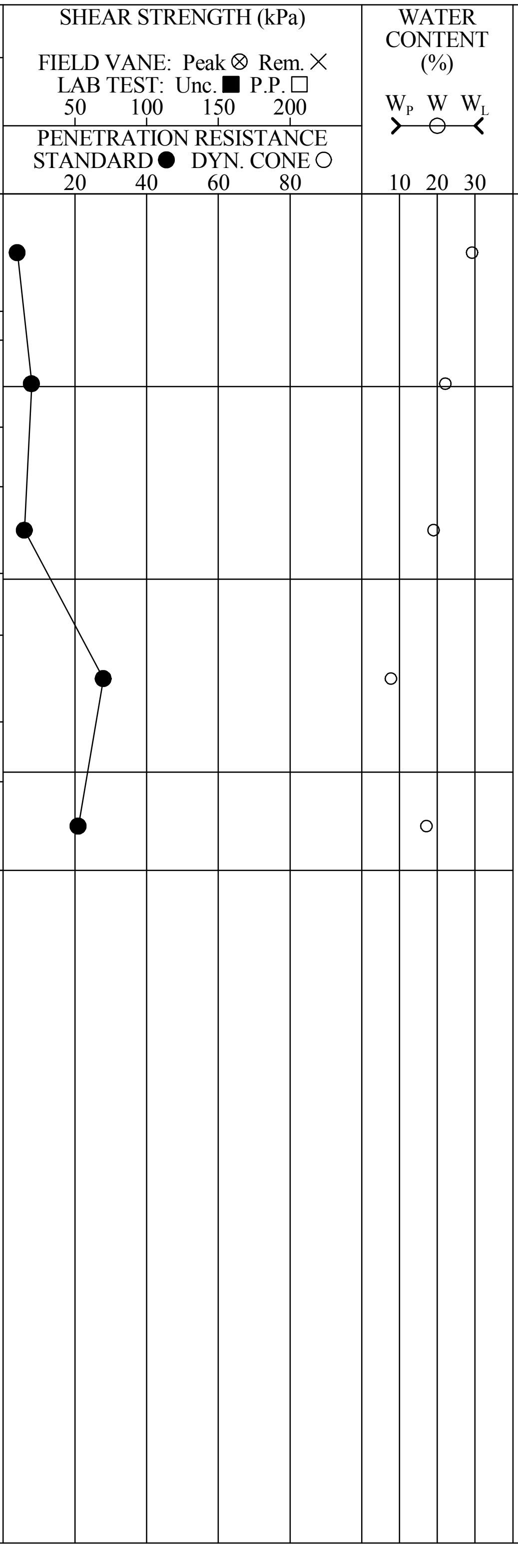
Machine: **D50T**
Method: **Solid Stem Auger**
Size: **150 mm O.D.**
Date: **Nov 23 / 17** TO **Nov 23 / 17**

## SOIL LITHOLOGY

Ground Elevation: **195.52 m**

| ELEV./ DEPTH (m) | DESCRIPTION | SAMPLE ID | TYPE | N-VALUE | REMARKS |
|---|---|---|---|---|---|
| | 460 mm TOPSOIL | 1 | SS | 4 | |
| 195.06<br>0.46 | loose to compact<br>brown<br>SAND AND SILT<br>some silt to silty<br>occ. silt and clayey silt seams<br>moist to wet<br>---------<br>sand and silt | 2 | SS | 8 | |
| | | 3 | SS | 6 | |
| | | 4 | SS | 28 | |
| 192.62<br>2.90 | compact, brown<br>SILT<br>some sand, trace clay<br>moist to wet | 5 | SS | 21 | |
| 192.01<br>3.51 | End of Borehole | | | | borehole open and dry to a depth of 3.51 m bgs upon completion of drilling |

DEPTH (m): 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5



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Enclosure No.: 24
Sheet 1 of 1

# FILE No: G17496

# BOREHOLE No. 24

Client: **GM BluePlan Engineering Limited**

Project: **Road Reconstruction / Realignment Projects**

Location: **Bruce County Roads 25 and 33, Saugeen Shores, Ontario**

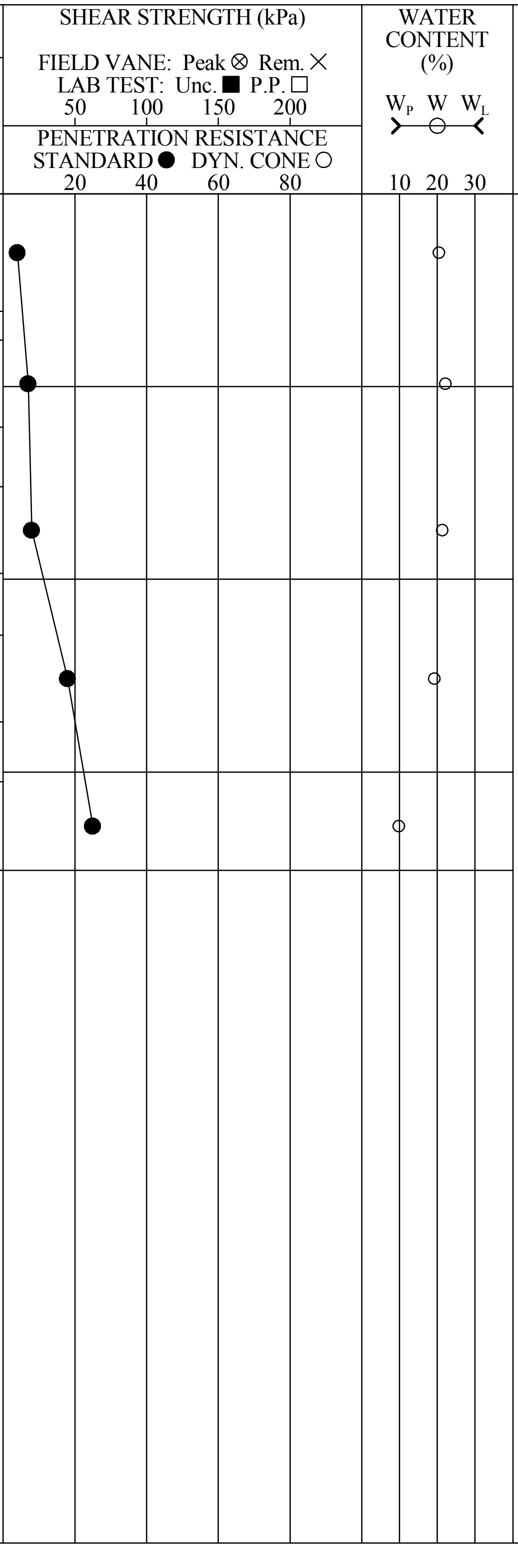
## EQUIPMENT DATA

Machine: **D50T**
Method: **Solid Stem Auger**
Size: **150 mm O.D.**
Date: **Nov 23 / 17** TO **Nov 23 / 17**

## SOIL LITHOLOGY

Ground Elevation: **195.02 m**

| ELEV./ DEPTH (m) | DESCRIPTION | SAMPLE ID | TYPE | N-VALUE | REMARKS |
|---|---|---|---|---|---|
|  | 330 mm TOPSOIL | 1 | SS | 4 |  |
| 194.69<br>0.33 | loose to compact<br>brown<br>SAND AND SILT<br>occ. clayey silt seams<br>moist to wet | 2 | SS | 7 |  |
|  |  | 3 | SS | 8 |  |
|  |  | 4 | SS | 18 |  |
| 192.12<br>2.90 | compact, brown<br>SAND<br>trace silt<br>moist | 5 | SS | 25 |  |
| 191.51<br>3.51 | End of Borehole |  |  |  | open and dry to a depth of 3.51 m bgs upon completion of drilling |



PROJECT MANAGER: **RVD**

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Enclosure No.: 25
Sheet 1 of 1

# FILE No: G17496

# BOREHOLE No. 25

Client: **GM BluePlan Engineering Limited**

Project: **Road Reconstruction / Realignment Projects**

Location: **Bruce County Roads 25 and 33, Saugeen Shores, Ontario**

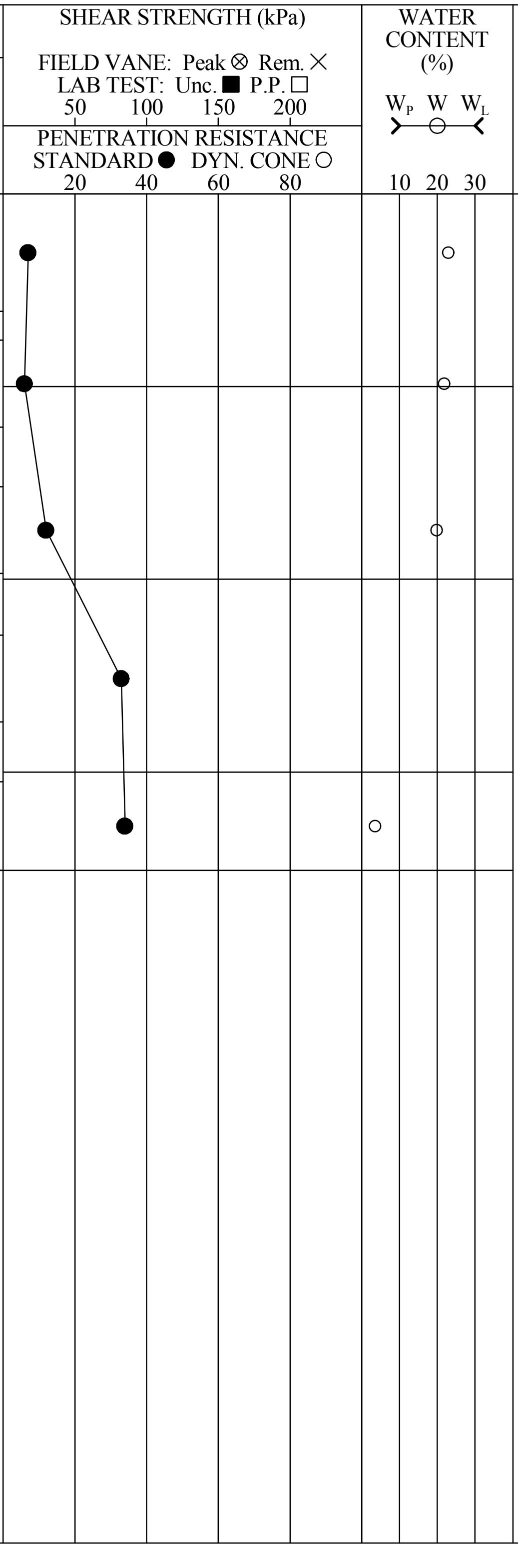
EQUIPMENT DATA

Machine: **D50T**
Method: **Solid Stem Auger**
Size: **150 mm O.D.**
Date: **Nov 23 / 17** TO **Nov 23 / 17**

SOIL LITHOLOGY

Ground Elevation: **194.46 m**

| ELEV./ DEPTH (m) | DESCRIPTION | SAMPLE ID | TYPE | N-VALUE | REMARKS |
|---|---|---|---|---|---|
| | 300 mm TOPSOIL | | | | |
| 194.16<br>0.30 | loose to compact<br>brown<br>SILT<br>trace to some sand<br>occ. clayey silt seams<br>moist | 1 | SS | 7 | |
| | | 2 | SS | 6 | |
| | | 3 | SS | 12 | |
| 192.36<br>2.10 | dense, brown<br>SAND<br>trace silt<br>damp | 4 | SS | 33 | |
| | | 5 | SS | 34 | |
| 190.95<br>3.51 | End of Borehole | | | | borehole open and dry to a depth of 3.51 m bgs upon completion of drilling |



PROJECT MANAGER: **RVD**

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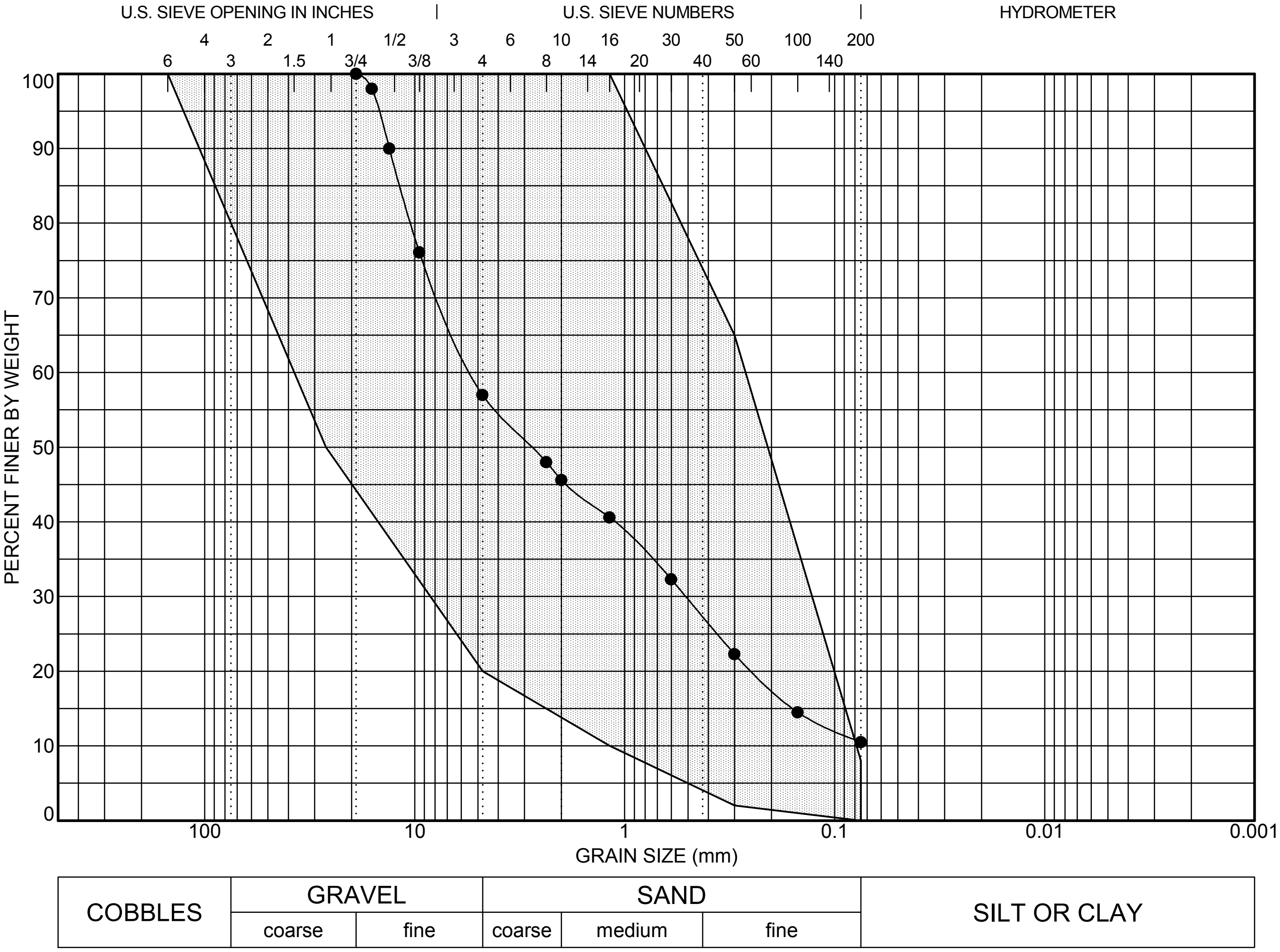
CVD BOREHOLE (2017) G17496 BRUCE COUNTY RDS 25 & 33 SAUGEEN SHORE.GPJ CVD_ENG.GDT 6/2/18



| LL | PL | PI | Cc | Cu | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  | 0.72 | 77.01 | 19 | 5.296 | 0.512 |  | 43.0 | 46.5 | 10.5 |  |

**Date:** Dec. 21 / 2017
**Client:** GM BluePlan Engineering Limited
**Contractor:**
**Source:**
**Sampled From:** BH 16, 0.15 to 0.30 m depth
**Sample No.:** 16-1
**Date Sampled:** Nov. 22 / 2017
**Sampled By:** JV
**Lab No.:** 2562
**Date Tested:** Dec. 04 / 2017
**Type of Material:** Granular Base, some silt

| Sieve Size (mm) | Percent Passing | OPSS 1010 Granular 'B' Type I |
|---|---|---|
| 150 |  | 100 |
| 26.5 |  | 50 - 100 |
| 4.75 | 57.0 | 20 - 100 |
| 1.18 | 40.6 | 10 - 100 |
| 0.300 | 22.3 | 2 - 65 |
| 0.075 | 10.5 | 0 - 8 |

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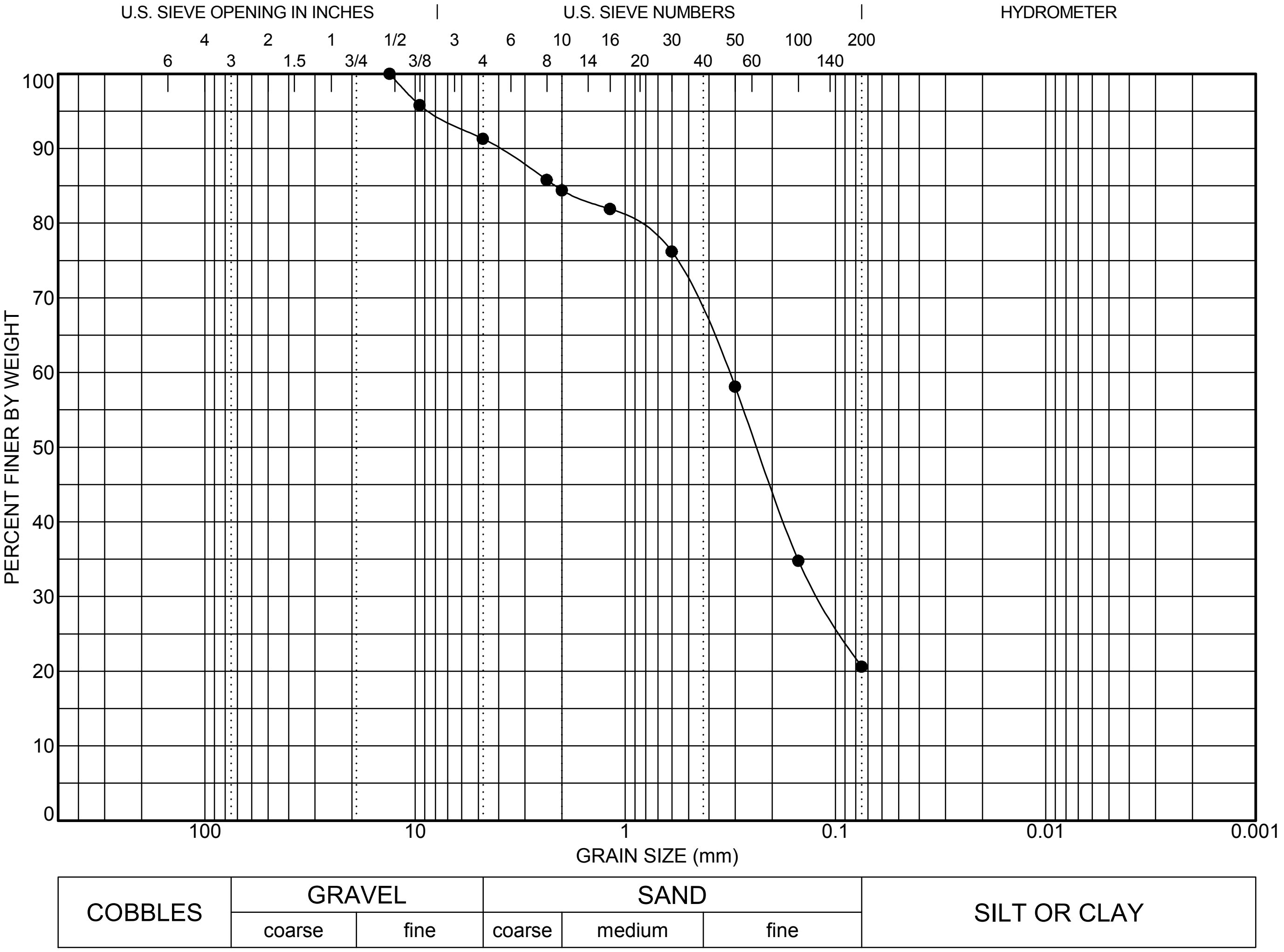
## GRAIN SIZE DISTRIBUTION

Project: Road Reconstruction / Realignment Projects

Location: Bruce County Roads 25 and 33, Saugeen Shores, Ontario

File No.: G17496

Enclosure No.: 26



| LL | PL | PI | Cc | Cu | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 13.2 | 0.323 | 0.119 | | 8.7 | 70.7 | 20.6 | |

| | |
|---|---|
| **Date:** | Dec. 21 / 2017 |
| **Client:** | GM BluePlan Engineering Limited |
| **Contractor:** | |
| **Source:** | |
| **Sampled From:** | BH 3, 0.15 to 0.30 m depth |
| **Sample No.:** | 3-1 |
| **Date Sampled:** | Nov. 20 / 2017 |
| **Sampled By:** | JV |
| **Lab No.:** | 255 |
| **Date Tested:** | Dec. 04 / 2017 |
| **Type of Material:** | Silty Sand Fill, trace gravel |

| Sieve Size (mm) | Percent Passing | No Specifications |
|---|---|---|
| | | |

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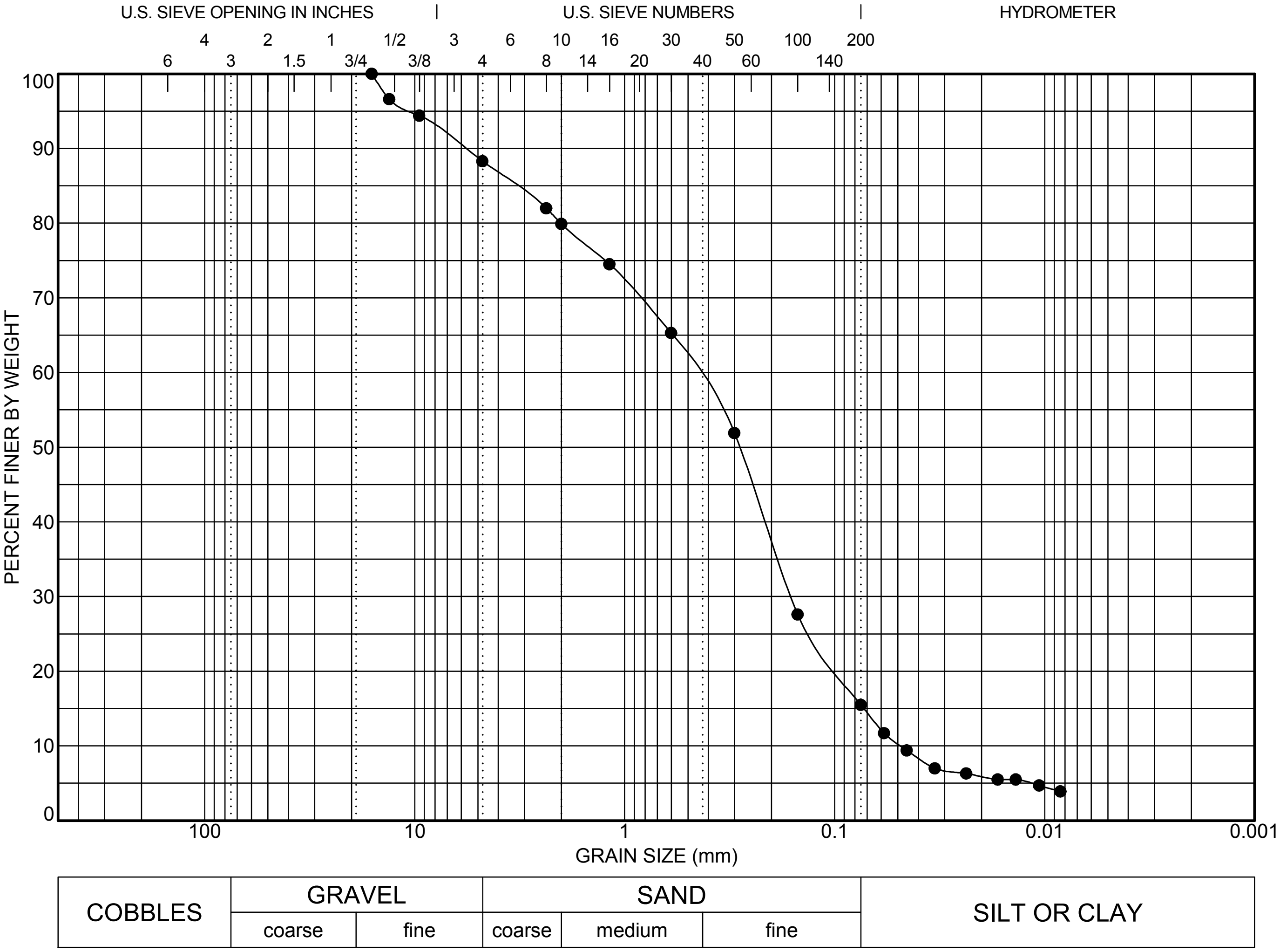
## GRAIN SIZE DISTRIBUTION

Project: Road Reconstruction / Realignment Projects

Location: Bruce County Roads 25 and 33, Saugeen Shores, Ontario

File No.: G17496

Enclosure No.: 27



| LL | PL | PI | Cc | Cu | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  | 1.17 | 9.44 | 16 | 0.456 | 0.161 | 0.048 | 11.7 | 72.8 | 15.5 |  |

**Date:** Dec. 21 / 2017
**Client:** GM BluePlan Engineering Limited
**Contractor:**
**Source:**
**Sampled From:** BH 6, 0.15 to 0.30 m depth
**Sample No.:** 6-1
**Date Sampled:** Nov. 21 / 2017
**Sampled By:** JV
**Lab No.:** 2556
**Date Tested:** Dec. 04 / 2017
**Type of Material:** Sand Fill, some silt and gravel

| Sieve Size (mm) | Percent Passing | No Specifications |
|---|---|---|

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## GRAIN SIZE DISTRIBUTION

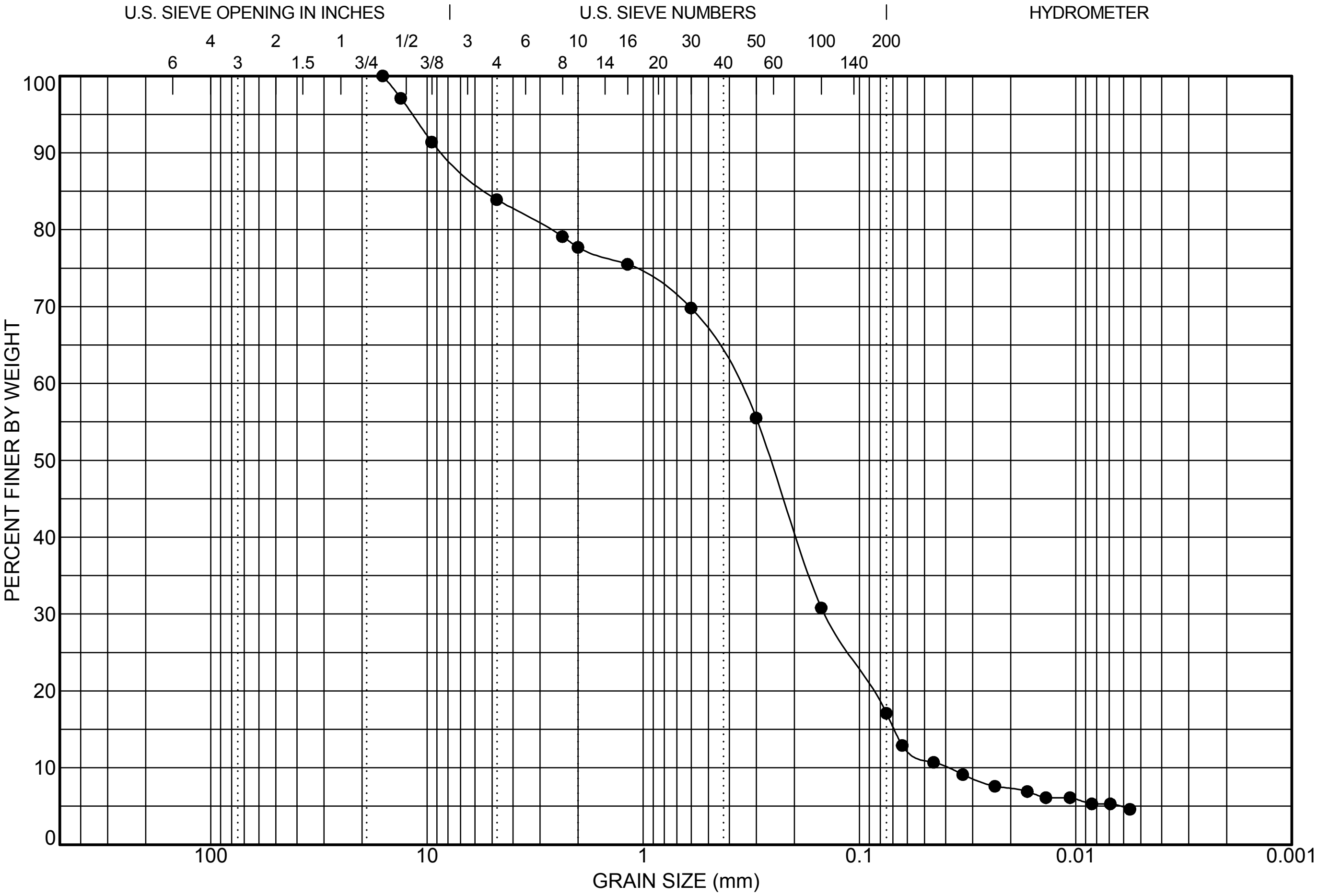
Project: Road Reconstruction / Realignment Projects

Location: Bruce County Roads 25 and 33, Saugeen Shores, Ontario

File No.: G17496

Enclosure No.: 28

DM - NO SPECIFICATIONS G17496 BRUCE COUNTY RDS 25 & 33 SAUGEEN SHORE.GPJ LAW LNDN.GDT 6/2/18



| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| LL | PL | PI | Cc | Cu | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1.41 | 9.44 | 16 | 0.373 | 0.144 | 0.04 | 16.1 | 66.8 | 17.1 | |

**Date:** Dec. 21 / 2017
**Client:** GM BluePlan Engineering Limited
**Contractor:**
**Source:**
**Sampled From:** BH 9, 0.15 to 0.30 m depth
**Sample No.:** 9-1
**Date Sampled:** Nov. 21 / 2017
**Sampled By:** JV
**Lab No.:** 2558
**Date Tested:** Dec. 04 / 2017
**Type of Material:** Sand Fill, some silt and gravel

| Sieve Size (mm) | Percent Passing | No Specifications |
|---|---|---|
| | | |

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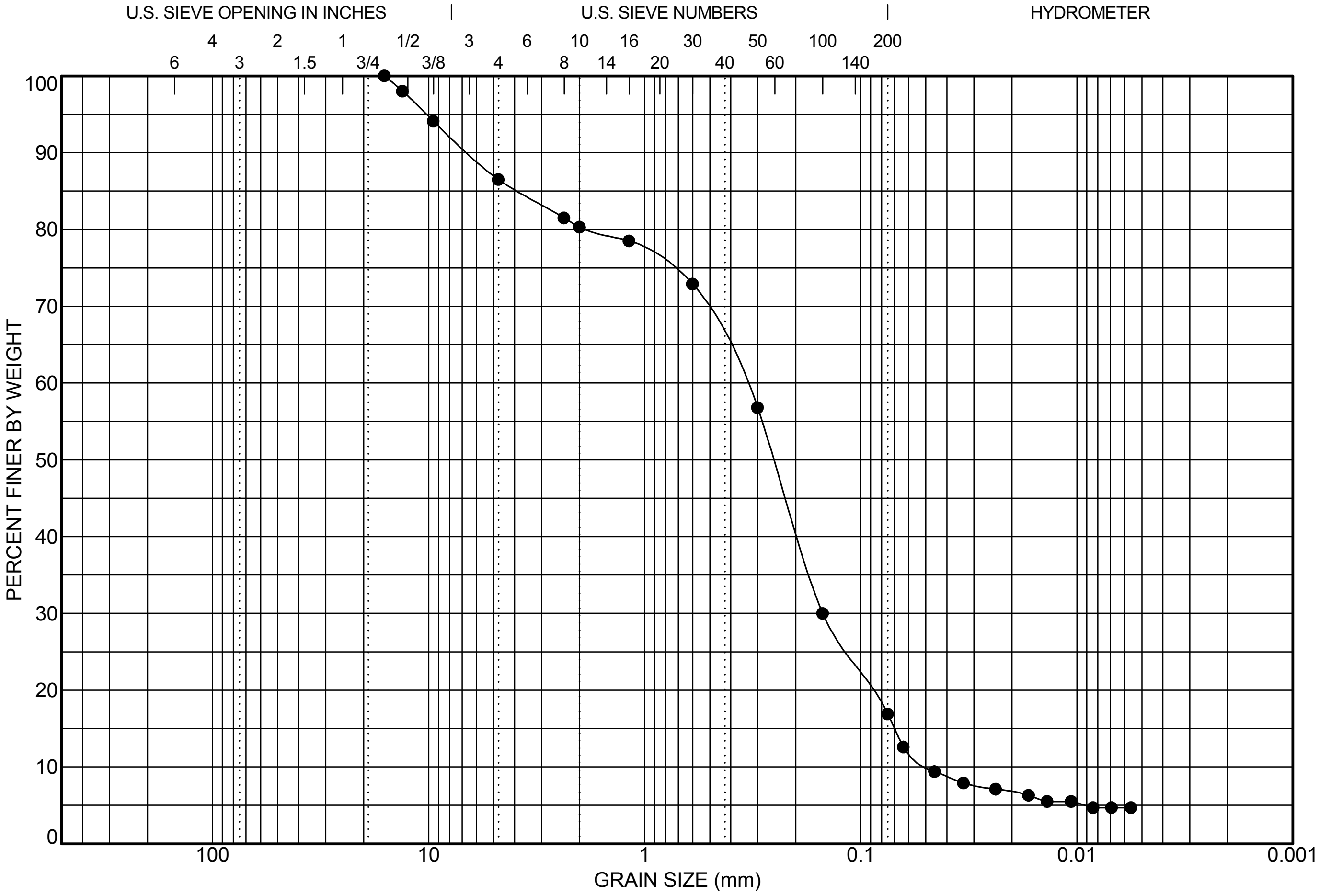
## GRAIN SIZE DISTRIBUTION

Project: Road Reconstruction / Realignment Projects

Location: Bruce County Roads 25 and 33, Saugeen Shores, Ontario

File No.: G17496

Enclosure No.: 29



| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| LL | PL | PI | Cc | Cu | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1.35 | 7.11 | 16 | 0.344 | 0.15 | 0.048 | 13.5 | 69.6 | 16.9 | |

**Date:** Dec. 21 / 2017
**Client:** GM BluePlan Engineering Limited
**Contractor:**
**Source:**
**Sampled From:** BH 12, 0.15 to 0.30 m depth
**Sample No.:** 12-1
**Date Sampled:** Nov. 22 / 2017
**Sampled By:** JV
**Lab No.:** 2559
**Date Tested:** Dec. 04 / 2017
**Type of Material:** Sand Fill, some silt and gravel

| Sieve Size (mm) | Percent Passing | No Specifications |
|---|---|---|

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## GRAIN SIZE DISTRIBUTION

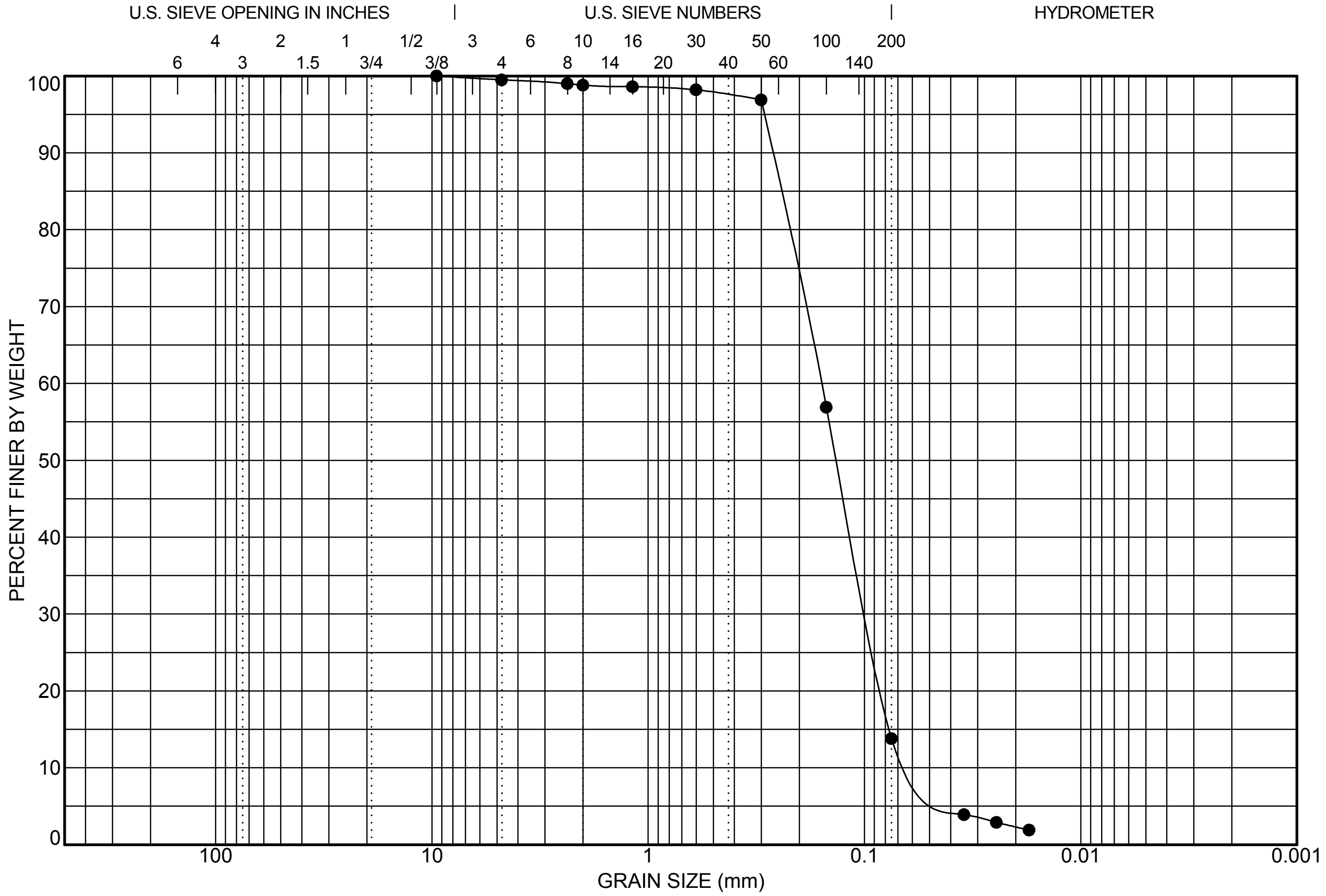
Project: Road Reconstruction / Realignment Projects

Location: Bruce County Roads 25 and 33, Saugeen Shores, Ontario

File No.: G17496

Enclosure No.: 30

DM - NO SPECIFICATIONS G17496 BRUCE COUNTY RDS 25 & 33 SAUGEEN SHORE.GPJ LAW LNDN.GDT 6/2/18



| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| LL | PL | PI | Cc | Cu | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1.07 | 2.84 | 9.5 | 0.158 | 0.097 | 0.056 | 0.5 | 85.7 | 13.8 | |

**Date:** Dec. 21 / 2017
**Client:** GM BluePlan Engineering Limited
**Contractor:**
**Source:**
**Sampled From:** BH 1, 1.52 to 1.98 m depth
**Sample No.:** 1-3
**Date Sampled:** Nov. 20 / 2017
**Sampled By:** JV
**Lab No.:** 2553
**Date Tested:** Dec. 04 / 2017
**Type of Material:** Sand, some silt, trace gravel

| Sieve Size (mm) | Percent Passing | No Specifications |
|---|---|---|
| | | |

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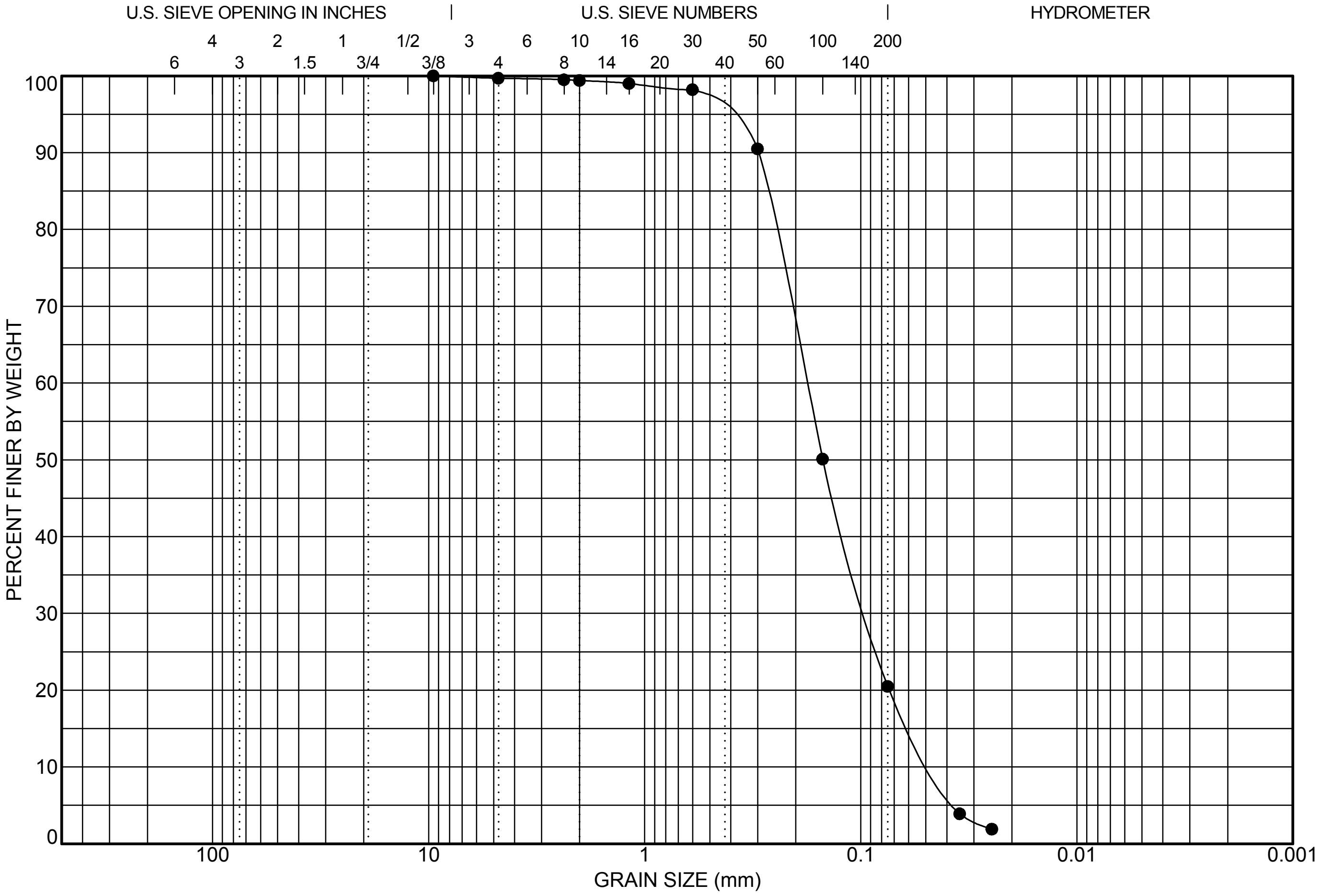
## GRAIN SIZE DISTRIBUTION

Project: Road Reconstruction / Realignment Projects

Location: Bruce County Roads 25 and 33, Saugeen Shores, Ontario

File No.: G17496

Enclosure No.: 31



| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| LL | PL | PI | Cc | Cu | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1.07 | 3.85 | 9.5 | 0.178 | 0.094 | 0.046 | 0.3 | 79.2 | 20.5 | |

| | |
|---|---|
| **Date:** | Dec. 21 / 2017 |
| **Client:** | GM BluePlan Engineering Limited |
| **Contractor:** | |
| **Source:** | |
| **Sampled From:** | BH 8, 1.52 to 1.98 m depth |
| **Sample No.:** | 8-3 |
| **Date Sampled:** | Nov. 21 / 2017 |
| **Sampled By:** | JV |
| **Lab No.:** | 2557 |
| **Date Tested:** | Dec. 04 / 2017 |
| **Type of Material:** | Sand, some silt to silty |

| **Sieve Size (mm)** | **Percent Passing** | **No Specifications** |
|---|---|---|
| | | |

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e-mail: info@cvdengineering.com

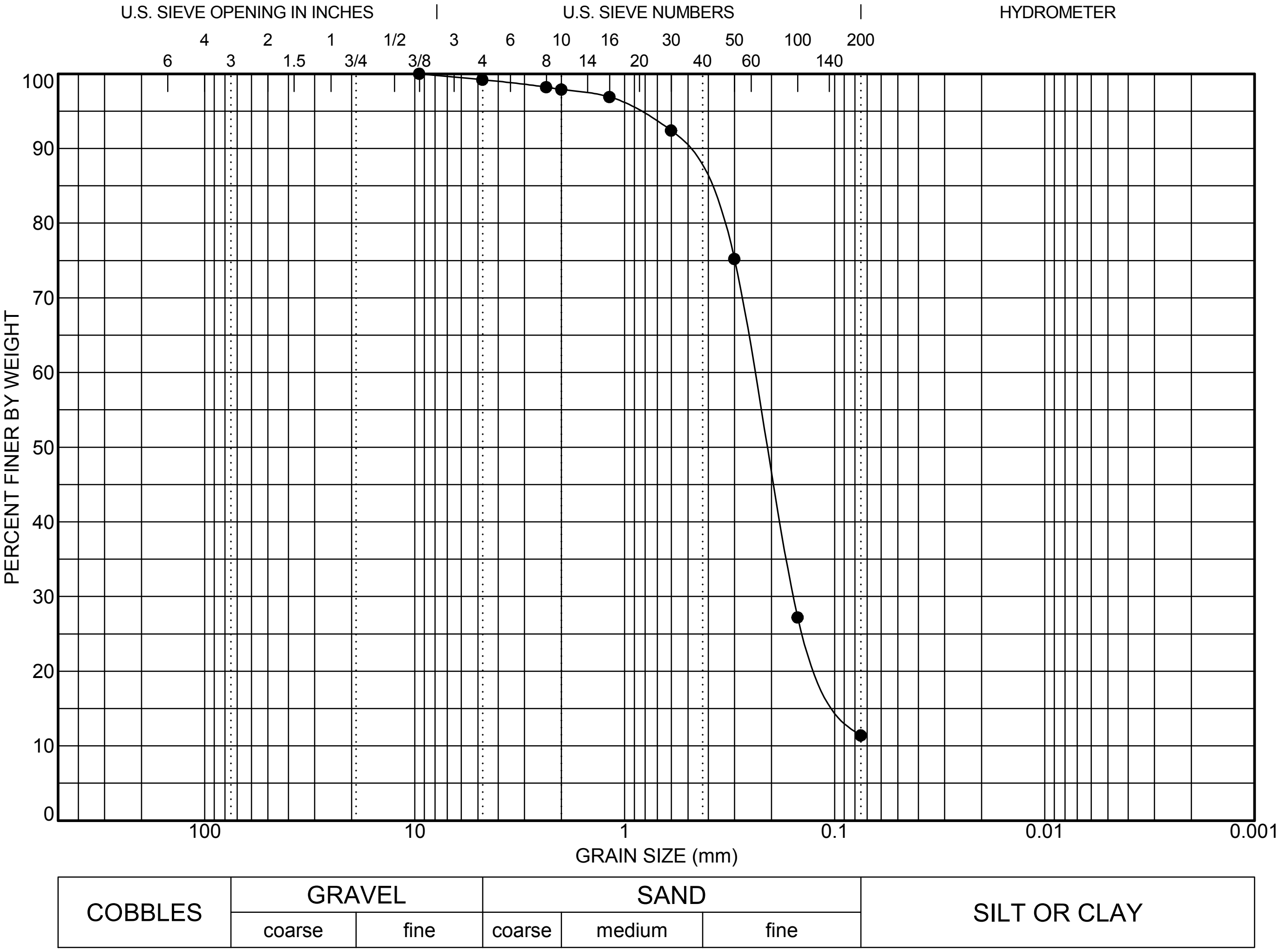
## GRAIN SIZE DISTRIBUTION

Project: Road Reconstruction / Realignment Projects

Location: Bruce County Roads 25 and 33, Saugeen Shores, Ontario

File No.: G17496

Enclosure No.: 32



| LL | PL | PI | Cc | Cu | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  | 1.44 | 3.42 | 9.5 | 0.241 | 0.156 |  | 0.8 | 87.8 | 11.4 |  |

**Date:** Dec. 21 / 2017
**Client:** GM BluePlan Engineering Limited
**Contractor:**
**Source:**
**Sampled From:** BH 12, 2.29 to 2.74 m depth
**Sample No.:** 12-4
**Date Sampled:** Nov. 22 / 2017
**Sampled By:** JV
**Lab No.:** 2560
**Date Tested:** Dec. 04 / 2017
**Type of Material:** Sand, some silt

| Sieve Size (mm) | Percent Passing | No Specifications |
|---|---|---|
|  |  |  |

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## GRAIN SIZE DISTRIBUTION

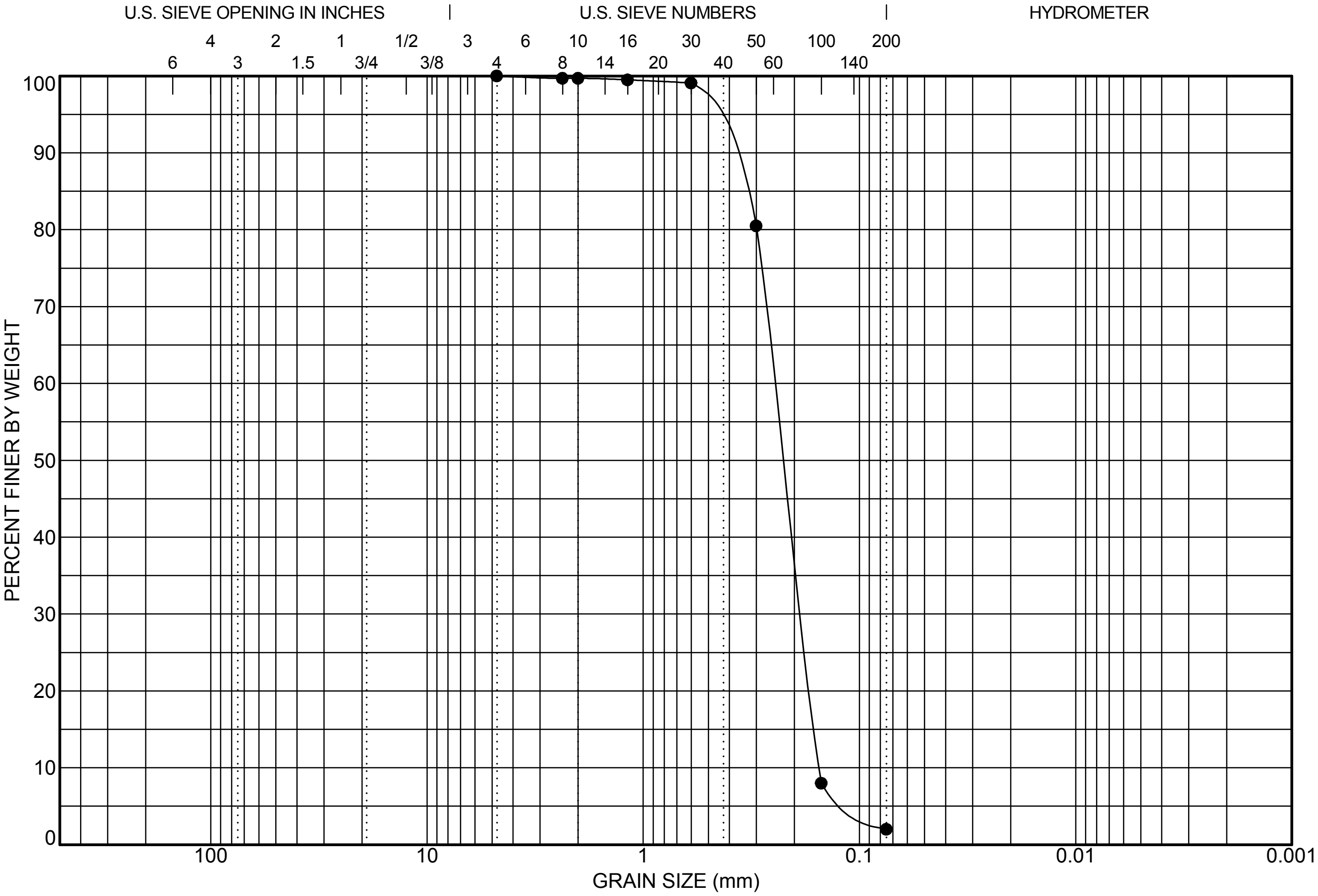
Project: Road Reconstruction / Realignment Projects

Location: Bruce County Roads 25 and 33, Saugeen Shores, Ontario

File No.: G17496

Enclosure No.: 33

DM - NO SPECIFICATIONS G17496 BRUCE COUNTY RDS 25 & 33 SAUGEEN SHORE.GPJ LAW LNDN.GDT 6/2/18



| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| LL | PL | PI | Cc | Cu | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 0.91 | 1.61 | 4.75 | 0.247 | 0.185 | 0.153 | 0.0 | 98.0 | 2.0 | |

| | |
|---|---|
| **Date:** | Dec. 21 / 2017 |
| **Client:** | GM BluePlan Engineering Limited |
| **Contractor:** | |
| **Source:** | |
| **Sampled From:** | BH 15, 3.81 to 4.27 m depth |
| **Sample No.:** | 15-6 |
| **Date Sampled:** | Nov. 22 / 2017 |
| **Sampled By:** | JV |
| **Lab No.:** | 2561 |
| **Date Tested:** | Dec. 04 / 2017 |
| **Type of Material:** | Sand, trace silt |

| Sieve Size (mm) | Percent Passing | No Specifications |
|---|---|---|
| | | |

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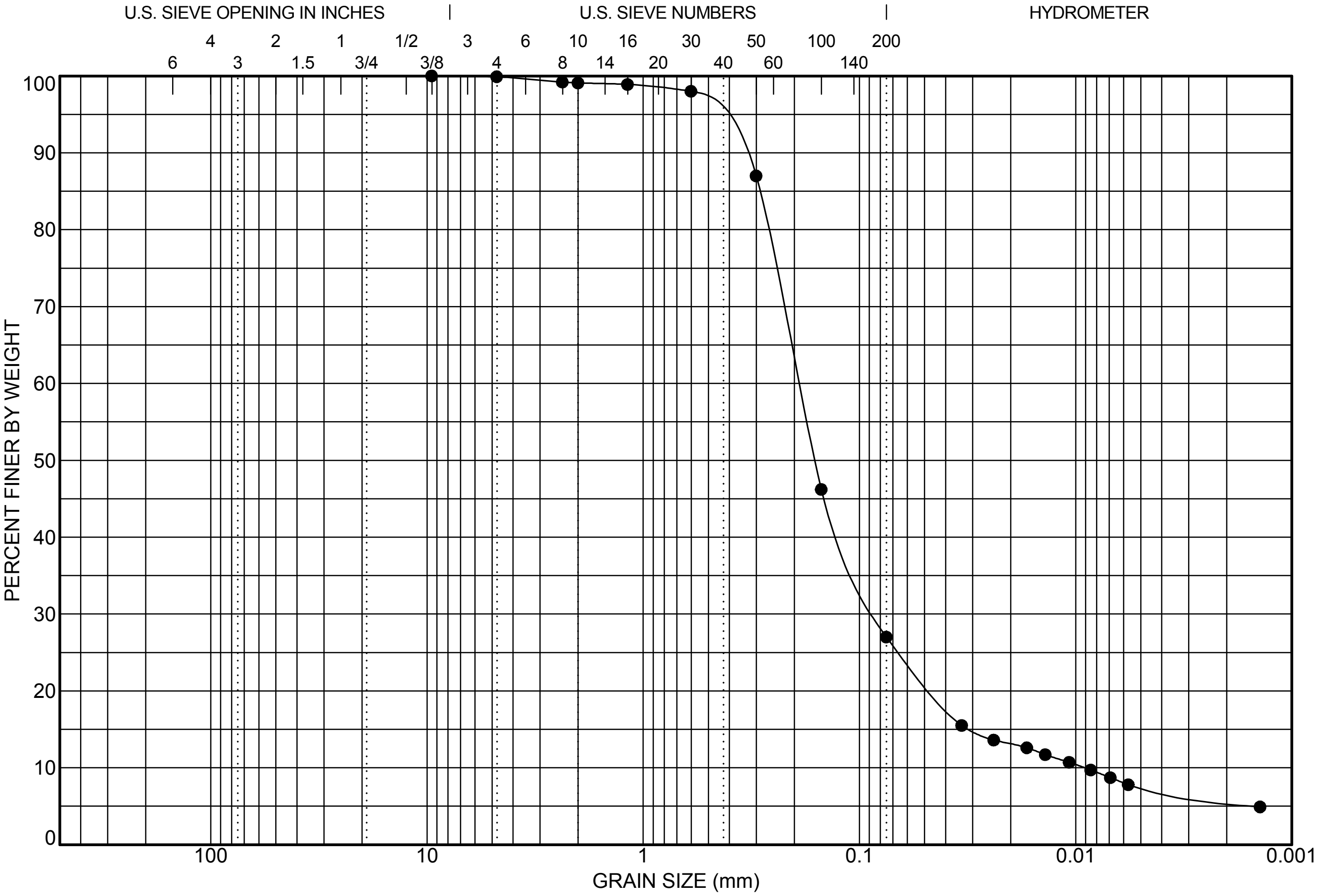
## GRAIN SIZE DISTRIBUTION

Project: Road Reconstruction / Realignment Projects

Location: Bruce County Roads 25 and 33, Saugeen Shores, Ontario

File No.: G17496

Enclosure No.: 34



| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| LL | PL | PI | Cc | Cu | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 4.04 | 20.82 | 9.5 | 0.19 | 0.084 | 0.009 | 0.1 | 72.9 | 27.0 | |

| | |
|---|---|
| **Date:** | Dec. 21 / 2017 |
| **Client:** | GM BluePlan Engineering Limited |
| **Contractor:** | |
| **Source:** | |
| **Sampled From:** | BH 18, 2.29 to 2.74 m depth |
| **Sample No.:** | 18-4 |
| **Date Sampled:** | Dec. 23 / 2017 |
| **Sampled By:** | JV |
| **Lab No.:** | 2563 |
| **Date Tested:** | Dec. 04 / 2017 |
| **Type of Material:** | Silty Sand, trace clay |

| **Sieve Size (mm)** | **Percent Passing** | **No Specifications** |
|---|---|---|
| | | |

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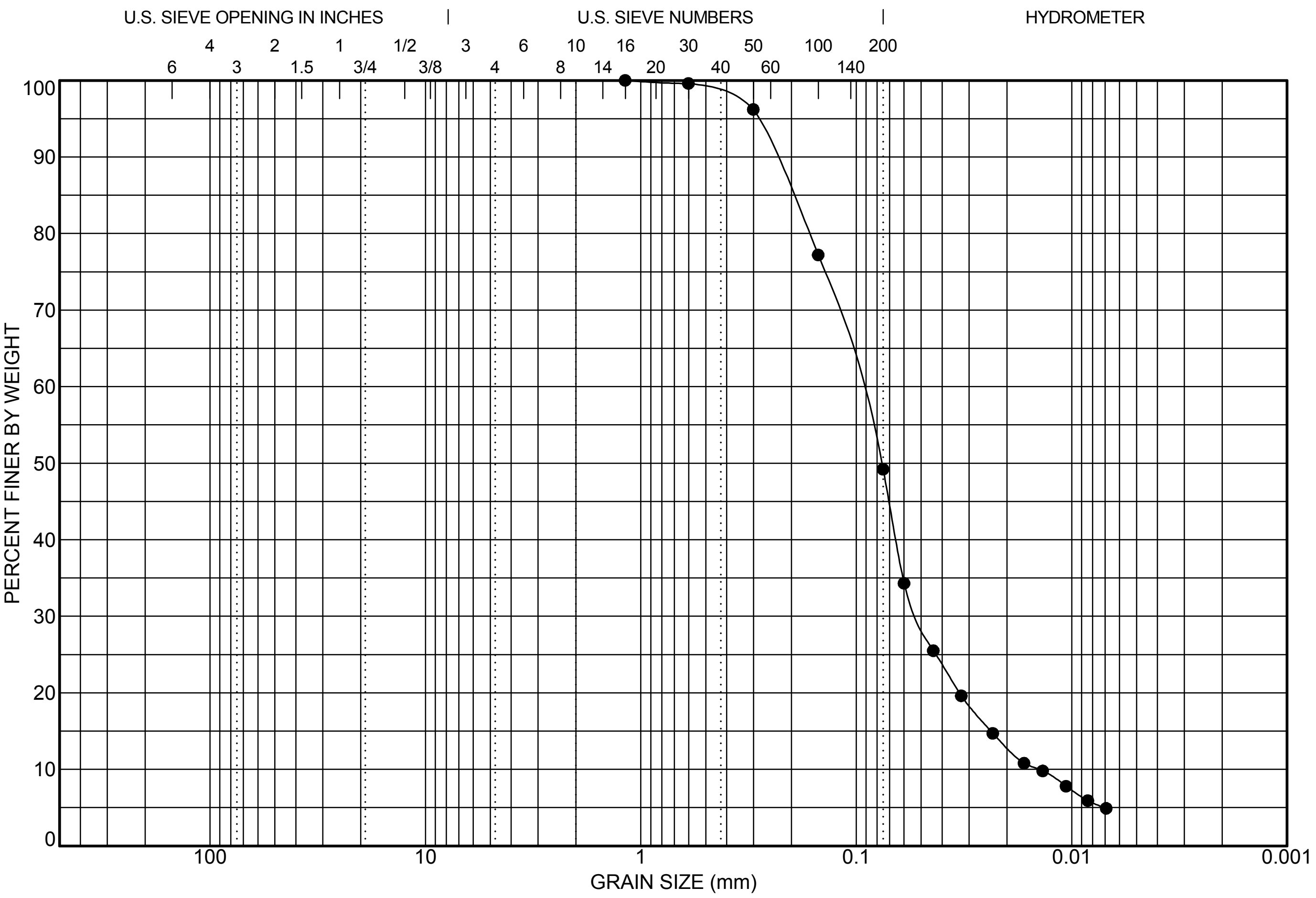
## GRAIN SIZE DISTRIBUTION

Project: Road Reconstruction / Realignment Projects

Location: Bruce County Roads 25 and 33, Saugeen Shores, Ontario

File No.: G17496

Enclosure No.: 35



| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |

| LL | PL | PI | Cc | Cu | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1.91 | 6.92 | 1.18 | 0.098 | 0.051 | 0.014 | 0.0 | 50.8 | 49.2 | |

**Date:** Dec. 21 / 2017
**Client:** GM BluePlan Engineering Limited
**Contractor:**
**Source:**
**Sampled From:** BH 23, 2.29 to 2.74 m depth
**Sample No.:** 23-4
**Date Sampled:** Nov. 23 / 2017
**Sampled By:** JV
**Lab No.:** 2564
**Date Tested:** Dec. 05 / 2017
**Type of Material:** Sand and Silt

| Sieve Size (mm) | Percent Passing | No Specifications |
|---|---|---|
| | | |

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## GRAIN SIZE DISTRIBUTION

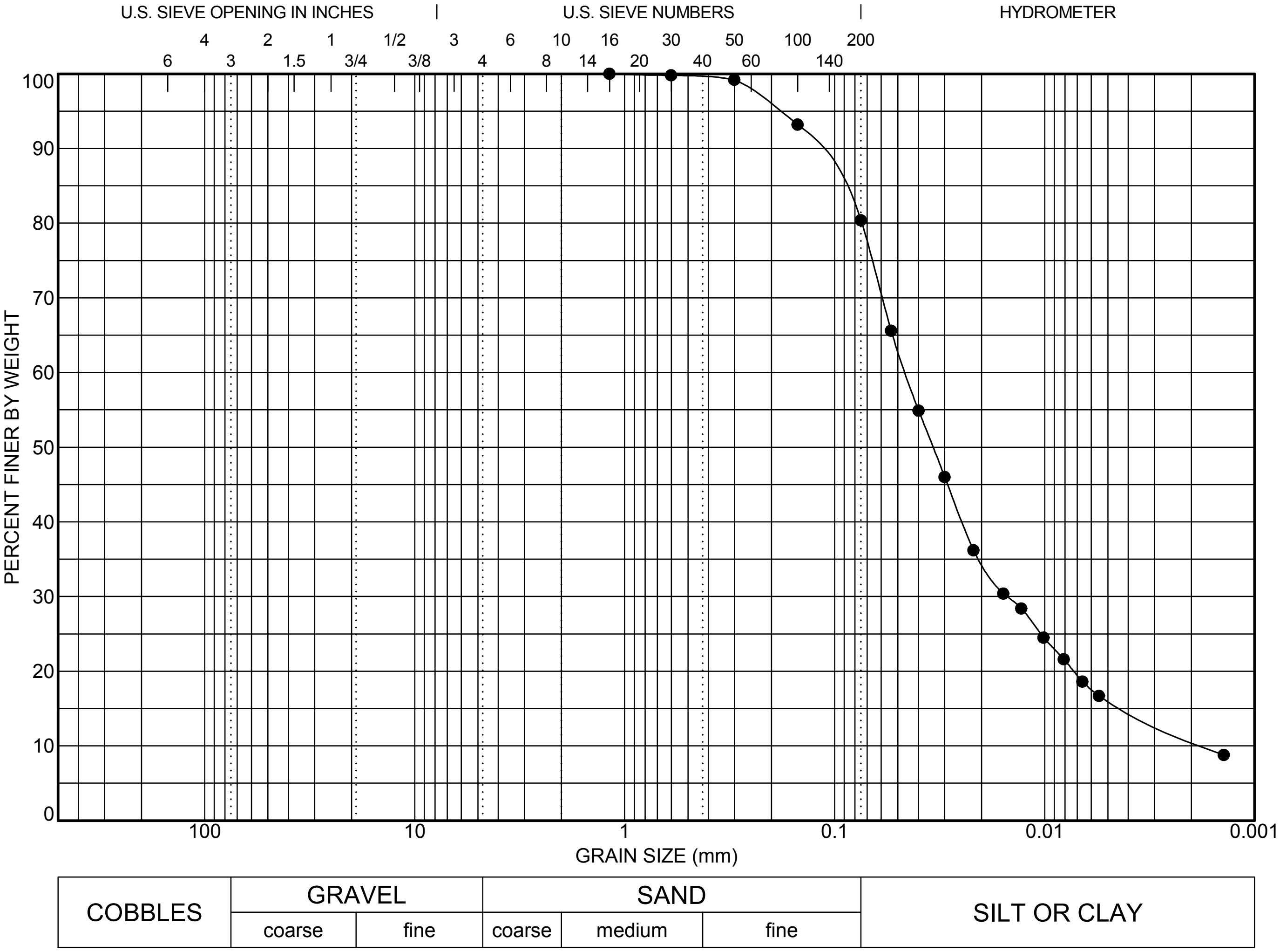
Project: Road Reconstruction / Realignment Projects

Location: Bruce County Roads 25 and 33, Saugeen Shores, Ontario

File No.: G17496

Enclosure No.: 36

DM - NO SPECIFICATIONS G17496 BRUCE COUNTY RDS 25 & 33 SAUGEEN SHORE.GPJ LAW LNDN.GDT 6/2/18



| LL | PL | PI | Cc | Cu | D100 | D60 | D30 | D10 | %Gravel | %Sand | %Silt | %Clay |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 2.88 | 26.66 | 1.18 | 0.046 | 0.015 | 0.002 | 0.0 | 19.6 | 80.4 | |

| | |
|---|---|
| **Date:** | Dec. 21 / 2017 |
| **Client:** | GM BluePlan Engineering Limited |
| **Contractor:** | |
| **Source:** | |
| **Sampled From:** | BH 2, 2.29 to 2.74 m depth |
| **Sample No.:** | 2-4 |
| **Date Sampled:** | Nov. 20 / 2017 |
| **Sampled By:** | JV |
| **Lab No.:** | 2554 |
| **Date Tested:** | Dec. 04 / 2017 |
| **Type of Material:** | Silt, some sand and clay |

| **Sieve Size (mm)** | **Percent Passing** | **No Specifications** |
|---|---|---|

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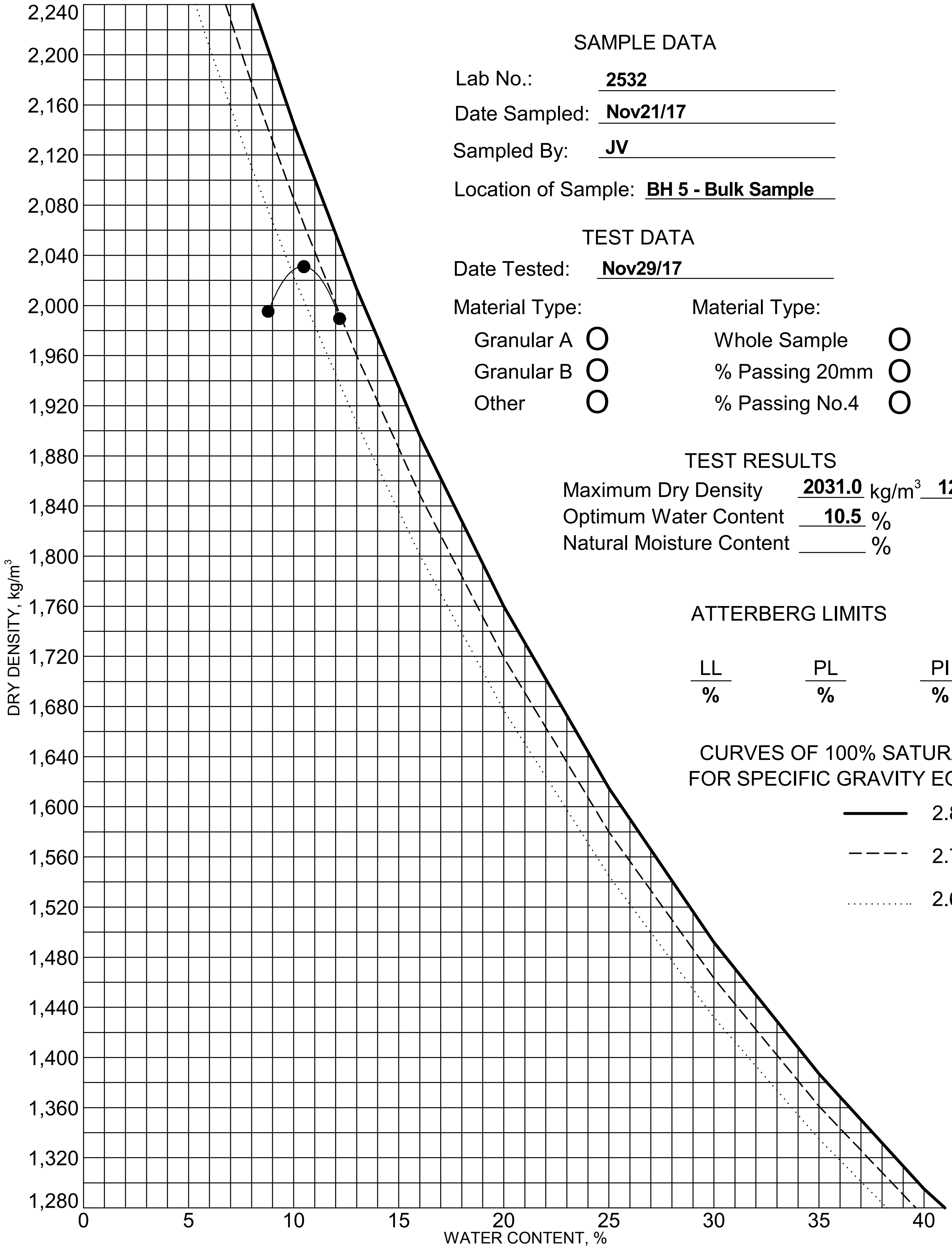
## GRAIN SIZE DISTRIBUTION

Project: Road Reconstruction / Realignment Projects

Location: Bruce County Roads 25 and 33, Saugeen Shores, Ontario

File No.: G17496

Enclosure No.: 37



SAMPLE DATA

Lab No.: **2532**

Date Sampled: **Nov21/17**

Sampled By: **JV**

Location of Sample: **BH 5 - Bulk Sample**

TEST DATA

Date Tested: **Nov29/17**

| Material Type: | | Material Type: | |
|---|---|---|---|
| Granular A | ○ | Whole Sample | ○ |
| Granular B | ○ | % Passing 20mm | ○ |
| Other | ○ | % Passing No.4 | ○ |

TEST RESULTS

Maximum Dry Density **2031.0** kg/m³ **126.8** PCF

Optimum Water Content **10.5** %

Natural Moisture Content ______ %

ATTERBERG LIMITS

| LL | PL | PI |
|---|---|---|
| % | % | % |

CURVES OF 100% SATURATION
FOR SPECIFIC GRAVITY EQUAL TO:

| | |
|---|---|
| ——— | 2.80 |
| – – – – | 2.70 |
| ………… | 2.60 |

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## STANDARD PROCTOR TEST RESULTS

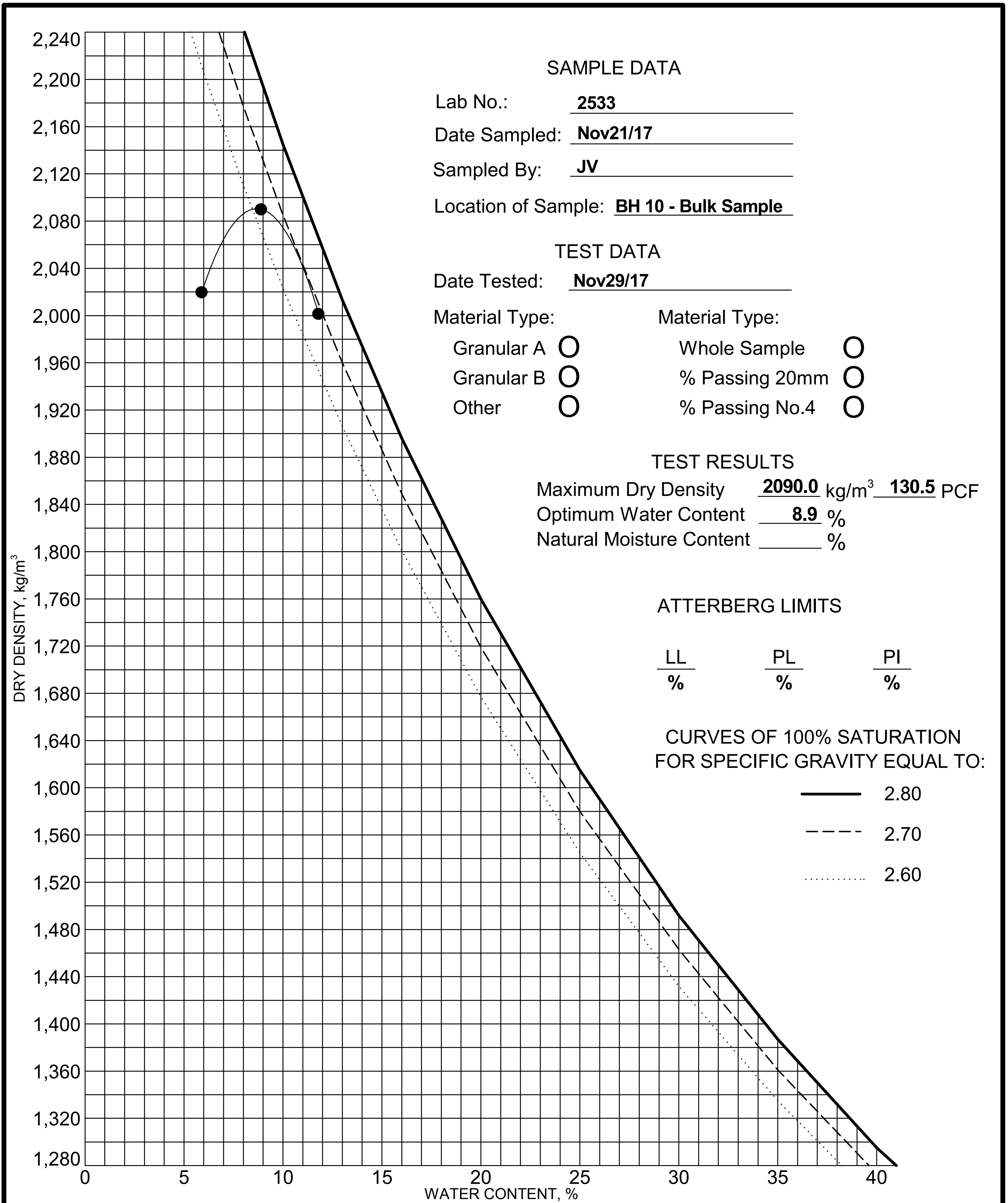
Project: **Road Reconstruction / Realignment Projects**

Location: **Bruce County Roads 25 and 33, Saugeen Shores, Ontario**

File No.: **G17496**

Enclosure No.: 38

CAN COMPACTION G17496 BRUCE COUNTY RDS 25 & 33 SAUGEEN SHORE.GPJ LAW LNDN.GDT 6/2/18



SAMPLE DATA

Lab No.: **2533**

Date Sampled: **Nov21/17**

Sampled By: **JV**

Location of Sample: **BH 10 - Bulk Sample**

TEST DATA

Date Tested: **Nov29/17**

| Material Type: | | Material Type: | |
|---|---|---|---|
| Granular A | ○ | Whole Sample | ○ |
| Granular B | ○ | % Passing 20mm | ○ |
| Other | ○ | % Passing No.4 | ○ |

TEST RESULTS

Maximum Dry Density **2090.0** kg/m³ **130.5** PCF
Optimum Water Content **8.9** %
Natural Moisture Content ______ %

ATTERBERG LIMITS

| LL | PL | PI |
|---|---|---|
| % | % | % |

CAN COMPACTION G17496 BRUCE COUNTY RDS 25 & 33 SAUGEEN SHORE.GPJ LAW LNDN.GDT 6/2/18

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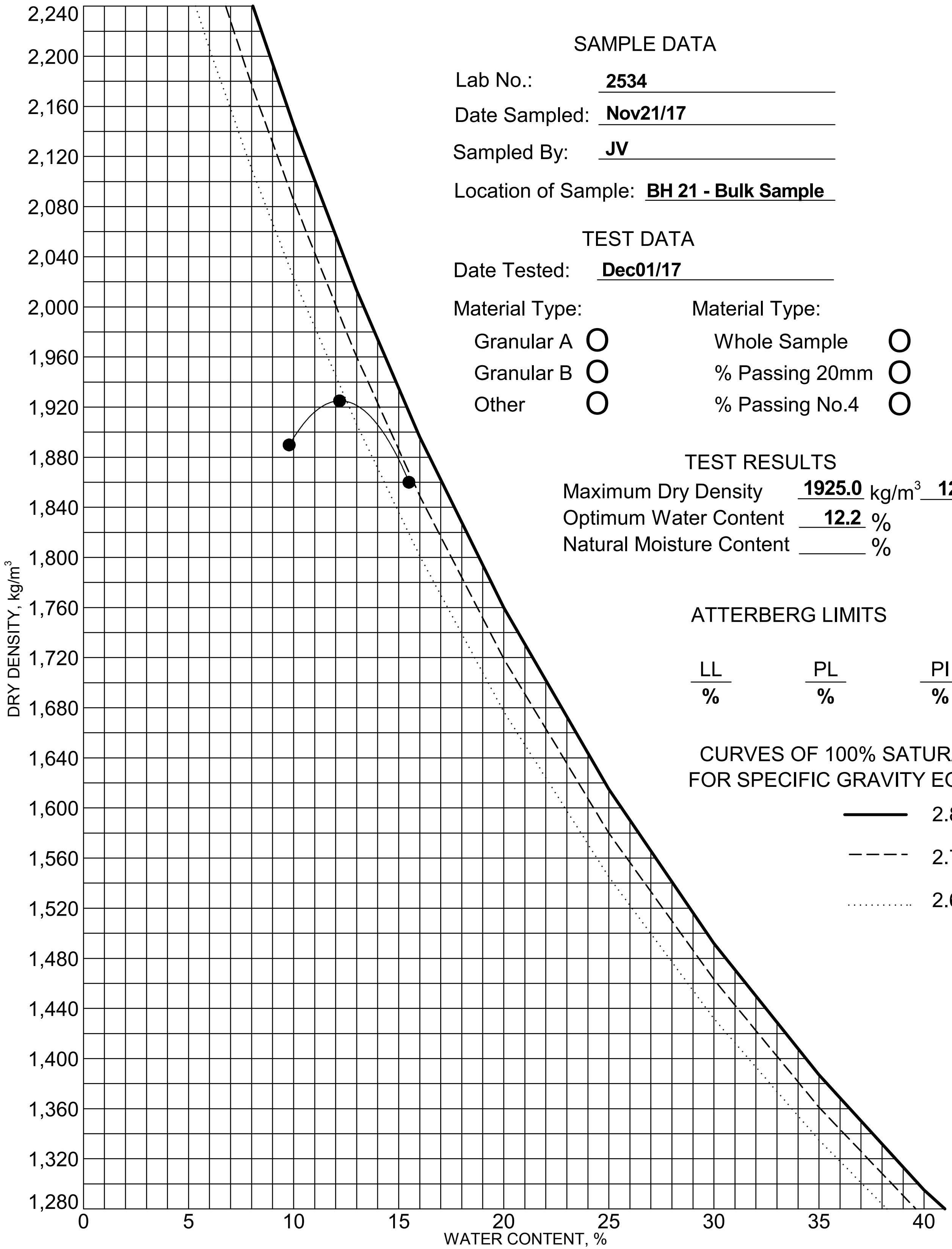
## STANDARD PROCTOR TEST RESULTS

Project: **Road Reconstruction / Realignment Projects**
Location: **Bruce County Roads 25 and 33, Saugeen Shores, Ontario**
File No.: **G17496**
Enclosure No.: 39



SAMPLE DATA

Lab No.: **2534**

Date Sampled: **Nov21/17**

Sampled By: **JV**

Location of Sample: **BH 21 - Bulk Sample**

TEST DATA

Date Tested: **Dec01/17**

| Material Type: | | Material Type: | |
|---|---|---|---|
| Granular A | ○ | Whole Sample | ○ |
| Granular B | ○ | % Passing 20mm | ○ |
| Other | ○ | % Passing No.4 | ○ |

TEST RESULTS

Maximum Dry Density **1925.0** kg/m³ **120.2** PCF

Optimum Water Content **12.2** %

Natural Moisture Content ______ %

ATTERBERG LIMITS

| LL | PL | PI |
|---|---|---|
| % | % | % |

CURVES OF 100% SATURATION
FOR SPECIFIC GRAVITY EQUAL TO:

| | |
|---|---|
| ——— | 2.80 |
| – – – | 2.70 |
| ........... | 2.60 |

## STANDARD PROCTOR TEST RESULTS

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Project: **Road Reconstruction / Realignment Projects**
Location: **Bruce County Roads 25 and 33, Saugeen Shores, Ontario**
File No.: **G17496**
Enclosure No.: 40

# APPENDIX H:
# CONSULTATION (COMMENTS)

# SUMMARY OF PUBLIC COMMENTS RECEIVED (February and March 2020)

| No. | Date | Comments<br>*(recorded sic erat scriptum)* | General Response |
|---|---|---|---|
| 1 | 25-Feb-20 | Per your notice first issued on Feb. 25, 2020, I would like to be added to the record as supporting the "Recommended Preferred Solution" (Alternative 2) for the proposed Bruce Road 25 Reconstruction, including the Bruce Road 33 re-alignment and the Bruce Street extension. I do not support the do nothing option (Alternative 1) ever, and see no need for a 4-lane cross-section (Alternative 3) at this time. | Support for the Recommended Preferred Solution (i.e. Alternative 2) is noted. |
| 2 | 27-Feb-20 | Phone call to the Town of Saugeen Shores:<br>Local resident inquiring about the proposed traffic control on BR25 to the lake. The Recommended Preferred Solution, including the provision for a roundabout, was explained and the resident was directed to the website for additional information. The resident felt that a stop sign would be better and, that as a self reported 'older person', the resident didn't like roundabouts because they are difficult to navigate. | Based on the analysis and assessment provided in the Traffic Control Evaluation completed by Harbourside (December, 2019), roundabouts *'reduce the frequency and severity of collisions'* . While it is recognized that roundabouts may initially be difficult to navigate, at times resulting in a higher collision rate in the short-term immediately after being built, over the long-term roundabouts provide the best results for safety and traffic operations. Short-term increases in collision rates, when noted, are typically reported in areas (or regions) where there are few existing roundabouts and roundabout intersections are new to the majority of drivers.<br><br>We note that, initially, only two legs of the roundabout will be constructed, with the Bruce Road 33 leg intended to be added in 2022. The Bruce Street leg will be added at some point in the future concurrent with subdivision development within the Town. This step-wise approach will gradually introduce the roundabout operations to new users. |

## SUMMARY OF PUBLIC COMMENTS RECEIVED (February and March 2020)

| No. | Date | Comments<br>*(recorded sic erat scriptum)* | General Response |
|---|---|---|---|
| 3 | 27-Feb-20 | The key purposes of this master plan's 4 lane section of CR25 and bypass was to handle Bruce Power traffic especially when Highway 21 is closed, new planned subdivisions are built on CR 25 all the while improving service to existing full time residents as well as growing seasonal resident / tourist traffic demands.<br>We have all seen it backed up at the light at Highway 21 for miles along CR 33 trying to get into town with police present to waive traffic through. I had assumed in the worst case traffic senario some traffic would divert along Bruce St. and at the light at Highway 21 BOTH lanes of the expanded CR25 would be allowed to turn left.<br><br>Summer traffic complaints accessing the town are on the rise.<br>Now with this unexplained change all of these intentioned uses seem to be at risk.<br><br>For some unexplained reason a fourth 3 lane option was not offered. The middle lane could be a East / West flex turning lane allowing left turns in both of the 2 lanes running eastbound up to the highway. This mid lane would also allow safe turns into the residences on both sides of CR 25 from the highway to Bruce St. and keep traffic flowing that would be stopped with just two lanes.<br><br>A significant part of the town's anticipated new residential growth will happen in subdivisions planned for the north side of CR 25 as people can walk to shop and the beach.<br><br>Hundreds of new homes will increase traffic into and out of town along CR25 requiring the originally planned 4 lanes.<br><br>It's very frustrating to see arbitrary changes made after the issuance of master plans, the related public announcements and after submissions were made on the traffic study.<br><br>This reversion back to two lanes seems very non progressive and ill matched to scale and intent of this master plan project combining traffic, drainage and recreational multi purpose pathway needs.<br><br>It seems out of sync with current let alone future traffic demands. We hope the originally planned and publicly announced 4 lanes will be the chosen option with 3 lanes the fall back solution. Status quo two lanes with a Bruce St. outlet is unsatisfactory.<br><br>**NOTE: Similar sentiments were articulated in an article posted in the Shoreline Beacon on March 4, 2020.** | The purpose of the Master Plan was to consider initiatives across a broad area and to identify specific projects that would require additional study through a Schedule 'B' or 'C' Environmental Assessment process. It is noted that, based on previous public engagement, several adjacent landowners did not support a widening of the road across the frontage of their properties. In consideration of the time elapsed since the previous Traffic Reports were completed (i.e. 2009 and 2012) and the Town's more recent planning, which includes for the extension of Bruce Street as a collector road, the Town's traffic planning consultant for their current Master Transportation Plan process was retained (i.e. Paradigm) to review existing and foreseeable traffic conditions and to provide recommendations specific to the road cross section. Based on the findings of the assessment completed by Paradigm, it was concluded that Bruce Road 25 and its intersections within the Study Area are currently operating at satisfactory levels of service and operating conditions are expected to remain acceptable into the future. Therefore, a two-lane cross section for Bruce Road 25 was supported by the traffic evaluations that were completed.<br><br>A three-lane option was not considered as a continuous centre turning lane generally is reserved for commercial neighborhoods where the number of left turns is significant. Therefore, a three-lane alternative is not recommended or supported by the analyses.<br><br>Response from Luke Charbonneau (Mayor, Town of Saugeen Shores)<br>Date: February 29, 2020<br><br>*"My understanding is that the County's consultant provided a Class EA Transportation Assessment in November. This assessment used existing traffic counts and added forecasts based on development planned within the next 21 years. The analysis of that data found that a two-lane configuration would operate well within its capacity for the entire planning period (2019-2040).*<br><br>*Based on this study, County staff believe that a two-lane configuration would be an acceptable design.*<br><br>*The option to expand the road to four-lanes will always exist but the need for those extra lanes has not been established through any study that we have at this time.*<br><br>*I see that you have cc'd Jim Donohoe. It's possible that he may have comments that can further clarify this for us."* |

## SUMMARY OF PUBLIC COMMENTS RECEIVED (February and March 2020)

| No. | Date | Comments<br>*(recorded sic erat scriptum)* | General Response |
|---|---|---|---|
| 4 | 2-Mar-20 | Hello:<br>I have read about this project and I would like to comment on the options available. Doing nothing I don't think is an option. The traffic will increase over the next few years and with BRUCE St. Opening something different needs to be done for this area. Also there is going to be major residential development in this area.<br>I would like to comment first on the road between BRUCE St and hwy 21. A four lane road seems to be excessive from the new street to the highway. Any four lane road I have seen increases the speed of traffic. This is not needed in this mainly residential area. I expect that most traffic will go down BRUCE St. leaving the intersection at 21 manageable even at the busiest of times. There are lights there and a turning lane already which should be able to handle any traffic. This is not a busy road for most of the year.<br>Secondly I agree with lining up BRUCE St. with the Shore road. BRUCE St. has been always designated as an entrance into town for normal traffic and as an emergency route when 21 is closed. It is very much needed for locals and tourists. Majority of visitors and locals live on the east side of town. They try to avoid the highway.<br>I also believe that to control the corner of BRUCE St. and cr25 that a round-about needs to be installed. Stop lights or signs will only make things impossible at certain times of the day and frustrating at other times.<br>I will give a few examples. Look at St. Jacobs corner near Kitchener. They had installed lights and there was gridlock always. They removed them and installed a roundabout and traffic moves smoothly all the time. Same at Tiviotdale, was always backed up for miles on long weekends but with a roundabout no problem!<br>Closer to home, Alvanley on the county line a roundabout was installed with no problems with traffic. Look further south on the same road near Tara , lights were installed. Talk about frustration as you are stopped with no traffic in site from any other direction. More roundabouts are coming everywhere, even a couple in Saugeen Shores. I have driven extensively in Europe, Australia etc. and roundabouts are used effectively in all these countries. It controls and slows down traffic once people know how to use them.<br>Back to cr25 and BRUCE St. , the traffic for most of the year will be busy there for only 2 to 4 hours at most in a 24 hour period. Why not keep traffic moving, slow the speed and make people happy with a roundabout. There is lots of room to construct a very useful roundabout to handle maximum traffic, maybe a walkway for bikes and pedestrians and make it look good for the area. It might even be cheaper in the long run and make it friendly for snow plowing. I thinks there are a lot of pros for a roundabout versus streetlights or stop signs. We have more than enough of the latter around town that are already frustrating locals!<br>My two cents, good luck with this necessary project! | Overall concurrence with the Recommended Preferred Alternative, a 2-lane cross-section, is noted.<br><br>Strong support for the roundabout traffic control option at the intersection of Bruce Street and BR25 as a means to decrease traffic congestion and slow down traffic. |
| 5 | 12-Mar-20 | Hello my name is XXX I live on XXX Bruce Rd. 25 Port Elgin. I am in favour of Alternative 2, re-construction of BR25 with two-lane urbanized cross section. I am also in favour of a roundabout on Bruce St. and county Rd. 25 were it would slow traffic down to the posted speed limit. | Support for the Recommended Preferred Solution (i.e. Alternative 2), including the roundabout, is noted. |

## SUMMARY OF PUBLIC COMMENTS RECEIVED (February and March 2020)

| No. | Date | Comments<br>*(recorded sic erat scriptum)* | General Response |
|---|---|---|---|
| 6 | 12-Mar-20 | Thanks for giving me the opportunity to comment on the Bruce Road 25 reconstruction.<br>First with a little background, being a seasonal resident of the Baker subdivision in 1986 becoming a full time resident in 2003,<br>I have followed and participated in the various road and drainage undertakings of Bruce Roads 25 and 33 since 2017.<br>I wish to make it clear that I fully support Alternative 2: Construct a two-lane urbanized cross section along BR25.<br>One needs to reject the rhetoric being created by the Beachers' organization regarding "miles long traffic backups".<br>I do not agree with the predicted notion that the two lane option would not be able to handle traffic in the area.........<br>Having lived here for the last 17 years and observing traffic volumes, it only becomes a major traffic issue when Highway 21 is closed with Bruce Power and OPG workers use this alternate route into Saugeen Shores, at the end of the work day.<br>It is my firm belief that some of the issues we see now can be averted with design and operations.<br>For design I am still of the belief that constructing a roundabout at the Bruce Rd 25 and future Bruce Rd 33 ( Bruce St) realignment would do wonders for traffic movement.<br>That along with a well designed left turn lane at Highway 21.<br>I will forward under separate cover, an email sent in February 2018 regarding the realignment of Bruce Road 33.<br>For operations when Highway 21 is closed due to weather and road conditions, the traffic signal at 21 should flash amber for Bruce 25 traffic instead of the present flashing red.<br>Unless there is a law or regulation preventing this to happen it is ridiculous to have a flashing amber for 21 as the traffic is not going anywhere down 21, whereas it could be switched to alleviate traffic on BR25. | Support for the Recommended Preferred Solution (i.e. Alternative 2), including the roundabout, is noted. |
| 7 | 16-Mar-20 | A letter was circulated asking for opinions on the options proposed for upgrading Bruce Rd 25 from Goderich St to Bruce St in Saugeen Shores. The letter directed me to this website. I prefer alternative 2 (a 2 lane urbanized section with a possible bike lane). This was the option initially recommended. Please add my name to the group supporting this alternative. | Support for the Recommended Preferred Solution (i.e. Alternative 2), including a bike lane, is noted. |

**Ministry of Heritage, Sport, Tourism, and Culture Industries**

Programs and Services Branch
401 Bay Street, Suite 1700
Toronto, ON  M7A 0A7
Tel:  416.314.7643

**Ministère des Industries du Patrimoine, du Sport, du Tourisme et de la Culture**

Direction des programmes et des services
401, rue Bay, Bureau 1700
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Tél:  416.314.7643

Ontario

March 6, 2020  EMAIL ONLY

Jim Donohoe, P. Eng.
Engineering Manager
The County of Bruce
30 Park Street, Box 398
Walkerton, ON  NOG 2VO
jdonohoe@brucecounty.on.ca

**MHSTCI File : 0012074**
**Proponent : The County of Bruce**
**Subject : Notice of Study Commencement -**
**Project : Bruce County Road 25 Re-Construction**
**Location : Roads 25 and 33, Saugeen Shores, County of Bruce**

---

Dear Jim Donohoe:

Thank you for providing the Ministry of Heritage, Sport, Tourism and Culture Industries (MHSTCI) with the Notice of Study Commencement for the above-referenced project. MHSTCI's interest in this Environmental Assessment (EA) project relates to its mandate of conserving Ontario's cultural heritage, which includes:

- Archaeological resources, including land and marine;
- Built heritage resources, including bridges and monuments; and,
- Cultural heritage landscapes.

Under the EA process, the proponent is required to determine a project's potential impact on cultural heritage resources.

**Project Summary**

The County of Bruce has initiated a Municipal Class EA to plan the re-construction of a section of Bruce County Road 25 in the town of Saugeen Shores. The project is being planned under Schedule 'B' of the Municipal Class Environmental Assessment (MCEA), as outlined in the MCEA Manual prepared by the Municipal Engineers Association (2015).

**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.

**Archaeological Resources**

This EA project may impact archaeological resources and should be screened using the MHSTCI *Criteria for Evaluating Archaeological Potential* to determine if an archaeological assessment is needed. MHSTCI archaeological sites data are available at *archaeology@ontario.ca*. If the EA project area exhibits archaeological potential, then an archaeological assessment (AA) should be undertaken by an archaeologist licenced under the *OHA*, who is responsible for submitting the report directly to MHSTCI for review.

**Built Heritage and Cultural Heritage Landscapes**

The MHSTCI *Criteria for Evaluating Potential for Built Heritage Resources and Cultural Heritage Landscapes* should be completed to help determine whether this EA project may impact cultural heritage resources. If potential or known heritage resources exist, MHSTCI recommends that a Heritage Impact Assessment (HIA), prepared by a qualified consultant, should be completed to assess potential project impacts. Our Ministry's *Info Sheet #5: Heritage Impact Assessments and Conservation Plans* outlines the scope of HIAs. Please send the HIA to MHSTCI for review, and make it available to local organizations or individuals who have expressed interest in review.

**Environmental Assessment Reporting**

All technical cultural heritage studies and their recommendations are to be addressed and incorporated into EA projects. Please advise MHSTCI whether any technical cultural heritage studies will be completed for this EA project, and provide them to MHSTCI before issuing a Notice of Completion or commencing any work on the site. If screening has identified no known or potential cultural heritage resources, or no impacts to these resources, please include the completed checklists and supporting documentation in the EA report or file.

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
*On behalf of*

Katherine Kirzati
Heritage Planner
Heritage Planning Unit
Katherine.Kirzati@Ontario.ca

Copied to: Amanda Froese, Saugeen Shores
John Slocombe, GM BluePlan
Andrea Nelson, Senior Hydrologist, GM BluePlan

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*.

## Drea Nelson - GM BluePlan

| | |
|---|---|
| **From:** | Drea Nelson - GM BluePlan |
| **Sent:** | Friday, March 06, 2020 10:59 AM |
| **To:** | 'Harvey, Joseph (MHSTCI)'; jdonohoe@brucecounty.on.ca |
| **Cc:** | Kirzati, Katherine (MHSTCI); Barboza, Karla (MHSTCI); amanda.froese@saugeenshores.ca; John Slocombe - GM BluePlan |
| **Subject:** | RE: Notice of Commencement - BRUCE COUNTY ROAD 25 RE-CONSTRUCTION |
| **Attachments:** | 1. Archaeological Assessment Bruce Road 25 Reconstruction.pdf; 2. Cultural Heritage Checklist.pdf; 2020-03-06_BruceRd25_MHSTCI-Ltr.pdf |

Joseph,

In response to your comments provided in correspondence dated March 6, 2020, we acknowledge that under the EA process, the proponent is required to determine a project's potential impact on cultural heritage resources. As such, the potential impacts to the cultural heritage resources were discussed in Section 8.3 of the Bruce County Road 25 Re-Construction Project File (Version 1), with copies of the Stage 1 & 2 Archaeological Assessment and the completed checklist for the *'Criteria for Evaluating Potential for Built Heritage Resources and Cultural Heritage Landscapes'* provided in Appendix E. Direct links to the Project File were provided to the MHSTCI in the email that accompanied the *Notice of Project Initiation* on February 25th, 2020. The Project File is also available on the County of Bruce and Town of Saugeen Shores websites for viewing purposes.

For your ease of reference, I provide the following:

1. A copy of the Archaeological Assessment (Stage 1 & 2) is attached.
2. A copy of the completed *'Criteria for Evaluating Potential for Built Heritage Resources and Cultural Heritage Landscapes'* checklist is attached.
3. Indigenous Community Consultation: As part of the EA consultation process and consistent with the indigenous community consultation requirements outlined by the Ministry of the Environment, Conservation and Parks (MECP), indigenous communities received the *Notice of Project Initiation* (by letter mail and email). Indigenous communities will continue to be consulted as the project progresses.
4. A summary of Cultural Heritage Resource assessment, as provided in Section 8.3 of the Project File, is provided below.

**Archaeology (Section 8.3.1 of the Project File)**
A Stage 1 & 2 Archeological Assessment was completed by Mayer Heritage Consultants Inc. (July 2008) in order to determine if any direct and/or indirect impacts would occur by proposed construction activities on archaeological resources that may be present. A copy of the report is provided in Appendix E.

The assessment ascertained that, based on the soil and topography which was determined to be suitable for human habitation, the proximity to water, and the historic significance of the geographic region, the study area exhibited high potential for the discovery of pre-contact Aboriginal and Euro-Canadian archaeological resources. As a result, Stage 2 investigation work was completed.

The Stage 2 archaeological assessment of the Study Area was conducted on July 24th, 2008 using test pitting methodology. Test pits were dug to subsoil at 5-meter intervals along the entire 1.2-kilometer length of the Study Area along BR25 between Lake Huron and Goderich Street. No artifacts were encountered during the Stage 2 general survey. Therefore, the report generally concluded that because there are no archaeological resources located within the study area, no additional assessment or mitigative measures are warranted for the subject lands. However, it is noted that compliance legislation must be adhered to in the event of the discovery of deeply buried cultural material or features.

**Cultural Heritage Landscape Evaluation (Section 8.3.2 of the Project File)**
The need for a Cultural Heritage assessment was screened out using the MTCS screening tool, provided in Appendix E.

As requested, the supporting documentation for cultural heritage resources will continue to be included in the Schedule 'B' EA Project File. We trust that this satisfies the MHSTCI reporting requirements. We will continue to consult with the MHSTCI throughout the EA process for Bruce Road 25.

Regards,
Andrea Nelson

**Andrea Nelson, M.Sc.**
Senior Hydrogeologist / Environmental Planner

**GM BluePlan Engineering Limited**
1260-2nd Avenue East | Owen Sound ON N4K 2J3
t: 519.376.1805 ext. 2219 | c: 519.372.4678
andrea.nelson@gmblueplan.ca | www.gmblueplan.ca

---

**From:** Harvey, Joseph (MHSTCI) <Joseph.Harvey@ontario.ca>
**Sent:** Friday, March 06, 2020 9:53 AM
**To:** jdonohoe@brucecounty.on.ca
**Cc:** Kirzati, Katherine (MHSTCI) <Katherine.Kirzati@ontario.ca>; Barboza, Karla (MHSTCI) <Karla.Barboza@ontario.ca>; Drea Nelson - GM BluePlan <Drea.Nelson@gmblueplan.ca>; amanda.froese@saugeenshores.ca; John Slocombe - GM BluePlan <John.Slocombe@gmblueplan.ca>
**Subject:** Notice of Commencement - BRUCE COUNTY ROAD 25 RE-CONSTRUCTION

Jim Donohoe,

Please find attached, a letter acknowledging the receipt of your notice of commencement. Contact us with any further questions or concerns.

Joseph Harvey
*On behalf of*

Katherine Kirzati
Heritage Planner
Heritage Planning Unit
Katherine.Kirzati@Ontario.ca

**From:** Harvey, Joseph (MHSTCI) <Joseph.Harvey@ontario.ca>
**Sent:** Tuesday, March 17, 2020 10:27 AM
**To:** Drea Nelson - GM BluePlan
**Cc:** Kirzati, Katherine (MHSTCI); Barboza, Karla (MHSTCI); amanda.froese@saugeenshores.ca
**Subject:** RE: Notice of Commencement - BRUCE COUNTY ROAD 25 RE-CONSTRUCTION

Andrea Nelson,

Thankyou for the additional information. After a review of the project file, it is determined that the project study area has been sufficiently screened for archeological resources. Please continue to keep MHSTCI informed of any relevant updates as the project moves forward.

Thanks,

Joseph Harvey
*On behalf of*

Katherine Kirzati
Heritage Planner
Heritage Planning Unit
Katherine.Kirzati@Ontario.ca

---

**From:** Drea Nelson - GM BluePlan <Drea.Nelson@gmblueplan.ca>
**Sent:** March 6, 2020 10:59 AM
**To:** Harvey, Joseph (MHSTCI) <Joseph.Harvey@ontario.ca>; jdonohoe@brucecounty.on.ca
**Cc:** Kirzati, Katherine (MHSTCI) <Katherine.Kirzati@ontario.ca>; Barboza, Karla (MHSTCI) <Karla.Barboza@ontario.ca>; amanda.froese@saugeenshores.ca; John Slocombe - GM BluePlan <John.Slocombe@gmblueplan.ca>
**Subject:** RE: Notice of Commencement - BRUCE COUNTY ROAD 25 RE-CONSTRUCTION

Joseph,

In response to your comments provided in correspondence dated March 6, 2020, we acknowledge that under the EA process, the proponent is required to determine a project's potential impact on cultural heritage resources. As such, the potential impacts to the cultural heritage resources were discussed in Section 8.3 of the Bruce County Road 25 Re-Construction Project File (Version 1), with copies of the Stage 1 & 2 Archaeological Assessment and the completed checklist for the *'Criteria for Evaluating Potential for Built Heritage Resources and Cultural Heritage Landscapes'* provided in Appendix E. Direct links to the Project File were provided to the MHSTCI in the email that accompanied the *Notice of Project Initiation* on February 25th, 2020. The Project File is also available on the County of Bruce and Town of Saugeen Shores websites for viewing purposes.

For your ease of reference, I provide the following:

1. A copy of the Archaeological Assessment (Stage 1 & 2) is attached.
2. A copy of the completed *'Criteria for Evaluating Potential for Built Heritage Resources and Cultural Heritage Landscapes'* checklist is attached.
3. Indigenous Community Consultation: As part of the EA consultation process and consistent with the indigenous community consultation requirements outlined by the Ministry of the Environment, Conservation and Parks (MECP), indigenous communities received the *Notice of Project Initiation* (by letter mail and email). Indigenous communities will continue to be consulted as the project progresses.

4. A summary of Cultural Heritage Resource assessment, as provided in Section 8.3 of the Project File, is provided below.

**Archaeology (Section 8.3.1 of the Project File)**
A Stage 1 & 2 Archeological Assessment was completed by Mayer Heritage Consultants Inc. (July 2008) in order to determine if any direct and/or indirect impacts would occur by proposed construction activities on archaeological resources that may be present. A copy of the report is provided in Appendix E.

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The Stage 2 archaeological assessment of the Study Area was conducted on July 24th, 2008 using test pitting methodology. Test pits were dug to subsoil at 5-meter intervals along the entire 1.2-kilometer length of the Study Area along BR25 between Lake Huron and Goderich Street. No artifacts were encountered during the Stage 2 general survey. Therefore, the report generally concluded that because there are no archaeological resources located within the study area, no additional assessment or mitigative measures are warranted for the subject lands. However, it is noted that compliance legislation must be adhered to in the event of the discovery of deeply buried cultural material or features.

**Cultural Heritage Landscape Evaluation (Section 8.3.2 of the Project File)**
The need for a Cultural Heritage assessment was screened out using the MTCS screening tool, provided in Appendix E.

As requested, the supporting documentation for cultural heritage resources will continue to be included in the Schedule 'B' EA Project File. We trust that this satisfies the MHSTCI reporting requirements. We will continue to consult with the MHSTCI throughout the EA process for Bruce Road 25.

Regards,
Andrea Nelson

**Andrea Nelson, M.Sc.**
Senior Hydrogeologist / Environmental Planner

**GM BluePlan Engineering Limited**
1260-2nd Avenue East | Owen Sound ON N4K 2J3
t: 519.376.1805 ext. 2219 | c: 519.372.4678
andrea.nelson@gmblueplan.ca | www.gmblueplan.ca

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**From:** Harvey, Joseph (MHSTCI) <Joseph.Harvey@ontario.ca>
**Sent:** Friday, March 06, 2020 9:53 AM
**To:** jdonohoe@brucecounty.on.ca
**Cc:** Kirzati, Katherine (MHSTCI) <Katherine.Kirzati@ontario.ca>; Barboza, Karla (MHSTCI) <Karla.Barboza@ontario.ca>; Drea Nelson - GM BluePlan <Drea.Nelson@gmblueplan.ca>; amanda.froese@saugeenshores.ca; John Slocombe - GM BluePlan <John.Slocombe@gmblueplan.ca>
**Subject:** Notice of Commencement - BRUCE COUNTY ROAD 25 RE-CONSTRUCTION

Jim Donohoe,

Please find attached, a letter acknowledging the receipt of your notice of commencement. Contact us with any further questions or concerns.

Joseph Harvey
*On behalf of*

Katherine Kirzati
Heritage Planner
Heritage Planning Unit
Katherine.Kirzati@Ontario.ca

---

**Ministry of Heritage, Sport,**
**Tourism, and Culture Industries**

Programs and Services Branch
401 Bay Street, Suite 1700
Toronto, ON M7A 0A7
Tel: 416.314.7643

**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: 416.314.7643

March 27, 2020 Email Only

John Slocombe, P.Eng.
GM BluePlan Engineering Limited
1260-2nd Avenue East, Unit 1
Owen Sound, ON N4K 2J3
john.slocombe@gmblueplan.ca

**MHSTCI File :** **0012074**
**Your File :** **218428**
**Proponent :** **County of Bruce**
**Subject :** **Project File Report – Version 1**
**Project :** **Bruce Road 25 Reconstruction**
**Location :** **Bruce Road 25, from Highway 21 (Goderich Street) westward to the proposed Bruce Road 33 Realignment, Town of Saugeen Shores, Bruce County**

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Dear Mr. Slocombe:

Thank you for providing the Ministry of Heritage, Sport, Tourism and Culture Industries (MHSTCI)with the Notice of Project Initiation which advised that the *County of Bruce and Town of Saugeen Shores, Bruce County 25 Re-Construction: Project File Report* (GM BluePlan Engineering Limited, February 25, 2020 - Version 1) for the above-referenced project is available for review. MHSTCI's interest in this environmental assessment (EA) project relates to its mandate of conserving Ontario's cultural heritage.

**Project Summary**
The County of Bruce has initiated a Municipal Class EA to plan the re-construction of a section of Bruce County Road 25 in the Town of Saugeen Shores. The project is being planned under Schedule 'B' of the Municipal Class Environmental Assessment (MCEA), as outlined in the MCEA Manual prepared by the Municipal Engineers Association (2015).

**Comments**
MHSTCI finds that due diligence has been undertaken by:

- undertaking a Stage 1 and 2 archaeological assessment and report (Mayer Heritage Consultants Inc. P040-280-2008), which has been entered into the Ontario Public Register of Archaeological Reports
- completing the checklist Criteria for Evaluating Potential Built Heritage Resources and Cultural Heritage Landscapes, which determined that potential is low and therefore no cultural heritage evaluation report and/or heritage impact was undertaken

MHSTCI has no further comments on the PFR.

Should you have any questions, please contact the undersigned.

Regards,

Katherine Kirzati
Heritage Planner
Heritage Planning Unit
katherine.kirzati@ontario.ca

c: Jim Donohoe, County of Bruce
Amanda Froese, Town of Saugeen Shores
Andrea Nelson, GM BluePlan

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*.

## Drea Nelson - GM BluePlan

**From:** Carl Seider <c.seider@greysauble.on.ca>
**Sent:** Wednesday, February 26, 2020 11:21 AM
**To:** Drea Nelson - GM BluePlan; Matt Nelson - GM BluePlan
**Cc:** Jim Donohoe; John Slocombe - GM BluePlan; Amanda Froese (amanda.froese@saugeenshores.ca); Kerri Meier; Miguel Pelletier; RMO Mailbox
**Subject:** RE: 218428 Bruce Road 25 Re-Construction: Notice of Project Initiation (Schedule 'B' EA)

Hi Andrea & Matthew,

Thank you for providing a copy of the Project File regarding the re-construction of Bruce Road 25.

As noted in your letter, this project does not fall within a high vulnerable source protection area (wellhead protection area or intake protection zone) where Source Protection Plan policies apply. Furthermore, the Source Protection Plan does not contain any policies directed to activities within significant groundwater recharge areas or highly vulnerable aquifers, therefore Source Protection Plan policies do not apply to the proposed Bruce Road 25 re-construction project.

Furthermore, the proposed project will not change or create new vulnerable areas, as the area is already identified as a Significant Groundwater Recharge Area (SGRA)/Highly Vulnerable Aquifer (HVA) with a vulnerability score of 6 (highest vulnerability score for this category). As noted in your letter, there are currently no Source Protection Plan policies that apply to either SGRA/HVA areas, which are deemed as moderate threat areas.

Based on the location of the project and proposed works, I can confirm that project activities are not considered a prescribed drinking water threat, and that any activities associated with the project will not change or create new vulnerable source protection areas.

If you have any questions related to this email, feel free to contact me directly.

Regards,

**Carl Seider,** Risk Management Official

**Grey Sauble Conservation**
**Risk Management Office**
237897 Inglis Falls Road, RR 4
Owen Sound, Ontario, N4K 5N6
Phone: 519-470-3000 Ext. 201
Toll Free: 877-470-3001
Fax: 519-371-0437
c.seider@greysauble.on.ca

Grey Sauble Conservation

---

**From:** Drea Nelson - GM BluePlan <Drea.Nelson@gmblueplan.ca>
**Sent:** February 25, 2020 9:55 AM
**To:** Carl Seider <c.seider@greysauble.on.ca>; Carl Seider <c.seider@greysauble.on.ca>
**Cc:** Jim Donohoe <JDonohoe@brucecounty.on.ca>; John Slocombe - GM BluePlan <John.Slocombe@gmblueplan.ca>; Amanda Froese (amanda.froese@saugeenshores.ca) <amanda.froese@saugeenshores.ca>; Kerri Meier <kmeier@brucecounty.on.ca>; Miguel Pelletier <MPelletier@brucecounty.on.ca>
**Subject:** 218428 Bruce Road 25 Re-Construction: Notice of Project Initiation (Schedule 'B' EA)

Good Morning,

Please find attached a *Notice of Project Initiation* for the Schedule 'B' Municipal Class Environmental Assessment (EA) for the re-construction of Bruce County Road 25 (BR25), as considered in the Master Plan for Bruce Roads 25 and 33 for Roads and Drainage. Documentation of the development and review of alternatives considered, including a summary of the planning and consultation process, a detailed evaluation and assessment of the alternatives and the rationale for the selection of a *Preliminary Recommended Solution*, is provided in Version 1 of the Bruce County Road 25 Re-Construction Project File, which is available for viewing purposes and can be accessed (and saved) by clicking on the link below. This link will be valid for 20 days.

https://sendafile.gmblueplan.ca/uploads/02-24-20_164752_218428_BR25_Reconstruction_Project_File_(Version_1).pdf

The County of Bruce and the Town of Saugeen Shores also have the Master Plan and the Bruce County Road 25 Re-Construction Project File posted on their websites and available at their offices for viewing purposes.

Further, in support of the EA process for this project, we are consulting you with respect to Source Water Protection. Please find enclosed correspondence describing the project that requests your comment.

Please contact Jim Donohoe, Engineering Manager, Transportation and Environmental Services (Bruce County) at the address listed on the attached *Notice of Project Initiation,* with any questions or comments regarding this project.

Best Regards,
Andrea Nelson

**Andrea Nelson, M.Sc.**
Senior Hydrogeologist / Environmental Planner

**GM BluePlan Engineering Limited**
1260-2nd Avenue East | Owen Sound ON N4K 2J3
t: 519.376.1805 ext. 2219 | c: 519.372.4678
andrea.nelson@gmblueplan.ca | www.gmblueplan.ca

1078 Bruce Road 12, P.O. Box 150, Formosa ON Canada N0G 1W0
Tel 519-367-3040, Fax 519-367-3041, publicinfo@svca.on.ca, www.svca.on.ca

Sent via electronic mail only

March 24, 2020

The County of Bruce
Brian Know, P.Eng.
30 Park St., Box 398
Walkerton, ON
N0G 2V0

Town of Saugeen Shores
Amanda Froese, P.Eng.
600 Tomlinson Drive
P.O. Box 820
Port Elgin, ON
N0H 2C0

GM BluePlan Engineering Limited
Consulting Professional Engineers
John Slocombe, P.Eng.
1260-2nd Ave. East, Unit 1
Owen Sound, ON
N4K 2J3

Dear Mr. Donohoe, Ms. Froese, and Mr. Slocombe:

RE: Schedule B Municipal Class Environmental Assessment
Bruce Rd. 25 Reconstruction
Part Lot 27-30, Lake Range
Geographic Township of Saugeen
Town of Saugeen Shores

Saugeen Valley Conservation Authority (SVCA) staff have reviewed this proposal in accordance with the SVCA's mandate and the Environmental Planning and Regulations Policies Manual, amended October 2018. The proposed Bruce Rd. 25 reconstruction would facilitate a revised layout roadway and drainage plan in an area of drainage problems. SVCA Staff provided comments February 8, 2018 associated with this project as a part of the larger proposal in the area.

The SVCA has reviewed the County of Bruce & Town of Saugeen Shores, Bruce Road 25 plan generally and the proposal looks generally acceptable. A permit from the SVCA will not be required for the proposed works. The SVCA has also reviewed some related plans associated with Bruce Rd. 25 proposed works to the west and the

Watershed Member Municipalities
Municipality of Arran-Elderslie, Municipality of Brockton, Township of Chatsworth, Municipality of Grey Highlands,
Town of Hanover, Township of Howick, Municipality of Morris-Turnberry, Municipality of South Bruce,
Township of Huron-Kinloss, Municipality of Kincardine, Town of Minto, Township of Wellington North,
Town of Saugeen Shores, Township of Southgate, Municipality of West Grey

related drainage proposal. Those works are completed now the SVCA understands on the western section of BR 25.

The SVCA will continue our review upon clarifications and/or revisions being provided to the SVCA. If you have any questions on the above, please do not hesitate to contact this office.

Yours Sincerely,

Erik Downing
Manager, Environmental Planning & Regulations
Saugeen Conservation

ED/
cc: Mike Myatt, Authority Member, SVCA, via email
Cheryl Grace, Authority Member, SVCA, via email.

**Ministry of the Environment,**
**Conservation and Parks**

733 Exeter Road
London ON N6E 1L3
Tel': 519 873-5000
Fax: 519 873-5020

**Ministère de l'Environnement,**
**de la Protection de la nature**
**et des Parcs**

733, rue Exeter
London ON N6E 1L3
Tél: 519 873-5000
Fax: 519 873-5020

March 10, 2020

Mr. J. Donohoe
Bruce County

Ms. A. Froese
Town of Saugeen Shores

Mr. J. Slocombe
GM BluePlan Engineering Ltd.

Dear Ms. Froese and Messrs. Donohoe and Slocombe:

**Re: Response to Notice of Project Initiation**
**Bruce County Rd. 25 Re-construction**
**MEA Class EA, Schedule "B" Project**

This letter acknowledges MECP receipt of the above-noted Notice. It is understood that the County has initiated this study to implement the findings of the earlier Master Plan as it relates to this segment of Bruce County Road 25. It is further understood that the reconstruction has been deemed necessary to meet current and future transportation needs.

Mapping of the study area was prepared to determine any features that would need to be considered as part of the project. This exercise has identified the following:

- The study area bisects an area identified as a Highly Vulnerable Aquifer,
- The study area also bisects a Significant Groundwater Recharge Area with a vulnerability score of 6
- Several water wells are also located within, or immediately adjacent to the study area.

It is our expectation that in consultation with the Conservation Authority, source water protection will be addressed by confirming these vulnerable areas and determining whether there are any policies in the Source Protection Plan that need to be addressed. Any risk to drinking water sources must also be identified and addressed.

Climate change should also be addressed in the context of mitigation and adaptation. The ministry has released a guidance document to support proponents in including climate change in environmental assessments. The guide can be accessed from this link:
https://www.ontario.ca/page/considering-climate-change-environmental-assessment-process
The 2015 amended MEA Class EA also speaks to this in Appendix 2, page 2-7.

Aboriginal Consultation

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 the Town of Saugeen Shores may proceed with 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 consultation to project proponents while retaining oversight of the process.

Bruce County's 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 County's project, the MECP is delegating the procedural aspects of rights-based consultation to the County 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 as to the nature and location of the project and the Crown's preliminary assessment, Bruce County should be consulting with the following communities:

- Saugeen Ojibway Nation (Saugeen First Nation and Chippewas of Nawash Unceded First Nation)
- Great Lakes Metis, with Notice to be sent to the Metis Nation of Ontario Lands and Resources Dept; and
- Historic Saugeen Metis

Steps that you may need to take in relation to Aboriginal consultation for your proposed project are outlined in the "Code of Practice for Consultation in Ontario Environmental Assessment Process" which can be found at the following link:

https://www.ontario.ca/document/consultation-ontarios-environmental-assessment-process
Additional information related to Ontario's Environmental Assessment Act is available online at: www.ontario.ca/environmentalassessments

You must contact the Director of Environmental Approvals and Permissions Branch 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 has reached an impasse
- A Part II Order request or elevation request is expected

The Director of the Environmental Assessment and Permissions Branch can be notified by email with the subject line "Potential Duty to Consult" to the address provided below:

| | |
|---|---|
| **Email:** | enviropermissions@ontario.ca<br>Subject: Potential Duty to Consult |
| **Fax:** | 416-314-8452 |
| **Address:** | Environmental Approvals and Permissions Branch<br>135 St. Clair Avenue West, 1st Floor<br>Toronto, ON, M4V 1P5 |

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 in them.

As of July 1st 2018, a standardized form is to be used by anyone who believes that the environmental assessment process was incomplete, incorrect in that it failed to follow the required process. The required form can be found on the Forms Repository website (http://www.forms.ssb.gov.on.ca/) by searching "Part II Order" or "012-2206E (the form ID number). Once completed, the form is then to be sent to both the Minister and Director of the Environmental Assessment and Permissions Branch. Their addresses are:

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

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

This concludes our comments. Please continue to provide all Notices using the new email address: eanotification.swregion@ontario.ca Should you have any questions or require clarification, please contact me either at (905) 521-7864 or at Barbara.slattery@ontario.ca

With best regards,

Barbara Slattery

EA/Planning Coordinator

Encl.

# 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 information;
- clearly articulating the potential impacts of the proposed project on Aboriginal or treaty rights; and
- discussing ways to mitigate 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.

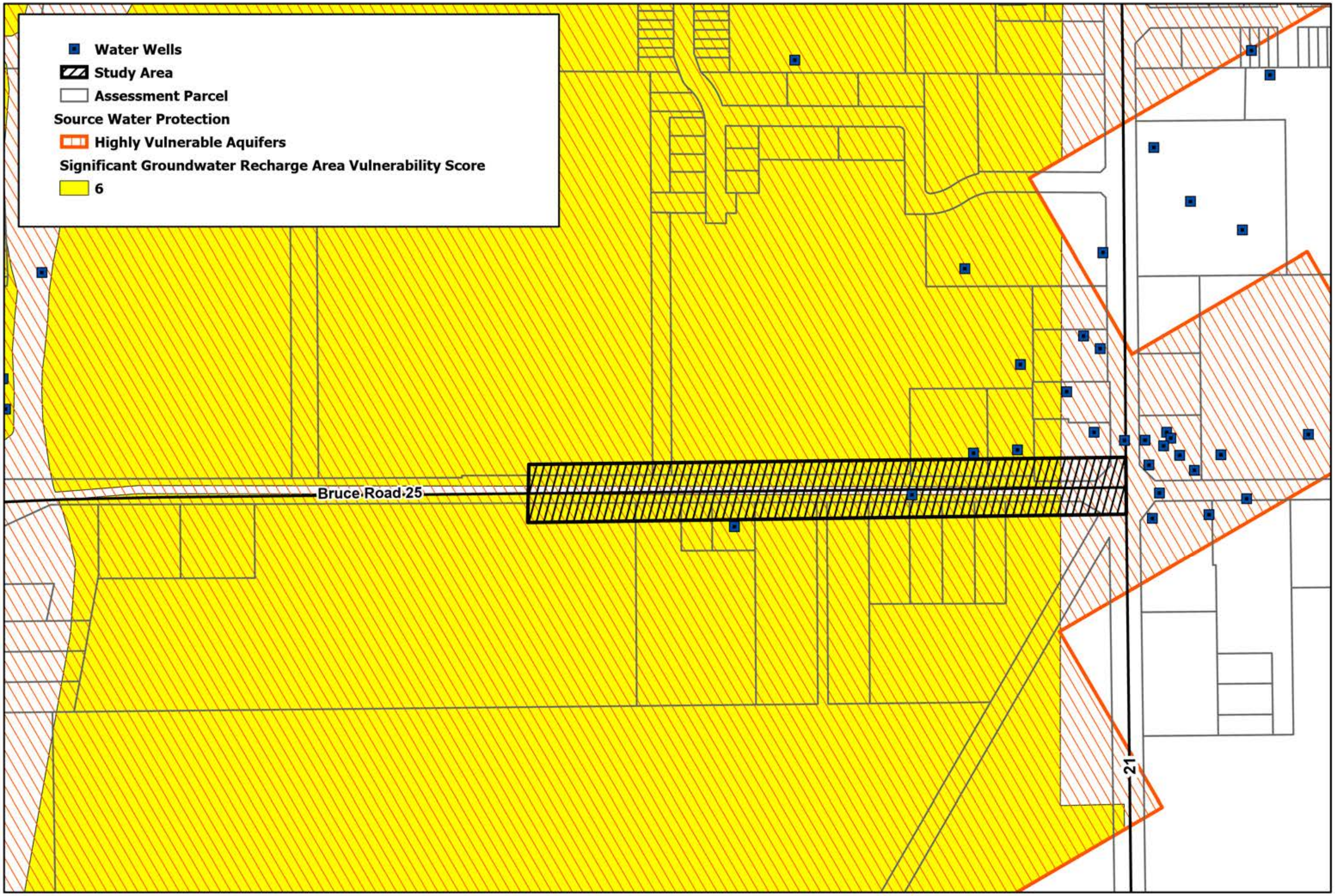
## VI. WHAT IF MORE THAN ONE PROVINCIAL CROWN MINISTRY IS INVOLVED IN APPROVING A PROPONENT'S PROJECT?

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.

Ontario

# Bruce Road 25 Re-Construction

*Ministry of the* Environment
Conservation *and* Parks



March 4 2020
Southwest Region
Ministry of the Environment
Conservation and Parks

0 100 200 300 400 500
Meters

1: 7,000

Data Credits:
Wells, Source Water: MECP
Assessment Parcel: 2019 MPAC
Roads: 2019 ORN

BruceRoad_25_Re_Construction

| | |
|---|---|
| **REPORT TO:** | **Community and Infrastructure Services Committee** |
| **DATE OF MEETING:** | **December 5, 2016** |
| **SUBMITTED BY:** | **Ken Carmichael, Interim Director of Transportation Services, 519-741-2200, ext. 7372** |
| **PREPARED BY:** | **Ken Carmichael, Interim Director of Transportation Services, 519-741-2200, ext. 7372** |
| **WARD(S) INVOLVED:** | **All Wards** |
| **DATE OF REPORT:** | **November 3, 2016** |
| **REPORT NO.:** | **INS-16-089** |
| **SUBJECT:** | **Level 2 Pedestrian Crossover (PXO) Implementation Strategy** |

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## RECOMMENDATIONS:

**That the City of Kitchener, in conjunction with the Region of Waterloo's Traffic Engineering Section, conduct an educational outreach program to provide the public with information related to the proper use of Level 2 Pedestrian Crossovers; and further,**

**That Level 2 Pedestrian Crossover (PXO) signing requirements be implemented at all City of Kitchener roundabout locations through winter 2016/17; and further,**

**That staff monitor compliance and pedestrian safety at new Pedestrian Crossover (PXO) locations in 2017; and further,**

**That staff develop an implementation priority list for midblock and non-roundabout intersection related locations in 2017; and further,**

**That staff begin implementing midblock and non-roundabout intersection priority locations in 2017, based on funding availability.**

## BACKGROUND:

Effective January 1, 2016, the Ministry of Transportation, Ontario (MTO) issued a new regulation (402/15) under the Highway Traffic Act which established a new traffic control device – Level 2 Pedestrian Crossover. This new traffic control device consists of new roadside signs and pavement markings that serve to enhance the mobility of pedestrians at mid-block locations and at intersections, including roundabouts. This new traffic control device is intended for locations where pedestrian volumes are insufficient to meet the warrants for a traffic control signal.

The new Level 2 Pedestrian Crossover device is an updated version of the traditional pedestrian crossover (PXO), which is now referred to as a Level 1 Pedestrian Crossover. Please refer to Appendices A and B providing graphic representations of the Level 1 and Level 2 Pedestrian Crossovers.

The City of Kitchener has since been working with area municipalities within the Region of Waterloo, including the Region of Waterloo, on an implementation strategy for this new pedestrian control device.

This report will outline the recommended implementation plan for the new Level 2 Pedestrian Crossovers on City of Kitchener roadways.

## REPORT:

With the advancement of Active Transportation within the Traffic Engineering field, along with the City of Kitchener Master Transportation Plan, which places focus on all modes of travel, walking plays a key role when providing appropriate traffic control on public roadways.

In the City of Kitchener, a number of long stretches of roadway exist today without convenient pedestrian crossing points. This deficiency can be attributed to the lack of pedestrian traffic control devices to serve the various ranges of pedestrian crossing demand.

Prior to January 1, 2016, pedestrian controls were limited to:

- traffic control signal
- crossing guard control
- traditional pedestrian crossover (Level 1 Pedestrian Crossover).

### Level 2 Pedestrian Crossover

The Level 2 Pedestrian Crossover provides right-of-way to pedestrians through the use of “Stop For Pedestrians” signs, “Pedestrian Crossing Ahead” warning signs and revised pavement markings reinforcing the requirement for vehicles to stop and provide right-of-way to pedestrians. Additional measures (rectangular rapid flashing beacons and overhead signs) are also included for locations that experience higher volumes of vehicle traffic.

This new legislation will provide municipalities with an additional option for pedestrian control at locations that previously would not have met a warrant for the installation of any type of pedestrian control.

Statutory Requirements

The Highway Traffic Act regulated the use of the Level 2 Pedestrian Crossover to roadways with a posted speed limit at 60 km/h or under. Drivers approaching a Level 2 Pedestrian Crossover shall stop before entering a crossover when a pedestrian is crossing on the roadway within a pedestrian crossover, shall not overtake another vehicle already stopped at a crossover, and shall not proceed into the crossover until the pedestrian is no longer on the roadway. The driver of any vehicle approaching another vehicle from the rear shall not pass another vehicle within 30 metres of a crossover. A pedestrian shall not leave the curb or other place of safety at a pedestrian crossover and walk, run or move into the path if a vehicle that is so close that is impractical for the driver to stop.

In summary, the legislation has been set up so that legal responsibility is assigned to both the motorist and pedestrian.

Installation Warrants

The warrant to install a Level 2 Pedestrian Crossover is less stringent than the warrant required for a traffic control signal or Level 1 Pedestrian Crossover. Accordingly, the warrant requirements for a Level 2 Pedestrian Crossover, as outlined in Ontario Traffic Manual Book 15, are as follows:

- 100 or more pedestrians (or equivalent) observed crossing over an 8 hour period
- No other controlled crossing within 200 m
- Adherence to Ontario Traffic Manual Book 15 lane configuration and traffic volume conditions
- Posted speed limit ≤ 60 km/h
- All above subject to an assessment using engineering judgement.

It is essential that requests for Pedestrian Crossovers be considered through an appropriate investigation and study to ensure that the warrant for its installation is met. This ensures consistency in the application of this traffic control, creating reasonable expectations for drivers, thereby increasing adherence to the control.

Roundabout Locations

Since 2009, the Region and all area municipalities have placed “Yield To Pedestrians” signs at all roundabout crosswalk locations. This has established the expectation for drivers to stop and provide right-of-way to pedestrians when crossing at a roundabout. Accordingly, it is proposed to replace all “Yield To Pedestrian” signs at roundabout crosswalks with Level 2 Pedestrian Crossover “Stop For Pedestrian” signs as outlined in the Ontario Traffic Manual.

As well, additional pavement markings are required, including “shark’s teeth” markings indicating the location that drivers must stop in advance of a crossing pedestrian, as well as crosswalk ladder markings, further reinforcing the existence of the pedestrian crosswalks. A new “Pedestrian Crossing Ahead” warning sign is also recommended on the approach to the roundabout.

The City of Kitchener currently has nine (9) roundabouts under their jurisdiction. Existing roundabout locations are proposed to be retrofitted with the updated Level 2 Pedestrian Crossover signs, while new roundabouts will include the new signing and markings as outlined in the Ontario Traffic Manual.

It is proposed to implement the Level 2 Pedestrian Crossover at all City of Kitchener roundabouts during the winter of 2016/17.

### Monitoring and Studies

It is recommended that staff conduct studies and monitoring in 2017 at the roundabout locations that have been updated with this new Level 2 Pedestrian Crossover to better determine how the new control is operating, including adherence by the motoring public.

### Intersection and Midblock Locations

As is the case with other traffic control devices, installation warrants (outlined above) will be followed to determine when and where Level 2 Pedestrian Crossovers may be considered.

A priority list for the implementation of Level 2 Pedestrian Crossovers at midblock and non-roundabout intersection locations will be developed after conducting monitoring and completing studies at pedestrian crossovers located at existing roundabouts.

### Educational Outreach

Educating the motoring public on this new legislation is necessary to help ensure adherence to this new pedestrian traffic control. Accordingly, in conjunction with the Region of Waterloo, and working with our Communications Division, the following avenues for public notification will be used:

- Posted on City of Kitchener website
- Posted on City of Kitchener social media
- Article in community newspaper
- Joint media release between City of Kitchener and Region of Waterloo
- Posted on Region of Waterloo website

- Posted on Ministry of Transportation, Ontario website
- Educational pamphlet sent to all households in the Region of Waterloo
- Article in the Region News.

The Region of Waterloo, along with other jurisdictions, has requested that the Ministry of Transportation, Ontario provide more information to the public related to this new Provincial legislation for Level 2 Pedestrian Crossovers.

## Proposed Implementation Strategy

In working with the Region of Waterloo, area municipalities and Waterloo Region Police Services, the following implementation strategy is recommended:

1. Educational Outreach (City and Region website, social media, pamphlet to households, community newspaper, Region News) – 2016
2. Implementation at all existing roundabouts – Winter 2016/17
3. Monitor compliance and pedestrian safety at roundabout locations – 2017
4. Develop an implementation priority list for midblock and non-roundabout intersection related locations – 2017
5. Begin implementing midblock and non-roundabout intersection priority locations based on funding availability – 2017 and beyond.

## Pedestrian Controls

The introduction of the new Level 2 Pedestrian Crossover helps to provide municipalities the ability to enhance pedestrian mobility in Ontario. This new device now provides municipalities the opportunity to implement pedestrian right-of-way on roadways where other devices are not suitable. A general summary and hierarchy of the typical pedestrian crossing devices applicable to municipal roads, including the new Level 2 Pedestrian Crossover, is included in Appendix C.

## Summary

This new legislation provides municipalities with an additional traffic control device to provide safer roadway crossing conditions for pedestrians. This is consistent with the City of Kitchener’s Transportation Master Plan which places equal importance on all modes of travel, as well as being in support of the increased focus on Active Transportation within the Traffic Engineering field.

A key aspect of the success of this new pedestrian traffic control is educating the motoring public on the expectation for drivers to stop and provide right-of-way to crossing pedestrians. Accordingly, the proposed implementation strategy will see this new control initially installed at roundabouts, where the existing signing requires drivers to provide right-of-way to crossing pedestrians. This will allow staff to monitor operations to better measure the success of this new control. This monitoring will be used to best consider a priority list for the installation of this device at midblock and non-roundabout intersection locations.

This strategy is consistent with the Region of Waterloo and area municipalities.

## ALIGNMENT WITH CITY OF KITCHENER STRATEGIC PLAN:

The recommendation of this report supports the achievement of the city’s strategic vision through the delivery of core service.

## FINANCIAL IMPLICATIONS:

The approximate cost to update signing and markings at all 32 City of Kitchener roundabouts is approximately $51,250. Funding for this legislated initiative has been included in the 2017 capital budget.

Upon development of a priority list for Level 2 Pedestrian Crossover implementations at midblock and non-roundabout intersection locations through 2017, staff will report back on possible additional funding requirements.

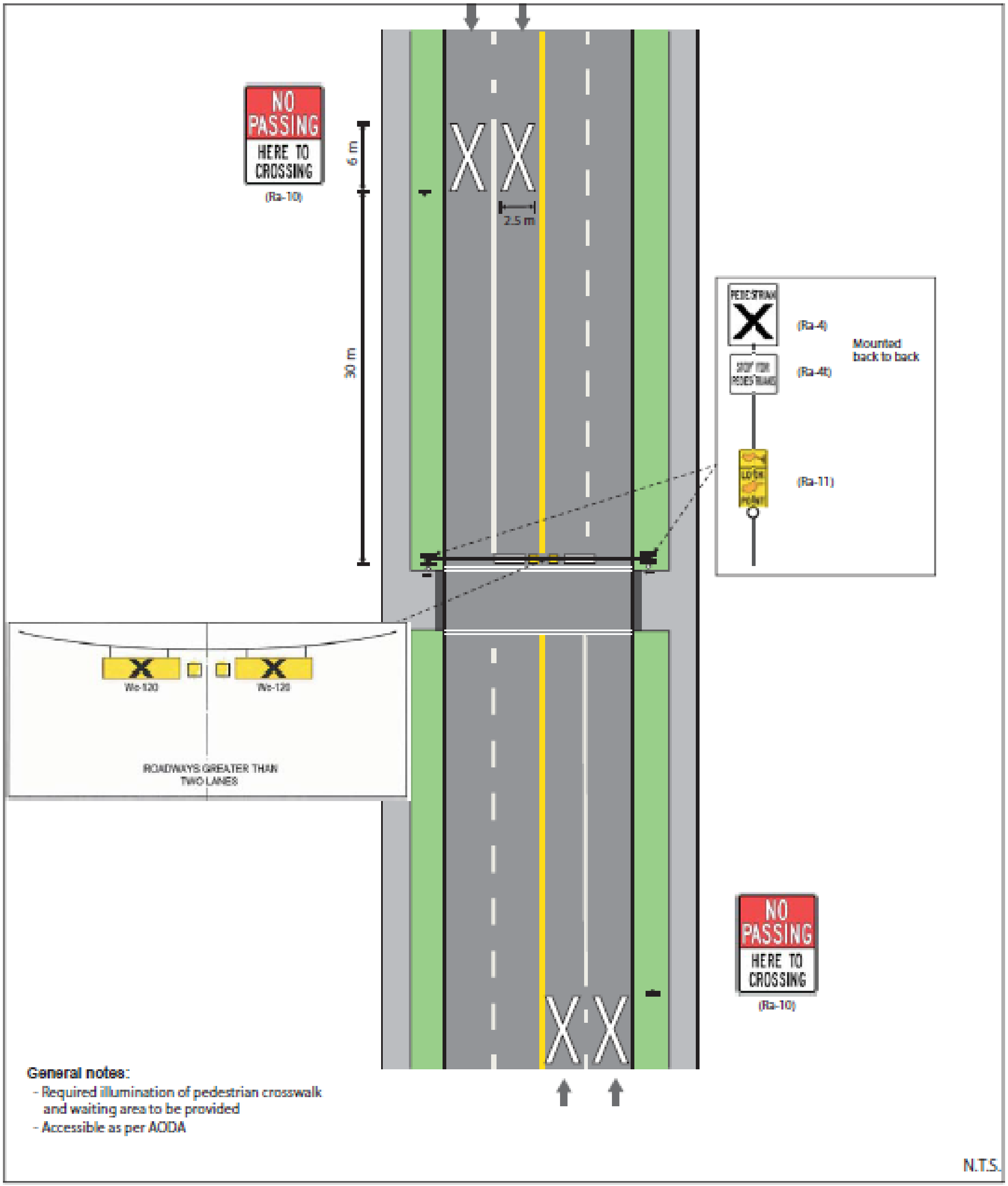
## COMMUNITY ENGAGEMENT:

INFORM – This report has been posted to the city’s website with the agenda in advance of the council / committee meeting. The City of Kitchener, along with the Region of Waterloo, will conduct an educational outreach program on this initiative through a number of various communication outlets.

**ACKNOWLEDGED BY:** Justin Readman, Interim Executive Director
Infrastructure Services Department

Appendix A – Level 1 Pedestrian Crossover
Appendix B – Level 2 Pedestrian Crossover
Appendix C – Summary of Pedestrian Crossing Devices

# Appendix A – Level 1 Pedestrian Crossover
(existing pedestrian control)

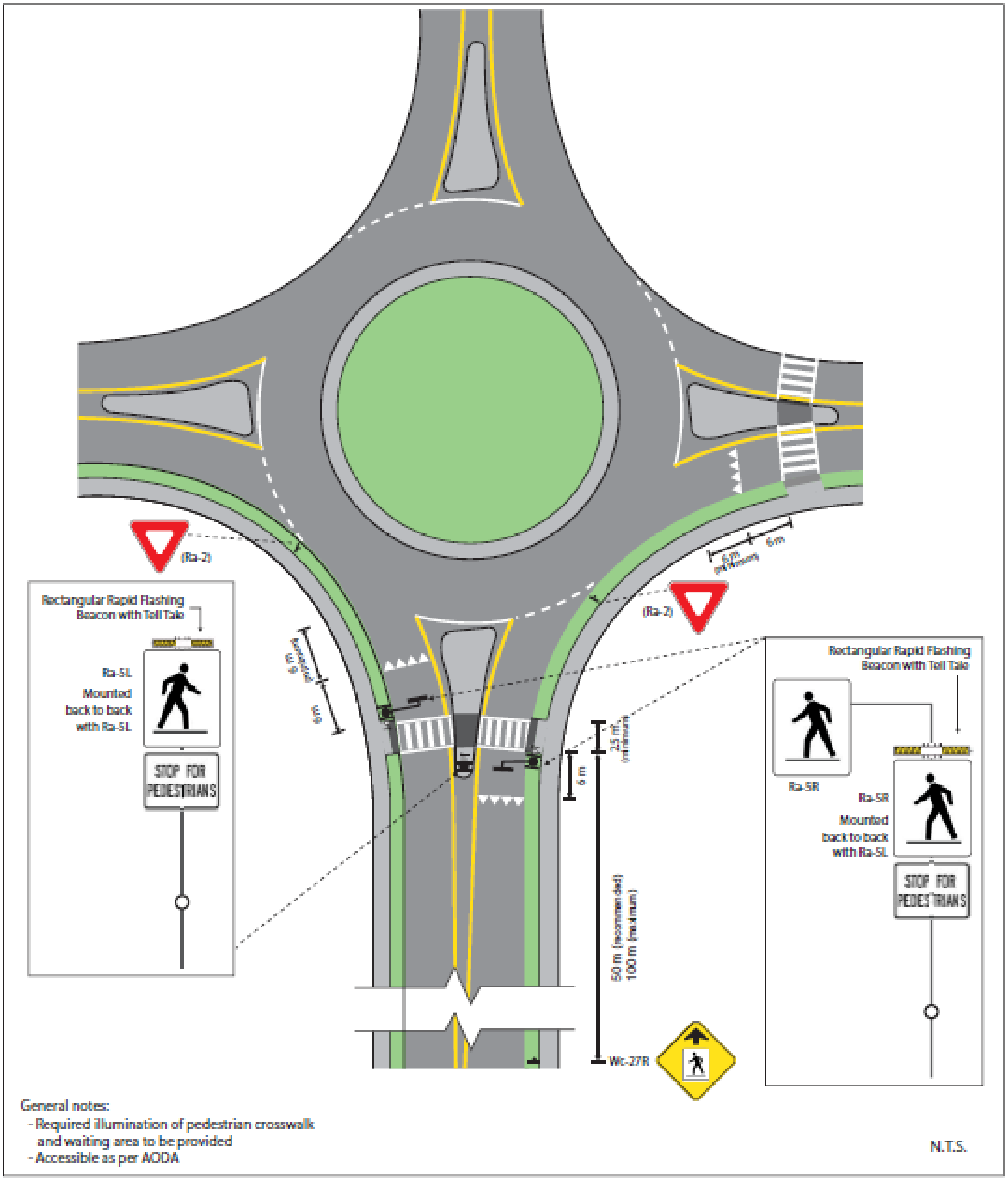


General notes:
- Required illumination of pedestrian crosswalk and waiting area to be provided
- Accessible as per AODA

Figure 20: Pedestrian Crossover Level 1 Type A – Mid-block (4-lane, 2-way)

*** This information is available in accessible formats upon request. ***
Please call 519-741-2345 or TTY 1-866-969-9994 for assistance.

# Appendix B – Level 2 Pedestrian Crossover
(new pedestrian control)



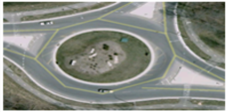
General notes:
- Required illumination of pedestrian crosswalk and waiting area to be provided
- Accessible as per AODA

N.T.S.

Figure 28: Pedestrian Crossover Level 2 Type B – Single-Lane Roundabout

*** This information is available in accessible formats upon request. ***
Please call 519-741-2345 or TTY 1-866-969-9994 for assistance.

# Appendix C – Summary of Pedestrian Crossing Devices

| Traffic Control Device | Figure | Controlled Crossing | Uncontrolled Crossing | When to Consider | Comments |
|---|---|---|---|---|---|
| Pedestrian Refuge Island |  |  | ● | Consider when pedestrian crossing volumes range between 0 and 99 | Motorists have the right-of-way at all times. Pedestrian refuge islands are proven to enhance pedestrian safety. |
| Crossing Guard |  | ● | ● | Area Municipality consideration / jurisdiction | Crossing guards are legally authorized to display a stop sign and when used affords pedestrians the right-of-way. |
| Level 2 Pedestrian Crossover (PXO) |  | ● |  | Consider when pedestrian crossing volumes exceed 99 | New Highway Traffic Act regulations provide pedestrians right-of-way at locations displaying appropriate signs and markings |
| Pedestrian Traffic Control Signals (IPS and MPS) |  | ● |  | Consider when pedestrian crossing volumes exceed 199 and when pedestrians experience sufficient delay as per OTM | Traffic signal control automatically affords pedestrians right-of-way. |
| Stop/Yield Control |  | ● |  | Consider when OTM Book 5 Stop Control Warrant is met | Stop control automatically affords pedestrians right-of-way. |
| Full Traffic Control Signals |  | ● |  | Consider when OTM Book 12 Traffic Signal Warrant is met | Traffic signal control automatically affords pedestrians right-of-way. |
| Roundabout |  | ● |  | Consider when an Intersection Control Study (ICS) deems a roundabout as the preferred traffic control | Roundabout control automatically affords pedestrians right-of-way. |

Note: All controls are subject to appropriate engineering reviews to ensure the control can operate effectively (e.g. Appropriate traffic volume conditions and geometric conditions.

# APPENDIX I:
# COMMITTEE REPORT

**Corporation of the County of Bruce** **brucecounty.on.ca**
**Transportation & Environmental Services**

# Committee Report

**To:** Warden Mitch Twolan
Members of the Transportation & Environmental Services Committee

**From:** Miguel Pelletier
Director of Transportation & Environmental Services

**Date:** April 16, 2020

**Re:** Bruce Road 25 Phase 3 Environmental Assessment

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## Staff Recommendation:

That the preferred solution to the Bruce Road 25 Environmental Assessment be Alternative 2: construction of a two-lane urbanized cross section along Bruce Road 25 (Goderich Street to future Bruce Street) in Port Elgin, including a roundabout at the planned alignment of the future Bruce Street, be approved.

## Background:

The County and the Town of Saugeen Shores completed a Master Plan for Roads and Drainage for Bruce Road 33 and Bruce Road 25 in May 2017. The outcome of the Master Plan identified the reconstruction of Bruce Road 25 from (future) Bruce Street to Goderich Street (Highway 21) as a Schedule B Environmental Assessment. The attached map provides an overview of the phases resulting from the Master Plan.

The Bruce Road 25 Phase 3 project from future Bruce Street to Goderich Street was undertaken in accordance with the Municipal Class Environmental Assessment (EA) Planning Process as a Schedule B project. The Notice of Project Initiation was issued on February 25, 2020 outlining three alternative solutions:

Alternative 1: Do Nothing
Alternative 2: Construct a two-lane urbanized cross section along BR 25 (Goderich Street to future Bruce Street)
Alternative 3: Construct a four-lane urbanized cross section along BR 25 (Goderich Street to future Bruce Street)

The Master Plan and Bruce Road 25 Phase 3 Schedule B EA project file was available for viewing by agencies, public, stakeholders and Indigenous Communities with comments due on March 24, 2020.

A summary of the comments received regarding the Bruce Road 25 Phase 3 project are included in the attached document and summarized below:

- General acceptance of Alternative 2: construction of a two-lane urbanized cross section which would address traffic flow and safety concerns.
- Interest in the intersection treatment options with the majority of comments received supporting the roundabout.
- Support for continuing with an active transportation route for pedestrian and cyclist safety.
- One comment suggested that the two-lane alternative will not address the traffic flow created by Bruce Power traffic and within an area planned for significant growth, including residential development and increased seasonal traffic. The Transportation Assessment that was completed by Paradigm in November 2019 analyzed and assessed the existing traffic and forecasted conditions based on projected future development and needs. The report concludes a 2-lane cross section is appropriate for the 20-year planning horizon.

The County, the Town of Saugeen Shores and Consultant reviewed all comments received through the process regarding the Bruce Road 25 Schedule ‘B’ project and recommend a *Preferred Solution* of Alternative 2: construction of a two-lane urbanized cross section along Bruce Road 25 (Goderich Street to future Bruce Street) in the Town of Port Elgin, complete with a roundabout intersection at Bruce Street.

A Notice of Completion, including the updated project file will be issued in the near future. The Department will provide a status report on this project after the 30-day review period is complete. Subject to the 30-day review period and the receipt of necessary approvals, the County intends to proceed with the planning, design and construction of this project in 2021.

## Financial/Staffing/Legal/IT Considerations:

There are no financial, staffing, legal or IT considerations associated with this report.

## Interdepartmental Consultation:

Not applicable

## Link to Strategic Goals and Elements:

Goal #6 – Explore alternative options to improve efficiency, service
Element #D – Coordinate working with other agencies

Written by: Kerri Meier

**Approved by:**

Bettyanne Cobean

Bettyanne Cobean
Acting Chief Administrative Officer

# Corporation of the County of Bruce
# Transportation and Environmental Services
# Committee Report (April 16th, 2020): Supporting Material
# RE: Bruce Road 25 Schedule 'B' Environmental Assessment
# Summary of Public, Stakeholder and Agency Comments

Please find below a summary of the comments provided by the interested public, stakeholders and agencies that will be addressed in the *'Bruce County Road 25 Re-Construction – Schedule 'B' EA Project File' (Version 2)*, to be issued in the near future.

## BEACHERS' ORGANIZATION

Feedback from the Beachers' Organization was provided in e-mail correspondence on February 27th, 2020 and was re-iterated in an article published in the Shoreline Beacon on March 4, 2020. In general, the Beachers' Organization does not support the *Recommended Preferred Alternative*, suggesting that the two-lane alternative would not be able to handle the traffic in an area planned for significant growth and citing residential growth, Bruce Power traffic and growing demands due to increased seasonal residents and tourist traffic as factors that may impact traffic movement in the area. It was further stated that *'it seems out of sync with current let alone future traffic demands*.'

Response:

The purpose of the Master Plan was to consider initiatives across a broad area and to identify specific projects that would require additional study through a Schedule 'B' or 'C' Environmental Assessment process. It is noted that, based on previous public engagement, several adjacent landowners did not support a widening of the road across the frontage of their properties. In consideration of the time elapsed since the previous Traffic Reports were completed (i.e. 2009 and 2012) and the Town's more recent planning, which includes for the extension of Bruce Street as a collector road, the Town's traffic planning consultant for their current Master Transportation Plan process was retained (i.e. Paradigm) to review existing and foreseeable traffic conditions and to provide recommendations specific to the road cross section. Based on the findings of the assessment completed by Paradigm, it was concluded that Bruce Road 25 and its intersections within the Study Area are currently operating at satisfactory levels of service and operating conditions are expected to remain acceptable into the future. Therefore, a two-lane cross section for Bruce Road 25 was supported by the traffic evaluations that were completed.

## PUBLIC COMMENTS

In addition to comments from the Beachers' Organization, a total of six comments from the general public were received. These comments can generally be summarized as follows:

1. Of the six public comments received, five supported the *Recommended Preferred Alternative* for a two-lane cross section along Bruce Road 25 between Goderich Street and the future Bruce Street. One provided no comment specific to the road cross section.

2. Overall, speed through the residential area was generally cited as a concern related to the four-lane cross section alternative. The recommended two-lane cross section and use of a roundabout were cited as a means to effectively slow down traffic along Bruce Road 25 between Goderich Street and the future Bruce Street.

3. In general, a roundabout at the intersection of the future Bruce Street, BR33 and BR25 was supported primarily due to the ability of this option to simultaneously slow down traffic while efficiently managing traffic during both peak and off-peak periods (i.e. lower delays and shorter queues).

4. One of the comments did not support the roundabout option due to concerns regarding the difficultly navigating this traffic control option. Paradigm was consulted and suggested that while it is recognized that roundabouts may initially be difficult to navigate, at times resulting in a higher

collision rate in the short-term immediately after being built, over the long-term roundabouts provide the best results for safety and traffic operations. Short-term increases in collision rates, when noted, are typically reported in areas (or regions) where there are few existing roundabouts and roundabout intersections are new to the majority of drivers. We note that, initially, only two legs of the roundabout will be constructed, with the Bruce Road 33 leg intended to be added in 2022. The Bruce Street leg will be added at some point in the future concurrent with subdivision development within the Town. This step-wise approach will gradually introduce the roundabout operations to new users.

5. One of the residents suggested that some of the existing issues along the subject section of road could be averted with design and operations including, but not limited to, the recommended construction of a roundabout intersection and a 'well designed' left turn lane at Highway 21. This will be considered in the design phase.

These comments will be addressed further in the updated Schedule 'B' EA Project File for the Re-Construction of Bruce County Road 25. However, a preliminary summary of the Comments and General Responses is provided as an attachment.

## AGENCY COMMENTS

Ministry of Heritage, Sport, Tourism and Culture Industries (MHSTCI):
The MHSTCI found that due diligence was undertaken by completing the Stage 1 and Stage 2 archaeological assessment and report (Mayer Heritage consultants Inc.) and completing the checklist Criteria for Evaluating Potential Built Heritage Landscapes.

Ministry of the Environment, Conservation and Parks (MECP):
The MECP noted that source water protection concerns need to be addressed with the Saugeen Valley Conservation Authority (SVCA). The SVCA Source Water Protection Risk Management Official was consulted via the *Notice of Project Initiation*. Confirmation that Source Protection Policies do not apply to the subject section of BR25 was received. In addition, the MECP re-iterated the requirement to address climate change considerations and to consult with Aboriginal Communities. This has been completed as part of the Schedule 'B' EA process.

Saugeen Valley Conservation Authority (SVCA):
The SVCA noted that comments associated with this project as part of a larger proposal in the area were previously provided on February 8, 2018. Based on their review of the plans specific to Bruce Road 25, the recommended alternative *'looks generally acceptable'* and a permit from the SVCA may not be required. However, it is noted that the SVCA will continue to be consulted as part of the design and construction the other Phases identified in the Master Plan.

SVCA Source Water Protection:
The SVCA Risk Management Office was consulted via the *Notice of Project Initiation*. The SVCA Risk Management Office provided comments specific to Source Water Protection on February 26, 2020, which confirmed that the project does not fall within a highly vulnerable source protection area (i.e. wellhead protection area or intake protection zone) where Source Protection Plan policies apply.

# SUMMARY OF PUBLIC COMMENTS RECEIVED (February and March 2020)

| No. | Date | Comments<br>*(recorded sic erat scriptum)* | General Response |
|---|---|---|---|
| 1 | 25-Feb-20 | Per your notice first issued on Feb. 25, 2020, I would like to be added to the record as supporting the "Recommended Preferred Solution" (Alternative 2) for the proposed Bruce Road 25 Reconstruction, including the Bruce Road 33 re-alignment and the Bruce Street extension. I do not support the do nothing option (Alternative 1) ever, and see no need for a 4-lane cross-section (Alternative 3) at this time. | Support for the Recommended Preferred Solution (i.e. Alternative 2) is noted. |
| 2 | 27-Feb-20 | Phone call to the Town of Saugeen Shores:<br>Local resident inquiring about the proposed traffic control on BR25 to the lake. The Recommended Preferred Solution, including the provision for a roundabout, was explained and the resident was directed to the website for additional information. The resident felt that a stop sign would be better and, that as a self reported 'older person', the resident didn't like roundabouts because they are difficult to navigate. | Based on the analysis and assessment provided in the Traffic Control Evaluation completed by Harbourside (December, 2019), roundabouts *'reduce the frequency and severity of collisions'* . While it is recognized that roundabouts may initially be difficult to navigate, at times resulting in a higher collision rate in the short-term immediately after being built, over the long-term roundabouts provide the best results for safety and traffic operations. Short-term increases in collision rates, when noted, are typically reported in areas (or regions) where there are few existing roundabouts and roundabout intersections are new to the majority of drivers.<br>We note that, initially, only two legs of the roundabout will be constructed, with the Bruce Road 33 leg intended to be added in 2022. The Bruce Street leg will be added at some point in the future concurrent with subdivision development within the Town. This step-wise approach will gradually introduce the roundabout operations to new users. |

## SUMMARY OF PUBLIC COMMENTS RECEIVED (February and March 2020)

| No. | Date | Comments<br>*(recorded sic erat scriptum)* | General Response |
|---|---|---|---|
| 3 | 27-Feb-20 | The key purposes of this master plan's 4 lane section of CR25 and bypass was to handle Bruce Power traffic especially when Highway 21 is closed, new planned subdivisions are built on CR 25 all the while improving service to existing full time residents as well as growing seasonal resident / tourist traffic demands.<br>We have all seen it backed up at the light at Highway 21 for miles along CR 33 trying to get into town with police present to waive traffic through. I had assumed in the worst case traffic senario some traffic would divert along Bruce St. and at the light at Highway 21 BOTH lanes of the expanded CR25 would be allowed to turn left.<br><br>Summer traffic complaints accessing the town are on the rise.<br>Now with this unexplained change all of these intentioned uses seem to be at risk.<br><br>For some unexplained reason a fourth 3 lane option was not offered. The middle lane could be a East / West flex turning lane allowing left turns in both of the 2 lanes running eastbound up to the highway. This mid lane would also allow safe turns into the residences on both sides of CR 25 from the highway to Bruce St. and keep traffic flowing that would be stopped with just two lanes.<br><br>A significant part of the town's anticipated new residential growth will happen in subdivisions planned for the north side of CR 25 as people can walk to shop and the beach.<br><br>Hundreds of new homes will increase traffic into and out of town along CR25 requiring the originally planned 4 lanes.<br><br>It's very frustrating to see arbitrary changes made after the issuance of master plans, the related public announcements and after submissions were made on the traffic study.<br><br>This reversion back to two lanes seems very non progressive and ill matched to scale and intent of this master plan project combining traffic, drainage and recreational multi purpose pathway needs.<br><br>It seems out of sync with current let alone future traffic demands. We hope the originally planned and publicly announced 4 lanes will be the chosen option with 3 lanes the fall back solution. Status quo two lanes with a Bruce St. outlet is unsatisfactory.<br><br>**NOTE: Similar sentiments were articulated in an article posted in the Shoreline Beacon on March 4, 2020.** | The purpose of the Master Plan was to consider initiatives across a broad area and to identify specific projects that would require additional study through a Schedule 'B' or 'C' Environmental Assessment process. It is noted that, based on previous public engagement, several adjacent landowners did not support a widening of the road across the frontage of their properties. In consideration of the time elapsed since the previous Traffic Reports were completed (i.e. 2009 and 2012) and the Town's more recent planning, which includes for the extension of Bruce Street as a collector road, the Town's traffic planning consultant for their current Master Transportation Plan process was retained (i.e. Paradigm) to review existing and foreseeable traffic conditions and to provide recommendations specific to the road cross section. Based on the findings of the assessment completed by Paradigm, it was concluded that Bruce Road 25 and its intersections within the Study Area are currently operating at satisfactory levels of service and operating conditions are expected to remain acceptable into the future. Therefore, a two-lane cross section for Bruce Road 25 was supported by the traffic evaluations that were completed.<br><br>A three-lane option was not considered as a continuous centre turning lane generally is reserved for commercial neighborhoods where the number of left turns is significant. Therefore, a three-lane alternative is not recommended or supported by the analyses.<br><br>Response from Luke Charbonneau (Mayor, Town of Saugeen Shores)<br>Date: February 29, 2020<br><br>*"My understanding is that the County's consultant provided a Class EA Transportation Assessment in November. This assessment used existing traffic counts and added forecasts based on development planned within the next 21 years. The analysis of that data found that a two-lane configuration would operate well within its capacity for the entire planning period (2019-2040).*<br><br>*Based on this study, County staff believe that a two-lane configuration would be an acceptable design.*<br><br>*The option to expand the road to four-lanes will always exist but the need for those extra lanes has not been established through any study that we have at this time.*<br><br>*I see that you have cc'd Jim Donohoe. It's possible that he may have comments that can further clarify this for us."* |

## SUMMARY OF PUBLIC COMMENTS RECEIVED (February and March 2020)

| No. | Date | Comments<br>*(recorded sic erat scriptum)* | General Response |
|---|---|---|---|
| 4 | 2-Mar-20 | Hello:<br>I have read about this project and I would like to comment on the options available. Doing nothing I don't think is an option. The traffic will increase over the next few years and with BRUCE St. Opening something different needs to be done for this area. Also there is going to be major residential development in this area.<br>I would like to comment first on the road between BRUCE St and hwy 21. A four lane road seems to be excessive from the new street to the highway. Any four lane road I have seen increases the speed of traffic. This is not needed in this mainly residential area. I expect that most traffic will go down BRUCE St. leaving the intersection at 21 manageable even at the busiest of times. There are lights there and a turning lane already which should be able to handle any traffic. This is not a busy road for most of the year.<br>Secondly I agree with lining up BRUCE St. with the Shore road. BRUCE St. has been always designated as an entrance into town for normal traffic and as an emergency route when 21 is closed. It is very much needed for locals and tourists. Majority of visitors and locals live on the east side of town. They try to avoid the highway.<br>I also believe that to control the corner of BRUCE St. and cr25 that a round-about needs to be installed. Stop lights or signs will only make things impossible at certain times of the day and frustrating at other times.<br>I will give a few examples. Look at St. Jacobs corner near Kitchener. They had installed lights and there was gridlock always. They removed them and installed a roundabout and traffic moves smoothly all the time. Same at Tiviotdale, was always backed up for miles on long weekends but with a roundabout no problem!<br>Closer to home, Alvanley on the county line a roundabout was installed with no problems with traffic. Look further south on the same road near Tara , lights were installed. Talk about frustration as you are stopped with no traffic in site from any other direction. More roundabouts are coming everywhere, even a couple in Saugeen Shores. I have driven extensively in Europe, Australia etc. and roundabouts are used effectively in all these countries. It controls and slows down traffic once people know how to use them.<br>Back to cr25 and BRUCE St. , the traffic for most of the year will be busy there for only 2 to 4 hours at most in a 24 hour period. Why not keep traffic moving, slow the speed and make people happy with a roundabout. There is lots of room to construct a very useful roundabout to handle maximum traffic, maybe a walkway for bikes and pedestrians and make it look good for the area. It might even be cheaper in the long run and make it friendly for snow plowing. I thinks there are a lot of pros for a roundabout versus streetlights or stop signs. We have more than enough of the latter around town that are already frustrating locals!<br>My two cents, good luck with this necessary project! | Overall concurrence with the Recommended Preferred Alternative, a 2-lane cross-section, is noted.<br>Strong support for the roundabout traffic control option at the intersection of Bruce Street and BR25 as a means to decrease traffic congestion and slow down traffic. |
| 5 | 12-Mar-20 | Hello my name is XXX I live on XXX Bruce Rd. 25 Port Elgin. I am in favour of Alternative 2, re-construction of BR25 with two-lane urbanized cross section. I am also in favour of a roundabout on Bruce St. and county Rd. 25 were it would slow traffic down to the posted speed limit. | Support for the Recommended Preferred Solution (i.e. Alternative 2), including the roundabout, is noted. |

# SUMMARY OF PUBLIC COMMENTS RECEIVED (February and March 2020)

| No. | Date | Comments<br>*(recorded sic erat scriptum)* | General Response |
|---|---|---|---|
| 6 | 12-Mar-20 | Thanks for giving me the opportunity to comment on the Bruce Road 25 reconstruction.<br>First with a little background, being a seasonal resident of the Baker subdivision in 1986 becoming a full time resident in 2003,<br>I have followed and participated in the various road and drainage undertakings of Bruce Roads 25 and 33 since 2017.<br>I wish to make it clear that I fully support Alternative 2: Construct a two-lane urbanized cross section along BR25.<br>One needs to reject the rhetoric being created by the Beachers' organization regarding "miles long traffic backups".<br>I do not agree with the predicted notion that the two lane option would not be able to handle traffic in the area.........<br>Having lived here for the last 17 years and observing traffic volumes, it only becomes a major traffic issue when Highway 21 is closed with Bruce Power and OPG workers use this alternate route into Saugeen Shores, at the end of the work day.<br>It is my firm belief that some of the issues we see now can be averted with design and operations.<br>For design I am still of the belief that constructing a roundabout at the Bruce Rd 25 and future Bruce Rd 33 ( Bruce St) realignment would do wonders for traffic movement. That along with a well designed left turn lane at Highway 21.<br>I will forward under separate cover, an email sent in February 2018 regarding the realignment of Bruce Road 33.<br>For operations when Highway 21 is closed due to weather and road conditions, the traffic signal at 21 should flash amber for Bruce 25 traffic instead of the present flashing red.<br>Unless there is a law or regulation preventing this to happen it is ridiculous to have a flashing amber for 21 as the traffic is not going anywhere down 21, whereas it could be switched to alleviate traffic on BR25. | Support for the Recommended Preferred Solution (i.e. Alternative 2), including the roundabout, is noted. |
| 7 | 16-Mar-20 | A letter was circulated asking for opinions on the options proposed for upgrading Bruce Rd 25 from Goderich St to Bruce St in Saugeen Shores. The letter directed me to this website. I prefer alternative 2 (a 2 lane urbanized section with a possible bike lane). This was the option initially recommended. Please add my name to the group supporting this alternative. | Support for the Recommended Preferred Solution (i.e. Alternative 2), including a bike lane, is noted. |