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Appendix A

Existing Conditions

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Grey Road 19 Class EA – Traffic Needs Memorandum

Date: February 4, 2021 **Project No.:** 300052076.0000

Project Name: Grey Road 19 Class Environmental Assessment

Client Name: Grey County

Submitted To: Trevor Ireton, P.Eng.

Submitted By: Xinli Tu, E.I.T.

Reviewed By: Henry Centen, P.Eng.

1.0 Introduction

R.J. Burnside & Associates Limited (Burnside) is completing an Environmental Assessment (EA) for the implementation of four (4) lanes along Grey Road (GR) 19 between GR 119 and GR 21 / Simcoe Road (SR) 34. The need to implement four lanes on this section of GR 19 was confirmed in the *Grey Road 19 Traffic Study – Phase 1* (Burnside, March 2020). The purpose of this Traffic Needs Memorandum is to summarize and expand upon the results of this previous study, as supporting documentation for the current EA and design of the four lanes on GR 19 in the study area. Reference may be made to the previous *Traffic Study*, if required, although the primary results of that study are reiterated in this current traffic memorandum.

A number of other related studies / designs have been completed affecting the GR 19 corridor in the study area, including the following:

- Grey County (County) and the County of Simcoe have progressed to the design stage, through their consultant C. C. Tatham & Associates Ltd. (CCTA), for a new 2 - lane roundabout at the intersection of GR 19 and GR 21 / SR 34 / Mountain Road. This roundabout was recommended in the *GR 19 & GR 21 / SR 34 Intersection Improvements Class Environmental Assessment* (CCTA, January 2019). This roundabout is planned for construction in 2022.
- CCTA is in the design stage for a roundabout at the intersection of GR 19 and Crosswinds Boulevard, which is proposed to be completed as part of the Windfall Development. This 2 - lane roundabout was proposed as a part of the *Windfall Traffic Impact Study* (CCTA, revised September 2018) for the Windfall Development. This roundabout is tentatively planned for construction in 2022 / 2023.

Reference should be made to these related studies, if required, although their primary results of these studies / designs are reiterated in this current traffic memorandum.

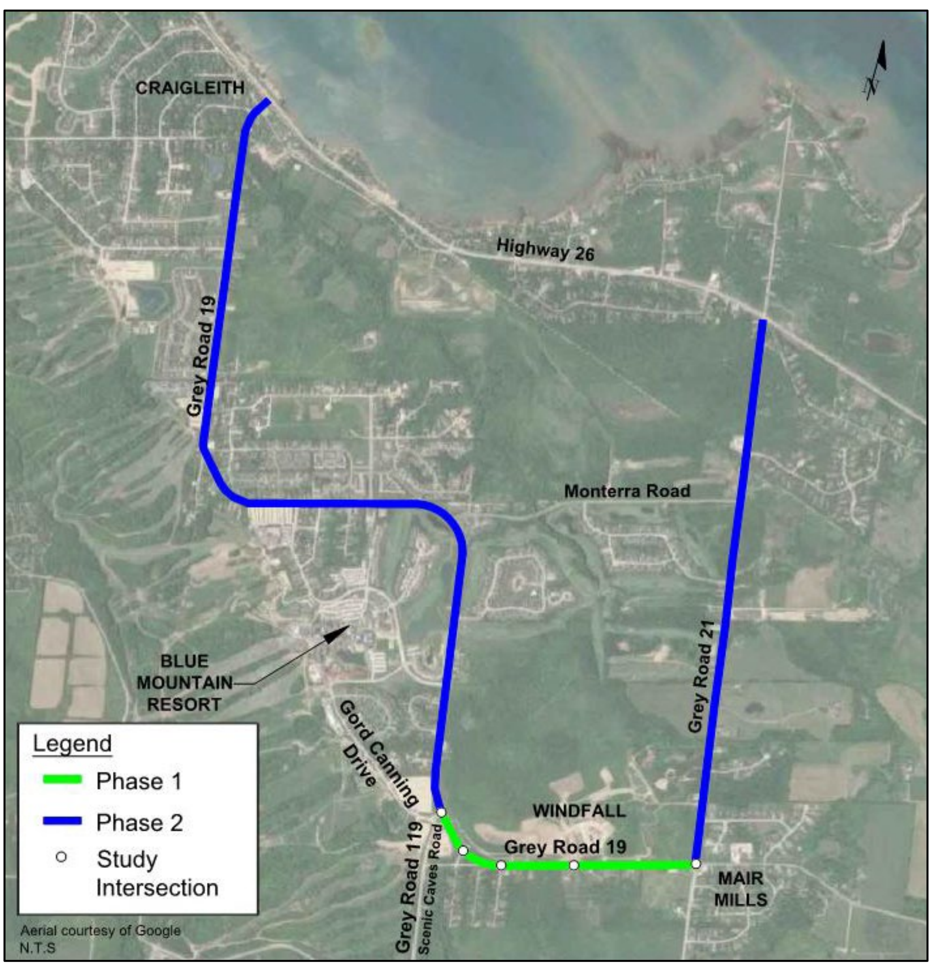
The purpose of this traffic memorandum is to:

- Confirm that the proposed lane configurations and traffic controls along the GR 19 corridor meet operational requirements within the study area;
- Identify traffic constraints / opportunities to effectively integrate the roundabout designs and the proposed 4 - lane widening of GR 19; and
- Identify traffic constraints / opportunities for active transportation along the corridor, to support the evaluation of active transportation solutions in the study area.

2.0 Study Area

GR 19 is a rural 2 - lane County collector road within the County. The project limit for this study extends from GR 21 to GR 119, as shown in Figure 1, for a length of approximately 1.36 km.

Figure 1: Study Area



The Phase 1 study area forms the subject area for the widening of GR 19 to 4 - lanes, as well as defines the area of previous traffic analysis conducted by Burnside.

Burnside is also currently completing a traffic study in the Phase 2 area, the limits of which are shown on Figure 1. The Phase 2 study area consists of GR 21 between GR 19 and Highway 26 as well as GR 19 between Highway 26 and Gord Canning Drive / GR 119. The Phase 2 work will not impact the proposed 4 - lane widening in the Phase 1 area, given the existing and proposed roundabouts that form the interface between the Phase 1 and Phase 2 areas.

The intention of the Phase 1 study was to determine the current and future requirements for the study corridor in relation to capacity, operational deficiencies, and safety for motor vehicle users, pedestrians and cyclists. Improvements were also identified to address these requirements.

The following intersections have been reviewed to assess their opportunities / constraints to implementing 4 - lanes in the study area, along with consideration for active transportation:

- GR 21 / SR 34 / Mountain Road
- Beckwith Lane
- Crosswinds Boulevard
- Martin Grove
- Claire Glen
- GR 119 / Gord Canning Drive

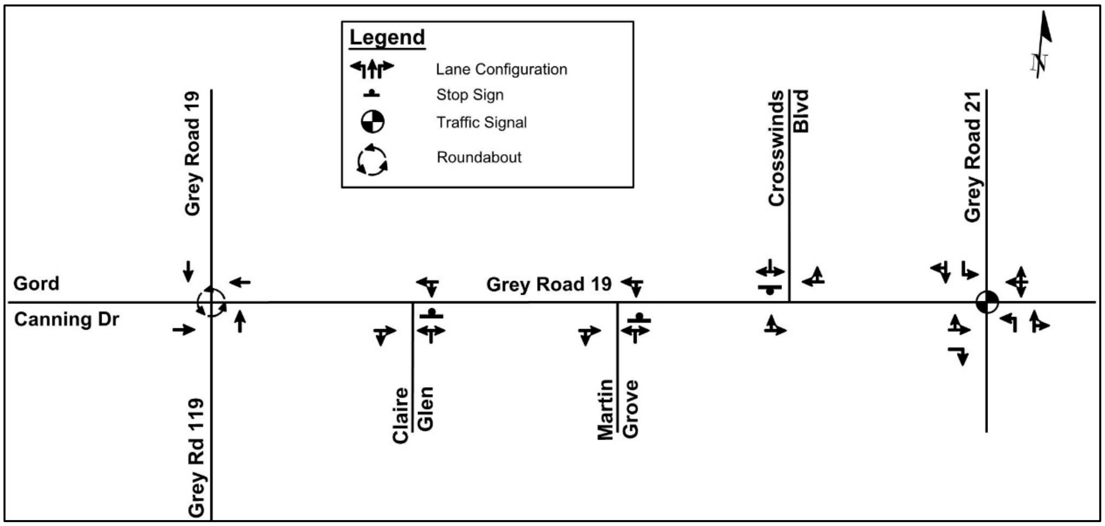
The spacing between the intersections along the corridor are as follows:

- GR 21 to Beckwith Lane - 170 m
- Beckwith Lane to Crosswinds Boulevard - 437 m
- Crosswinds Boulevard to Martin Grove - 360 m
- Martin Grove to Claire Glen - 210 m
- Claire Glen to GR 119 - 180 m

2.1 Existing Road Network

The existing road network is described below and is illustrated in Figure 2, including existing traffic control.

Figure 2: Existing Road Network



GR 21 / SR 34	GR 21 / SR 34 is a north-south 2 - lane County Road, with functional classifications of County Collector road in the Grey County Official Plan and Primary Arterial road in the Simcoe County Official Plan. The road is a boundary road and is therefore under the jurisdiction of both Counties. The road has a posted speed of 60 km/h.
GR 19 / Mountain Road	East of GR 21 / SR 34, the road is referred to as “Mountain Road” and is under the jurisdiction of the Town of Collingwood. It is an east-west 2 - lane Arterial road with a posted speed limited of 60 km/h. West of the GR 21 / SR 34 intersection, the roadway is “Grey Road 19” and is under the jurisdiction of the County. To the east of the intersection at GR 119 / Gord Canning Drive, the road is an east-west 2 - lane County Collector road, with a rural cross section and a paved shoulder on the north side of the road. To the north of this intersection the road is a north-south County Collector road, with a rural cross section and paved shoulder bike lanes on each side of the road. The posted speed on GR 19 is 60 km/h.
GR 119 (Scenic Caves Road)	GR 119 (Scenic Caves Road) forms the south leg of the roundabout intersection at GR 19 / GR 119 / Gord Canning Drive. The roadway consists of a 2 - lane, urban cross section with a posted speed limit of 50 km/h.

Gord Canning Drive	Gord Canning Drive is a local 2 - lane east-west road, forming the west leg of the roundabout intersection at GR 19 / GR 119. The roadway is under the jurisdiction of the Town of the Blue Mountains. The road has a posted speed of 40 km/h and has an urban cross section. This road provides access to the east part of the Blue Mountains Ski Resort.
Crosswinds Boulevard	Crosswinds Boulevard is a north-south collector road under the jurisdiction of the Town of the Blue Mountains (currently unassumed subdivision road). This road is one of the main accesses to the development north of GR 19, which includes Windfall and Second Nature developments. The roadway consists of a dual carriageway and has an assumed unposted speed limit of 50 km/h. Sidewalks are provided on both sides of the roadway. Figure 2 shows this intersection as being unsignalized, however temporary signals have recently been added, as an interim measure pending the future construction of a roundabout at this location.
Martin Grove	Martin Grove is a north-south local heritage road under the jurisdiction of the Town of the Blue Mountains. This road is the access for 16 single-family homes. The roadway is a 2 - lane gravel road (rural cross section) with an assumed unposted speed limit of 50 km/h.
Claire Glen	Claire Glen is a north-south local heritage road under the jurisdiction of the Town of the Blue Mountains. This road is one of two accesses for 13 single-family homes along Claire Glen and 17 single-family homes along Patricia Drive. The second access to this subdivision is from GR119 (Scenic Caves Road). Claire Glen is a 2 - lane road with an assumed unposted speed limit of 50 km/h.

2.2 Safety Considerations

The provision of a safe corridor for vehicular travel is dependent upon the appropriate controls being implemented at the study area intersections and the sufficiency of the lane configurations along the corridor. The *Phase 1 Study* identified the traffic operations (i.e., capacity and delay considerations) at intersections and between intersections, to recommend the timeframe for road improvements, to ensure continuing safe vehicular traffic operations.

The relatively short length of corridor under consideration, along with the density of the intersections along the corridor and the turning movements at these intersections, generally restrict the need for traffic to undertake passing movements. Given the existing and proposed 2 - lane roundabouts in the study area, the implementation of a 4 - lane cross section along the corridor will reduce the potential for merging conflicts occurring on the approaches to these roundabouts, which would potentially occur under the current 2 - lane configuration on these links. Therefore, there are safety advantages to coordinating the implementation of the 4 - lane configuration on the approaches to the roundabouts with the implementation of the roundabouts. Implementation of the roundabout projects and the 4 - lane widening project also provides cost reductions due to the reduction of work required to interface between the projects, minimization of the period of construction disruption, and general cost reductions due to the larger scale of the project.

Horizontal and vertical alignment constraints at intersections, as well as along the corridor, are also a consideration in maintaining safe vehicular movements at these locations. The vertical alignment of GR 19 is relatively flat in the study area and therefore provides for adequate sight distances to be maintained. The horizontal alignment of GR 19 is relatively straight between GR 21 and Martin Grove, providing adequate sight distances in that area. A horizontal curve exists on GR19 between Martin Grove and the GR 19 / GR 119 / Gord Canning Drive roundabout, which restricts sight distances to about 210 m to the east from Clair Glen and 210 m to the west from Martin Grove. Based on a 70 km/h design speed (60 km/h posted speed) the recommended stopping sight distance is 105 m, the recommended intersection sight distance for left turn egress is 150 m and the recommended intersection sight distance for right turn egress is 130 m (*Geometric Design Guide for Canadian Roads*, Transportation Association of Canada, June 2017). Therefore, it is concluded that the available sight distance is adequate at all intersections along the corridor.

This EA is also considering the opportunities / constraints to implementing improved active transportation along the GR19 corridor and crossing the corridor. The establishment of the road widths and shoulder widths for the road widening will consider the potential for pedestrian and / or cyclist conflicts with vehicular movements in the study area.

3.0 Results from *Grey Road 19 Phase 1 Traffic Study*

The *Grey Road 19 Phase 1 Traffic Study* (Burnside, March 2020) provided a preliminary assessment of key transportation related issues, including a review of all relevant background reports / studies and existing traffic data.

The *Phase 1 Traffic Study* confirmed the need to widen GR 19 between GR 21 to GR 119 to 4 lanes to address lane capacity concerns. Future operations were assessed, to accommodate growth in the study horizons 2025, 2030 and 2040 along the study area, to determine the transportation needs. This includes a review of the type of intersection control (i.e., signalization, roundabouts, stop-control), auxiliary lanes, widening of the road and ROW, transportation demand management, transit, and the accommodation of active transportation infrastructure.

A summary of findings and recommended improvements, to address traffic operation needs in support of the 4 - lane widening along the study corridor as identified in the *Traffic Study*, are provided in the following sections of this memorandum.

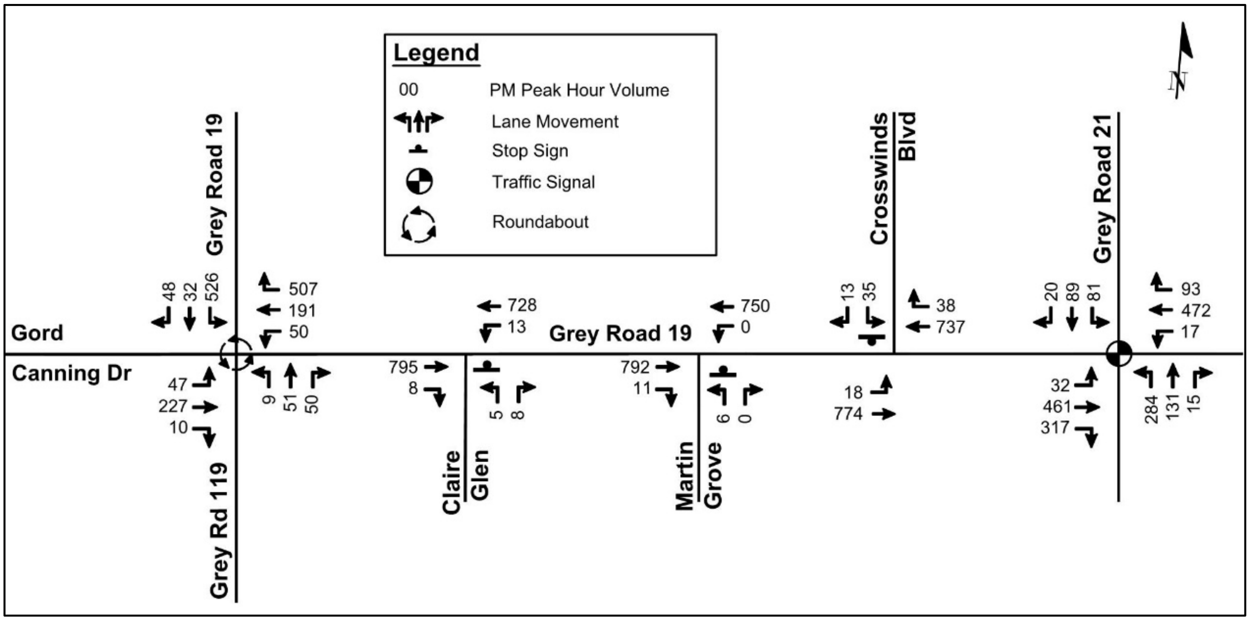
3.1 Existing Traffic Operations

The following is a summary of findings regarding existing traffic volumes in the study area.

- The traffic volumes in the study area are highly impacted by the operations at the Blue Mountain Village and Ski Resort, as well as by weather conditions.
- PM peak periods were found to be higher than AM peak periods.
- Weekend peak periods were found to be similar to Friday PM peak periods.
- Peak traffic in non-winter seasons, although high on weekends, were found to be lower than the Friday PM peak periods in the winter.
- The traffic count data collected on Friday January 17, 2020 were taken during normal operation of the ski resort and under favourable weather conditions; it is expected that similar conditions may be experienced during weekend periods in non-winter periods. Therefore, the Friday PM peak hour winter traffic was considered to be representative of the design condition for this corridor.
- It is acknowledged that higher traffic volumes will be experienced during other periods (e.g., some weekends, Christmas holidays, Family Day holiday, March break). However, such periods of increased traffic activity are considered to be of short duration and therefore are not representative of the design condition.

Based on the findings above, the Friday PM traffic counts were factored up by 15% in the analysis, to ensure that the design captures a conservative analysis. The adjusted existing Friday afternoon peak hour traffic volumes are shown in Figure 3.

Figure 3: Existing Friday PM Peak Traffic Volumes



The traffic analysis for existing traffic volumes indicated that most study intersections are operating with excess capacity, queue lengths within respective storage and link distances, and a level of service (LOS) E or better. The only exception was the GR 19 / Crosswinds Boulevard intersection. Under existing conditions (stop-control), the intersection operates with excess capacity, but the southbound movement experiences a delay of 51 seconds resulting in a level of service F. This is due to high eastbound and westbound through traffic making it difficult for drivers to make a left or right turn out of Crosswinds Boulevard. Subsequent to the completion of the *Phase 1 Traffic Study*; the County has installed temporary signals at this intersection to improve traffic operations, pending the completion of the planned roundabout at this location. The traffic analysis confirms the Crosswinds roundabout should be implemented in the short term to address the ongoing development in the Windfall Development.

3.2 Future Road Network

In addition to the 2 - lane roundabouts at the GR 19 / GR 21 / SR 34 and GR 19 / Crosswinds Boulevard intersections, that are planned to be constructed in the short term, the following road network improvements are planned in the Study Area.

- Crosswinds Boulevard is proposed to extend northward and to a second connection with GR 19, immediately across from Jozo Weider Boulevard. The road extension is expected to be open to public traffic by 2022.
- Beckwith Lane currently connects to GR 21, immediately across from Laurel Boulevard. Beckwith Lane is proposed to extend to the south to a connection with GR 19, as part of the completion of the Mountain House development.

- A roadway is proposed north of Laurel Boulevard on GR 21, that will extend west and connect to Crosswinds Boulevard. The timing of this connection will be dependent on the Blue Vista (Nederand) development in this area.

3.3 Future Traffic Operations

In reviewing future traffic conditions, the study horizon years of 2025, 2030 and 2040 were analyzed. To project future traffic, historical traffic growth on study roads, traffic from planned future developments, as well as any planned road network connections and improvements were considered.

The growth applied, to forecast future conditions, was derived based on traffic generation from developments that may use this corridor for travel, together with providing for nominal growth from traffic in the broader study area. A growth rate of 0.5% compounded annually up to the study horizon years (2025, 2030 and 2040) was applied to all movements, with some exceptions, to account for the nominal growth from the broader study area. A slightly higher compounded annual growth rate of 1% was applied to the turning movements to / from GR 19 from / to GR 21 / SR 34, to recognize the potential for through-traffic using GR21, in lieu of travelling along the Highway 26 connecting link through Collingwood.

The resulting traffic volumes for 2025, 2030 and 2040 are illustrated in Figure 4, Figure 5 and Figure 6, respectively.

Figure 4: 2025 Traffic Volumes

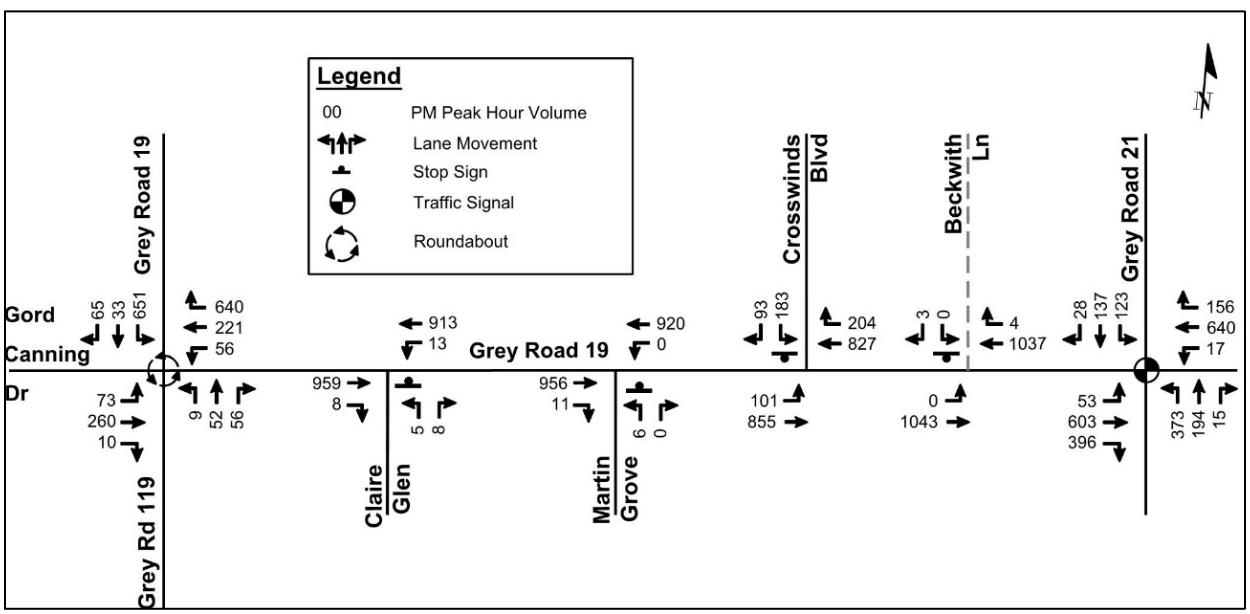


Figure 5: 2030 Traffic Volumes

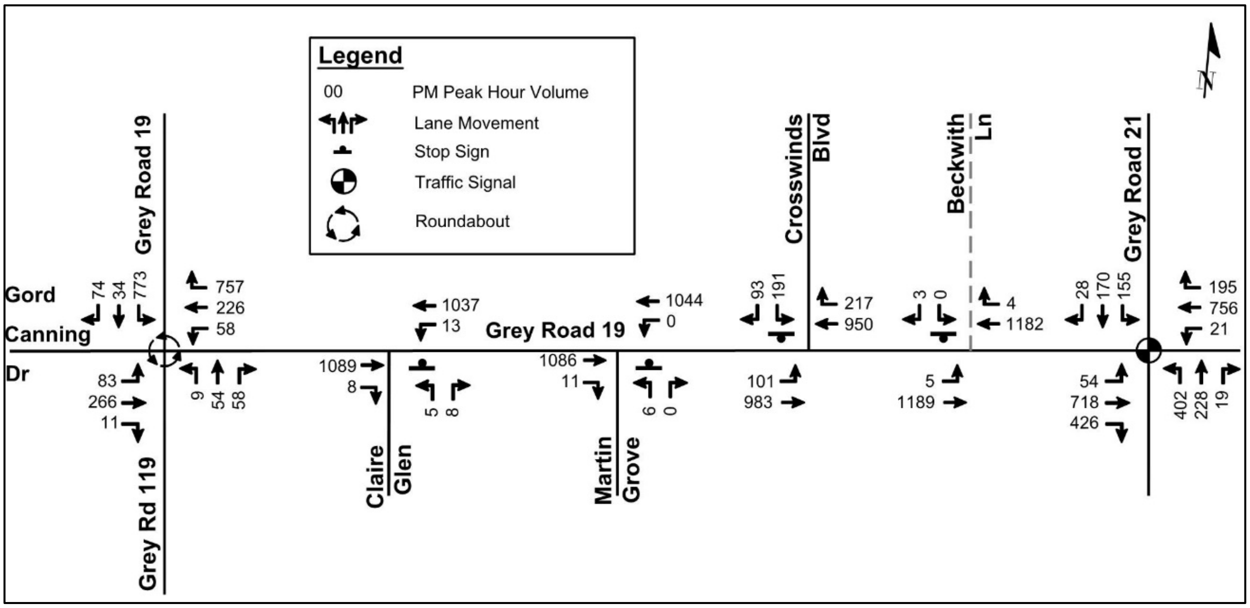
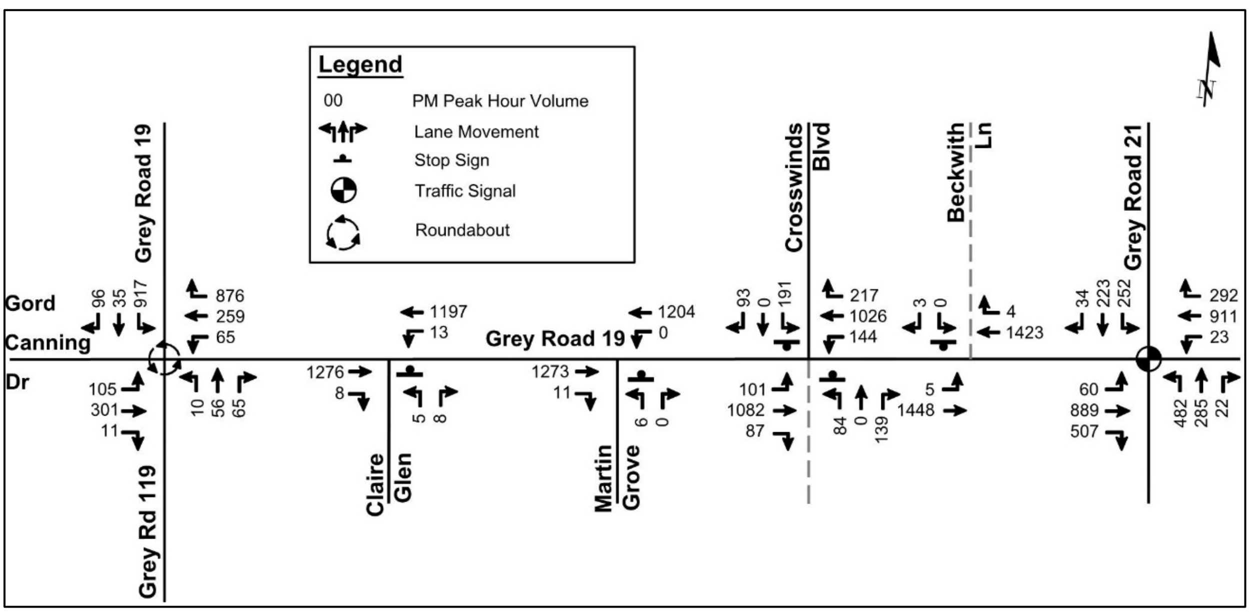


Figure 6: 2040 Traffic Volumes



The *Phase 1 Traffic Study* confirmed the need to the 4 - lane widening along the corridor and for the 2 - lane roundabout at GR19/Crosswinds Boulevard. The *GR 19 & GR 21/SR 34 Intersection Improvements Class Environmental Assessment* confirmed the need for the 2 - lane roundabout at GR19 / GR21 / SR34 / Mountain Road. A summary of the traffic operations, for the various horizon periods, is shown in Table 1, with consideration for the above-noted improvements to the corridor and intersections being in place. Volume-to-capacity (i.e., v/c) values are noted to provide the utilization of the available capacity and Level of Service (LOS) and delays are also noted to confirm the operations (i.e., LOS F reflects long delays). Reference to these previous studies can be made for additional details of the alternative lane configurations and alternative traffic controls that were considered.

Table 1: Future Traffic Operations Summary

Intersection with GR 19	Intersection Control	Traffic Operations
Future 2025 Conditions		
GR21 / SR34 / Mountain Road	2 - lane Roundabout with GR 19 as a 4 - lane cross section	Roundabout control was identified as the preferred traffic control at this intersection, rather than signalized control. Under 2 - lane roundabout control, the intersection operates with excess capacity and a level of service A or B. Queues are projected to be within existing link distances. An ARCADY analysis, together with interface requirements, confirms that operations with a 4 - lane widening on GR19 is preferred.
Crosswinds Boulevard	2 - lane Roundabout with GR19 as a 2 - lane cross section	The intersection capacity requirements cannot be met with stop control or with a single lane roundabout and therefore a 2 - lane roundabout is required. While the intersection can operate acceptably under signal control in this horizon period, signals are not preferred to meet the long-term requirements at this location. Under 2 - lane roundabout control, the intersection operates with excess capacity and a LOS A. Queues are projected to be within existing link distances.
GR 119 / Gord Canning Drive	Existing roundabout	The intersection is forecasted to operate well and with excess capacity.
Beckwith Lane	Existing stop control	Egress from this road will operate with excess capacity (v/c = 0.01) and will experience a delay that results in a LOS C (23 second delay).
Martin Grove	Existing stop control	Egress from this road will operate with excess capacity (v/c = 0.11) and experience a delay that results in a LOS F (delay of 71 seconds), under 2025 conditions. Traffic operations are considered to be acceptable, considering these operations.
Claire Glen	Existing stop control	Egress from this road will operate with excess capacity (v/c = 0.12) and LOS E (39 second delay).
Future 2030 Conditions		
GR21 / SR34 / Mountain Road	2 - lane Roundabout with GR 19 as a 4 - lane cross section	This intersection will continue to operate with excess capacity and a level of service A or B. Queues are projected to be within existing link distances.
Crosswinds Boulevard	2 - lane Roundabout with GR19 as a 2 - lane cross section	The intersection will continue to operate with excess capacity and a level of service A or B. Queues are projected to be within existing link distances. This analysis is based on maintaining a 2 - lane cross section on GR 19 (i.e., beyond the immediate approaches to the roundabout). Therefore, from a capacity and delay perspective, the operations of the 2 - lane roundabout do not rely on widening of GR 19 to a 4 - lane

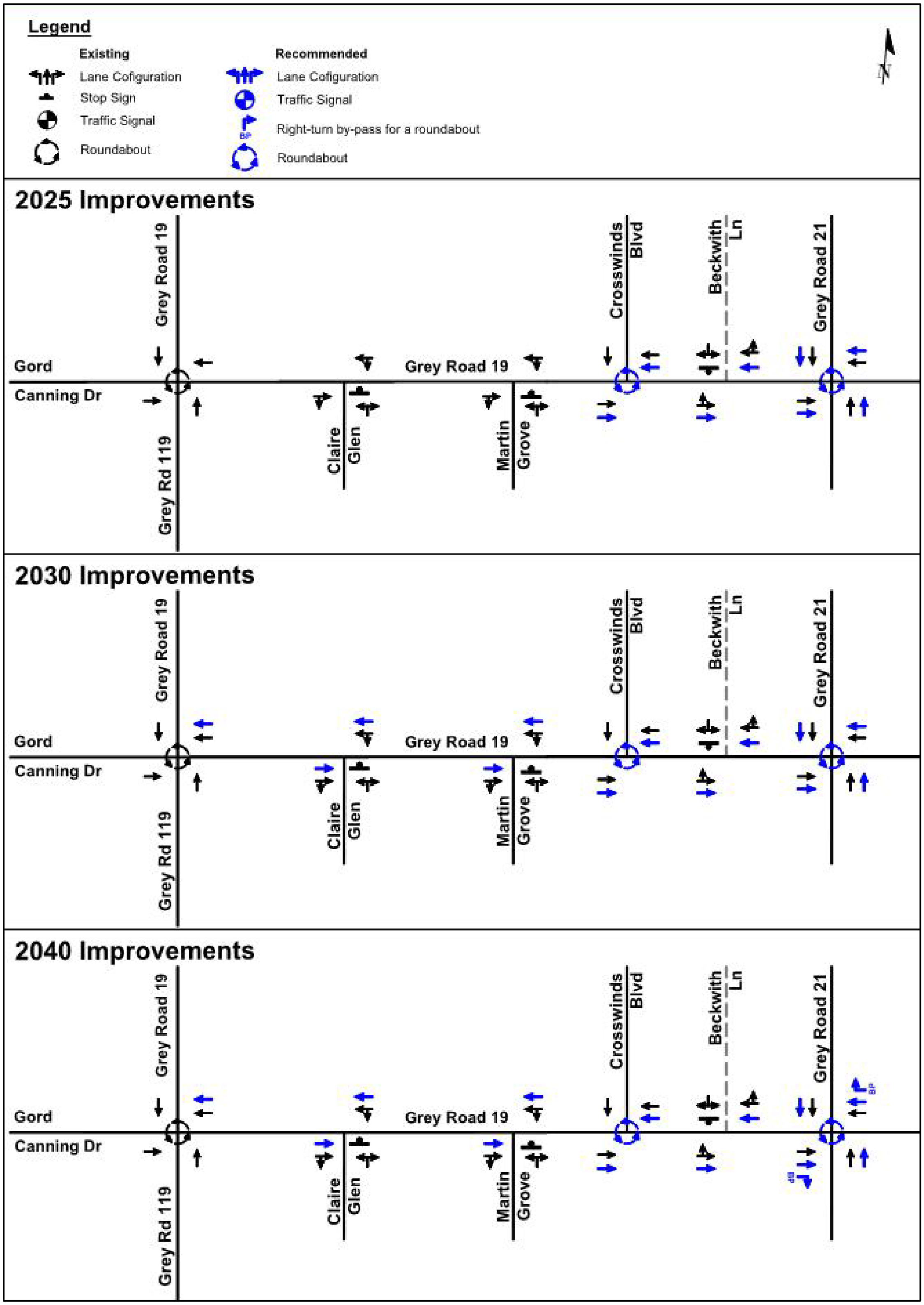
Intersection with GR 19	Intersection Control	Traffic Operations
		cross section in this timeframe. However, implementing a 4 - lane cross section on GR19 will improve safety in the short term and is required over the long term.
GR 119 / Gord Canning Drive	Existing Roundabout with GR 19 East Leg as a 4 - lane cross section	A 4-lane cross section is required on GR 19 in this horizon period to maintain acceptable capacity for the westbound approach to the roundabout. Assuming the 4 - lane cross section is implemented; all movements will operate with excess capacity and a LOS C of better. This improvement was carried through to the operation analysis for 2040 conditions.
Beckwith Lane	Existing stop control with 4 - lane cross section on GR19	The southbound egress movement from this road is forecasted to operate with LOS E (37 seconds) and with significant excess capacity (v/c = 0.03) remaining. A second access is also available to this development (i.e., Beckwith connection to GR 21), which provides an alternate travel route for egress. Ingress movements to this road will have an acceptable LOS due to the provision of 4 - lanes on GR19. It was also confirmed that the eastbound queuing at the GR21 roundabout will not block this access.
Martin Grove	Stop-controlled with 4-lane cross section on GR19	The egress delays from this road will be unacceptable with a 2 - lane cross section on GR 19 and therefore a 4 - lane cross section is required. With additional eastbound and westbound through lanes, the delay and volume to capacity ratio will be reduced to acceptable levels (i.e. LOS F, 57 second delay, v/c = 0.09). The minor volume of left-turn movements into this road can be served adequately by the 4 - lane cross section on GR19.
Claire Glen	Existing stop control with 4-lane cross section on GR19	The egress from this road is forecasted to operate with LOS D (30 seconds) and with significant excess capacity remaining (v/c = 0.09). An alternate access is also provided to this subdivision from Grey Road 119. The minor volume of left-turn movements into this road can be served adequately by the 4 - lane cross section on GR19.
Future 2040 Conditions		
GR 21 / SR34 / Mountain Road	2 - lane Roundabout with GR19 as a 4 - lane cross section	This intersection will approach capacity for the westbound and eastbound movements in the 2040 horizon period. Significant queues are projected to extend upstream for both movements.
	2 - lane Roundabout with GR19 as a 4 - lane cross section and with by-passes	An eastbound and westbound right turn by-pass can be considered and will improve operations. With the bypasses, all approaches will operate with excess capacity. However, the need for the bypasses will be dependent on the Ministry of Transportation's future planning work related to Highway 26 operations and travel to the west of Collingwood. Future property acquisition may be required to accommodate right turn by-pass lanes.

Intersection with GR 19	Intersection Control	Traffic Operations
Crosswinds Boulevard	2 - lane Roundabout with GR19 as a 4 - lane cross section	This roundabout is forecasted to have acceptable traffic operations in this horizon period, assuming a 4 - lane cross section is provided on GR19.
GR 119/Gord Canning Drive	Existing Roundabout with GR 19 East Leg as a 4 - lane cross section	This intersection will operate with excess capacity in this horizon period.
Beckwith Lane	Stop-controlled with 4 - lane cross section on GR19	The southbound egress movement is forecasted to operate with LOS F (132 second delay) and v/c = 0.10). A second access is also available to this development (i.e., Beckwith connection to GR 21), which provides an alternate travel route for egress during such periods. Ingress movements will have an acceptable LOS due to the provision of 4 - lanes on GR19. It was also confirmed that the eastbound queuing at the GR21 roundabout will not block this access.
Martin Grove	Stop-controlled with 4 - lane cross section on GR19	The egress delays from this road will be long (LOS F, 91 second delay), however there is significant reserve capacity (v/c = 0.14). The minor volume of left-turn movements into this road can be served adequately by the 4 - lane cross section on GR19.
Claire Glen	Stop-controlled with 4 - lane cross section on GR19	The egress delay from this road is forecasted to be significant (LOS F, 61 second delay), however operations are acceptable, given the reserve capacity available (v/c=0.18). An alternate access is also provided to this subdivision from Grey Road 119. The minor volume of left-turn movements into this road can be served adequately by the 4 - lane cross section on GR19.

3.4 Preferred Transportation Solution

The implementation of a 4 - lane cross section on GR19, together with the required upgraded traffic controls are summarized in the following sections and detailed in Figure 7, for the various time horizon periods. These improvements represent the preferred transportation solution for this corridor, based on traffic operations. However, it is expected that the time periods for implementing these improvements may vary, to better coordinate the roundabout projects with the 4 - lane widening requirements of the east and west segments of the corridor, if possible.

Figure 7: Summary of Recommended Transportation Improvements



3.4.1 GR 21 / SR 34 / GR 19 Intersection

From a traffic operations perspective, a 2 - lane roundabout will accommodate for the projected traffic better than a signalized intersection at this location. It is recommended that a 2 - lane roundabout be implemented in the short term to provide capacity for this intersection. In addition, it is recommended that a 2 - lane cross section be implemented on GR 19 in the short term, with the proposed roundabout designed to interface with this widening.

3.4.2 Crosswinds Boulevard / GR 19 Intersection

From a traffic operations perspective, this intersection can operate as a signalized intersection or a 2 - lane roundabout in the short term. However, a 2 - lane roundabout is recommended to provide control continuity along the corridor (i.e., three consecutive roundabouts along GR 19) and to meet the needs over the long term. The design of the Crosswinds roundabout should provide appropriate interface with the planned 4 - lane widening of GR 19 in this area, both east and west of the roundabout. The implementation of 4 lanes along the corridor is recommended to occur in the short term, to address operational issues at the stop-controlled intersections (i.e., Beckwith Lane, to the east, and Martin Grove and Claire Glen, to the west).

3.4.3 GR 119 / GR 19 Intersection

This intersection will operate with excess capacity under the existing geometrics for all study horizons, assuming the 4 - lane widening is provided on GR19 by 2030, to maintain acceptable capacity for the westbound approach.

3.4.4 Beckwith Lane / GR 19 Intersection

It is forecasted that the Beckwith Lane intersection will be able to function as a stop-controlled intersection, through horizon year 2040, assuming that GR19 is widened to 4 lanes in the short term.

3.4.5 Martin Grove / GR 19 Intersection

It is forecasted that the Martin Grove intersection will continue to have acceptable operations, as a stop-controlled intersection, through horizon year 204,0 assuming that GR19 is widened to 4 lanes in the short term.

3.4.6 Claire Glen / GR 19 Intersection

It is forecasted that the Claire Glen intersection will continue to have acceptable operations, as a stop-controlled intersection, through horizon year 2040, assuming that GR19 is widened to 4 lanes in the short term.

4.0 Proposed Roundabout Operations

It is recommended that the designs for the implementation of a 4 - lane cross section on GR 19 be coordinated with the designs being planned by the County for the two proposed roundabouts, as well as for the existing roundabout in the study area. The forecasted traffic operations for these roundabouts, as per the *Phase 1 Traffic* Study are summarized in Table 2.

Table 2: 2040 Future Traffic Operations for Roundabouts

Movement	Existing Storage / Link Distance (m)	Weekday PM Peak Hour		
		v/c	LOS (Delays in secs)	95th Queue (m)
GR 21/SR 34/GR 19				
WB	300+	0.96	E (40)	411
SB	98	0.54	A (8)	20
EB	300+	0.97	E (43)	490
NB	300+	0.75	B (12)	59
Crosswinds Boulevard/GR 19 [1]				
WB	300+	0.80	A (9)	83
SB	150	0.30	A (5)	9
EB	300+	0.72	A (7)	28
NB	150	0.24	A (5)	7
GR 119/Gord Canning Drive				
WB	150	0.67	A (6)	22
SB	300+	0.74	A (9)	45
EB	300+	0.83	E (37)	210
NB	200	0.32	B (12)	66

Notes: 1. An inscribed circle diameter (ICD) of 50 m was used for the analysis to align with proposed design geometrics.

From a traffic operations perspective, most movements at the roundabouts are forecasted to operate with excess capacity, a level of service E or better, minimal delays (i.e., less than one minute) and queue lengths within respective link and storage distances. However, the westbound and eastbound movements at the GR 21 / SR 34 intersection may approach capacity by 2040. Significant queues are also projected to extend upstream for both movements at this intersection. An eastbound and westbound right turn by-pass can be considered and will improve operations. With the bypasses, all approaches will operate with excess capacity, as summarized in Table 3. Future property acquisition may be required to accommodate right turn by-pass lanes. However, the long-term traffic forecasts for this intersection will be dependent on the Ministry of Transportation's ongoing planning studies for increasing capacity along Highway 26 and for alternate travel routes to this highway.

Table 3: 2040 Future Traffic Operations at the GR 21/SR34/GR19 Intersection

Movement	Existing Storage / Link Distance (m)	Weekday PM Peak Hour		
		v/c	LOS (Delays in secs)	95^{th} Queue (m)
GR 21/SR 34/GR 19 (with By-Passes)				
WB	300+	0.73	A (9)	42
SB	98	0.55	A (7)	20
EB	300+	0.63	A (6)	14
NB	300+	0.75	B (12)	67

5.0 Roundabout Geometric Design Considerations

It is recommended that the geometric design parameters for the proposed roundabouts (i.e., approach road half width, entry width, effective flare length, entry radius, entry angle and inscribed circle diameter) meet the requirements set out in the *Canadian Roundabout Design Guide* (Transportation Association of Canada (TAC), January 2017). On this basis, the roundabout designs should offer a reasonable trade-off between traffic mobility and safety. A geometric design, with appropriate roadway transition that maintains required entry / exit angles for the roundabout, should be considered to ensure reasonable fastest path speeds.

A preliminary review of constraints along the corridor indicates that the centerline of road may need to be shifted within the right-of-way. The final design of the roundabouts should be reviewed against the final location of the widened cross section on the roundabout approaches, to ensure that required operational parameters are achieved. In addition, the construction of the roundabouts should be coordinated with the construction of the 4 - lane widening, where possible, to minimize re-work and multiple disruptions due to construction.

6.0 Active Transportation Considerations

The County's *Transportation Master Plan* (Cole Engineering Group and C.C. Tatham & Associates, September 2014) identifies GR 19 as a cycling route. It is understood that the County's current policy is to pave shoulders (1.2 to 2.0 m) on rural arterials to reduce maintenance, but which can also support non-motorized travel such as bicycles and pedestrians. However, GR 19 is currently designated as a collector road in the Official Plan and is located in a semi-urban environment and therefore its active transportation needs are further reviewed in this memorandum.

Paved shoulder bike lanes currently exist on both side of GR19, to the north of the intersection of GR 19 / GR 119 / Gord Canning Drive. Paved shoulder bike lanes also exist along the north side of GR19 from this intersection to about Martin Grove, although pavement markings do not exist in the section between Claire Glen and Martin Grove.

A multi-use path (MUP) currently exists along the north side of GR 19 between the roundabout at the intersection of GR 19 / GR 119 / Gord Canning Drive and the roundabout at GR19 / GR21. This trail is located within a buffer area, outside of the GR19 ROW, and is under the jurisdiction of the Town of the Blue Mountains. This MUP provides good pedestrian and cyclist connectivity along the GR19 corridor in this area, however it currently has a stone dust surface. It is recommended this trail be paved and that all-season maintenance be provided, to provide a desirable Level of Service.

The existing and proposed roundabouts are to provide for pedestrian and cyclist crossings of GR19 that facilitate acceptable access to the MUP. It is recommended that the designs for the roundabouts incorporate appropriate signage and lane markings to facilitate these crossings.

It is understood that the County is considering paving the shoulders along the 4 - lane section of GR19, to minimize shoulder maintenance. The provision of paved shoulders along GR19 will provide an opportunity to incorporate “bicycle accessible shoulder” facilities in this area, as defined in *Book 18, Cycling Facilities of the Ontario Traffic Manual* (MTO, 2013). It is recommended that the design of these paved shoulders meet the following minimum criteria, in accordance with *Book 18*, as well as the *Geometric Design Guide for Canadian Roads* (Transportation Association of Canada, June 2017). It is recommended that the designs for the 4 - lane cross section on GR19 include bicycle accessible paved shoulders along both sides. A number of considerations should be taken into account in the determination of appropriate design widths for the paved shoulders, including the following:

- The traffic volumes and traffic speeds along the corridor.
- The lack of a buffer between the paved shoulder and the travel lanes.
- That vehicular travel lane widths may be lower than desirable due to the ROW constraints.
- That relatively deep ditches, with significant slopes, run along the shoulders in some areas.
- That a horizontal curve exists along part of the corridor which is conducive to off tracking.
- That wider shoulders also provide a refuge for stopped and emergency vehicles.

From a traffic operation and safety perspective, the following desirable shoulder widths should be considered in the design, if possible:

- Minimum 1.5 m paved shoulders.
- Minimum 1.0 m gravel rounding adjacent to the paved shoulders.
- Inclusion of Bicycle Route Signs along the corridor.

It should be noted that “bicycle accessible shoulders” are not designated bicycle lanes and therefore will not have bicycle lane markings. Cyclists and pedestrians should be encouraged to use the adjacent MUP as a safer option for cyclist travel in this area, due to the reduced potential for conflict that it presents.

It is expected that cyclists that choose to use the paved shoulders will travel through the roundabouts in the travel lanes, rather than being routed around these lanes. Cyclist volumes are expected to be low, as only a small percentage of cyclists are expected to choose to use the shoulder facility, since the MUP provides an alternate route for other cyclists.

Cyclists or pedestrians originating from Martin Grove or from Claire Glen may be required to travel along the GR19 shoulders or to cross GR19 at an uncontrolled location. The volumes of such pedestrians / cyclists are likely to be very low and therefore provision of more extensive pedestrian / cycling facilities to serve those areas is not recommended, considering the ROW constraints.

7.0 Transit Considerations

Colltrans, the Town of Collingwood's public transit system, currently has one route that services the study area (i.e., the Collingwood / Blue Mountain link). Figure 8 illustrates the existing transit route. This route connects the Blue Mountain Resort / Village to the Collingwood area. The headway for this transit route is approximately 30 minutes and it operates Monday to Sunday from 7:00 AM to 10:00 AM and 3:00 PM to 7:00 PM. The closest access to a transit stop from the study area is located on Gord Canning Drive, approximately 500 m north of the intersection of GR 19 / GR 119 / Gord Canning Drive. There are no transit stops currently in the Study Area, nor along the County's roads in the broader area. If improved transit access is provided in the future, further consideration can be made to establishing strategic locations for additional transit stops, taking into consideration both areas of neighbourhood demand and minimizing impacts to traffic mobility within the road network. However, at this time, no provision for transit stops are proposed along GR19 in the study area.

Figure 8: Existing Transit Route

Reference: South Georgian Bay Tourism, 2018

8.0 Right-of-Way Considerations

The existing ROW on GR 19 varies along the corridor, from about 30 m to about 40 m. The centerline of the road is currently offset to the south of the centerline of the ROW. A 30 m buffer also exists adjacent to the north side of the ROW, across the Windfall development and Mountain House development, which provides for a landscape buffer and trail system.

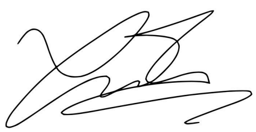
The County *Official Plan* notes that County Arterial and County Collector roads should generally have a ROW width of 30 m and therefore the corridor currently meets this requirement. However, it is typically recognized that additional constraints (e.g., turning lanes, topography, utilities, bike lanes, pedestrian trails, etc.) may necessitate wider ROW requirements in localized areas and this will be further assessed in the detailed designs.

The ultimate ROW requirements will be established in the detailed design work for the proposed roundabouts and for the widening of the road to a 4 - lane cross section along the full length of the corridor.

The ROW in the area of the approaches to the roundabouts will depend on the alignments chosen to accommodate the roundabout functional requirements and to interface with the road upstream and downstream of these approaches. Property requirements should accommodate a minimum of 5 m from the outside edge of the pavement in the roundabout, or greater if required to meet sight line or servicing requirements.

The ROW between the roundabouts should accommodate the 4 travel lanes, partially paved shoulders and adjacent gravel shoulders, in accordance with the requirements of the *Geometric Design Guide for Canadian Roads* (TAC, 2017) and with the *Ontario Traffic Manuals*. The adjacent boulevard area must accommodate utilities, drainage ditches, culverts, etc. No turning lanes or tapers are proposed along this corridor in the study area, considering the low traffic speeds and low turning volumes at the stop-controlled intersections.

R.J. Burnside & Associates Limited



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Technical Memorandum Stormwater No. 1

Date: July 7, 2022 **Project No.:** 300052076.0000

Project Name: Grey Road 19 Environmental Assessment

Client Name: Grey County

Submitted To: Project Management Team

Submitted By: Rachel Walton, P.Eng., MASc.

Reviewed By: Adrian Holvik, P.Eng.

1.0 Introduction

R.J. Burnside & Associates Limited (Burnside) was retained by Grey County (County) to complete a Municipal Class Environmental Assessment (MCEA) for Grey Road 19. The purpose of the MCEA was to consider improvements for Grey Road 19 between Grey Road 21 / Mountain Road / Simcoe Road 34 and Grey Road 119 / Gord Canning Drive to meet the needs of increased traffic demand, with a consideration for active transportation.

The purpose of this technical memorandum is to describe the stormwater management design considerations to support the proposed improvements to Grey Road 19. The overall Environmental Study Report prepared by Burnside should be referenced for information regarding the MCEA process, environmental considerations, alternative investigations etc. For the purpose of this technical memorandum, the preferred Alternative Solution 2) Widen four lanes with paved shoulders for maintenance was considered for the stormwater management design.

2.0 Study Area

The Study Area corridor is approximately 1.36 km long and contains residential, commercial, treed and open areas as well as roadside drainage ditches and a crossing of one watercourse, known as Silver Creek. A multi-use trail is located adjacent to the north of the road, parallel to the right-of-way (ROW). The Town of Collingwood and Simcoe County are located immediately to the east of the Study Area. The Study Area corridor provides an alternate linkage for inter-municipal travel along the south side of Georgian Bay. The Study Area corridor also serves as the main access route to the Blue Mountain Resort to the west and provides access to existing and proposed development in the Town of the Blue Mountains and in the west part of Collingwood.

Grey Road 19 drains several large external drainage areas from the south to the north. There are three culverts that cross south to north under the right of way that drain the external drainage areas.

The study area falls within the Nottawasaga Valley Conservation Authority (NVCA) regulated area. The study area also falls within the Niagara Escarpment Commission (NEC) under the Escarpment Recreation Area designation.

2.1 Existing Ditches

Grey Road 19 is currently drained by ditches on the north and south side of the right-of-way. The ditches generally drain from west to east, ultimately contributing to Silver Creek.

2.2 Windfall Development Stormwater Management Channel

To the north of Grey Road 19 is the Windfall residential development. An existing stormwater management channel referred to as the Windfall Channel was constructed as part of this development, to the north of the existing walking trail along Grey Road 19. The Grey Road 19 ditch connects into the Windfall Channel to the west of the Crosswinds Boulevard and Grey Road 19 intersection. The Windfall Channel ultimately drains to Silver Creek.

The Windfall channel is outside of the right-of-way limits, and as such, improvements to or analysis of the channel are outside of the scope of this project.

2.3 Price's Culvert

The western most culvert crossing is referred to as the Price's Culvert and is a 1200 mm by 2400 mm box culvert. This culvert was designed and installed as part of a project designed by Greenland Consulting Group Limited (Greenland) on behalf of the Town of Blue Mountains (TBM) for improvements to the Price's Subdivision Area. Price's culvert drains an external drainage area of approximately 104 ha under Grey Road 19. This drainage area consists of lands to the west of Scenic Caves Road, including some of Blue Mountain Ski Resort. Two culvert crossings under Scenic Caves Road were sealed off during the installation of Price's culvert to reduce flow directed towards Price's Subdivision Area (Claire Glen, Patricia Drive and Martin Grove), increasing the drainage area directed towards Price's Culvert on Grey Road 19. This is an important note for the analysis of Grey Road 19 as it reduced the drainage areas contributing to the other culverts along Grey Road 19. For further details on the design of this crossing, refer to Preliminary Design Report: Price's Subdivision Stormwater Drainage, dated January 2018, prepared by Greenland and Price's Subdivision – Scenic Caves Road Drainage – Drainage Report Addendum (Update), dated June 19, 2018, prepared by Greenland.

Price's culvert was installed in the summer of 2021. Based on a preliminary review of the Preliminary Design Report: Price's Subdivision Stormwater Drainage, dated January 2018, prepared by Greenland and Price's Subdivision – Scenic Caves Road Drainage – Drainage Report Addendum (Update), dated June 19, 2018, prepared by Greenland, the sizing of Price's culvert appears adequate. However, it appears that the Regional Event was not modelled for the design, as such, safe access should be reviewed during the more detailed review of the sizing to be completed during detailed design.

The inlet and outlet of Price's culvert are shown in Figures 1 and 2 and appear to be in a good state of repair. As the condition and sizing of the culvert appear to be adequate, the external areas and culvert will not be considered for stormwater improvements within this technical memorandum

Figure 1: Price's Culvert Inlet

Figure 2: Price's Culvert Outlet

2.4 Grey Road 19 Culvert

The Grey Road 19 culvert is a 900 mm diameter CSP culvert located in the ditch in front of 796090 Grey Road 19. Grey Road 19 culvert drains a catchment area of approximately 18.9 ha. The catchment area contains the Price's subdivision area, which consists of single-family homes serviced by rural right-of-ways drained by ditches.

The Grey Road 19 culvert outlets into a 1.1 m rise CSPA culvert that drains into the Windfall Channel to the north of the walking trail. Improvements to the CSPA culvert are outside of this scope of work.

The inlet of the Grey Road 19 culvert was observed to be crushed, as reflected in Figure 3. The outlet is shown in Figure 4 and appears to be in good condition.


Figure 3: Grey Road 19 Culvert Inlet


Figure 4: Grey Road 19 Culvert Outlet

2.5 Silver Creek Culvert

The Silver Creek Culvert is located approximately 210 m west of the Grey Road 19 and Grey Road 21 intersection. This culvert is a 1200 mm diameter CSP and drains a tributary of Silver Creek across Grey Road 19. According to the County, this culvert is planned for replacement to support the future Grey Road 19/21 Simcoe Road 34 Roundabout project which is to be designed by Tatham Engineering. Although this culvert is noted as background information within this MCEA, evaluation of this culvert is deferred to the future Grey Road 19/21 Simcoe Road 34 Roundabout project since it is assumed that any potential replacement will be during the future roundabout project. Refer to the design drawings for the culvert prepared by Tatham included in Appendix C.

The Silver Creek Culvert drains a catchment area of approximately 45.66 ha. The catchment area consists of wetlands, forested areas, and a driving range.

Both the inlet and the outlet of the Silver Creek culvert were observed to be in good condition in the field, as shown in Figures 5 and 6 below.


Figure 5: Silver Creek Culvert Inlet


Figure 6: Silver Creek Culvert Outlet

3.0 Design Assumptions

For the purposes of the stormwater management design at the MCEA level, the following assumptions have been made. It is assumed that the design and assumptions will be further refined at the detailed design stage.

- Grey Road 19 will be widened to four lanes, resulting in an increase in impervious area. The alignment selected assumes the centerline of the road will be shifted to the north, generally maintaining the south edge of shoulder location.
- Driveway culvert sizing will be confirmed during detailed design.
- Price’s culvert was recently replaced in the summer of 2021. Grey Road 19 is already four lanes wide in the location of Price’s Culvert; therefore, the impervious area of the road will be maintained in the proposed condition. As such, improvements for Price’s Culvert are unlikely to be required and are not considered in this technical memorandum.

4.0 Hydrology

The existing Grey Road 19 right-of-way has an impervious area of approximately 1.3 ha. With the proposed widening to four lanes and asphalt shoulder, the proposed Grey Road 19 impervious area is approximately 1.8 ha. As such, stormwater quantity control measures will be required to support the widening.

The existing catchment areas for the Grey Road 19 area are shown in Figure SWM-1. The catchment areas consist of external areas and the Grey Road 19 right-of-way. The catchments to the north and the south of the right-of-way are generally split along the existing Grey Road 19 centreline of road.

The proposed catchment areas for Grey Road 19 are shown in Figure SWM-2. The proposed centerline of the road is to be shifted to the north. As such, the proposed catchment area sizes differ slightly from the existing based on the shift in the road centerline.

The Rational Method was used to calculate peak flows for the study area. Runoff coefficients were analyzed for the existing and proposed condition. Table 1 and Table 2 provide a summary of the existing and proposed runoff peak flows. Refer to Appendix A for the detailed calculations and figures showing the catchment areas.

Table 1: Existing Runoff Peak Flows calculated using the Rational Method

Return Period	Existing Condition Peak Flow (m^3/s)				
	GR19 1	GR19 2	GR19 3	SC 1	SC 2
2	0.04	1.25	0.07	0.09	0.25
5	0.05	1.66	0.1	0.11	0.33
10	0.06	1.93	0.12	0.13	0.38
25	0.08	2.51	0.15	0.17	0.49
50	0.1	3.04	0.18	0.21	0.6
100	0.11	3.48	0.21	0.24	0.69

Table 2: Future Runoff Peak Flows calculated using the Rational Method

Return Period	Proposed Condition Peak Flow (m^3/s)				
	GR19 1	GR19 2	GR19 3	SC 1	SC 2
2	0.04	1.29	0.08	0.10	0.23
5	0.05	1.71	0.11	0.13	0.30
10	0.06	1.99	0.13	0.15	0.35
25	0.08	2.58	0.17	0.19	0.45
50	0.1	3.14	0.20	0.23	0.55
100	0.11	3.59	0.23	0.27	0.63

5.0 Quantity Control

The Modified Rational Method was used to determine the storage volume required to control the proposed condition peak flows to existing rates. To determine the storage volume, the study area was analyzed as a whole. The goal is to provide quantity control overall, which may result in overcontrolling peak flows in some catchments, while providing little or no control in other catchments. This overall approach will still ensure that quantity control is provided prior to outlettling to the ultimate outlet, Silver Creek. A 25% factor of safety has been added to the proposed storage volumes to provide future flexibility during detailed design.

The catchments GR19 1, GR19 2, GR19 3, SC 1 and SC 2 have a total drainage area of 24.8 ha. The existing condition composite runoff coefficient was calculated to be 0.46. The proposed condition composite runoff coefficient was calculated to be 0.48. Detailed calculations are provided in Appendix A.

Table 3 outlines the storage volume required to control to the existing condition peak flow levels.

Table 3: Storage Volumes to provide quantity control using the Modified Rational Method

Return Period	Storage Volume (m^3)
2	272
5	355
10	418
25	459
50	693
100	715

It is proposed to provide stormwater storage in the ditches. The ditches are to be oversized to allow stormwater to build up in ditches during high runoff events so that it can be released slowly downstream in the 24-48 hours following the storm. It is recommended that the ditches designed for quantity control are placed on the north side of the right-of-way. There are no residential properties fronting the north side of the right-of-way. Under a major runoff event, if the ditches were to become inundated on the north, in general it appears that overtopping would occur over the walking trail and into the Windfall channel prior to impacting residential properties. This should be reviewed in detail during detailed design.

6.0 Quality Control

It is recommended that stormwater quality control be provided within the proposed roadside ditches. An enhanced grass swale concept can be applied to roadside ditches, to achieve stormwater quality control.

The Low Impact Development Stormwater Management Planning and Design Guide, prepared by Credit Valley Conservation Authority and Toronto Region Conservation Authority (2010) was referenced for design guidance to achieve water quality control through the use of enhanced grass swales. Table 4 below outlines the water quality guidance.

Table 4: Grass Swale Water Quality Enhancements excerpted from Low Impact Development Stormwater Management Planning and Design Guide, Prepared by Credit Valley Conservation Authority and Toronto Region Conservation Authority (2010). "Removal rates" refer to the percentage of Total Suspended Solids that are removed from runoff.

Factors that Reduce Removal Rates	Factors that Enhance Removal Rates
Longitudinal slope > 1%	Longitudinal slope < 1%
Measured soil infiltration rate < 15 mm/hr	Measured soil infiltration rate is 15 mm/hr or greater
Flow velocity within channel > 0.5 m/s during a 4 hour, 25 mm Chicago storm event	Flow velocity within channel is 0.5 m/s or less during a 4 hour, 25 mm Chicago storm event
No pretreatment	Pretreatment with vegetated filter strips, gravel diaphragms and/or sedimentation forebays
Side slopes steeper than 3:1 (H:V)	Side slopes 3:1 (H:V) or less

During detailed design, the guidance in Table 4 should be followed to design ditches to provide stormwater quality control for the Grey Road 19 catchment areas.

7.0 Culvert Hydraulics

The hydraulic capacity of the existing Grey Road 19 and Silver Creek culverts have been established using the hydraulic modelling software, HY-8. The existing condition capacity will be used as a benchmark for comparisons to any proposed culvert improvements. The following design criteria have been used in the hydraulic analysis of the proposed structures:

- Based on the proposed structure having a combined span equal to or less than 6.0 m and located on a local roadway, the Return Period for the Design Flood Event is the 10-year Storm, as per the MTO Highway Drainage Design Standards, WC-1 Design Flows (Bridges and Culverts) (2008).
- The minimum freeboard for a culvert crossing with a solid bottom, as noted in WC-7 Culvert Crossings on a Watercourse, shall be 0.3 m for a Local Roadway. The minimum freeboard is measured vertically from the High-Water Level for the Design Flow to the edge of the travelled lane.

- The Regional Storm flood depths relative to emergency access criteria is to be reviewed during the detailed design.

The existing culvert has been modelled using the HY-8 hydraulic modelling software to determine the performance of the existing structure under various flow conditions. Flows were iterated in the model to establish headwater elevations up to the centerline of the roadway. Peak flows producing headwater elevations up to the centerline of road are assumed to be contained without spilling over the roadway and therefore represent the total capacity of the culvert.

The HY-8 version 7.60 Hydraulic Model developed by the Federal Highway Administration, in cooperation with Aquaveo LLC and Environmental Modelling Research Laboratory has been used for our analysis. HY-8 is recognized throughout the industry by various Ministries as being an effective method by which bridge, and culvert hydraulics can be analyzed.

Driveway culvert sizing has not been analyzed at this time as it is not anticipated to impact property requirements. It is assumed that the driveway culverts will be analyzed during detailed design.

Table 5 summarizes the existing structure geometry.

Table 5: Grey Road 19 and Silver Creek Culvert – Existing Structure Geometry

Culvert Name	Structure Description	Upstream (U/S) Invert Elevation (m)	Downstream (D/S) Invert Elevation (m)	Length (m)	Slope (%)	Inlet Condition
Grey Road 19	900 mm CSP	225.164	224.415	28	2.7	Projecting
Silver Creek Culvert	1200 mm CSP	215.419	215.304	24.5	0.47	Projecting

Table 6 summarizes the peak flows contributing to the culverts.

Table 6: Peak Flows contributing to the Grey Road 19 and Silver Creek Culverts

Recurrence Interval (Year)	Peak Flows (m^3/s)	
	Grey Road 19 (GR19 1 + GR19 2)	Silver Creek (SC 1 +SC EXT)
2	1.33	1.94
5	1.76	2.57
10	2.05	3.0
25	2.66	3.89
50	3.24	4.72
100	3.7	5.41

Tables 7 and 8 provide a summary of the HY-8 results for the Grey Road 19 culvert and the Silver Creek culvert, respectively. The output from HY-8 is included in Appendix B.

Table 7: HY8 Output Summary for Grey Road 19 Culvert

Recurrence Interval (Year)	Total Discharge (m^3/s)	Headwater Elevation (m)	Proposed Freeboard to Min Centreline Road Elevation (m)
2	1.33	226.50	0.12
5	1.76	226.69	-0.07
10	2.05	226.72	**-0.1**
25	2.66	226.78	-0.16
50	3.24	226.83	-0.21
100	3.70	226.87	-0.25

Table 8: HY8 Output Summary for Silver Creek Culvert

Recurrence Interval (Year)	Total Discharge (m^3/s)	Headwater Elevation (m)	Proposed Freeboard to Min Centreline Road Elevation (m)
2	1.94	216.79	1.28
5	2.57	217.19	0.88
10	3.00	217.55	**0.52**
25	3.89	218.14	0.07
50	4.72	218.23	-0.16
100	5.41	218.29	-0.22

The Grey Road 19 culvert is overtopped under storm events exceeding the 2-year peak flow event. It is recommended that this culvert is replaced with a larger structure that is able to convey the 10-year peak flow event while maintaining 0.3 m of freeboard from the headwater to the minimum edge of travelled lane during the widening of Grey Road 19. During detailed design any aquatic requirements for the culvert, such as stone embedment or a low flow channel, should be confirmed.

The Silver Creek culvert is overtopped under storm events exceeding the 25-year storm event. A 0.3 m freeboard from the 10-year headwater elevation to the minimum edge of travelled lane is provided, as such, the existing size appears adequate. This should be confirmed during detailed design when the road profile is confirmed. It is understood that the Silver Creek culvert is planned for replacement during the Grey Road 19 / Grey Road 21 / Simcoe Road 34 roundabout. A like-for-like replacement appears adequate. It is assumed that any aquatic requirements will be determined during the detailed design of the culvert.

8.0 Proposed Ditch Geometry

A proposed ditch geometry for each catchment area has been assessed using a simple Manning's Channel calculation and is summarized in Table 9 below. The proposed 100-year runoff peak flows calculated in Section 4 have been used to assess the ditch geometry. A 25% factor of safety has been added to the peak flow values to provide flexibility in the future detailed design. A 0.3 m freeboard from the 100-year high water elevation to the top of the ditch bank has been assumed for each cross section. It is assumed that the proposed ditch profiled will generally follow the existing ditch profile, as such, the minimum slope for each catchment area has been assumed for the analysis. The side slopes are assumed to be 3:1, however this may change as the grading limits are refined during the detailed design.

Table 9: Preliminary Ditch Geometry

	GR19 1	GR19 2	GR 19 3	SC 1	SC 2
Flow (m^3/s)	0.14	4.35	0.29	0.34	0.79
Depth (m)	0.51	1.1	0.56	0.68	0.86
Bottom width (m)	1.5	2	1	1	1
Side Slopes (H:V)	3:1	3:1	3:1	3:1	3:1
Assumed Minimum Slope (%)	0.3	1	1	0.3	0.3
Manning's 'n'	0.05	0.05	0.05	0.05	0.05
Ditch Top Width (m)	4.6	8.6	4.4	5.1	6.2
Approximate minimum width available (Proposed edge of shoulder to property line measurement) (m)	8	10.5	4.5	5.5	11.5

This is a high-level analysis of the ditch. As the detailed design progresses it is assumed that the ditch geometry will be refined.

The geometry in Table 9 has been proposed for drainage purposes only. As discussed in Section 5, stormwater quality and quantity control are also proposed within the ditches. The ditches may need to be enlarged in some locations to provide the required stormwater control. This will be reviewed during detailed design.

8.1 Ditch Volume

The quantity control volume requirements to control runoff to existing levels was discussed in Section 5. A storage volume of approximately 715 m^3 was calculated to control runoff to existing levels. As discussed above, it is recommended the storage volume is provided in the north ditch. Based on the geometry proposed in Section 8.0, the following volume is available in the ditches:

- **GR3 Ditch – 653 m^3**
- **SC1 Ditch – 670 m^3**
- **Total (GR3 + SC1) = 1323 m^3**

Based on this high-level analysis, providing the required storage volume in the north ditches appears feasible. Further detailed analysis is required during detailed design. Volume calculations are provided in Appendix A.

9.0 Conclusions and Recommendations

An MCEA is being conducted to consider improvements for Grey Road 19 between Grey Road 21 / Mountain Road / Simcoe Road 34 and Grey Road 119 / Gord Canning Drive to meet the needs of increased traffic demand, with a consideration for active transportation. The MCEA recommends the preferred alternative, which is to widen Grey Road 19 to four lanes, including a paved shoulder. This memorandum has been prepared to review the stormwater management for the recommended widening of Grey Road 19. The following aspects have been analyzed to provide recommendations for the detailed stormwater management design.

Stormwater Quantity Control

- To provide stormwater quantity control to the existing 100-year peak flow rates, approximately 715 m^3 of stormwater storage is required. It is recommended that this storage be provided in the proposed ditches along the north side of Grey Road 19.
- An analysis of the typical ditch cross section shows that sufficient storage volume is anticipated within the northern ditches.

Stormwater Quality Control

- It is recommended that stormwater quality control be provided within the Grey Road 19 ditches through an enhanced swale design.

Grey Road 19 Ditch Design

- It is recommended that Grey Road 19 ditches be designed to drain the 100-year peak flow event while maintaining 0.3 m of freeboard to the top of the ditch bank. This design is anticipated to result in ditch top widths ranging from 4.4 m to 8.6 m. This range of ditch widths is considered feasible given the existing right-of-way width.

Culvert Hydraulics

- Price’s culvert was replaced in the summer of 2021 to provide drainage improvements to Price’s subdivision. Based on a preliminary review of the design report the sizing and structure appear adequate, a detailed review of this culvert is recommended during the detailed design.
- The Grey Road 19 culvert inlet was observed to be crushed in the field. The HY-8 model showed the that the culvert is overtopped during storm events exceeding the 2-year event. It is recommended that the Grey Road 19 culvert should be replaced and enlarged during the widening of Grey Road 19. The size should be verified during detailed design.

- Visible deficiencies of the Silver Creek culvert were not observed in the field. The Silver Creek culvert is planned for replacement to support the future Grey Road 19/21 Simcoe Road 34 Roundabout project which is to be designed by Tatham Engineering. Evaluation of this culvert is deferred to the future Grey Road 19/21 Simcoe Road 34 Roundabout project since it is assumed that any potential alterations to that culvert would occur during the future roundabout project.

R.J. Burnside & Associates Limited

Rachel Walton, P.Eng., MASc.
Project Engineer
RW:sm

Enclosure(s) Appendix A Hydrology
Appendix B Hydraulics
Appendix C Background Information

cc: N/A

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Appendix A
Hydrology

Appendix A

Hydrology

Notes

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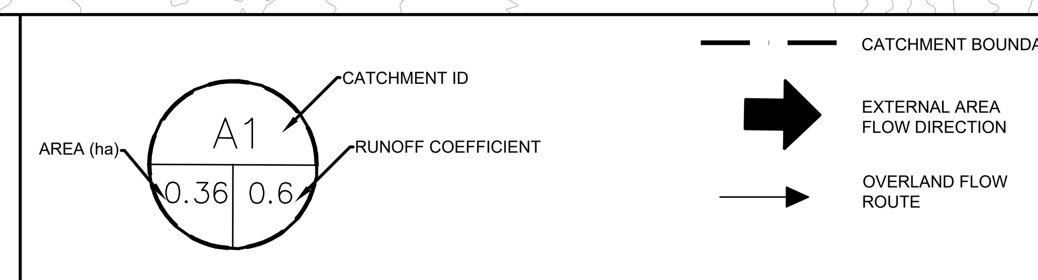
No.	Issue / Revision	Date	Auth.
1	ISSUED FOR 60% REVIEW	22/01/07	



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Client
GREY COUNTY
STREET NAME & NUMBER
CITY, PROVINCE
POSTAL CODE

Drawing Title
GREY ROAD 19

EXISTING GREY ROAD 19 STORM CATCHMENT AREAS

Drawn	Checked	Designed	Checked	Date	Drawing No.
RW	ACH	RW	ACH	JUNE 2022	SWM1
Project No. 300052076		Contract No. CONTRACT NO.		Revision No. 0	
Scale 1:2,000		0 40 80 120m			

Notes

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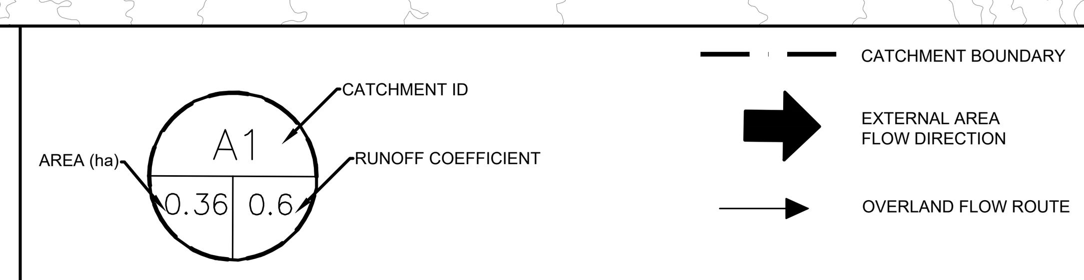
2. The contractor shall verify all dimensions, levels, and datums on site and report any discrepancies or omissions to this office prior to construction.
3. This drawing is to be read and understood in conjunction with all other plans and documents applicable to this project.

NOT FOR CONSTRUCTION

No.	Issue / Revision	Date	Auth.
1	ISSUED FOR 60% REVIEW	22/01/07	



BURNSIDE

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Client
GREY COUNTY
STREET NAME & NUMBER
CITY, PROVINCE
POSTAL CODE

Drawing Title
GREY ROAD 19

PROPOSED GREY ROAD 19 STORM CATCHMENT AREAS

Drawn	Checked	Designed	Checked	Date	Drawing No.
??	??	??	??	YY/MM/DD	SWM2
Project No. 300052076		Contract No. CONTRACT NO.		Revision No. 0	
Scale 1:2,000	0 40 80 120m				

File: \\collingwood\Shared Work Areas\052076 - Grey Road 19\03_ProductionDwg\052076_S...

Project :	Grey Road 19 EA
Project No. :	300052076
Location :	Grey County
Created By :	RW
Checked By :	ACH
Date Created :	20-Jun-22

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Existing Runoff Coefficient

Catchment	Area (ha)					Composite Runoff Coefficient
	Total	**GR19 Pavement**	**Residential**	**Ditch**	**Wetland**	
GR19 2	18.2	0.15	17.3	0.22		0.49
GR19 3	1.35	0.33		1.02		0.37
SC1	1.33	0.43		0.9		0.43
SC2	3.85	0.39	1.6	0.6	1.26	0.36
TOTAL	**24.7**	**1.3**	**18.9**	**2.74**	**1.26**	**0.46**

Proposed Runoff Coefficient

Catchment	Area (ha)					Composite Runoff Coefficient
	Total	**GR19 Pavement**	**Residential**	**Ditch**	**Wetland**	
GR19 2	18.4	0.2	17.92	0.28		0.50
GR19 3	1.18	0.46		0.72		0.47
SC1	1.13	0.6		0.53		0.57
SC2	4.09	0.52	1.6	0.6	1.37	0.37
TOTAL	**24.8**	**1.78**	**19.52**	**2.13**	**1.37**	**0.48**

Runoff Coefficients from NVCA Stormwater Technical Guide

GR19 Pavement	Residential	Ditch	Wetland
0.9	0.5	0.2	0.1

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Project:	Grey Road 19
Project No.:	300052076
Modelled by:	R.Walton
Date:	21-Jun-22

Input Information - For 'C' greater than or equal to 0.40

BRANSBY WILLIAMS FORMULA

Catchment Number	**Area** (ha)	**Length** (m)	**Slope** (%)	**Runoff Coefficient**	**Height** (m)
GR2	13.8	406	1.5	0.5	6.1
SC EXT	41.8	1405	4.4	0.6	61.8

Design Spreadsheet

Bransby Williams Time of Concentration (hr)	**Bransby Williams Time of Concentration** (min)	**Bransby Williams Time to Peak** (hr)
0.274	16.4	0.184
0.685	41.08	0.459

<< Elements requiring Input Information

Project :	Grey Road 19 EA
Project No. :	300052076
Location :	Grey County
Created By :	RW
Checked By :	ACH
Date Created :	20-Jun-2022
Updated :	21-Jun-2022

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RATIONAL METHOD PEAK FLOW ESTIMATION

CATCHMENT : **GR19 1**

Rational Method Parameters			
Area (ha)	A =	**0.55**	
Runoff Coefficient	$C_{2,5,10}$ =	**0.50**	Runoff C Modification
	C_{25} =	**0.55**	$C_{25} = C_{2,5,10} \times 1.1$
	C_{50} =	**0.60**	$C_{50} = C_{2,5,10} \times 1.2$
	C_{100} =	**0.63**	$C_{100} = C_{2,5,10} \times 1.25$
Time of Concentration (min)	T_C =	**15.00**	

Note: Runoff coefficient modification as per MTO Drainage Management Manual methodology

Q = 2.78 Ca x C x I x A
Q - Peak flow or runoff rate (L/s)
Ca - Antecedent precipitation factor (for storm events greater than the 5-year storm)
A - Catchment Area (ha)
I - Rainfall intensity (mm/hr)
C - Runoff coefficient

	Collingwood ON					
	2 Year	**5 Year**	**10 Year**	**25 Year**	**50 Year**	**100 Year**
	A = **20.3**	A = **27.0**	A = **31.5**	A = **37.1**	A = **41.3**	A = **45.4**
	B = **-0.699**	B = **-0.699**	B = **-0.699**	B = **-0.699**	B = **-0.699**	B = **-0.699**
Rainfall Intensity (mm/hr) =	53.50	71.15	83.01	97.77	108.84	119.65
Peak Runoff (L/s) =	40.9	54.4	63.5	82.2	99.9	114.3
Peak Runoff (m3/s) =	**0.04**	**0.05**	**0.06**	**0.08**	**0.10**	**0.11**
Peak Runoff per Area (L/s/ha) =	74.4	98.9	115.4	149.5	181.5	207.9

User Input Cells

Project : Grey Road 19 EA
Project No. : 300052076
Location : Grey County
Created By : RW
Checked By : ACH
Date Created : 20-Jun-2022
Updated : 21-Jun-2022

RATIONAL METHOD PEAK FLOW ESTIMATION

CATCHMENT : **GR19 2 Existing**

Rational Method Parameters		
Area (ha)	A =	**18.20**
Runoff Coefficient	$C_{2,5,10}$ =	**0.49**
	C_{25} =	**0.54**
	C_{50} =	**0.59**
	C_{100} =	**0.61**
Time of Concentration (min)	T_C =	**16.40**

Runoff C Modification
$C_{25} = C_{2,5,10} \times 1.1$
$C_{50} = C_{2,5,10} \times 1.2$
$C_{100} = C_{2,5,10} \times 1.25$

Note: Runoff coefficient modification as per MTO Drainage Management Manual methodology

Q = 2.78 Ca x C x I x A
Q - Peak flow or runoff rate (L/s)
Ca - Antecedent precipitation factor (for storm events greater than the 5-year storm)
A - Catchment Area (ha)
I - Rainfall intensity (mm/hr)
C - Runoff coefficient

	Collingwood ON					
	2 Year	**5 Year**	**10 Year**	**25 Year**	**50 Year**	**100 Year**
	A = **20.3**	A = **27.0**	A = **31.5**	A = **37.1**	A = **41.3**	A = **45.4**
	B = **-0.699**	B = **-0.699**	B = **-0.699**	B = **-0.699**	B = **-0.699**	B = **-0.699**
Rainfall Intensity (mm/hr) =	50.26	66.85	77.99	91.86	102.26	112.41
Peak Runoff (L/s) =	1246.1	1657.4	1933.6	2505.1	3042.3	3483.6
Peak Runoff (m3/s) =	**1.25**	**1.66**	**1.93**	**2.51**	**3.04**	**3.48**
Peak Runoff per Area (L/s/ha) =	68.5	91.1	106.2	137.6	167.2	191.4

User Input Cells

Project : Grey Road 19 EA
Project No. : 300052076
Location : Grey County
Created By : RW
Checked By : ACH
Date Created : 20-Jun-2022
Updated : 21-Jun-2022

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RATIONAL METHOD PEAK FLOW ESTIMATION

CATCHMENT : **GR19 2 Proposed**

Rational Method Parameters		
Area (ha)	A =	**18.40**
Runoff Coefficient	$C_{2,5,10}$ =	**0.50**
	C_{25} =	**0.55**
	C_{50} =	**0.60**
	C_{100} =	**0.63**
Time of Concentration (min)	T_C =	**16.40**

Runoff C Modification
$C_{25} = C_{2,5,10} \times 1.1$
$C_{50} = C_{2,5,10} \times 1.2$
$C_{100} = C_{2,5,10} \times 1.25$

Note: Runoff coefficient modification as per MTO Drainage Management Manual methodology

$Q = 2.78\ Ca \times C \times I \times A$
Q - Peak flow or runoff rate (L/s)
Ca - Antecedent precipitation factor (for storm events greater than the 5-year storm)
A - Catchment Area (ha)
I - Rainfall intensity (mm/hr)
C - Runoff coefficient

	Collingwood ON					
	2 Year	**5 Year**	**10 Year**	**25 Year**	**50 Year**	**100 Year**
	A = 20.3	**A = 27.0**	**A = 31.5**	**A = 37.1**	**A = 41.3**	**A = 45.4**
	B = -0.699	**B = -0.699**	**B = -0.699**	**B = -0.699**	**B = -0.699**	**B = -0.699**
Rainfall Intensity (mm/hr) =	50.26	66.85	77.99	91.86	102.26	112.41
Peak Runoff (L/s) =	1285.5	1709.8	1994.8	2584.3	3138.5	3593.8
Peak Runoff (m3/s) =	**1.29**	**1.71**	**1.99**	**2.58**	**3.14**	**3.59**
Peak Runoff per Area (L/s/ha) =	69.9	92.9	108.4	140.5	170.6	195.3

User Input Cells

Project :	Grey Road 19 EA
Project No. :	300052076
Location :	Grey County
Created By :	RW
Checked By :	ACH
Date Created :	20-Jun-2022
Updated :	21-Jun-2022

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RATIONAL METHOD PEAK FLOW ESTIMATION

CATCHMENT : **GR19 3 Existing**

Rational Method Parameters			
Area (ha)	A =	1.35	
Runoff Coefficient	$C_{2,5,10}$ =	0.37	Runoff C Modification
	C_{25} =	0.41	$C_{25} = C_{2,5,10} \times 1.1$
	C_{50} =	0.44	$C_{50} = C_{2,5,10} \times 1.2$
	C_{100} =	0.46	$C_{100} = C_{2,5,10} \times 1.25$
Time of Concentration (min)	T_C =	15.00	

Note: Runoff coefficient modification as per MTO Drainage Management Manual methodology

Q = 2.78 Ca x C x I x A

Q - Peak flow or runoff rate (L/s)
Ca - Antecedent precipitation factor (for storm events greater than the 5-year storm)
A - Catchment Area (ha)
I - Rainfall intensity (mm/hr)
C - Runoff coefficient

Collingwood ON	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
A =	20.3	27.0	31.5	37.1	41.3	45.4
B =	-0.699	-0.699	-0.699	-0.699	-0.699	-0.699
Rainfall Intensity (mm/hr) =	53.50	71.15	83.01	97.77	108.84	119.65
Peak Runoff (L/s) =	74.3	98.8	115.3	149.3	181.4	207.7
Peak Runoff (m3/s) =	**0.07**	**0.10**	**0.12**	**0.15**	**0.18**	**0.21**
Peak Runoff per Area (L/s/ha) =	55.0	73.2	85.4	110.6	134.3	153.8

User Input Cells

Project : Grey Road 19 EA
Project No. : 300052076
Location : Grey County
Created By : RW
Checked By : ACH
Date Created : 20-Jun-2022
Updated : 21-Jun-2022

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RATIONAL METHOD PEAK FLOW ESTIMATION

CATCHMENT : GR19 3 Proposed

Rational Method Parameters			
Area (ha)	A =	1.18	
Runoff Coefficient	$C_{2,5,10}$ =	0.47	Runoff C Modification
	C_{25} =	0.52	$C_{25} = C_{2,5,10} \times 1.1$
	C_{50} =	0.56	$C_{50} = C_{2,5,10} \times 1.2$
	C_{100} =	0.59	$C_{100} = C_{2,5,10} \times 1.25$
Time of Concentration (min)	T_C =	15.00	

Note: Runoff coefficient modification as per MTO Drainage Management Manual methodology

Q = 2.78 Ca x C x I x A
Q - Peak flow or runoff rate (L/s)
Ca - Antecedent precipitation factor (for storm events greater than the 5-year storm)
A - Catchment Area (ha)
I - Rainfall intensity (mm/hr)
C - Runoff coefficient

	Collingwood ON					
	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
	A = 20.3	A = 27.0	A = 31.5	A = 37.1	A = 41.3	A = 45.4
	B = -0.699	B = -0.699	B = -0.699	B = -0.699	B = -0.699	B = -0.699
Rainfall Intensity (mm/hr) =	53.50	71.15	83.01	97.77	108.84	119.65
Peak Runoff (L/s) =	82.5	109.7	128.0	165.8	201.4	230.6
Peak Runoff (m3/s) =	**0.08**	**0.11**	**0.13**	**0.17**	**0.20**	**0.23**
Peak Runoff per Area (L/s/ha) =	69.9	93.0	108.5	140.5	170.7	195.4

User Input Cells

Project :	Grey Road 19 EA
Project No. :	300052076
Location :	Grey County
Created By :	RW
Checked By :	ACH
Date Created :	20-Jun-2022
Updated :	21-Jun-2022

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RATIONAL METHOD PEAK FLOW ESTIMATION

CATCHMENT : **SC 1 Existing**

Rational Method Parameters			
Area (ha)	A =	**1.33**	
Runoff Coefficient	$C_{2,5,10}$ =	**0.43**	Runoff C Modification
	C_{25} =	**0.47**	$C_{25} = C_{2,5,10} \times 1.1$
	C_{50} =	**0.52**	$C_{50} = C_{2,5,10} \times 1.2$
	C_{100} =	**0.54**	$C_{100} = C_{2,5,10} \times 1.25$
Time of Concentration (min)	T_C =	**15.00**	

Note: Runoff coefficient modification as per MTO Drainage Management Manual methodology

Q = 2.78 Ca x C x I x A

Q - Peak flow or runoff rate (L/s)
Ca - Antecedent precipitation factor (for storm events greater than the 5-year storm)
A - Catchment Area (ha)
I - Rainfall intensity (mm/hr)
C - Runoff coefficient

	Collingwood ON					
	2 Year	**5 Year**	**10 Year**	**25 Year**	**50 Year**	**100 Year**
	A = 20.3	**A = 27.0**	**A = 31.5**	**A = 37.1**	**A = 41.3**	**A = 45.4**
	B = -0.699	**B = -0.699**	**B = -0.699**	**B = -0.699**	**B = -0.699**	**B = -0.699**
Rainfall Intensity (mm/hr) =	53.50	71.15	83.01	97.77	108.84	119.65
Peak Runoff (L/s) =	85.1	113.1	132.0	171.0	207.7	237.8
Peak Runoff (m3/s) =	**0.09**	**0.11**	**0.13**	**0.17**	**0.21**	**0.24**
Peak Runoff per Area (L/s/ha) =	64.0	85.1	99.2	128.6	156.1	178.8

User Input Cells

Project : Grey Road 19 EA
Project No. : 300052076
Location : Grey County
Created By : RW
Checked By : ACH
Date Created : 20-Jun-2022
Updated : 21-Jun-2022

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RATIONAL METHOD PEAK FLOW ESTIMATION

CATCHMENT : **SC 1 Proposed**

Rational Method Parameters			
Area (ha)	A =	**1.13**	
Runoff Coefficient	$C_{2,5,10}$ =	**0.57**	Runoff C Modification
	C_{25} =	**0.63**	$C_{25} = C_{2,5,10} \times 1.1$
	C_{50} =	**0.68**	$C_{50} = C_{2,5,10} \times 1.2$
	C_{100} =	**0.71**	$C_{100} = C_{2,5,10} \times 1.25$
Time of Concentration (min)	T_C =	**15.00**	

Note: Runoff coefficient modification as per MTO Drainage Management Manual methodology

Q = 2.78 Ca x C x I x A
Q - Peak flow or runoff rate (L/s)
Ca - Antecedent precipitation factor (for storm events greater than the 5-year storm)
A - Catchment Area (ha)
I - Rainfall intensity (mm/hr)
C - Runoff coefficient

	Collingwood ON					
	2 Year	**5 Year**	**10 Year**	**25 Year**	**50 Year**	**100 Year**
	A = 20.3	**A = 27.0**	**A = 31.5**	**A = 37.1**	**A = 41.3**	**A = 45.4**
	B = -0.699	**B = -0.699**	**B = -0.699**	**B = -0.699**	**B = -0.699**	**B = -0.699**
Rainfall Intensity (mm/hr) =	53.50	71.15	83.01	97.77	108.84	119.65
Peak Runoff (L/s) =	95.8	127.4	148.6	192.6	233.9	267.8
Peak Runoff (m3/s) =	**0.10**	**0.13**	**0.15**	**0.19**	**0.23**	**0.27**
Peak Runoff per Area (L/s/ha) =	84.8	112.8	131.5	170.4	207.0	237.0

User Input Cells

Project :	Grey Road 19 EA
Project No. :	300052076
Location :	Grey County
Created By :	RW
Checked By :	ACH
Date Created :	20-Jun-2022
Updated :	21-Jun-2022

RATIONAL METHOD PEAK FLOW ESTIMATION

CATCHMENT : **SC 1 Existing**

Rational Method Parameters			
Area (ha)	A =	**3.85**	
Runoff Coefficient	$C_{2,5,10}$ =	**0.43**	Runoff C Modification
	C_{25} =	**0.47**	$C_{25} = C_{2,5,10} \times 1.1$
	C_{50} =	**0.52**	$C_{50} = C_{2,5,10} \times 1.2$
	C_{100} =	**0.54**	$C_{100} = C_{2,5,10} \times 1.25$
Time of Concentration (min)	T_C =	**15.00**	

Note: Runoff coefficient modification as per MTO Drainage Management Manual methodology

Q = 2.78 Ca x C x I x A

Q - Peak flow or runoff rate (L/s)
Ca - Antecedent precipitation factor (for storm events greater than the 5-year storm)
A - Catchment Area (ha)
I - Rainfall intensity (mm/hr)
C - Runoff coefficient

	Collingwood ON					
	2 Year	**5 Year**	**10 Year**	**25 Year**	**50 Year**	**100 Year**
	A = 20.3	**A = 27.0**	**A = 31.5**	**A = 37.1**	**A = 41.3**	**A = 45.4**
	B = -0.699	**B = -0.699**	**B = -0.699**	**B = -0.699**	**B = -0.699**	**B = -0.699**
Rainfall Intensity (mm/hr) =	53.50	71.15	83.01	97.77	108.84	119.65
Peak Runoff (L/s) =	246.2	327.5	382.1	495.0	601.1	688.3
Peak Runoff (m3/s) =	**0.25**	**0.33**	**0.38**	**0.49**	**0.60**	**0.69**
Peak Runoff per Area (L/s/ha) =	64.0	85.1	99.2	128.6	156.1	178.8

User Input Cells

Project :	Grey Road 19 EA
Project No. :	300052076
Location :	Grey County
Created By :	RW
Checked By :	ACH
Date Created :	20-Jun-2022
Updated :	21-Jun-2022

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RATIONAL METHOD PEAK FLOW ESTIMATION

CATCHMENT : **SC 1 Proposed**

Rational Method Parameters			
Area (ha)	A =	**4.09**	
Runoff Coefficient	$C_{2, 5, 10}$ =	**0.37**	Runoff C Modification
	C_{25} =	**0.41**	$C_{25} = C_{2,5,10} \times 1.1$
	C_{50} =	**0.44**	$C_{50} = C_{2,5,10} \times 1.2$
	C_{100} =	**0.46**	$C_{100} = C_{2,5,10} \times 1.25$
Time of Concentration (min)	T_C =	**15.00**	

Note: Runoff coefficient modification as per MTO Drainage Management Manual methodology

Q = 2.78 Ca x C x I x A

Q - Peak flow or runoff rate (L/s)
Ca - Antecedent precipitation factor (for storm events greater than the 5-year storm)
A - Catchment Area (ha)
I - Rainfall intensity (mm/hr)
C - Runoff coefficient

	Collingwood ON					
	2 Year	**5 Year**	**10 Year**	**25 Year**	**50 Year**	**100 Year**
	A = 20.3	**A = 27.0**	**A = 31.5**	**A = 37.1**	**A = 41.3**	**A = 45.4**
	B = -0.699	**B = -0.699**	**B = -0.699**	**B = -0.699**	**B = -0.699**	**B = -0.699**
Rainfall Intensity (mm/hr) =	53.50	71.15	83.01	97.77	108.84	119.65
Peak Runoff (L/s) =	225.1	299.3	349.2	452.5	549.5	629.2
Peak Runoff (m3/s) =	**0.23**	**0.30**	**0.35**	**0.45**	**0.55**	**0.63**
Peak Runoff per Area (L/s/ha) =	55.0	73.2	85.4	110.6	134.3	153.8

User Input Cells

Project :	Grey Road 19 EA
Project No. :	300052076
Location :	Grey County
Created By :	RW
Checked By :	ACH
Date Created :	20-Jun-2022
Updated :	21-Jun-2022

RATIONAL METHOD PEAK FLOW ESTIMATION

CATCHMENT : **SC EXT**

Rational Method Parameters			
Area (ha)	A =	**41.60**	
Runoff Coefficient	$C_{2,5,10}$ =	**0.60**	Runoff C Modification
	C_{25} =	**0.66**	$C_{25} = C_{2,5,10}$ x 1.1
	C_{50} =	**0.72**	$C_{50} = C_{2,5,10}$ x 1.2
	C_{100} =	**0.75**	$C_{100} = C_{2,5,10}$ x 1.25
Time of Concentration (min)	T_C =	**41.00**	

Note: Runoff coefficient modification as per MTO Drainage Management Manual methodology

Q = 2.78 Ca x C x I x A

Q - Peak flow or runoff rate (L/s)
Ca - Antecedent precipitation factor (for storm events greater than the 5-year storm)
A - Catchment Area (ha)
I - Rainfall intensity (mm/hr)
C - Runoff coefficient

Collingwood ON	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
A =	20.3	27.0	31.5	37.1	41.3	45.4
B =	-0.699	-0.699	-0.699	-0.699	-0.699	-0.699
Rainfall Intensity (mm/hr) =	26.49	35.23	41.11	48.41	53.89	59.24
Peak Runoff (L/s) =	1838.1	2444.8	2852.3	3695.3	4487.6	5138.6
Peak Runoff (m3/s) =	**1.84**	**2.44**	**2.85**	**3.70**	**4.49**	**5.14**
Peak Runoff per Area (L/s/ha) =	44.2	58.8	68.6	88.8	107.9	123.5

User Input Cells

Modified Rational Method
Grey Road 19 Drainage Study

As per Hydrology Handbook, Second Edition, American Society of Civil Engineers, 1996

	Area (ha)	Time of Concentration (min)	Time Increments (min)
Q= 0.00278CIA	24.8	15	5

Calculate

Storm (yrs)	Coeff A	Coeff B	Coeff C	Outflow (m^3/s)	Runoff Coefficient
2	355.16	0	0.699	1.59	0.48
5	472.4	0	0.699	2.12	0.48
10	551.11	0	0.699	2.47	0.48
25	649.1	0	0.699	3.23	0.52
50	722.55	0	0.699	3.88	0.58
100	794.3	0	0.699	4.49	0.6

i=a/(b+Td)^c

Storm	Storage	Time	Storage + 25% FS
	m^3	min	m^3
2	217.80	10	272
5	284.35	10	355
10	334.15	10	418
25	367.57	10	459
50	554.15	10	693
100	571.96	10	715

Pre-Development Runoff Rate

	2	5	10	25	50	100
C	0.46	0.46	0.46	0.51	0.55	0.58
I	50.26	66.85	77.99	91.86	102.26	112.4
A	24.8	24.8	24.8	24.8	24.8	24.8
Q	1.593	2.118	2.471	3.227	3.875	4.491

Time	2 Year Intensity mm/hr	2 Year Inflow m^3/s	2 Year Outflow m^3/s	2 Year Storage m^3		5 Year Intensity mm/hr	5 Year Inflow m^3/s	5 Year Outflow m^3/s	5 Year Storage m^3		10 Year Intensity mm/hr	10 Year Inflow m^3/s	10 Year Outflow m^3/s	10 Year Storage m^3	
5	115.30	3.816	1.590	190.73	27.08	153.37	5.071	2.12	249.39	34.96	178.92	5.916	2.47	292.88	41.27
10	71.03	2.351	1.590	217.80	-55.44	94.47	3.124	2.12	284.35	-74.70	110.21	3.644	2.47	334.15	-86.66
15	53.50	1.770	1.590	162.37	-162.37	71.16	2.353	2.12	209.65	-209.65	83.01	2.745	2.47	247.49	-247.49
20	43.75	1.448	0.000	0.00	0.00	58.20	1.924	0	0.00	0.00	67.89	2.245	0	0.00	0.00
25	37.43	1.239	0.000	0.00	0.00	49.79	1.646	0	0.00	0.00	58.09	1.921	0	0.00	0.00
30	32.95	1.091	0.000	0.00	0.00	43.83	1.449	0	0.00	0.00	51.14	1.691	0	0.00	0.00
35	29.59	0.979	0.000	0.00	0.00	39.36	1.301	0	0.00	0.00	45.91	1.518	0	0.00	0.00
40	26.95	0.892	0.000	0.00	0.00	35.85	1.185	0	0.00	0.00	41.82	1.383	0	0.00	0.00
45	24.82	0.821	0.000	0.00	0.00	33.02	1.092	0	0.00	0.00	38.52	1.274	0	0.00	0.00
50	23.06	0.763	0.000	0.00	0.00	30.67	1.014	0	0.00	0.00	35.78	1.183	0	0.00	0.00
55	21.57	0.714	0.000	0.00	0.00	28.69	0.949	0	0.00	0.00	33.48	1.107	0	0.00	0.00
60	20.30	0.672	0.000	0.00	0.00	27.00	0.893	0	0.00	0.00	31.50	1.042	0	0.00	0.00

Time	25 Year Intensity mm/hr	25 Year Inflow m^3/s	25 Year Outflow m^3/s	25 Year Storage m^3		50 Year Intensity mm/hr	50 Year Inflow m^3/s	50 Year Outflow m^3/s	50 Year Storage m^3		100 Year Intensity mm/hr	100 Year Inflow m^3/s	100 Year Outflow m^3/s	100 Year Storage m^3	
5	210.73	7.549	3.2300	326.67	40.90	234.58	9.373	3.880	483.81	70.33	257.87	10.659	4.490	503.615	68.34
10	129.81	4.650	3.2300	367.57	-122.33	144.50	5.774	3.880	554.15	-132.34	158.85	6.566	4.490	571.956	-162.14
15	97.77	3.502	3.2300	245.24	-245.24	108.84	4.349	3.880	421.81	-421.81	119.65	4.945	4.490	409.817	-409.82
20	79.96	2.864	0.0000	0.00	0.00	89.01	3.557	0.000	0.00	0.00	97.85	4.045	0.000	0.000	0.00
25	68.42	2.451	0.0000	0.00	0.00	76.16	3.043	0.000	0.00	0.00	83.72	3.460	0.000	0.000	0.00
30	60.23	2.158	0.0000	0.00	0.00	67.04	2.679	0.000	0.00	0.00	73.70	3.046	0.000	0.000	0.00
35	54.08	1.937	0.0000	0.00	0.00	60.20	2.405	0.000	0.00	0.00	66.17	2.735	0.000	0.000	0.00
40	49.26	1.765	0.0000	0.00	0.00	54.83	2.191	0.000	0.00	0.00	60.28	2.491	0.000	0.000	0.00
45	45.36	1.625	0.0000	0.00	0.00	50.50	2.018	0.000	0.00	0.00	55.51	2.295	0.000	0.000	0.00
50	42.14	1.510	0.0000	0.00	0.00	46.91	1.874	0.000	0.00	0.00	51.57	2.132	0.000	0.000	0.00
55	39.43	1.412	0.0000	0.00	0.00	43.89	1.754	0.000	0.00	0.00	48.25	1.994	0.000	0.000	0.00
60	37.10	1.329	0.0000	0.00	0.00	41.30	1.650	0.000	0.00	0.00	45.40	1.877	0.000	0.000	0.00

Project :	Grey Road 19 EA
Project No. :	300052076
Location :	Grey County
Created By :	RW
Checked By :	ACH
Date Created :	20-Jun-22

Ditch Volume Calculations

	GR3 Ditch	SC1 Ditch
Length (m)	432	303
Bottom width (m)	1	1
Top width (m)	4.4	5.5
Conveyance Depth (m)	0.56	0.68
Volume (m^3)	653	670

$$trapezoidal\ prism\ volume = 1/2 \times (bw + tw) \times l \times d$$

Total Volume in North Ditch (m^3)	**1323**

Therefore it is feasible to assume that sufficient storage volume will be avaliable in the north ditch cross sections

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Appendix B

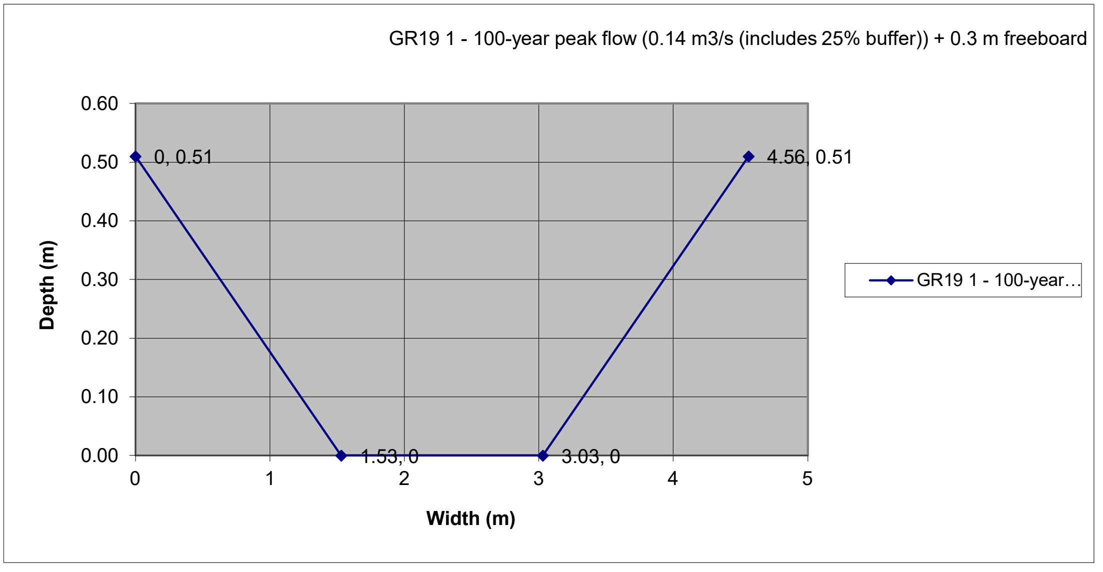
Hydraulics

Project Name:	Grey Road 19 MCEA
Project No.:	300052076
Location:	Grey County
Created By:	RW
Checked By:	ACH
Date Created:	21-Jun-2022
Date Modified:	6/21/2022

BURNSIDE

GR19 1 - 100-year peak flow (0.14 m3/s (includes 25% buffer)) + 0.3 m freeboard

Mannings' Equation			Trapezoidal Channel	
Flow Depth (m) =	0.51		Top Width	
Left Side Slope Ratio (H:V) =	3.0	: 1	4.6	m
Right Side Slope Ratio (H:V) =	3.0	: 1		
Bed Width (m) =	1.50		Hydraulic Radius 'R'	
Area (m2) =	1.55		0.33	m
Wetted Perimeter (m) =	4.73		Friction Slope 'Sf'	
Slope (%) =	0.30		0.0030	m/m
Manning 'n' =	0.050		Velocity	
Channel Capacity, Q (m3/s) =	0.80		0.52	m/s

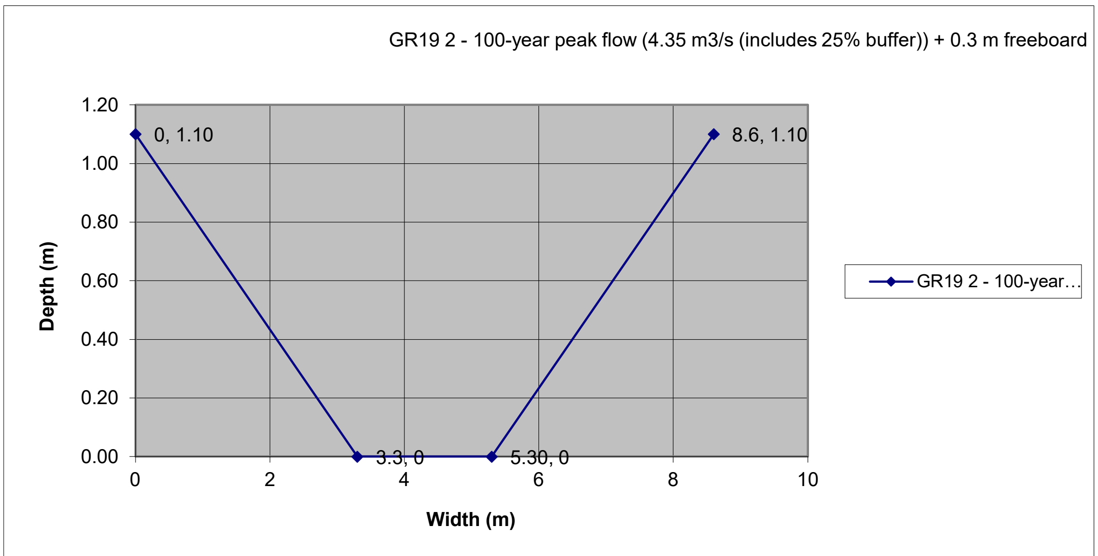


Project Name: Grey Road 19 MCEA
Project No.: 300052076
Location: Grey County
Created By: RW
Checked By: ACH
Date Created: 21-Jun-2022
Date Modified: 6/21/2022

BURNSIDE

GR19 2 - 100-year peak flow (4.35 m3/s (includes 25% buffer)) + 0.3 m freeboard

Mannings' Equation			Trapezoidal Channel	
Flow Depth (m) =	1.10		Top Width	
Left Side Slope Ratio (H:V) =	3.0	: 1	8.6	m
Right Side Slope Ratio (H:V) =	3.0	: 1		
Bed Width (m) =	2.00		Hydraulic Radius 'R'	
Area (m2) =	5.83		0.65	m
Wetted Perimeter (m) =	8.96		Friction Slope 'Sf'	
Slope (%) =	1.00		0.0100	m/m
Manning 'n' =	0.050		Velocity	
Channel Capacity, Q (m3/s) =	8.76		1.50	m/s

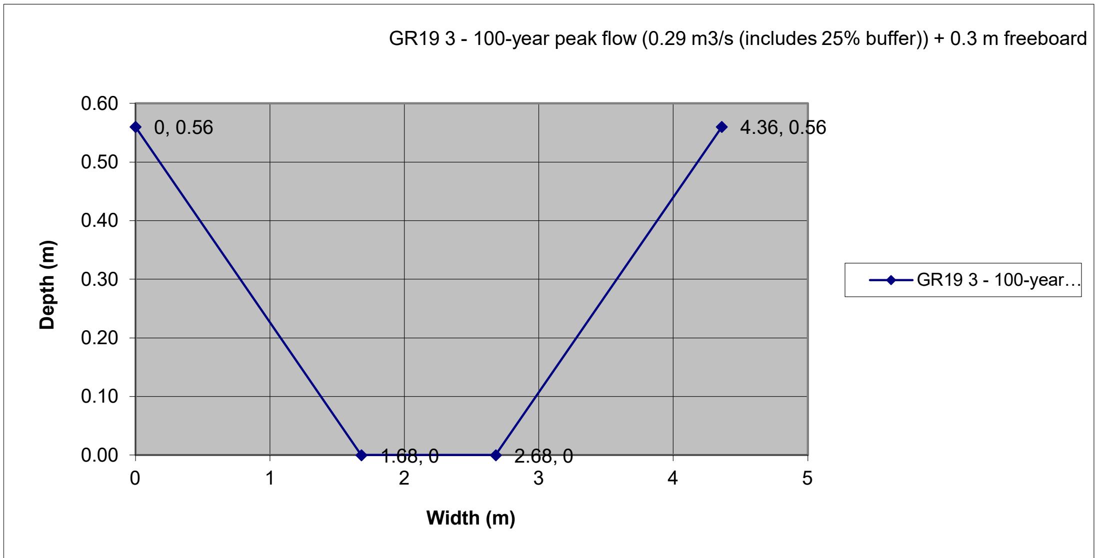


Project Name:	Grey Road 19 MCEA
Project No.:	300052076
Location:	Grey County
Created By:	RW
Checked By:	ACH
Date Created:	21-Jun-2022
Date Modified:	6/21/2022

BURNSIDE

GR19 3 - 100-year peak flow (0.29 m3/s (includes 25% buffer)) + 0.3 m freeboard

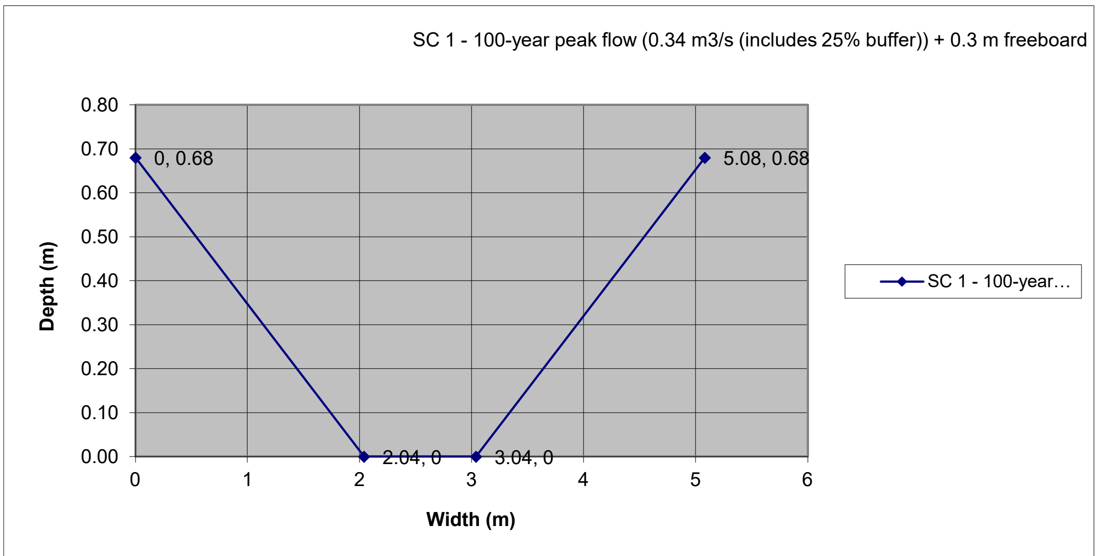
Mannings' Equation			Trapezoidal Channel	
Flow Depth (m) =	0.56		Top Width	
Left Side Slope Ratio (H:V) =	3.0	: 1	4.4	m
Right Side Slope Ratio (H:V) =	3.0	: 1		
Bed Width (m) =	1.00		Hydraulic Radius 'R'	
Area (m2) =	1.50		0.33	m
Wetted Perimeter (m) =	4.54		Friction Slope 'Sf'	
Slope (%) =	1.00		0.0100	m/m
Manning 'n' =	0.050		Velocity	
Channel Capacity, Q (m3/s) =	1.43		0.96	m/s



Project Name:	Grey Road 19 MCEA
Project No.:	300052076
Location:	Grey County
Created By:	RW
Checked By:	ACH
Date Created:	21-Jun-2022
Date Modified:	6/21/2022

SC 1 - 100-year peak flow (0.34 m3/s (includes 25% buffer)) + 0.3 m freeboard

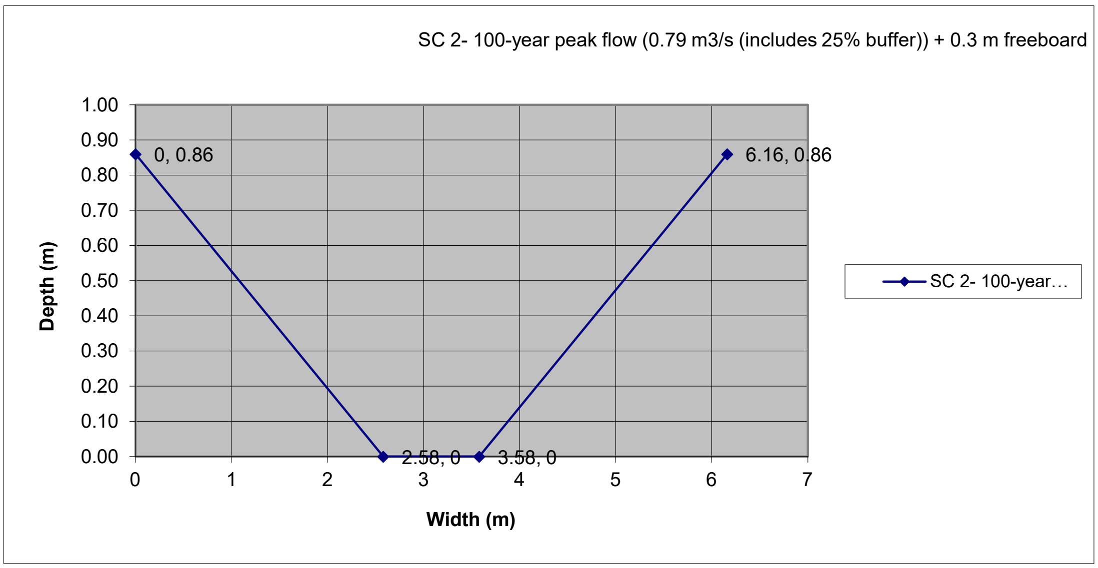
Mannings' Equation			Trapezoidal Channel	
Flow Depth (m) =	0.68		Top Width	
Left Side Slope Ratio (H:V) =	3.0	: 1	5.1	m
Right Side Slope Ratio (H:V) =	3.0	: 1		
Bed Width (m) =	1.00		Hydraulic Radius 'R'	
Area (m2) =	2.07		0.39	m
Wetted Perimeter (m) =	5.30		Friction Slope 'Sf'	
Slope (%) =	0.30		0.0030	m/m
Manning 'n' =	0.050		Velocity	
Channel Capacity, Q (m3/s) =	1.21		0.58	m/s



Project Name:	Grey Road 19 MCEA
Project No.:	300052076
Location:	Grey County
Created By:	RW
Checked By:	ACH
Date Created:	21-Jun-2022
Date Modified:	6/21/2022

SC 2- 100-year peak flow (0.79 m3/s (includes 25% buffer)) + 0.3 m freeboard

Mannings' Equation			Trapezoidal Channel	
Flow Depth (m) =	0.86		Top Width	
Left Side Slope Ratio (H:V) =	3.0	: 1	6.2	m
Right Side Slope Ratio (H:V) =	3.0	: 1		
Bed Width (m) =	1.00		Hydraulic Radius 'R'	
Area (m2) =	3.08		0.48	m
Wetted Perimeter (m) =	6.44		Friction Slope 'Sf'	
Slope (%) =	0.30		0.0030	m/m
Manning 'n' =	0.050		Velocity	
Channel Capacity, Q (m3/s) =	2.06		0.67	m/s



HY-8 Culvert Analysis Report

Site Data - GR19

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 225.16 m

Outlet Station: 28.00 m

Outlet Elevation: 224.41 m

Number of Barrels: 1

Culvert Data Summary - GR19

Barrel Shape: Circular

Barrel Diameter: 900.00 mm

Barrel Material: Corrugated Steel

Embedment: 0.00 mm

Barrel Manning's n: 0.0240

Culvert Type: Straight

Inlet Configuration: Thin Edge Projecting

Inlet Depression: None

Table 1 - Culvert Summary Table: GR19

Discharge Names	Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
2 year	1.33	1.33	226.50	1.339	0.978	5-S2n	0.624	0.683	0.624	0.364	2.823	1.540
5 year	1.76	1.48	226.69	1.521	1.225	5-S2n	0.683	0.719	0.683	0.488	2.867	1.265
10 year	2.05	1.51	226.72	1.557	1.273	5-S2n	0.694	0.725	0.694	0.530	2.872	1.192
25 year	2.66	1.56	226.78	1.619	1.355	5-S2n	0.715	0.735	0.715	0.573	2.878	1.222
50 year	3.24	1.60	226.83	1.669	1.420	5-S2n	0.732	0.743	0.732	0.599	2.879	1.309
100 year	3.70	1.62	226.87	1.705	1.467	5-S2n	0.746	0.748	0.746	0.619	2.878	1.370

****

Straight Culvert

Inlet Elevation (invert): 225.16 m, Outlet Elevation (invert): 224.41 m

Culvert Length: 28.01 m, Culvert Slope: 0.0268

****

Water Surface Profile Plot for Culvert: GR19

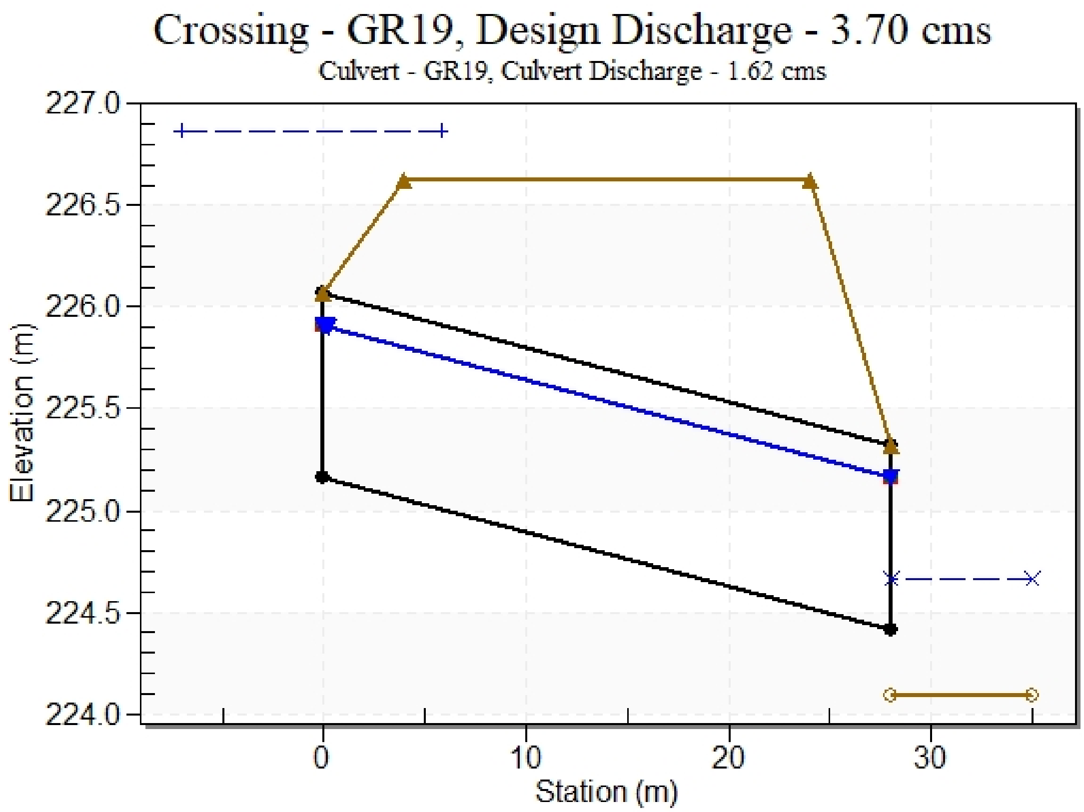


Table 2 - Downstream Channel Rating Curve (Crossing: GR19)

Flow (cms)	Water Surface Elev (m)	Depth (m)	Velocity (m/s)	Shear (Pa)	Froude Number
1.33	224.39	0.29	2.02	141.00	1.33
1.76	224.44	0.34	2.21	164.25	1.36
2.05	224.47	0.37	2.31	178.44	1.37
2.66	224.59	0.49	1.87	236.31	1.32
3.24	224.64	0.55	1.73	262.21	1.30
3.70	224.66	0.56	1.77	271.32	1.31

Tailwater Channel Data - GR19

Tailwater Channel Option: Irregular Channel

Channel Slope: 0.0490

User Defined Channel Cross-Section:

Coord No.	Station (m)	Elevation (m)	Manning's n
1	0.00	225.00	0.0400
2	7.91	224.95	0.0400
3	8.74	224.12	0.0400
4	10.63	224.09	0.0400
5	11.76	224.61	0.0400
6	13.18	224.65	0.0400
7	17.78	224.50	0.0400
8	22.78	225.00	0.0000

Roadway Data for Crossing: GR19

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 10.00 m

Crest Elevation: 226.62 m

Roadway Surface: Paved

Roadway Top Width: 20.00 m

Crossing Discharge Data

Discharge Selection Method: Recurrence

Table 3 - Summary of Culvert Flows at Crossing: GR19

Headwater Elevation (m)	Discharge Names	Total Discharge (cms)	GR19 Discharge (cms)	Roadway Discharge (cms)	Iterations
226.50	2 year	1.33	1.33	0.00	1
226.69	5 year	1.76	1.48	0.27	7
226.72	10 year	2.05	1.51	0.53	5
226.78	25 year	2.66	1.56	1.10	5
226.83	50 year	3.24	1.60	1.64	4
226.87	100 year	3.70	1.62	2.07	3
226.62	Overtopping	1.43	1.43	0.00	Overtopping

Site Data - Silver Creek

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 m

Inlet Elevation: 215.42 m

Outlet Station: 24.50 m

Outlet Elevation: 215.30 m

Number of Barrels: 1

Culvert Data Summary - Silver Creek

Barrel Shape: Circular

Barrel Diameter: 1200.00 mm

Barrel Material: Corrugated Steel

Embedment: 0.00 mm

Barrel Manning's n: 0.0240

Culvert Type: Straight

Inlet Configuration: Thin Edge Projecting

Inlet Depression: None

Table 4 - Culvert Summary Table: Silver Creek

Discharge Names	Total Discharge (cms)	Culvert Discharge (cms)	Headwater Elevation (m)	Inlet Control Depth (m)	Outlet Control Depth (m)	Flow Type	Normal Depth (m)	Critical Depth (m)	Outlet Depth (m)	Tailwater Depth (m)	Outlet Velocity (m/s)	Tailwater Velocity (m/s)
2 year	1.94	1.94	216.79	1.305	1.373	3-M2t	1.200	0.766	0.824	0.578	2.342	1.105
5 year	2.57	2.57	217.19	1.686	1.773	7-M2t	1.200	0.884	0.905	0.659	2.807	1.189
10 year	3.00	3.00	217.55	2.004	2.132	7-M2t	1.200	0.952	0.954	0.708	3.112	1.238
25 year	3.89	3.62	218.14	2.560	2.718	7-M2t	1.200	1.032	1.043	0.797	3.466	1.323
50 year	4.72	3.70	218.23	2.640	2.808	7-M2t	1.200	1.041	1.115	0.869	3.373	1.390
100 year	5.41	3.73	218.29	2.673	2.869	7-M2t	1.200	1.044	1.169	0.923	3.318	1.440

****

Straight Culvert

Inlet Elevation (invert): 215.42 m,   Outlet Elevation (invert): 215.30 m

Culvert Length: 24.50 m,   Culvert Slope: 0.0047

****

Water Surface Profile Plot for Culvert: Silver Creek

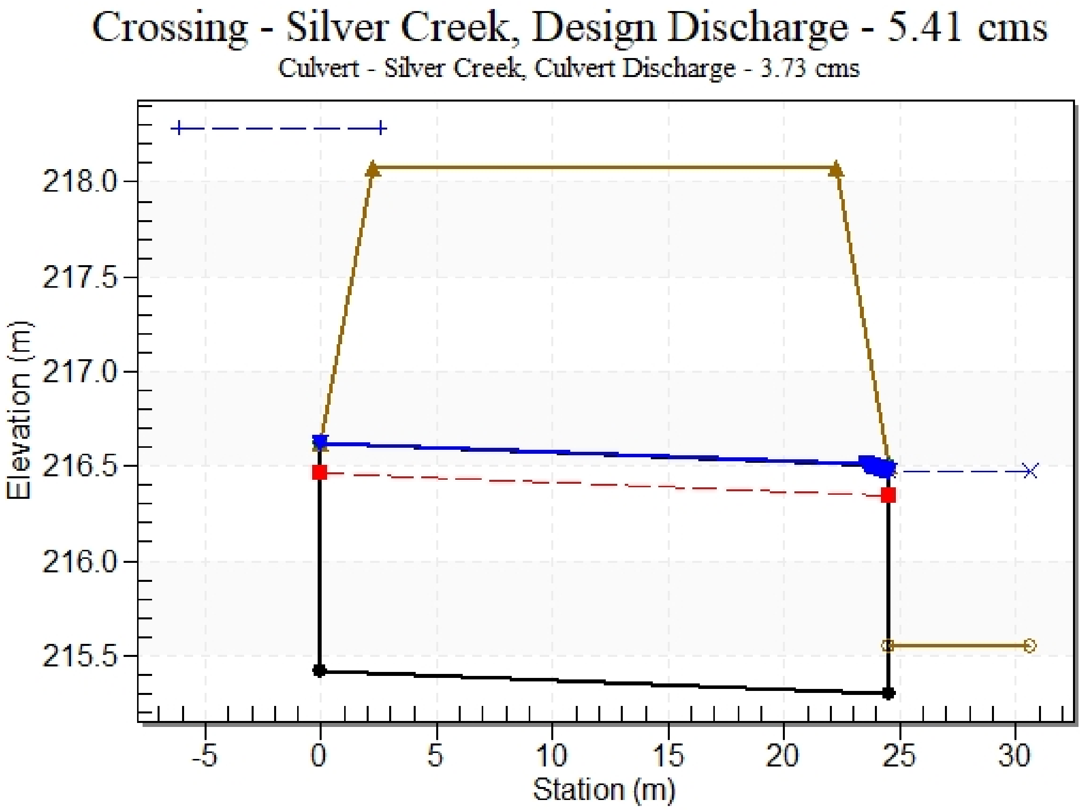


Table 5 - Downstream Channel Rating Curve (Crossing: Silver Creek)

Flow (cms)	Water Surface Elev (m)	Depth (m)	Velocity (m/s)	Shear (Pa)	Froude Number
1.94	216.13	0.58	1.11	44.22	0.58
2.57	216.21	0.66	1.19	50.41	0.59
3.00	216.26	0.71	1.24	54.13	0.60
3.89	216.35	0.80	1.32	60.92	0.61
4.72	216.42	0.87	1.39	66.44	0.61
5.41	216.47	0.92	1.44	70.60	0.62

Tailwater Channel Data - Silver Creek

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 1.30 m

Side Slope (H:V): 3.00 (_:1)

Channel Slope: 0.0078

Channel Manning's n: 0.0400

Channel Invert Elevation: 215.55 m

Roadway Data for Crossing: Silver Creek

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 10.00 m

Crest Elevation: 218.07 m

Roadway Surface: Paved

Roadway Top Width: 20.00 m

Crossing Discharge Data

Discharge Selection Method: Recurrence

Table 6 - Summary of Culvert Flows at Crossing: Silver Creek

Headwater Elevation (m)	Discharge Names	Total Discharge (cms)	Silver Creek Discharge (cms)	Roadway Discharge (cms)	Iterations
216.79	2 year	1.94	1.94	0.00	1
217.19	5 year	2.57	2.57	0.00	1
217.55	10 year	3.00	3.00	0.00	1
218.14	25 year	3.89	3.62	0.27	6
218.23	50 year	4.72	3.70	1.02	5
218.29	100 year	5.41	3.73	1.68	5
218.07	Overtopping	3.55	3.55	0.00	Overtopping

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Appendix C

Background Information

Appendix C
Background Information

GREENLAND®

Water Resources
Municipal Infrastructure
Environmental Management
Monitoring
Information Systems
Research & Development

June 19, 2018 File No.17-G-3591

Town of The Blue Mountains
32 Mill Street, P.O. Box 310
Thornbury, ON N0H 2P0

Attention: **Mr. Reg Russwurm, P.Eng., MBA.**
Director, Engineering and Public Works Department.

RE: Price's Subdivision – Scenic Caves Road Drainage – Drainage Report Addendum (Update)

Dear Sir:

Subject to comments received from the public during the open house for the Price's Subdivision Drainage Improvements at the Town offices on April 12, 2018, Greenland International Consulting Ltd. (Greenland) has completed a further investigation into the drainage routes for the two culverts on Scenic Caves Road. The following updated addendum report includes:

- the results of the field investigation;
- additional adjustment to the proposed condition hydrology model; and,
- hydraulic analysis of the ditch system along the west side of Scenic Caves Road.

The two culverts in question are referred to as SCA and SCB in the drainage report that was recently prepared for Price's Subdivision (Greenland 2018). **Figure 1** shows the location of the two culverts.

Figure 1 Culvert Locations - Scenic Caves Road

SITE VISIT

On April 27, 2018, Nicholas Keast of Greenland visited the Price's subdivision within the Town of the Blue Mountains to investigate the drainage routes along Scenic Caves Road. On that evening, heavy to moderate to light precipitation was occurring along the escarpment, with heavy precipitation at the upper most elevations to light precipitation at the base of the escarpment in the parking lot. The precipitation rate increased over the period of the site visit. The precipitation was sufficient to observe that surface water was flowing in the roadside ditch along Scenic Caves Road, through both culvert SCA and culvert SCB, and flowing along the drainage paths within the woods. Of specific note were the connectivity between culvert SCA and culvert SCB, and the downstream drainage path of SCA.

SCA CULVERT DRAINAGE PATH

The drainage path from culvert SCA was followed from the culvert down the hillside. The drainage path was tracked using a Garmin Vivoactive HR GPS watch. **Figure 2** provides an overview of the drainage path. The condition of the drainage path was noted throughout the site visit in order to provide additional insight into potential drainage solutions. The conditions are summarized in the list below, the locations of the photos are provided in **Figure 3**, and the photos are included in **Attachment 1**.

- Culvert SCA Inlet – No erosion, riprap protected ditch, and earthen berm downstream to pool and direct drainage through Culvert SCA (Photo 1);
- Culvert SCA Ditch Connectivity – Removal of earth fill downstream of Culvert SCA would provide ditch connectivity (Photo 2)
- Culvert SCA Culvert Outlet – Slope failure with eroded riprap and filter fabric collected in the drainage path (Photo 3);
- Culvert SCA Drainage Path – Coarse substrate material is evident below the organic topsoil, however, no test pits or estimates of depths and types made in the field (Photo 3 and Photo 4);
- Culvert SCA Drainage Path – Channel incising occurring along the drainage path producing mobile bed material and enabling nature processes to occur;
- Culvert SCA Drainage Path – Woody debris and bed material build-up at the transition from steep channel slope to mild channel slope indicating the development and/or existence of an alluvial fan (Photo 4); and
- Culvert S A Drainage Path – Channel avulsions evident at the slope transition zone along with woody debris build-up (Photo 5).

The evidence from the existing channel avulsions at the slope transition zone indicates that channelization within the woods would be problematic as any woody debris build-up and the coarse substrate would promote unpredictable channel avulsions. There is evidence of changes in the drainage paths from earlier routes.

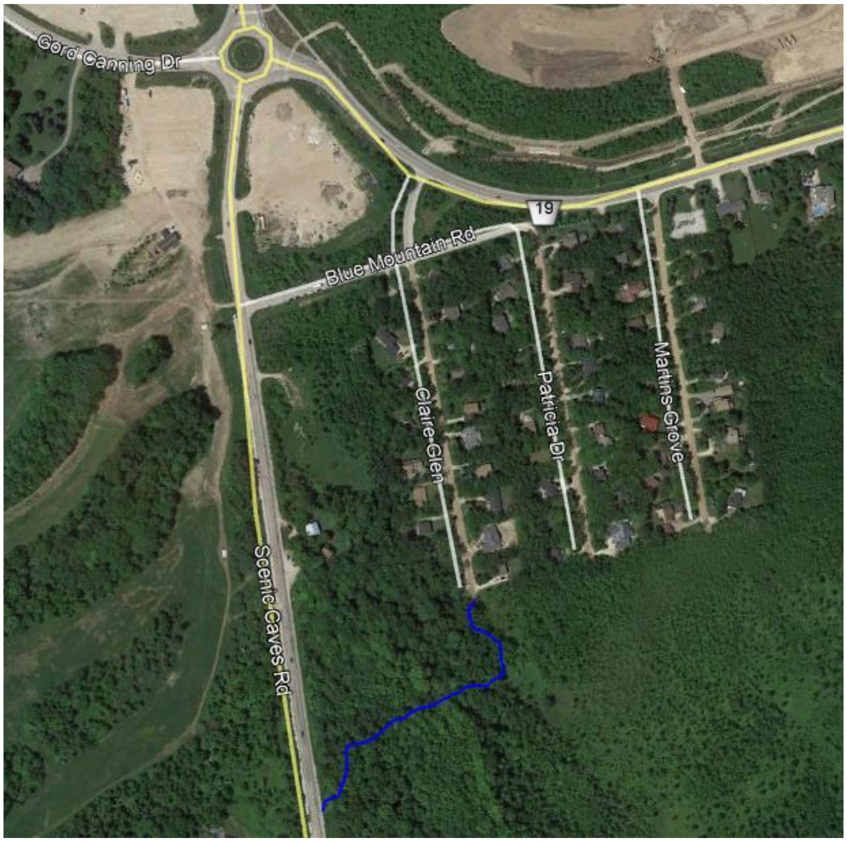


Figure 2 – SC A Drainage Path

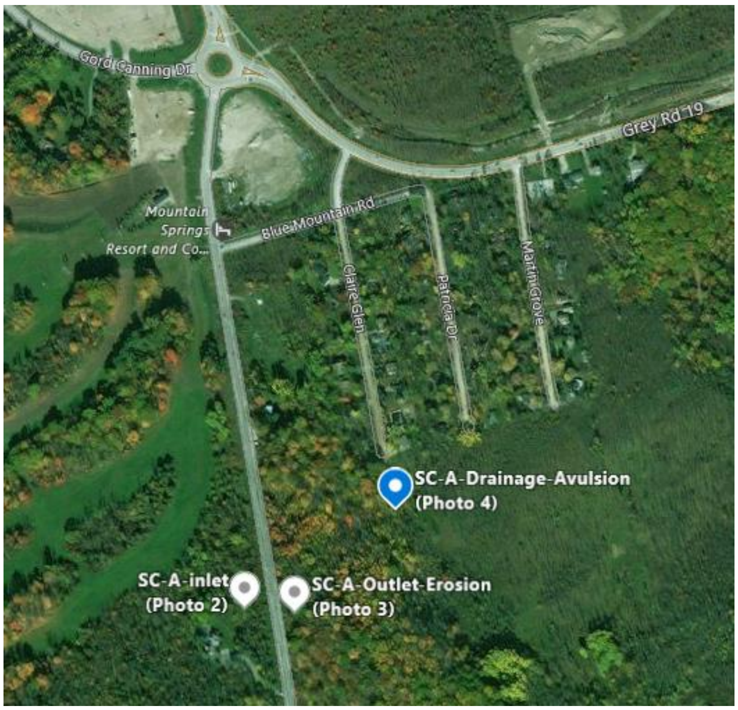


Figure 3 – SC A Photo Locations

SC B CULVERT

The roadside ditch along the west side of Scenic Caves Road at culvert SCB was inspected along with the drainage path. The roadside ditch does not have apparent erosion, is riprap protected, and has a riprap berm downstream to pool and direct drainage through SCB (Photo 6). If culvert SCA and culvert SCB are sealed and the flows directed along the west ditch, this ditch would require regrading to provide connectivity further downstream past culvert SCB. Some of the material could be sourced from the work at culvert SCA. The two berms would be removed and the ditch regraded immediately downstream of each of the culverts.

UPDATED HYDROLOGY

The proposed condition hydrology model that has been previously developed to analyze the drainage conditions for all the area that interacts with the Prices subdivision was updated. The model was modified to redirect flows from the upstream area of culvert SCA to the west ditch of Scenic Caves Road. The model has been previously prepared with the flows from culvert SCB redirected to the same roadside ditch. The updated hydrology now has flows diverted from both culvert crossings to the west ditch along Scenic Caves Road. A very small drainage area south of Area 1031 drains to the south directly to Silver Creek. This flow is directed away from the ditch system along Scenic Caves Road.

The updated model has Area 1031 and Area 1032 now added together and then added to the flows in the ditch from Area 102 which includes some of the ski slopes. These flows are then added to Area 109 and Area 101 to account for all area draining to the triple culverts adjacent the Orchard parking lot near the intersection of Scenic Caves Road with Blue Mountain Road. **Attachment 2** includes the drainage area plan that references these areas. The flows from the drainage area to the two culvert locations that are to be sealed are added together and can be found in ADD HYD 2065. These new flows are added to the flows from Area 102 at ADD HYD 2066. **Figure 4** provides a schematic of the overall hydrology model for the proposed conditions.

The flows at the key locations along the Scenic Caves Road for the proposed drainage strategy are summarized in **Table 1**.

Table 1 Updated Ditch Flow Conditions – Scenic Caves Road

Design Storm	ADD HYD 2065	ADD HYD 2066
	At Culvert SCB	At Blue Mountain Rd
25 mm	0.229	0.501
2 Year	0.492	1.076
5 Year	0.949	2.057
10 Year	1.273	2.759
25 Year	1.799	3.917
50 Year	2.177	4.748
100 Year	2.572	5.621
	cms	cms

The flows that will be conveyed by the road side ditch at the critical reach will be as high as 5.62 cms during the 100 year flow condition. The 4 hr Chicago storm distribution provides the more conservative flows for these more severe return periods that the other storm distribution used in the analysis – 24 hr SCS distribution.

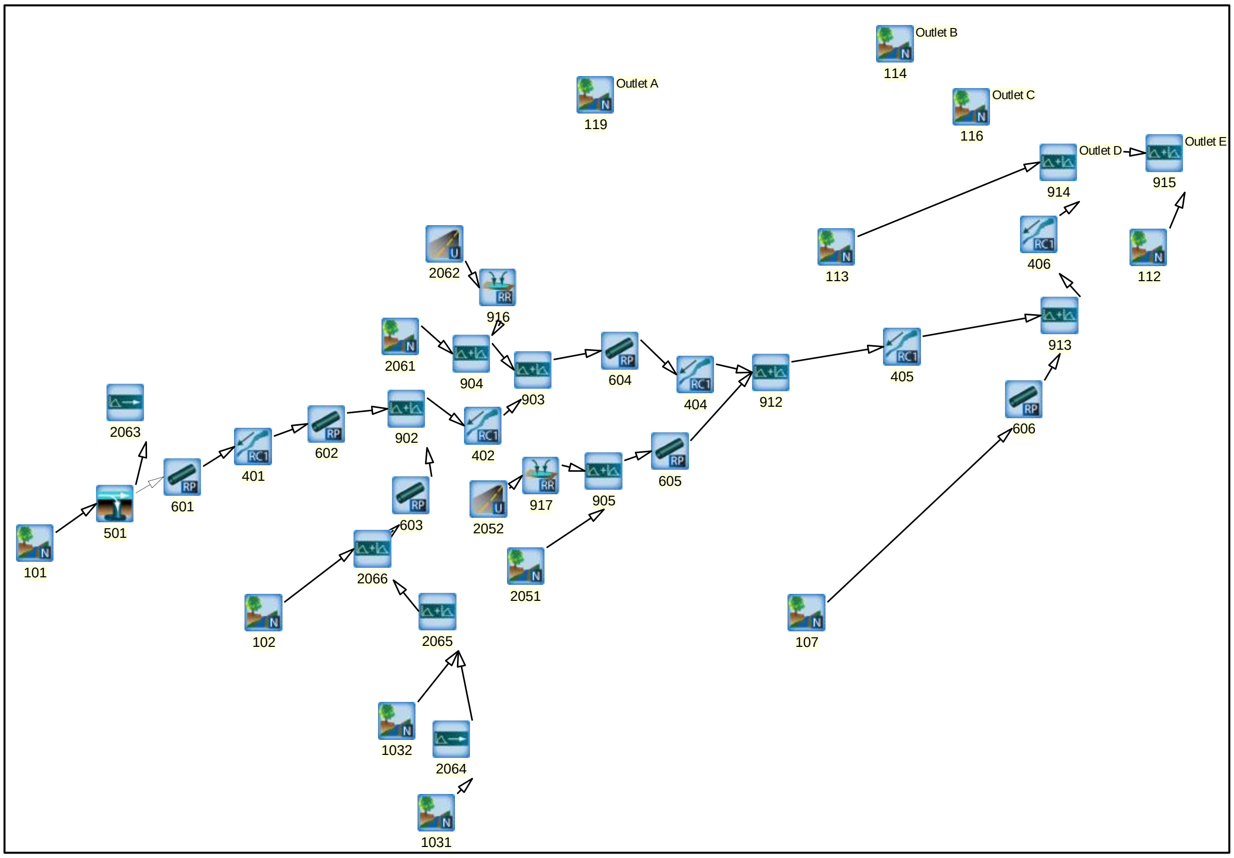


Figure 4 Updated Proposed Condition Model Schematic

DITCH HYDRAULIC ANALYSIS

The hydraulics of the ditch system on the west side of Scenic Caves was evaluated more closely to ensure the additional flows could be conveyed safely to the updated culvert adjacent the intersection at Blue Mountain Road. The ditch system was divided into three reaches. **Figure 5** shows the locations of the three reaches. The steepest portion of this existing ditch system has a longitudinal slope of 9.0%. The flows will increase to 2.57 cms in this reach and produce velocities that can reach 3.58 m/sec.

The existing erosion protection was investigated along all three reaches. The erosion protection is adequate upstream of the culvert SCA. Between culvert SCB and culvert SCA, the existing erosion protection can be augmented by extending up the west slope of the ditch to provide at least 0.6 m vertically from the ditch bottom. The critical reach with the analysis of the ditch system along Scenic Caves Road is the first 130 metres north of culvert

SCB. The ditch should have the existing rip rap stones replaced with rock protection with a D_{50} of 300 mm or greater (OPSS 1004 - Table 8 - 30.5 cm rock protection). **Table 2** provides the maximum flows, depths and velocities to be expected in each of the three reaches.

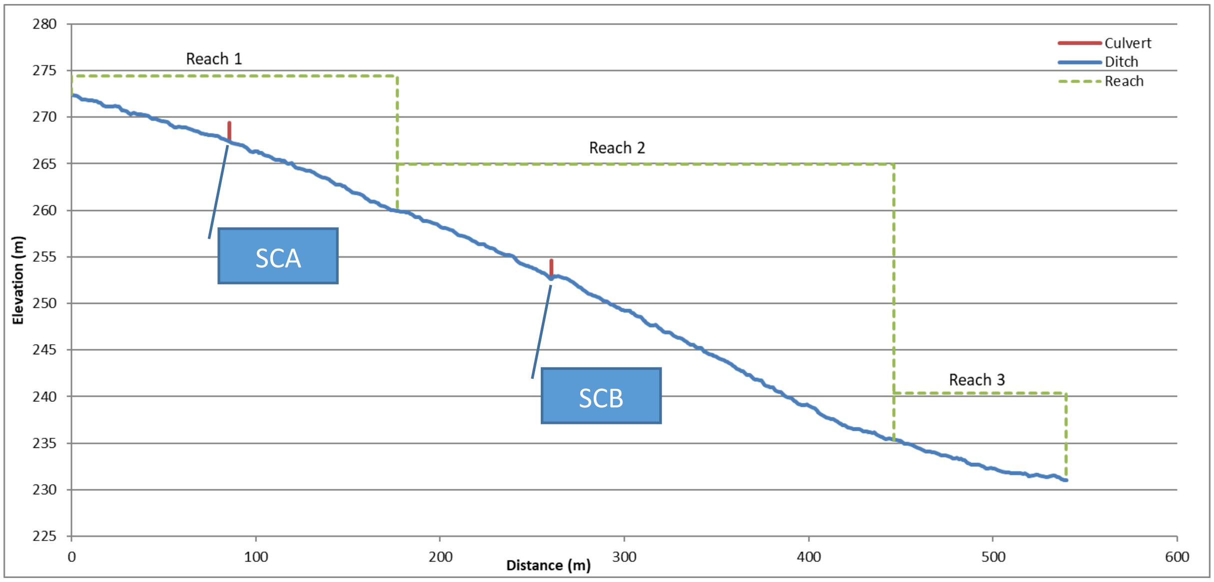


Figure 5 Scenic Caves Road Ditch Profile

The final 130 m of the ditch immediately south of the intersection with Blue Mountain Road will convey the largest flows. The updated flows that will reach 5.6 cms, although the ditch slope reduces to 4.5%, this section of the ditch can experience velocities up to 3.33 m/sec.

Table 2 Updated Ditch Hydraulics – West Side of Scenic Caves Road

	100 Year Flow (cms)	Max Ditch Slope (%)	100 Year Water Depth (m)	Bottom Width (m)	Side Slope (m/m)	100 Year Velocity (m/s)	USACE Stone Dia (mm)	Prop Stone (mm)
Reach 1	1.43	7.0	0.40	0.48	2	2.8	170	150 - 250
Reach 2	2.57	9.0	0.50	0.45	2	3.58	280	300
Reach 3	5.62	4.5	0.70	1.00	2	3.33	240	250

The stone protection that presently exists along this final 130 m of ditch includes 150 to 250 mm diameter riprap stones. This present protection includes a series of steps to slow down the flow velocities along this reach. With the increased flows being proposed with the flatter slopes, the stone protection should be enhanced by adding additional stone along the west slope of the ditch. The bottom width in this reach will be 1.0 m and the maximum depth of flow can be as high as 0.7 m during a 100 year event.

The stone sizing has been determined using nomographs prepared by the US Army Corps Engineers from field tests that were completed on various erosion protection locations through their jurisdiction (see **Attachment 3**).

A review of the existing ditch system reveals that the upper two (2) reaches have roughly a 0.5 m flat bottom and the lower reach has a 1.0 m flat bottom. With the conditions described in **Table 2**, the expected 100 year flow depth of 0.4 m in the upper reach of the ditch will result in 0.9 to 1.0 m of freeboard.

With the expected 100 year flow depth of 0.5 m in the middle reach of the ditch will result in 0.7 to 0.9 m of freeboard. Based on the expected 100 year flow depth of 0.7 m in the lower reach of the ditch will result in 0.6 to 0.7 m of freeboard.

The back slope of the upper reach has scour protection for the 0.4 m depth of flow. The back slope of the lower reach does not have sufficient scour protection. When the scour protection is removed from the first 130 m north of culvert SCB and replaced by the heavier stone, the excess material can be used in other locations in the ditch system. Also, at the locations where there is a small existing step being used for energy dissipation, the protection should be extended up the back slope to the depth stated in **Table 2**.

COSTS

Costs Presented at the PIC

The costs presented during the PIC for Alternative C included the peripheral drainage improvements that would divert flows along Scenic Caves Road to an upgraded culvert north of the intersection with Blue Mountain Road. The costs were summarized as follows:

- Removal of Culvert SCB $ 11,000
- Remove Existing Three Culverts and Replace with Box Culvert $ 62,000
- Install Culvert GW CSPA at Grey Road 19 $ 60,000

The costs presented at the PIC included the road restoration at each location. With engineering and contingencies this cost was presented as **$166,000**.

Updated Costs

The updated plan for Alternative C would include the removal of Culvert SCA and improvements to the stone protection through portions of the ditch system. The north culvert of the triple culverts would remain as part of the updated plan. These additional costs are estimated to be $36,000. The addition of engineering and contingencies would bring this updated drainage option to **$211,250.00.**

The costs for addressing culvert SCA and SCB are based the more conservative option of removal. The updated portion of the OPC is provided in **Table 3**.

Table 3 Summary of Alternative C Costs

External Drainage Improvements				
Remove and Dispose Existing Culverts	3.0	ea.	$ 1,500.00	$ 4,500.00
Supply and Place 900mm x 3000 mm Box Culvert	1.0	l.s	$ 45,000.00	$ 45,000.00
Supply and Install 1830mm x 2500mm CSPA	1.0	l.s	$ 25,000.00	$ 25,000.00
Block / remove Culvert SCA Scenic Caves Road	1.0	l.s	$ 2,500.00	$ 2,500.00
Block / remove Culvert SCB Scenic Caves Road	1.0	l.s	$ 2,500.00	$ 2,500.00
Re-Grade Channel with 1.0m bottom width	130.0	m	$ 50.00	$ 6,500.00
Supply and Install 300mm dia. rock protection stone	260.0	m2	$ 60.00	$ 15,600.00
Re-locate existing rip rap	1.0	l.s	$ 2,500.00	$ 2,500.00
Scenic Caves Road Restoration (3 Locations)	1.0	l.s	$ 30,000.00	$ 30,000.00
Grey Road 19 Restoration	1.0	ea	$ 34,880.00	$ 34,880.00
Sub-Total				**$ 168,980.00**

CLOSING

This document has been prepared to summarize the conditions noted in the field and to provide additional background information to the Town and County for drainage improvements along Scenic Caves Road. The proposed solution of sealing the two culverts on Scenic Caves Road and redirecting the flows will also provide drainage improvements within Price's subdivision.

Yours truly,

GREENLAND INTERNATIONAL CONSULTING LTD.

Don Moss M. Eng., P.Eng.
Senior Engineer

ATTACHMENT 1 - PHOTOS

Photo 1 – SC A Culvert Inlet

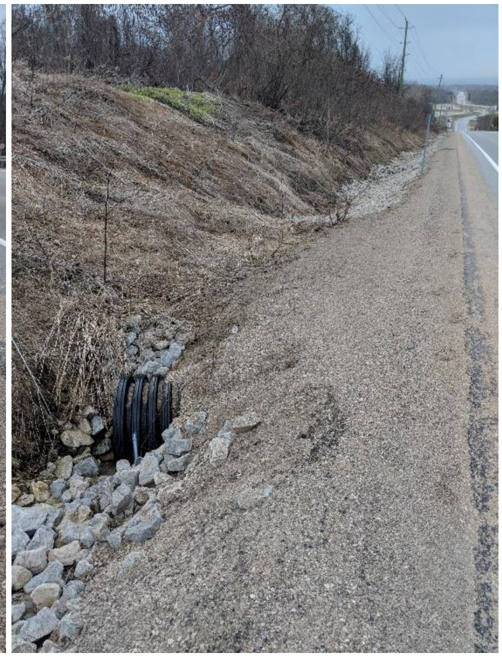


Photo 2 – SC A Culvert Inlet & Roadside Ditch

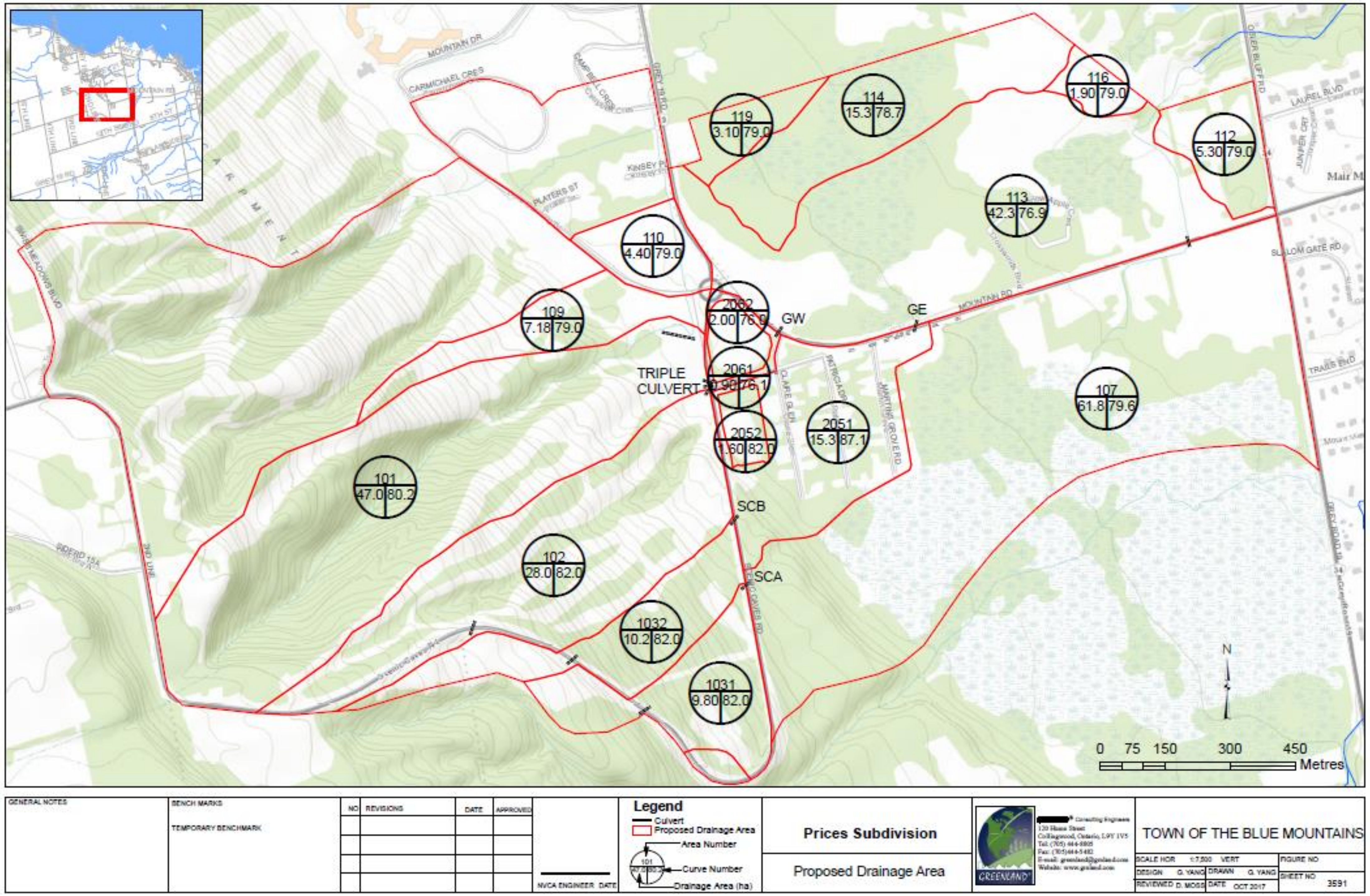
Photo 3 – SC A Culvert Outlet, Slope Erosion, & Coarse Substrate

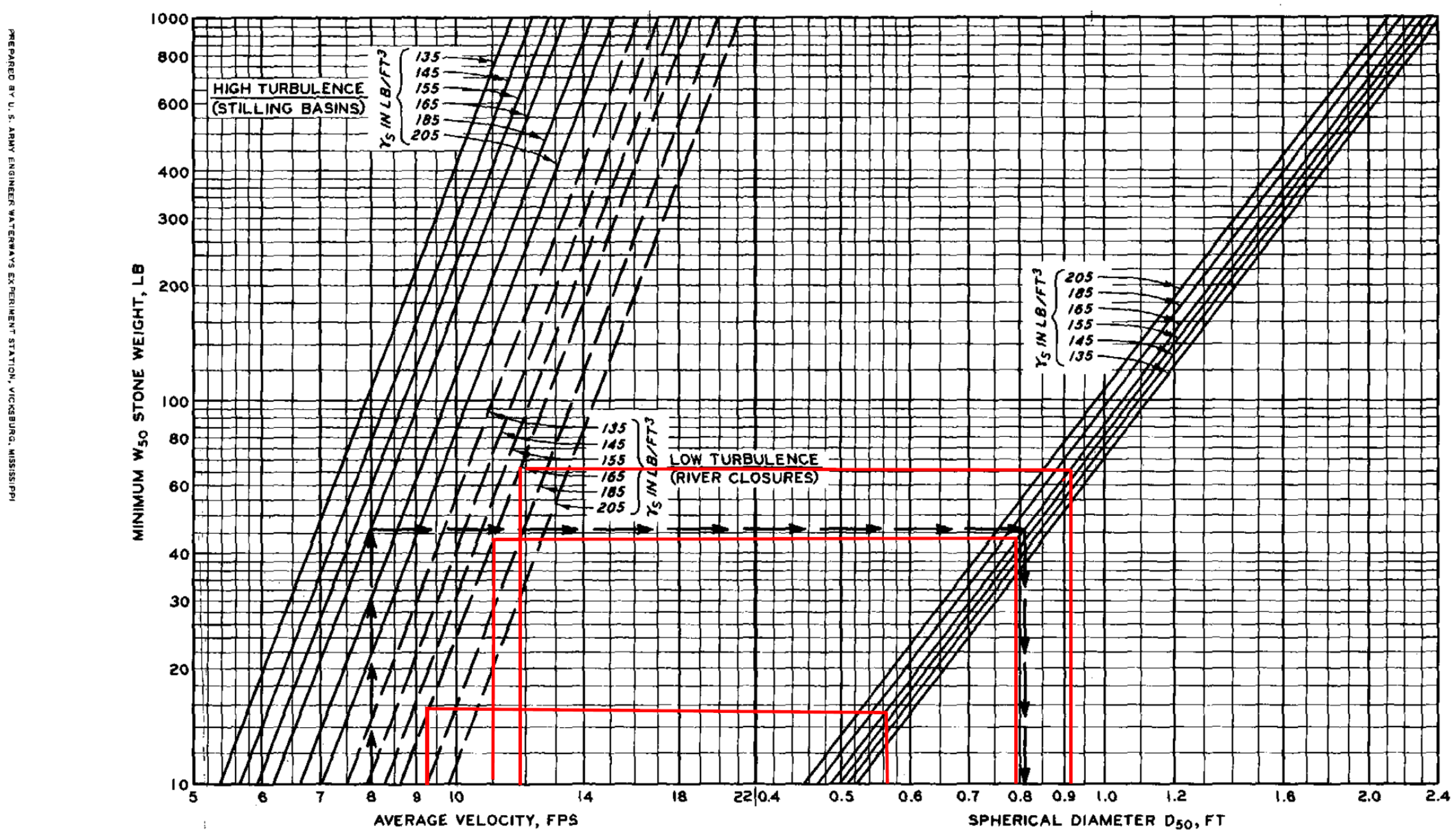
Photo 4 – SC A Drainage Path with Coarse Substrate & Woody Debris Build-up

Photo 5 – SC A Drainage Path Avulsion with Woody Debris & Bed Material Build-up

Photo 6 – SC B Roadside Ditch

ATTACHMENT 2 – DRAINAGE AREA PLAN





BASIC EQUATIONS

$$V = C\left[2g\left(\frac{\gamma_S-\gamma_W}{\gamma_W}\right)\right]^{1/2}(D_{50})^{1/2}$$

$$D_{50} = \left(\frac{6W_{50}}{\pi\gamma_S}\right)^{1/3}$$

WHERE:
- V = VELOCITY, FPS
- γ_S = SPECIFIC STONE WEIGHT, LB/FT³
- γ_W = SPECIFIC WEIGHT OF WATER, 62.5 LB/FT³
- W_{50} = WEIGHT OF STONE. SUBSCRIPT DENOTES PERCENT OF TOTAL WEIGHT OF MATERIAL CONTAINING STONE OF LESS WEIGHT.
- D_{50} = SPHERICAL DIAMETER OF STONE HAVING THE SAME WEIGHT AS W_{50}
- C = ISBASH CONSTANT (0.86 FOR HIGH TURBULENCE LEVEL FLOW AND 1.20 FOR LOW TURBULENCE LEVEL FLOW)
- g = ACCELERATION OF GRAVITY, FT/SEC²

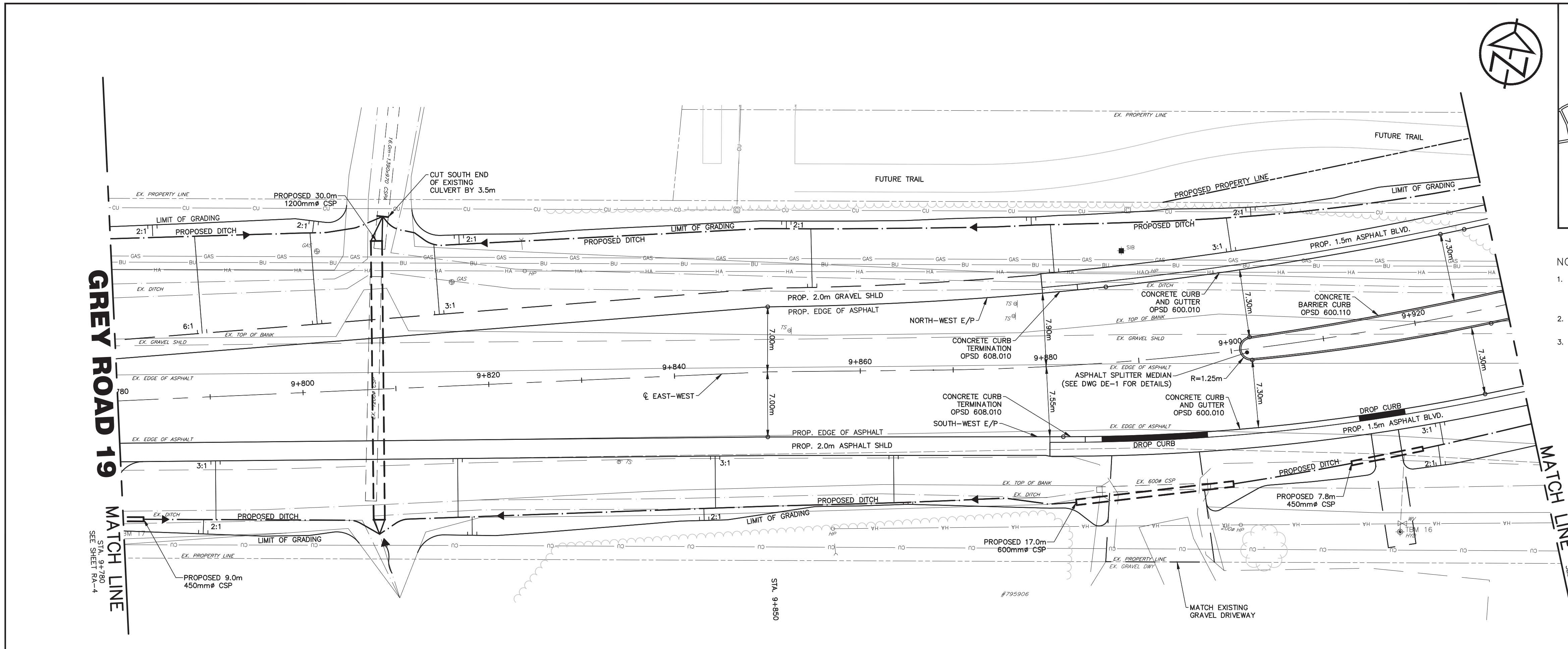
STONE STABILITY

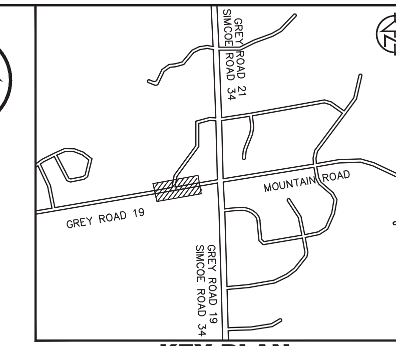
VELOCITY VS STONE DIAMETER

HYDRAULIC DESIGN CHART 712-1

(SHEET 1 OF 2)

REV 8-56, 9-70 WES 6-57

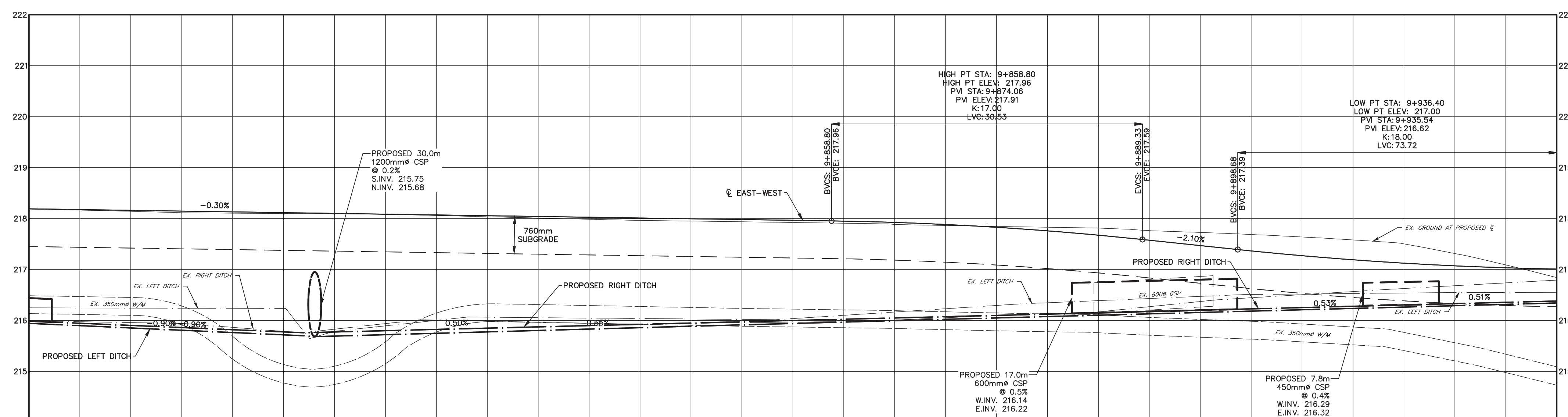




KEY PLAN

NOTES

1. ALL BOULEVARD AREAS BETWEEN THE PROPOSED GRADING LIMITS AND THE EXISTING/PROPOSED PROPERTY LINE SHALL BE GRADED MIN. 2% TOWARDS PROPOSED DITCHES TO ACHIEVE POSITIVE DRAINAGE.
2. ALL DISTURBED AREAS TO BE RESTORED WITH 100mm TOPSOIL, SEED & MULCH.
3. SEE DWG RA-1 FOR ALIGNMENT DETAILS & DIMENSIONS.



PROPOSED C/L ELEV	218.13	218.07	218.01	217.95	217.76	217.37	217.07
EXISTING C/L ELEV	218.11	218.06	217.96	217.91	217.83	217.69	217.31
CHAINAGE	9+800	9+820	9+840	9+860	9+880	9+900	9+920

DISCLAIMER AND COPYRIGHT

CONTRACTOR MUST VERIFY ALL DIMENSIONS AND BE RESPONSIBLE FOR SAME. ANY DISCREPANCIES MUST BE REPORTED TO THE ENGINEER BEFORE COMMENCING WORK. DRAWINGS ARE NOT TO BE SCALED.

BENCHMARKS

TBM16 – ELEVATION 217.986
TOP NUT OF HYDRANT #263, FIRST HYDRANT WEST OF OSLER BLUFF ROAD ON SOUTH SIDE OF GREY ROAD 19.

BM 72U311 – ELEVATION 181.032
CONC. CULVERT UNDER HWY26, OVER SILVER CREEK, 4.2km EAST OF JUNCTION OF HWY26 WITH BLUE MOUNTAIN PARK ROAD, 45.4m SOUTHEAST OF CENTRE LINE OF A SIDE ROAD, TABLET IN WEST FACE OF CULVERT AT SOUTH END, 54cm BELOW TOP OF HEADWALL AND 24cm NORTH OF SOUTH END OF CULVERT.

NOTES

No.	REVISION DESCRIPTION	DATE
1.	60% SUBMISSION	JAN 2020
2.	90% SUBMISSION	MAY 2020

ENGINEER STAMP

GREY ROAD 19/21 & SIMCOE ROAD 34 ROUNDABOUT
COUNTY OF GREY / COUNTY OF SIMCOE

PLAN & PROFILE
GREY ROAD 19
STA. 9+780 TO STA. 9+930

TATHAM ENGINEERING

DESIGN: TP/KS	FILE: 114258	DWG: RA-5
DRAWN: TP/KS	DATE: JAN 2020	
CHECK: MJC	SCALE: H 1:250 V 1:25	

Drawing Name: 114258-RA02.dwg, Plotted: May 15, 2020

R.J. Burnside & Associates Limited 128 Wellington Street West Suite 301 Barrie ON L4N 8J6 CANADA
telephone (705) 797-2047 **fax** (705) 797-2037 **web** www.rjburnside.com

BURNSIDE
[THE DIFFERENCE IS OUR PEOPLE]

Technical Memorandum – Terrestrial Assessment

Date: February 22, 2021 **Project No.:** 300052076.0000

Project Name: Natural Heritage Memo - GR19 EA

Client Name: Grey County

Submitted To: File

Submitted By: Sylvia Radovic, B.E.S.

Reviewed By: Deanna De Forest, B.Sc., E.P. and Kevin Butt, B.Sc. (Env)., Eco. Rest. Cert.

R.J. Burnside & Associates Limited (Burnside) was retained by the Grey County to complete a Schedule C Municipal Class Environmental Assessment (EA) to consider improvements to Grey Road 19 (GR19) between Grey Road 21 (GR21)/ Mountain Road and Grey Road 119 (GR119)/ Gord Canning Drive following a recent Traffic Study, in which Grey County (County) has identified the need to widen GR19 to meet the needs of increased traffic demand.

A component of the EA includes the characterization of the natural environment within the Study Area to evaluate the alternative solutions including do nothing; widen to 4 lanes; widen to 4 lanes with active transportation. The characterization of the natural environment is included herein.

Aquatic habitat is addressed in the Burnside GR19 Environmental Assessment – Aquatic Assessment Tech Memo.

1.0 Study Area

For the purposes of this technical memorandum, the Study Area is defined as the GR19 right-of-way (ROW) plus 10 metres, between the intersections of GR21 / Mountain Road and GR119 / Gord Canning drive, excluding the intersection of GR 19 and Crosswinds Boulevard (refer to Figure 1). The Study Area corridor is 1.3 km long with a mix of residential (rural, single and high density) and light industry as well as areas and wetland, wooded areas, and open pastures. A multi-use gravel trail was observed parallel to the north of the ROW. Narrow drainage ditches were noted parallel to Grey Road 19 within the Study Area and Silver Creek crosses the ROW in the eastern portion of the Study Area. The Study Area is located within the Niagara Escarpment Plan and falls entirely with the Recreation Area Land Use Designation.

2.0 Methodology

A review of existing data was conducted to obtain secondary source information relating to the Study Area. Sources reviewed included:

- Aerial photography.
- Natural heritage GIS data layers from Land Information Ontario ("LIO").
- Ontario Breeding Bird Atlas (OBBA) (Square 17NK52).
- Ontario Reptile and Amphibian Atlas (ORAA) (Square 17NK52).
- Ministry of Natural Resources and Forestry (MNRF) Aquatic Resources Area mapping.
- MNRF Natural Heritage Information Centre (NHIC) online map viewer/database (Square 17NK5527 and 17NK5627).

A Burnside ecologist completed a field assessment within the Study Area of GR19 on October 13, 2020 from the publicly-owned right-of-way (ROW), to characterize vegetation communities according to the Ecological Land Classification (ELC) System for Southern Ontario, First Approximations (Lee et al., 1998).[1] updated (Lee, MNRF, 2008) The field assessment included the assessment of the potential for habitat of Species at Risk (SAR), including breeding bird, bat, amphibian and reptile habitat, and incidental wildlife observations.

3.0 Vegetation Communities

Lands are comprised of riparian vegetation associated with Silver Creek, as well as open aquatic, recreation and residential lands, marsh, pasture and treed vegetation communities. A total of 17 vegetation communities were identified in the Study Area as follows:

- Silver Creek: Mixed Organic Shallow Marsh (MASO3)
  - Drainage Ditches: Graminoid Mineral Shallow Marsh (MASM1) / Forb Mineral Shallow Marsh (MASM2)
  - Drainage Channel - Forb Mineral Shallow Marsh (MASM2)
- Rural Property (CVR_4)
- Single Family Residential (CVR_3)
- Green Lands - Golfing Range (CGL_1)
- Speckled Alder Mineral Deciduous Thicket Swamp (SWTM1-1)
  - Cattail Mineral Shallow Marsh Type (MASM1-1)
- Apple Deciduous Shrub Thicket Type (THDM2-10)
- Fresh - Moist Green Ash - Hardwood Lowland Deciduous Forest Type (FODM7-2)
- White Cedar Mineral Coniferous Swamp (SWCM1-1)
- Fresh Poplar Deciduous Forest (FODM3-1)
- Open Pasture (OAGM4)
  - Mixed Hedgerow (FODM11)

---

[1] Lee, H.T., et al. (1998). Ecological Land Classification for Southern Ontario: First Approximation and Its Application. Ontario Ministry of Natural Resources, Southcentral Science Section, Science Development and Transfer branch. SCSS Field Guide FG-02.

- High Density Residential (CVR_2)
- Transportation and Utilities (CVI)

These communities are described below and illustrated on Figure 1. All of the communities identified are considered to be relatively common in Ontario. Sensitive vegetation communities or provincially significant plant species were not observed within the Study Area during the field assessment.

3.1 Silver Creek: Mixed Organic Shallow Marsh (MASO3)

Photo 1: MASO3 as viewed looking north from multi-use gravel trail north of GR19 (October 13, 2020).

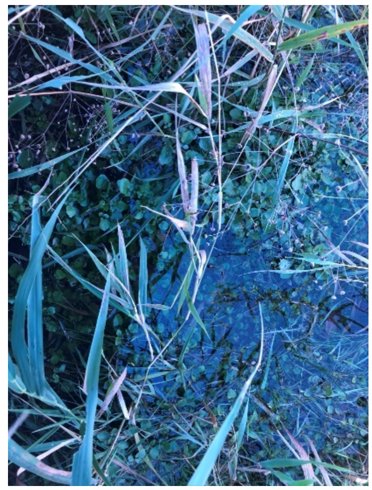


Photo 2 Silver Creek as viewed looking north at culvert outlet within MAS03 (October 13, 2020).

The MASO3 community was dominated by Reed Canary Grass (*Phalaris arundinacea*) with forbs including Peppermint (*Mentha ^{x}piperita*), Spotted Joe-pye Weed (*Eutrochium maculatum*), Common Boneset (*Eupatorium perfoliatum*), Wild Bergamot (*Monarda fistulosa*), Grass-leaved-Goldenrod (*Euthamia graminifolia*) and Watercress (*Nasturtium officinale*). Occasional Red-osier Dogwood (*Cornus sericea*) and Bebb's Willow (*Salix bebbiana*) were noted in the understory. Silver Creek flows from west to east, bending at the culvert inlet to flow from south to north through this community within the Study Area.

3.1.1 Drainage Ditches: Graminoid Mineral Shallow Marsh (MASM1) / Forb Mineral Shallow Marsh (MASM2)

Photo 3: MASM1 community as viewed looking west from ROW on south side of GR19 (October 13, 2020)

Photo 4: MASM2 community as viewed looking west from north side of GR19 ROW (October 13, 2020).

Naturalized drainage ditches adjacent to both the south and north of GR19 were noted through the Study Area. Abundant wetland species were noted associated with these drainage ditches including Narrow-leaved Cattail (*Typha angustifolia*), Bittersweet Nightshade (*Solanum dulcamara*), Reed Canary Grass, and Canada Bluejoint (*Calamagostis canadensis*). Occasional Staghorn Sumac (*Rhus typhina*) and Highbush Cranberry (*Viburnum trilobum*) shrubs were noted.

3.1.2 Drainage Channel - Forb Mineral Shallow Marsh (MASM2)

Photo 5: As viewed looking east from north side of multi-use gravel trail (October 13, 2020).

Photo 6: Red Maple tree planting (October 13, 2020).

Naturalized anthropogenic drainage channel feature north of GR19 was noted associated with Silver Creek adjacent to the multi-use gravel trail (gravel trail) in this area. This channel meanders through various wetland communities from east to west through the Study Area. Abundant wetland species were noted associated with these drainage channels included Heart-leaved willow (*Salix cordata*) and Red-osier Dogwood saplings in the canopy and Peppermint, Spotted Jewelweed (*Impatiens capensis*), Narrow-leaved Cattail, New England Aster (*Symphotrichium novae-angliae*), Tall Goldenrod (*Solidago gigantea*) and Reed Canary Grass in the groundcover. Restoration planting efforts were noted; Red Maple (*Acer rubrum*) wetland tolerant species tree saplings in plastic protective sleeves were observed in this area.

3.2 Rural Property (CVR_4)

Photo 7: CVR_4 community as viewed looking south from north side of GR19 (October 13, 2020).

CVR_4 community has White Spruce *(Picea glauca)* hedgerow with planted trees. Planted trees included Common Apple (*Malus sp.*), Norway Spruce (*Picea abies*), Scots Pine (*Pinus sylvestris*) and White Cedar (*Thuja occidentalis*). Individual White Elm (*Ulmus americana*) trees were also noted. Wetland species within ROW drainage ditches observed as described within MASM1 and MASM2 communities. Common Milkweed (*Asclepias syriaca*) was noted within ROW.

3.3 Single Family Residential (CVR_3)

Photo 8: CVR_3 community as viewed looking west from GR19 ROW (October 13, 2020).

Planted Sugar Maple (*Acer saccharum*), Red Cedar (*Juniperus virginiana*), White Spruce with manicured mown lawn observed. Wetland species within ROW drainage ditches observed as listed within MASM1 and MASM2 communities. Common Milkweed was noted within ROW.

3.4 Green Lands - Golfing Range (CGL_1)

Photo 9: CGL_1 community as viewed from GR19 looking east from ROW (October 13, 2020).

Photo 10: CGL_1 community as viewed from GR19 looking east from ROW (October 13, 2020).

This CGL_1 community is a golfing driving range. The open vegetation area of this community is noted to include mown graminoid species, typical of this community. This CGL_1 is partially bordered at the Study Area limits by a deciduous treed inclusion; the tree canopy is dominated by poplar species including Paper Birch (*Betula papyrifera*) and Trembling Aspen (*Populus tremuloides)*. The sub-canopy consists of some Common Buckthorn (*Rhamnus cathartica*) shrubs. Within the ROW adjacent to this community is a narrow ditch abundant with wetland species and is dominated by Narrow-leaved Cattail. Groundcover of water tolerant species included Sandbar Willow (*Salix exigua)*, New England Aster, Canada Goldenrod, (*Solidago canadensis*) and Reed Canary Grass. Common Milkweed was observed within the ROW.

3.5 Speckled Alder Mineral Deciduous Thicket Swamp (SWTM1-1) with Cattail Mineral Shallow Marsh Type (MASM1-1)

Photo 11: SWTM1-1 community as viewed looking east from gravel trail (October 13, 2020).

Photo 12: MASM1-1 Cattail marsh inclusion as viewed looking northwest as viewed from gravel trail (October 13, 2020).

Speckled Alder (*Alnus incana*) and Sandbar Willow shrubs dominated the canopy layer. The subcanopy layer had an abundance of Bebb's Willow and Red-osier Dogwoods with Peach-Leaf Willow (*Salix amygdaloides*) and some non-native Black Locust (*Robinia pseudoacacia*) observed. The groundlayer had New England Aster, Reed Canary Grass, Grass-leaved Goldenrod, and Spotted Joe-pye Weed. The gravel trail is noted to meander through this community.

Cattails dominate the inclusion in this community. Sparse Green Ash (*Fraxinus pennsylvanica*) and Specked Alder in the canopy. Occasional Chokecherry (*Prunus virginiana*) within shrub layer. Species characteristic of disturbed areas included Coltsfoot (*Tussilago farfara*), Elecampane (*Inula helenium*), and Purple Loose-strife (*Lythrum salicaria*).

3.6 Apple Deciduous Shrub Thicket (THDM2-10)

Photo 13: THDM2-10 community as viewed looking west from paved path to non-motorized travel trail. Poison Ivy (*Toxicodendron radicans)* warning sign noted (October 13, 2020).

Photo 14: Distrubured areas within THDM2-10 community as viewed looking south from gravel trail (October 13, 2020).

This THDM2-10 community was noted to be dominated by Common Apple species in the canopy with occasional Green Ash. Understory included abundant Common Apple and Chokecherry and occasional species typically found in disturbed sites including the invasive Common Buckthorn shrub and non-native Everlasting Pea (*Lathyrus latifolius*) vine. Groundcover was dominated by graminoids species including Timothy (*Phleum pratense*), and Reed Canary Grass; abundant Elecampane, Wild-Bergamot, Canada Goldenrod, Common Dandelion *(Taraxacum officinale*) and New England Aster forb species and Common Apple saplings were noted. Common Milkweed was observed within the ROW.

This community included a treed fencerow community that was dominated by Green Ash and had occasional Paper Birch and was noted to be heavily disturbed; observations of tree stumps, and piles of twigs and mulch were noted. Poison Ivy warning signs noted.

3.7 Fresh - Moist Green Ash - Hardwood Lowland Deciduous Forest Type (FODM7-2)

Photo 15: FODM7-2 as viewed looking east along gravel trail north of GR19 (October 13, 2020).

Photo 16: FODM7-2 as viewed looking east along gravel trail north of GR19 (October 13, 2020).

The FODM7-2 community in the Study Area is dominated by Green Ash in the canopy and subcanopy. Sparse mature Red Oak (*Quercus rubra)* and Sugar Maple trees were noted at the edge of the community fragmented by drainage channel features. Occasional American Basswood (*Tilia americana*), White Elm, Paper Birch and Red Maple were noted in the canopy and subcanopy. Groundcover at forest edge was noted to have been encroached by adjacent communities and species typical of disturbed sites and adjacent gravel trail influence.

3.8 White Cedar Mineral Coniferous Swamp (SWCM1-1)

Photo 17: SWCM1-1 as viewed looking northeast from gravel trail north of GR 19 (October 13, 2020).

The SWCM1-1 was noted as a small community at the edge of the greater Study Area typically almost entirely dominated by White Cedar with groundcover encroached by adjacent communities and species typical of disturbed sites and adjacent gravel trail influence.

3.9 Fresh Poplar Deciduous Forest (FODM3-1)

Photo 18: FODM3-1 as viewed looking east from the south side of GR19 ROW (October 13, 2020).

Photo 19: FODM3-1 as viewed looking west from the south side of GR19 ROW (October 13, 2020).

The FODM3-1 community is dominated by poplar species including Trembling Aspen and Largetooth Aspen (*Populus grandidentata*). Abundant canopy species included Sugar Maple, Red Oak, and Paper Birch. Subcanopy included occasional Green Ash, Ironwood (*Ostrya virginiana*), American Basswood, White Cedar and Sugar Maple. The groundcover was noted to be dominated by saplings of upper canopy trees. Wetland species within ROW drainage ditches observed as described within MASM1 and MASM2 communities.

3.10 Open Pasture (OAGM4) with Naturalized Deciduous Hedge-row (FODM11)

Photo 20: FODM11 bordering OAGM_4 as viewed from ROW looking west along GR19 (October 13, 2020).

Photo 21: Gated entrance accessing OAGM_4 bordered by FODM11, as viewed looking southwest from ROW (October 13, 2020).

The OAGM4 community has a gated access road that leads to a mown pasture with anthropogenic influences including dirt piles. A FODM11 inclusion community borders each side of the OAGM4. The canopy trees are comprised of Common Apple, Green Ash and Trembling Aspen. A fencerow of planted coniferous tree was noted; the canopy consisted of White Spruce and White Pine (*Pinus strobus*). The FODM11 sub-canopy has occasional Sumac shrubs, Riverbank Grape (*Vitis riparia*) and canopy saplings. The groundcover is dominated by Canada Goldenrod, with New England Aster, Reed Canary and Timothy grasses. Wetland species within ROW drainage ditches observed as described within MASM1 and MASM2 communities. Common Milkweed was observed within the ROW.

3.11 High Density Residential (CVR_2)

Photo 22: CVR_2 as viewed from GR19 looking north (October 13, 2020).

Photo 23: CVR_2 as viewed from gravel trail looking east (October 13, 2020).

The CVR_2 community contains remnants of a deciduous forest community with no dominant layers. Individual trees noted included White Elm, Green Ash and Common Apple. Understorey included Common Buckthorn. Understorey noted included Red-osier Dogwood and Common Lilac (*Syringa vulgaris*) shrubs with Riverbank Grape vines. Groundcover was comprised of New England Aster, Queen Ann's Lace (*Daucus carota*), Common Vetch (*Vicia sativa*), Smooth Brome (*Bromus inermis*), Panicled Aster (*Symphyotrichum lanceolatum*), Tall Goldenrod (*Solidago altissima*). Common Milkweed was noted at the community edge.

3.12 Transportation and Utilities (CVI)

Photo 24: Equipment storage and stockpiling area as viewed from GR 19 looking northwest from ROW (October 13, 2020).

Photo 25: Hydro Station as viewed from GR 19 looking west from ROW (October 13, 2020).

These CVI communities have been partially paved and maintained for access (equipment storage, soil stockpiles, hydro power box). The vegetation communities are comprised mainly of bordered treed fencerows. The tree canopy is dominated by small diameter Red Elm (*Ulmus rubra*), White Spruce, and Sugar Maples. Sub-canopy consists of some Common Buckthorn shrubs. Within the ROW adjacent to this community are narrow ditches abundant with wetland species and is dominated by Narrow-leaved Cattail. Groundcover of water tolerant species included New England Aster, Spotted Jewelweed, Canada Goldenrod, Bull Thistle (*Cirsium vulgare*) and Reed Canary Grass. Groundcover species typical of disturbed areas included Wild Teasel (*Dipsacus fullonum*), Common Vetch, Elecampane and Common Milkweed.

4.0 Wildlife and Habitat Observations

Habitat features within the Study Area Residential (CVR) and Transportation and Utility communities (CVI) communities are considered to be suitable to support wildlife species habituated to anthropogenic landuse including Eastern grey squirrel (*Sciurus carolinensis*), Eastern chipmunk (*Tamias minimus*), Raccoon (*Procyon lotor*) and Eastern cottontail (*Sylvilagus floridanus*).

Evidence of wildlife observed in the Study Area included excavated holes in White Cedar trees by Pileated Woodpecker, Sapsucker holes in Paper Birch, Squirrel nests in the FODM3-1 and foraging evidence on Common Milkweed by caterpillars in the ROW. Common Milkweed is the sole food source for Monarch caterpillars.

Photo 26: Abandoned bird nest in tree snag within FODM3-1 community (October 13, 2020).

Photo 27: Sapsucker holes in Paper Birch within FODM3-1 community (October 13, 2020).

The majority of these species are considered widespread and common in Ontario (i.e., provincial ranking of S5), with the exception of Monarch. Monarch is listed as a Special Concern species provincially under the Endangered Species Act (ESA).

4.1 Species at Risk (SAR)

The Species at Risk in Ontario (SARO) List is Ontario Regulation 230/08 issued under the *Endangered Species Act, 2007* (ESA 2007). The ESA 2007 provides both species protection (Section 9) and habitat protection (Section 10) to species listed as "Endangered" or "Threatened" on the SARO List. If an activity or project will result in adverse effects to Endangered or Threatened species and/or their habitat, additional action would need to be taken by a proponent to remain in compliance with the ESA 2007. Species listed as "Special Concern" are not afforded legal protection under the ESA, however, they may receive protection by some agencies, such as provincial and national parks, or other acts, such as the Ontario Fish and Wildlife Conservation Act, and the Migratory Birds Convention Act (MBCA), which prohibits the killing, capturing, injuring, harassment and trapping of specially protected species.

4.1.1 Birds

A review of the OBBA (17NK52) indicated the potential for the following provincial SAR bird species in the general vicinity of the Study Area:

- Bank Swallow (*Riparia riparia*) – Threatened
- Barn Swallow (*Hirundo rustica*) – Threatened
- Bobolink (*Dolichonyx oryzivorus*) – Threatened
- Eastern Meadowlark (*Sturnella magna)* – Threatened
- Eastern Wood-pewee (*Contopus virens*) – Special Concern
- Golden-winged Warbler (*Vermivora chrysoptera*) – Special Concern
- Louisiana Waterthrush (*Parkesia motacilla*) – Threatened

- Wood Thrush (*Hylocichla mustelina*) – Special Concern

NHIC database squares 17NK5527 and 17NK5627indicated the potential for Bobolink and Wood Thrush provincial SAR bird species in the general vicinity of the Study Area.

Potential for SAR and SAR habitat in the Study Area is evaluated in the SAR Screening Table attached.

FODM3-1 forest in the Study Area may represent potential habitat for Eastern Wood-pewee and Wood Thrush, however suitable habitat in the Study Area is considered marginal in the absence of preferred intermediate to mature forests. Although a thicker understory is present for Wood Thrush, only sparse preferred Sugar Maple nest building saplings were noted and no preferred American Beech nest building saplings were noted in this forest community, representing marginal habitat.

The Study Area represents suitable habitat for Golden-winged Warblers with forest and swamp communities present but the preferred habitat of early successional abandoned fields bordered by woodland swamps and a required habitat of>10 ha is not present within the Study Area.

Potential habitat for the remaining SAR birds listed above was not observed in the Study Area.

Bank Swallows were not observed during the field assessment. The creek banks did not possess the vertical slopes required by Bank Swallows.

Barn Swallows were not observed during the field assessment. Suitable habitat for Barn Swallows was not observed within the Study Area, however, potential nesting habitat was observed adjacent to the Study Area within a concrete culvert structure observed on the north leg of the Crosswinds intersection. No evidence of nesting was observed within the culvert structure at the time of the field assessment.

Bobolink and Eastern Meadowlark, prefer large areas (minimum of 10 ha) of grassland habitat; their preferred habitat is not present in the Study Area which consists of forest and swamp communities.

Louisiana Waterthrush prefer habitat of running streams and steep slopes within wooded ravines or large tracts of mature forests. The watercourse within the Study Area, Silver Creek, does not have the preferred waterflow characteristics or preferred vegetation; water was observed to be conveyed through a marsh wetland with a poorly defined channel.

4.1.2 Candidate Bat Maternity Roosting Habitat

Since 2013, four bat species have been listed as endangered under the Endangered Species Act 2007 due to rapid declining population sizes caused by White-nose Syndrome (WNS).

Among the four listed species, three are known to roost in forested habitats: Little Brown Myotis (*Myotis lucifugus*), Northern Myotis (*Myotis septentrionalis*), and Tri-colored Bat (*Pipistrellus subflavus*). While Little Brown Bat typically choose maternity roosts in anthropogenic structures, according to MNRF and Environment Canada (2015), key features of significant bat maternity roosting habitat sites for Northern myotis and Tri-colored bat species, and to a lesser extent Little brown myotis, include:

- Deciduous Forest (FOD), Mixedwood Forest (FOM), Coniferous Forest (FOC), Deciduous Swamp (SWD), Mixedwood Swamp (SWM) and Coniferous Swamp (SWC) communities.
- Older forest stands that typically feature increased snag availability for roosting and foraging under a relatively closed canopy and mature large-diameter trees with >25 cm DBH.
- Cavities with small entrances/crevices or loose bark.
- Cavities in tall tree snags of live trees that exhibit early to mid-stages of decay.

Snag trees >25 cm DBH, with dying limbs and preferred tree cavities/snags or peeling bark suitable for roosting bats, were observed adjacent to the Study Area limits within the edge limits of the FODM7-2 (see Figure 1).

Based on site observations and a review of aerial photographs, four of the 17 vegetation community types present in the Study Area are considered to be preferred by bats for roosting; SWD, SWCM1-1, FODM7-2 and FODM3-1. Of these communities, one (FODM3-1) had large diameter trees with cavities/loose bark noted within the Study Area. Silver Creek was observed to contain abundant floating and emergent vegetation that limit the suitability for foraging, typical of an open aquatic community preferred by bats. Suitable foraging habitat may be present outside of the Study Area. Open aquatic ponds were noted in the greater area through aerial photography that may represent suitable foraging open aquatic community preferred by bats.

4.1.3 Amphibians and Reptiles

A review of the ORAA Square 17NK52 and NHIC square 17NK5627 identified the following provincial Special Concern or Specially Protected amphibian and reptile species as having potential to be located within the Study Area:

- Snapping Turtle (*Chelydra serpentina)* (ORAA – 2018; NHIC – OGD ID 958401)
- Midland Painted Turtle (*Graptemys geographica)* (ORAA – 2018)
- Eastern Ribbonsnake (*Thamnophis sauritus)* (ORAA – 1988)

Snapping Turtle is provincially listed as a Special Concern species on the SARO list and has been designated as a Specially Protected Reptile under the Ontario Fish and Wildlife Conservation Act. The Midland Painted Turtle has been designated as a Specially Protected Reptile under the Ontario Fish and Wildlife Conservation Act. The Eastern Ribbonsnake is listed as a Special Concern species on the SARO list and has been designated as a Specially Protected Reptile under the Ontario Fish and Wildlife Conservation Act. Observations of Midland Painted Turtle and Snapping Turtle both occurred in 2018, as per the ORAA database, indicating recent presence in the vicinity of the Study Area. A single observation of the Eastern Ribbonsnake occurred in 1988, as per the ORAA database. Occurrences that have not been reconfirmed for 20 or more years are considered historical (NHIC 2012)/ Species at Risk Act Management Plan Series). The observation for Eastern Ribbonsnake in 1998 can be considered historical given a lapse of greater than 20 years.

Snapping Turtles, generally inhabit shallow waters, where they can hide under the soft mud and leaf litter and are usually found in large bodies of water but sometimes inhabit small ponds. During nesting season, females travel overland in search of suitable nesting sites and often take advantage of manmade structures for nest sites (especially gravel shoulders).

Snapping Turtles, if present, may take advantage of the gravel trail noted to the north of the ROW in search of nesting sites, however, waterbodies with suitable depth and substrate were not observed within the Study Area. Suitable habitat may be present in waterbodies located beyond the Study Area.

Midland Painted Turtle generally inhabit shallow, slow-moving creek watercourses with the opportunity for basking areas associated with open areas on shorelines and instream boulders and rocks protruding from the water. The watercourse features within the Study Area do not appear to provide suitable habitat for Midland Painted Turtle due to a lack of a characteristically slow-moving creek watercourse and opportunity for basking areas associated with open areas on shorelines and in-stream boulders and rocks.

Eastern Ribbonsnake is usually found close to water, especially in marshes, where it hunts for frogs and small fish. Silver Creek, within the Mixed Organic Marsh community (MASO3) in the Study Area, may represent habitat for Eastern Ribbonsnake. NHIC square 17NK5929 database (located within the greater ORAA square 17NK52) indicates Eastern Ribbonsnake (wherein the Silver Creek Wetland Complex (CL7) is noted) to the northeast and outside of the Study Area. Preferred habitat may be located within this wetland located beyond the Study Area.

During the field assessment, reptiles and amphibians were not observed.

4.1.4 Monarch Butterfly Habitat

The Monarch was already assessed as a species of Special Concern in Ontario when the Endangered Species Act took effect in 2008. The Monarch's range extends from Central America to southern Canada. In Canada, Monarchs are most abundant in southern Ontario and Quebec where breeding habitat, including milkweed plants and are widespread. Common Milkweed was observed at the edges or within the ROW of over half of the vegetation communities, notably CVR_4, CVR_3, CGL_1, THDM2-10, OAGM4, CVR_2 and CVI. Monarch butterflies were not observed within the Study Area communities during the field assessment.

5.0 Preferred Alternative

Project activities associated with the alternative solutions are anticipated to include, but are not limited to, excavation, grading and asphalt application as well as vegetation removal in select areas as a result of road widening, improved ditches, and culvert replacement. Improvements are anticipated to be located primarily within the existing ROW with potential impact to trees and shrubs that encroach into the ROW, including impact to wildlife species, Species of Special Concern (birds, reptiles, Milkweed; sole source food for Monarch), as a result of vegetation clearing and grading. It is anticipated that direct impact to wildlife species, Species of Special

Concern, SAR can be avoided through minimizing the footprint of construction and the timing of certain project activities (i.e., outside of the active season).

R.J. Burnside & Associates Limited

Sylvia Radovic, B.E.S.
Ecologist
SAR:sd

Enclosure(s) Figure 1 – Existing Conditions: ELC
Appendix A – SAR Table

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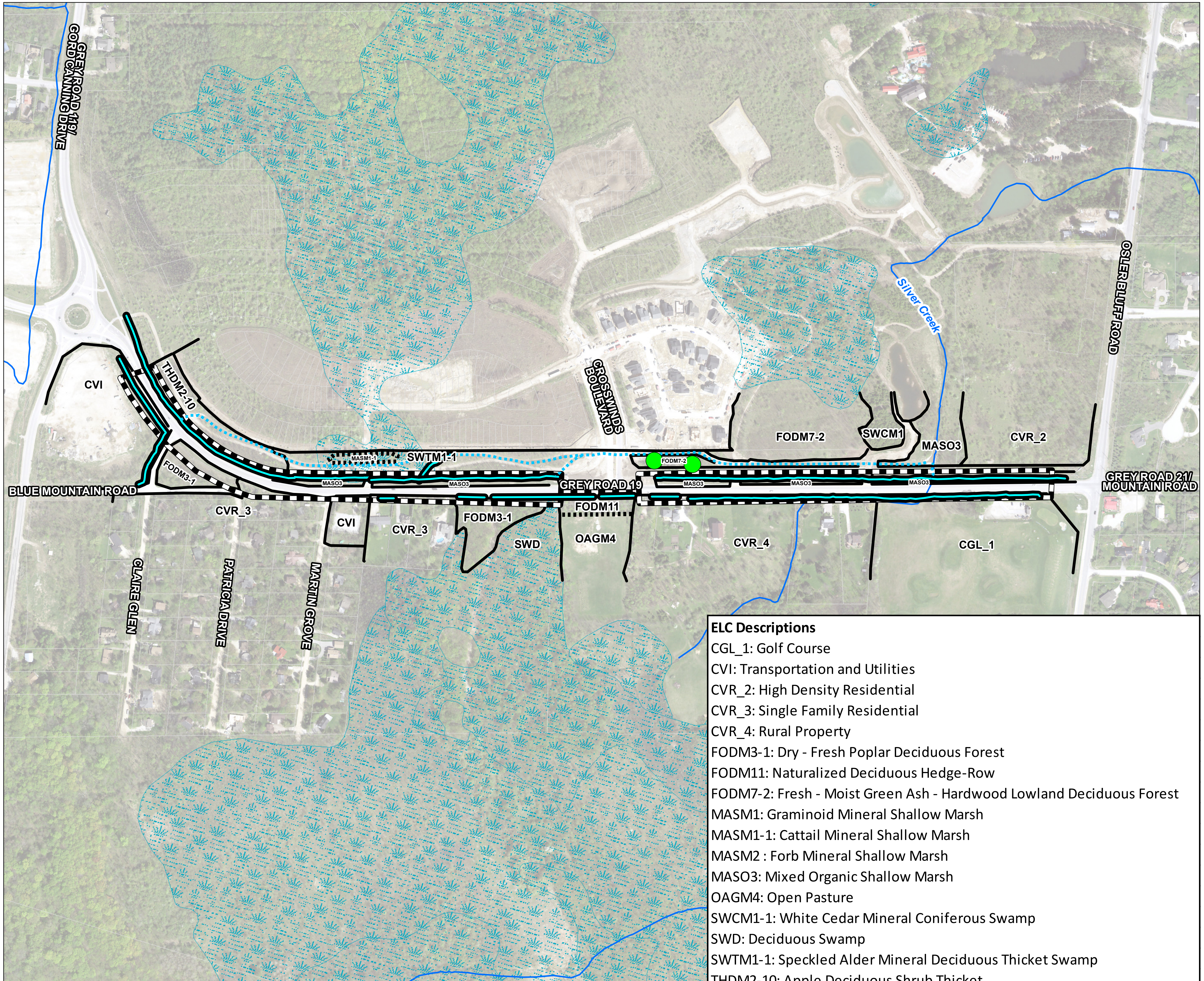
Figure

Figure



ELC Descriptions

CGL_1: Golf Course
CVI: Transportation and Utilities
CVR_2: High Density Residential
CVR_3: Single Family Residential
CVR_4: Rural Property
FODM3-1: Dry - Fresh Poplar Deciduous Forest
FODM11: Naturalized Deciduous Hedge-Row
FODM7-2: Fresh - Moist Green Ash - Hardwood Lowland Deciduous Forest
MASM1: Graminoid Mineral Shallow Marsh
MASM1-1: Cattail Mineral Shallow Marsh
MASM2 : Forb Mineral Shallow Marsh
MASO3: Mixed Organic Shallow Marsh
OAGM4: Open Pasture
SWCM1-1: White Cedar Mineral Coniferous Swamp
SWD: Deciduous Swamp
SWTM1-1: Speckled Alder Mineral Deciduous Thicket Swamp
THDM2-10: Apple Deciduous Shrub Thicket

Potential Bat Roosting Habitat
Drainage Channel (MASM2)
Drainage Ditch (MASM1/MASM2)
ELC
Watercourse (LIO)
Wetland (LIO)
Study Area

Sources:

1. Ministry of Natural Resources and Forestry, © Queen's Printer for Ontario.
2. Natural Resources Canada © Her Majesty the Queen in Right of Canada.

Disclaimer:

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Grid North

0 100 200 300 400
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BURNSIDE

Client

GREY COUNTY

Figure Title

GREY ROAD 19
ENVIRONMENTAL ASSESSMENT

EXISTING CONDITIONS

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Appendix A

SAR Table

Appendix A: Screening Table - Background Review of Species at Risk and Species of Conservation Concern Potentially Present in the Study Area

Grey Road 19, Grey County (300052076)

Common Name	Scientific Name	Provincial S-RANK[1]	Provincial SARO Status[2]	COSEWIC[3]	Federal SARA Status[3]	Federal SARA Schedule[4]	Habitat Description	Habitat Present in Study Area?	Species Observed In Study Area During Site Assessment?
BIRDS									
Bank Swallow (Source: OBBA)	*Riparia riparia*	S4B	THR	THR	THR	1	In Ontario, Bank Swallows typically nest in exposed vertical earthen banks, created by erosion, along watercourses and lakeshores. It has also adapted to nesting in these banks in sand and gravel pits, along roadsides and in stockpiles of soil and other materials. The largest populations are supported by the shorelines of the lower Great Lakes and they can also be found throughout southern Ontario in the Carolinian and Lake Simcoe-Rideau regions.[7]	No. No exposed, eroded riverbanks, pits, stockpiles and other suitable habitat are not present on site.	No.
Barn Swallow (Source: OBBA)	*Hirundo rustica*	S4B	THR	THR	THR	1	Barn Swallows usually build mud nests on ledges of walls in, or outside, of a barn or other man-made structures, including building and bridges. Natural nesting locations include caves and cliffs, but they are now rarely used. They often nest in small colonies in areas often associated with other insectivores. Foraging occurs in open areas where insects are present: over water, meadows, marshes, and agricultural fields. They are most abundant south of the Canadian Shield, within agricultural lands in the Carolinian and Lake Simcoe-Rideau regions.[5]	No. Concrete culvert structures suitable for nesting adjacent to the Study Area within a concrete culvert structure observed on the north portion of the Crosswinds intersection	No.

Common Name	Scientific Name	Provincial S-RANK[1]	Provincial SARO Status[2]	COSEWIC[3]	Federal SARA Status[3]	Federal SARA Schedule[4]	Habitat Description	Habitat Present in Study Area?	Species Observed In Study Area During Site Assessment?
Bobolink (Source: OBBA)	*Dolichonyx oryzivorus*	S4B	THR	THR	THR	1	Bobolinks generally prefer open grasslands and hay fields for nesting, typically featuring relatively tall vegetation. Sometimes uses large fields (>50 ha) of winter wheat and rye in southwestern Ontario. Sensitive to vegetation structure and composition, they are positively associated with high grass-to-forb ratios, and moderate litter depth. They tolerate wetter portions of fields and are more likely to nest closer to field centers rather than field margins. They have a lower tolerance to presence of patches of bare ground and appear to prefer larger fields (>10 ha).[5, 7] This area sensitivity is also heavily influenced by the amount of regional grassland cover.	No. Preferred larger hayfields were not present within the corridor.	No.
Eastern Meadowlark (Source: OBBA)	*Sturnella magna*	S4B	THR	THR	THR	1	Generally, prefers grassy pastures, meadows and hay fields. Prefers moderately tall grass with abundant litter cover, a high proportion of grass cover, moderate forb density, low proportions of shrub and woody vegetation cover, and low percent of bare ground. Prefers to nest in drier sites and frequently nests around field margins.[5, 7]	No. No field habitat suitable for nesting/foraging (i.e., tall grass pasture and meadows, etc.) is present on site.	No.
Eastern Wood-pewee (Source: OBBA)	*Contopus virens*	S4B	SC	SC	SC	1	This species is known to inhabit the mid-canopy layer of forest openings and edges of deciduous and mixed forests (MNRF 2018). It is most abundant in intermediate-age mature forest stands with little understorey vegetation (MNRF 2018). Eastern Wood-pewees generally nest in the interior of deciduous and mixed-wood forested habitats but are often found foraging along woodland edges and in within forest gaps. They do not require large habitats, but occurrences are noted less frequently in woodlots surrounded by development than in those without. Species distribution is throughout southern and northern Ontario, occurring less in the Hudson's Bay Lowlands.[5]	No. The deciduous wooded FODM3-1 community is present but is not an intermediate-age mature forest but a second growth forest with a thicker understorey.	No.

Common Name	Scientific Name	Provincial S-RANK[1]	Provincial SARO Status[2]	COSEWIC[3]	Federal SARA Status[3]	Federal SARA Schedule[4]	Habitat Description	Habitat Present in Study Area?	Species Observed In Study Area During Site Assessment?
Golden-Winged Warbler (Source: OBBA)	*Vermivora chrysoptera*	S4B	SC	THR	THR	1	Generally, prefer areas of early successional vegetation, found primarily on field edges, hydro or utility right-of-ways, or recently logged areas.[6] early successional habitat; shrubby, grassy abandoned fields with small deciduous trees bordered by low woodland and wooded swamps; alder bogs; deciduous, damp woods; shrubbery clearing in deciduous woods with saplings and grasses; brier-woodland edges; requires >10 ha of habitat	No. The preferred habitat of early successional abandoned fields bordered by woodland swamps and a required habitat of>10 ha is not present within the Study Area.	No.
Louisiana Waterthrush (Source: OBBA; NHIC)	Parkesia motacilla	S3B	THR	THR	SC	1	Generally, prefer wooded ravines with running streams; also woodland swamps; large tracts of mature deciduous or mixed forests; canopy cover is essential; has strong affinity to nest sites; nests on ground Generally, inhabits mature forests along steeply sloped ravines adjacent to running water. It prefers clear, cold streams and densely wooded swamps.[7]	No. The preferred habitat of running streams and steep slopes within wooded ravines is not present within the Study Area.	No.
Wood Thrush (Source: OBBA)	*Hylocichla mustelina*	S4B	SC	THR	THR	1	The Wood Thrush breeds in southeastern Canada, from southern Ontario, east to Nova Scotia. Nesting typically occurs in second-growth, mature deciduous and mixed forests. The presence of tall trees and a thick understory are usually prerequisites for site occupancy.[6, 8] They prefer large forested areas, but they may also nest in small forest fragments. Nest building commonly occurs in Sugar Maples and American Beech saplings, trees or shrubs.[8] Wintering occurs in Central America, along the Atlantic and Pacific slopes.[6]	Low. The deciduous wooded FODM3-1 community is present but is not an intermediate-age mature forest but a second growth forest with a thicker understorey. There were occasional preferred Sugar Maple saplings but no American Beech saplings within this FODM3-1.	No.

Common Name	Scientific Name	Provincial S-RANK[1]	Provincial SARO Status[2]	COSEWIC[3]	Federal SARA Status[3]	Federal SARA Schedule[4]	Habitat Description	Habitat Present in Study Area?	Species Observed In Study Area During Site Assessment?
INSECTS									
Monarch (Source: RJB)	*Danaus plexippus*	S2N,S4B	SC	END	SC	1	Monarchs can be found in areas that Milkweed (*Asclepius sp.*) and other wildflowers are present. This includes open spaces (fields), abandoned farmland, and roadsides. Pin-sized green eggs are laid on the underside of Milkweed species (*Asclepias spp.*), which are the primary food source of the Monarch caterpillar. Adult Monarchs migrate in late summer/early fall. Overwintering occurs along the California coast, and the Oyamel Fir Forest in central Mexico.[8\\]	Yes. Appropriate foraging and breeding habitat was present in the open roadside areas and noted within the ROW of CVR communities.	Yes.
MAMMALS									
Eastern Small-Footed Myotis (Source: MNRF)	*Myotis leibii*	S2S3	END	-	-	-	Eastern Small-footed Myotis can be found from southern Georgian Bay to Lake Erie, and east to the Pembroke area. Record sightings also exist within the Bruce Peninsula, the Espanola area and Lake Superior Provincial Park.[8] Roosting habitat: during the spring and summer they will roost under rocks, in rock outcrops, in buildings, under bridges, or in caves, mines or hollow trees. They often change their roosting locations every day.[8] Hibernacula: caves and abandoned mines that tend to be colder and drier than the hibernacula of similar bats, and they will return to the same hibernacula every year. As with Little Brown Myotis, Eastern Small-footed myotis populations have been declining rapidly due to a fungal infection (White-nose Syndrome) that affects bats while in hibernation.[8]	No. Hibernacula is not present (i.e., caves/mines). Roosting habitat is not considered present, given its preference for open, sunny rocky habitats within close proximity to its hibernacula.	No.

Common Name	Scientific Name	Provincial S-RANK[1]	Provincial SARO Status[2]	COSEWIC[3]	Federal SARA Status[3]	Federal SARA Schedule[4]	Habitat Description	Habitat Present in Study Area?	Species Observed In Study Area During Site Assessment?
Little Brown Myotis (Source: MNRF)	*Myotis lucifugus*	S3	END	END	END	1	Population distribution within Canada includes the boreal forest, south of the tree line through to the U.S. border.[10] Roosting habitat: mainly considered to be a cavity-roosting species, however, tree foliage and rock crevices may also be used for day and maternity roosting. Communal night roosts are used when temperatures are cool and tend to be in spaces that are warm or can be warmed by an accumulation of bats. Females prefer to roost in maternity colonies, preferring tree cavities, exfoliating bark, cracks and crevices in cliffs and small caves and crevices heated by hot springs. Temperature is the principal criterion for the selection of a maternity roost location. Maternity colonies form just after bats come out of hibernation (late April and early May) and are located within 1 kilometer of water.[10] Hibernacula: hibernation typically takes place in caves or abandoned mines, with favorable temperatures and humidity conditions. Migration to hibernation sites can be up to 1,000km, and typically occurs in early September.[11] Little Brown Myotis populations in Ontario have declined dramatically in recent years due to White-nose Syndrome, a fungal infection caused by *Pseudogymnoascus destructans*, which infects bats while in hibernation.[10]	Low. No Snags were present within the preferred swamp (SWCM1-1 and SWD). Forest (FODM3-1) within study area noted to have large diameter trees with cavities/loose bark noted snags. Potential BMH trees were noted adjacent to the Study Area (FODM7-2), permanent water body source for foraging is present (Silver Creek) but does not exhibit preferred open aquatic habitat.	No.
Northern Myotis (Source: MNRF)	*Myotis septentrionalis*	S3	END	END	END	1	Roosting habitat: males and non-breeding females roost alone or in small groups, choosing trees, caves, and buildings. Breeding females roost in tree hollows, cavities, crevices or under loose bark of living or decaying trees, sometimes in groups of up to 60 adults. They often change roosting locations every few days. Prey mainly includes terrestrial insects such as flies, moths, beetles, caddisflies, lacewings and leafhoppers, as well as non-flying species, such as spiders and caterpillars. They	Low. No Snags were present within the preferred swamp (SWCM1-1 and SWD). Forest (FODM3-1) within study area noted to have large diameter trees with cavities/loose bark noted snags. Potential BMH trees were noted	No.

Common Name	Scientific Name	Provincial S-RANK[1]	Provincial SARO Status[2]	COSEWIC[3]	Federal SARA Status[3]	Federal SARA Schedule[4]	Habitat Description	Habitat Present in Study Area?	Species Observed In Study Area During Site Assessment?
							tolerate cooler conditions than the Little Brown Myotis and are therefore not usually found near that species.[10] Hibernacula: tend to enter hibernation later than other species, around late September to early November, and will emerge from hibernation sometime between March and May. They spend the summer relatively close to their hibernacula (56km between summer and winter sites). [10] As with Little Brown Myotis, White-nose Syndrome has cause a dramatic decline in Ontario populations.[10]	adjacent to the Study Area (FODM7-2), permanent water body source for foraging is present (Silver Creek) but does not exhibit preferred open aquatic habitat.	
Tri-colored Bat (Source: MNRF)	*Perimyotis subflavus*	S3?	END	END	END	1	Roosting habitat: females roost alone, or in small colonies, and have been shown to exhibit fidelity to small roosting areas. Foraging typically occurs in forested riparian areas, over open water and in relatively open areas. Studies have shown that Tri-coloured bats forage in forested areas with the greatest coverage, suggesting that they may avoid agricultural clearings, urban areas and areas where forest harvesting has occurred.[10] Hibernacula: tends to hibernate in the deepest parts of caves or abandoned mines, where temperature is least variable and humidity levels are high. They hibernate solitarily and exhibit high fidelity to hibernacula.[10]	Low. No Snags were present within the preferred swamp (SWCM1-1 and SWD). Forest (FODM3-1) within study area noted to have large diameter trees with cavities/loose bark noted snags. Potential BMH trees were noted adjacent to the Study Area (FODM7-2), permanent water body source for foraging is present (Silver Creek) but does not exhibit preferred open aquatic habitat.	Low.
REPTILES & AMPHIBIANS									
Midland Painted Turtle (Source: ORAA)	*Chrysemys picta marginata*	S4	-	SC	-	-	Inhabits waterbodies, such as ponds, marshes, lakes and slow-moving creeks, that have a soft bottom and provide abundant basking sites and aquatic vegetation. These turtles often bask on shorelines or on logs and rocks that protrude from the water. The midland painted turtle hibernates on the bottom of	No. Appropriate habitat does not exist within the study area; Silver Creek found in the MASO3 community within the Study Area is not the characteristically preferred slow-	No.

Common Name	Scientific Name	Provincial S-RANK[1]	Provincial SARO Status[2]	COSEWIC[3]	Federal SARA Status[3]	Federal SARA Schedule[4]	Habitat Description	Habitat Present in Study Area?	Species Observed In Study Area During Site Assessment?
							waterbodies.	moving waterbody and does not have logs or rocks protruding from the water for basking.	
Snapping Turtle (Source: ORAA)	*Chelydra serpentina*	S3	SC	SC	SC	1	Snapping Turtles generally inhabit shallow waters, where they can hide under the soft mud and leaf litter. Usually found in large bodies of water but sometimes inhabit small ponds. Nesting sites usually occur on gravely or sandy areas along streams. They often take advantage of man-made structures for nest sites, including roads (especially gravel shoulders), dams and aggregate pits. During nesting season, females travel overland in search of suitable nesting sites.[8]	No. Appropriate habitat does not exist within the study area within the MASO3 community. The water body noted within the greater area of this MASO3 community, was not of suitable depth and substrate. Snapping Turtles, if present, may take advantage of gravel pathways in search of nesting sites, observed adjacent to Study Area, beyond the ROW.	No.
Eastern Ribbonsnake (ORRA)	*Thamnophis sauritus*	S4	SC	SC	SC	1	The Eastern Ribbonsnake is usually found close to water, especially in marshes, where it hunts for frogs and small fish. A good swimmer, it will dive in shallow water, especially if it is fleeing from a potential predator. At the onset of cold weather, these snakes congregate in underground burrows or rock crevices to hibernate together.	Low. Marginal appropriate marsh habitat was found in MASO3 community in Study Area but preferred habitat may be located within wetland beyond Study Area.	No.

** Sources: Natural Heritage Information Centre (NHIC) database searched on December 15, 2020 for square 17NK5527 & 17NK5627; Ontario Reptile and Amphibian Atlas (ORAA) for Square 17NK52, searched online on December 15, 2020; Ontario Breeding Bird Atlas (OBBA) 2001-2005 database for Square 17NK52 searched online on December 15, 2020.

[1]S-Ranks (provincial)
Provincial (or Subnational) ranks are used by the Natural Heritage Information Centre (NHIC) to set protection priorities for rare species and natural communities. These ranks are not legal designations. Provincial ranks are assigned in a manner similar to that described for global ranks, but consider only those factors within the political boundaries of Ontario (Please refer to: http://explorer.natureserve.org/nsranks.htm). S-Ranks obtained from the NHIC updated December 15, 2020.

SX — Presumed Extirpated - Species or community is believed to be extirpated from the province. Not located despite intensive searches of historical sites and other appropriate habitat, and virtually no likelihood that it will be rediscovered.
SH — Possibly Extirpated (Historical) - Species or community occurred historically in the province, and there is some possibility that it may be rediscovered. Its presence may not have been verified in the past 20–40 years. A species or community could become SH without such a 20-40 year delay if the only known occurrences in a province were destroyed or if it had been extensively and unsuccessfully looked for. The SH rank is reserved for species or communities for which some effort has been made to relocate occurrences, rather than simply using this status for all elements not known from verified extant occurrences.
S1 — Critically Imperiled - Critically imperiled in the province or state because of extreme rarity (often 5 or fewer occurrences) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the province.
S2 — Imperiled - Imperiled in the province because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the province.
S3 — Vulnerable - Vulnerable in the province due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation.
S4 — Apparently Secure - Uncommon but not rare; some cause for long-term concern due to declines or other factors.
S5 — Secure - Common, widespread, and abundant in the province.
SNR — Unranked - Province conservation status not yet assessed.
SU — Unrankable - Currently unrankable due to lack of information or due to substantially conflicting information about status or trends.
SNA — Not Applicable - A conservation status rank is not applicable because the species is not a suitable target for conservation activities.
S#S# — Range Rank - A numeric range rank (e.g., S2S3) is used to indicate any range of uncertainty about the status of the species or community. Ranges cannot skip more than one rank (e.g., SU is used rather than S1S4).
S#? – Inexact or Uncertain - Denotes inexact or uncertain numeric rank.

Breeding Status Qualifiers
B – Breeding Conservation status refers to the breeding population of the species in the nation or state/province.

N – Nonbreeding Conservation status refers to the non-breeding population of the species in the province.
M – Migrant species occurring regularly on migration at particular staging areas or concentration spots where the species might warrant conservation attention. Conservation status refers to the aggregating transient population of the species in the province.

[2]SARO *Endangered Species Act, 2007*
(Provincial status from https://www.ontario.ca/page/species-risk-ontario#section-1 updated November 9, 2020)
The provincial review process is implemented by the Committee on the Status of Species at Risk in Ontario (COSSARO).

Extinct - A species that no longer exists anywhere.
Extirpated (EXT) - Lives somewhere in the world, and at one time lived in the wild in Ontario, but no longer lives in the wild in Ontario.
Endangered (END) - Lives in the wild in Ontario but is facing imminent extinction or extirpation.
Threatened (THR) - Lives in the wild in Ontario, is not endangered, but is likely to become endangered if steps are not taken to address factors threatening it.
Special concern (SC) - Lives in the wild in Ontario, is not endangered or threatened, but may become threatened or endangered due to a combination of biological characteristics and identified threats.
Not at Risk (NAR) - A species that has been evaluated and found to be not at risk.
Data Deficient (DD) - A species for which there is insufficient information for a provincial status recommendation.

[3]SARA (Federal *Species at Risk Act*) Status and Schedule (includes COSEWIC Status)
The Act establishes Schedule 1, as the official list of wildlife species at risk. It classifies those species as being either Extirpated, Endangered, Threatened, or Special Concern. Once listed, the measures to protect and recover a listed wildlife species are implemented. Obtained from the Species at Risk Public Registry on December 15, 2020.

Extinct - A wildlife species that no longer exists.
Extirpated (EXT) - A wildlife species that no longer exists in the wild in Canada, but exists elsewhere.
Endangered (END) - A wildlife species facing imminent extirpation or extinction.
Threatened (THR) - A wildlife species that is likely to become an endangered if nothing is done to reverse the factors leading to its extirpation or extinction.
Special Concern (SC) - A wildlife species that may become threatened or endangered because of a combination of biological characteristics and identified threats.
Data Deficient (DD) - A category that applies when the available information is insufficient (a) to resolve a wildlife species' eligibility for assessment or (b) to permit an assessment of the wildlife species' risk of extinction.
Not At Risk (NAR) - A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.

[4]SARA Schedule
Obtained from the Species at Risk Public Registry on December 15, 2020.
Schedule 1: is the official list of species that are classified as extirpated, endangered, threatened, and of special concern.
Schedule 2: species listed in Schedule 2 are species that had been designated as endangered or threatened, and have yet to be re-assessed by COSEWIC using revised criteria. Once these species have been re-assessed, they may be considered for inclusion in Schedule 1.
Schedule 3: species listed in Schedule 3 are species that had been designated as special concern, and have yet to be re-assessed by COSEWIC using revised criteria. Once these species have been re-assessed, they may be considered for inclusion in Schedule 1.

The Act establishes Schedule 1 as the official list of wildlife species at risk. However, please note that while Schedule 1 lists species that are extirpated, endangered, threatened and of special concern, the prohibitions do not apply to species of special concern.

Species that were designated at risk by COSEWIC prior to October 1999 (Schedule 2 & 3) must be reassessed using revised criteria before they can be considered for addition to Schedule 1 of SARA. After they have been assessed, the Governor in Council may on the recommendation of the Minister, decide on whether or not they should be added to the List of Wildlife Species at Risk.

Sources:
[5] Cadman, M.D., et al. (eds). 2007. *Atlas of the Breeding Birds of Ontario, 2001-2005*. Bird Studies Canada, Environment Canada, Ontario Field Ornithologists, Ontario Ministry of Natural Resources, and Ontario Nature, Toronto, xxii + 706 pp
[6] Species at Risk Public Registry http://www.sararegistry.gc.ca
[7] McCracken, J.D. et al. 2013. Recovery Strategy for the Bobolink (Dolichonyx oryzivorus) and Eastern Meadowlark (Sturnella magna) in Ontario .Ontario Recovery Strategy Series. Prepared for the Ontario Ministry of Natural Resources and Forestry, Peterborough, Ontario, viii + 88 pp.
[8] MNRF SARO List Species Descriptions (https://www.ontario.ca/page/species-risk-ontario#section-1)
[9] COSEWIC Species Assessment Reports
[10] Naughton, Donna. 2012. *The Natural History of Canadian Mammals*. Canadian Museum of Nature and University of Toronto Press, Toronto, + 784 pp
[11]Farrar, John Laird, 2017, *Trees in Canada*, Natural Resources Canada | Canada Forest Services, and, Fitchenry &Whiteside Limited, pp.238 – 239
[12]Significant Wildlife Habitat Technical Guide – Appendix G – Table G-3

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Technical Memorandum – Aquatic Habitat Assessment

Date:	February 19, 2021	**Project No.:**	300052076
Project Name:	Grey Road 19 Environmental Assessment		
Client Name:	Grey County		
Submitted To:	File		
Submitted By:	Matthew Moote, H.B.Sc., C.Tech., CAN-CISEC-IT, Aquatic Ecologist		
Reviewed By:	Chris Pfohl, C.E.T., EP, CAN-CISEC, Sr. Aquatic Ecologist		

1.0 Project Description

Following a recent Traffic Study, Grey County (County) has identified the need to widen GR19 to meet the needs of increased traffic demand. R.J. Burnside & Associates Limited (Burnside) was retained to complete a Schedule C Municipal Class Environmental Assessment (EA). The EA will consider improvements to Grey Road 19 (GR19) between Grey Road 21 (GR21), Mountain Road, Grey Road 119 (GR19) and Gord Canning Drive.

A component of the EA includes the characterization of the natural environment within the Study Area to evaluate the alternative solutions including do nothing; widen to 4 lanes; or widen to 4 lanes with active transportation. The characterization of the aquatic habitat in the Study Area is included herein.

2.0 Project Background

A single watercourse crossing (Latitude: 44.497401, Longitude:-80.287935) is present on GR19 approximately 210 m west of GR21. As such, Burnside's Aquatic Ecologist visited the site to perform an aquatic habitat assessment to determine fish habitat conditions. The aquatic habitat assessment was performed following the MTO Environmental Guide for Fish and Fish Habitat (MTO, 2009).

The federal *Fisheries Act* prohibits causing Harmful Alteration, Disruption or Destruction (HADD) of fish habitat. The Act also prohibits causing the Death of Fish by means other than fishing. It is prohibited to release a deleterious substance (sediment, fuel etc.) to fish habitat. This memo describes the historical and existing fish habitat conditions in the vicinity of the watercourse crossing. The mitigation measures that should be implemented if in-water works (i.e. culvert replacement) are required for the construction of the preferred design alternative are presented in Section 4 of this memo.

3.0 Aquatic Habitat Assessment

3.1 Background Information Review

Burnside's Aquatic Ecologist reviewed the following sources of information to determine historical fish habitat conditions and potential constraints for future construction:

- Aerial Imagery;
- Ministry of Natural Resources and Forestry (MNRF) Aquatic Resources area (ARA) mapping (2017);
- Natural Heritage Information Centre (NHIC) Mapping (2020);
- Department of Fisheries and Oceans (DFO) Species at Risk (SAR) mapping (2020);

The watercourse in the study area is classified as having a warm-water thermal regime and known as Silver Creek. The species of fish that have historically been observed in the watercourse are presented below in Table 1.

The DFO SAR and NHIC mapping does not state the potential presence of aquatic SAR in the Study Area. Silver lamprey (*Ichthyomyzon unicuspis*) are noted in the DFO SAR mapping as being observed in the watercourse approximately 960 m downstream from the Study Area. This species is listed as Special Concern under the provincial Endangered Species Act (ESA) and the federal *Species at Risk Act* (SARA) and thus are not provided habitat or species protection.

Table 1. Fish Species Historically Observed in Silver Creek

Species Name	Scientific Name	Thermal Regime Preference
Blacknose dace	*Rhinichthys spp.*	Cool
Blacknose shiner	*Notropis heterolepis*	Cool
Bluntnose minnow	*Pimephales notatus*	Warm
Brook trout	*Salvelinus fontinalis*	Cold
Brown trout	*Salmo trutta*	Cold
Central Mudminnow	*Umbra limi*	Cool
Chinook salmon	*Oncorhynchus tshawytscha*	Cold
Common shiner	*Luxilus cornutus*	Cool
Creek chub	*Semotilus atromaculatus*	Cool
Fathead minnow	*Pimephales promelas*	Warm
Johnny darter	*Etheostoma nigrum*	Cool
Longnose dace	*Rhinichthys cataractae*	Cool
Mimic shiner	*Notropis volucellus*	Warm

Species Name	Scientific Name	Thermal Regime Preference
Mottled sculpin	*Cottus bairdii*	Cold
Northern pearl dace	*Margariscus nachtriebi*	Cool
Northern redbelly dace	*Chrosomus eos*	Cool
Rainbow trout	*Oncorhynchus mykiss*	Cold
Rosyface shiner	*Notropis rubellus*	Warm
Silver lamprey	*Ichthyomyzon unicuspis*	Cool
White sucker	*Catostomus commersonii*	Cool

Source: MNRF ARA mapping (2017).

3.2 Existing Habitat Conditions

The aquatic habitat assessment was performed on November 5, 2020. The weather conditions during the assessment were sunny, water clarity was clear, and the temperature was 13°C. Conditions were observed from the right-of-way due to property access constraints. The upstream and downstream reaches of the watercourse were observed for Brook trout presence and spawning habitat and activity in the watercourse in the right-of-way.

3.2.1 Upstream

The watercourse flows from west to east, bending at the culvert inlet to flow from south to north through the corrugated steel pipe (CSP) beneath GR19. South of the watercourse a golf course is present. A roadside drain also flows to the inlet from the east and it is densely vegetated with grasses and cattails (Photo 1). The roadside embankment and GR 19 are present north of the watercourse. The road and golf course represent potential sources of pollution to the watercourse from road runoff (salt and hydrocarbons) and fertilizers used for golf course maintenance.

The watercourse flows in a channel that functions as a roadside ditch upstream of the culvert (Photo 2). The channel is very densely vegetated with grasses and woody shrubs. The wetted width and depth of the upstream reach of the watercourse were measured to be 0.9 m and 0.05 m respectively. The substrate of the upstream reach is comprised of sand and gravel. The wetted width and depth of the ditch to the east of the culvert was measured to be 1.0 m and 0.05 m, respectively.

The right bank (north side of channel) of the upstream reach is very steep and serves as the roadside embankment. It is stable and vegetated with grasses and shrubs. The left upstream (south) bank of the watercourse is more gently sloped and is also vegetated with grasses and shrubs. This vegetation, along with the in-stream plants overhangs and provides shading and cover for aquatic life in the watercourse. Trees are present on the left bank (south side) approximately 80 m upstream of the culvert.

Numerous driveway culverts convey the flow of the watercourse upstream of the culvert (Photo 3). One of the culverts is located approximately 100 m upstream of GR 19 was observed to be hanging (perched by 0.15 m). Fish were observed in a deeper scour pool at the outlet of this driveway culvert. The species could not be confirmed, although based on body size and movement were determined to be cyprinids.

Photo 1: Facing east, the ditch to the east of the culvert (11-5-2020).

Photo 2: Facing west, the watercourse upstream of the culvert (11-5-2020).

Photo 3: Facing west, the outlet of a driveway culvert with scour pool present. Fish were observed in this location (11-5-2020).

3.2.2 Downstream

Downstream of the culvert the watercourse flows from south to north. A pedestrian pathway is present approximately 3 m downstream from the outlet of the GR 19 culvert. A second CSP culvert is present beneath the pathway conveying flows of the watercourse. The lands surrounding the downstream reach of the watercourse are comprised of residential land that is currently under construction and vacant woodlots. The review of the aerial imagery shows stormwater management ponds to the west of the watercourse. These ponds may discharge to the watercourse and can be confirmed. Runoff from the road and residential lands, and discharge from the SWM ponds are all potential sources of pollution to the watercourse.

The downstream reach between the two culverts was observed to flow in a linear channel with a wetted width and depth of 1.0 m and 0.12 m (Photo 4). Downstream of the pedestrian path, the watercourse flows within a ponded area for approximately 10 m (Photo 5). The ponded area has a wetted width and depth of 4 m and 0.15 m respectively (Photo 5). The watercourse then narrows to approximately 1.25 m and it flows through a forested channel (Photo 6). The substrate was observed to be comprised of muck and detritus. Flows were minimal during the November 2020 site visit. A densely vegetated ditch was observed to convey flows from west to east to the watercourse downstream of the pathway (Photo 7).

Dense in-stream and overhanging vegetation was observed downstream of the pathway. The in-stream vegetation was comprised primarily of grasses, although Watercress (*Nasturtium officinale*) was also observed, indicating the potential presence of groundwater upwelling. The banks of the watercourse downstream of GR 19 are stable and large boulders are present on both banks.

Fish were not observed downstream of the culvert.

Photo 4: Facing south, the outlet of the CSP beneath GR19 (11-5-2020).

Photo 5: Facing north, the watercourse downstream of the pathway (11-5-2020).

Photo 6: Facing north, the watercourse flowing in a narrower channel downstream of the ponded area (11-5-2020).

Photo 7: Facing west, the ditch that conveys flows to the watercourse downstream of GR 19 (11-5-2020).

3.2.3 Fish Habitat

Brook trout and spawning habitat for fall spawning species was not observed upstream or downstream of GR19. Fish were observed upstream of GR19 and fish could inhabit the downstream reach of the watercourse and as a result it is considered fish habitat as defined by the *Fisheries Act*.

4.0 Impacts and Mitigation

Under the federal *Fisheries Act* it is prohibited to cause Harmful Alteration, Disruption or Destruction (HADD) of fish habitat as well as the death of fish by means other than fishing. The background information states that Brook trout may inhabit the watercourse, although preferred habitat of the species (diversity of morphology, granular substrate) was not observed in the downstream or upstream reach of the watercourse. At this stage the timing window for in-water works in the Study Area is July 15th to September 30th. At the detailed design phase of the project the timing window for in-water works should be confirmed with the MNRF.

Work zone isolation should be performed if in-water works (i.e. culvert replacement) are required for the construction of the preferred design alternative. Cofferdams constructed of clean, non-erodible materials should be constructed upstream and downstream of the works area to isolate it. Flows should be maintained downstream through pumping or a by-pass culvert and the isolated work area should be dewatered. All pump intakes must be screened to prevent the entrainment or impingement of fish.

If in-water works and work zone isolation are required, then the Death of Fish must be mitigated by performing a fish salvage prior to the commencement of in-water works under a License to Collect Fish (LCF) obtained from the Midhurst District MNRF. If any flow events result in overtopping of the cofferdams subsequent fish salvages will be performed to ensure fish are not killed.

Erosion and sediment controls (ESC) should be installed throughout the work area to prevent sedimentation of the watercourse or other sensitive features present. Inspection of the ESC measures is recommended during construction to ensure that they protect the watercourse and sensitive work areas.

Post-construction the disturbed area of the watercourse should be restored with a mix of suitably sized round stone and native substrate place through the culvert and at the inlet and outlet. The embankments disturbed above the annual highwater mark should be restored with erosion control blankets, topsoil and seeding, and plantings where appropriate. The slopes and disturbed area adjacent to the watercourse should be restored with rip-rap above the annual high-water mark. Angular stone is not to be placed below the annual high-water mark.

5.0 Conclusion

The watercourse is considered fish habitat as defined under the Federal *Fisheries Act*. As such the mitigation measures described Section 4 of this memo should be implemented if in-water works are required for the preferred design alternative to ensure that HADD and the Death of Fish does not occur.

R.J. Burnside & Associates Limited

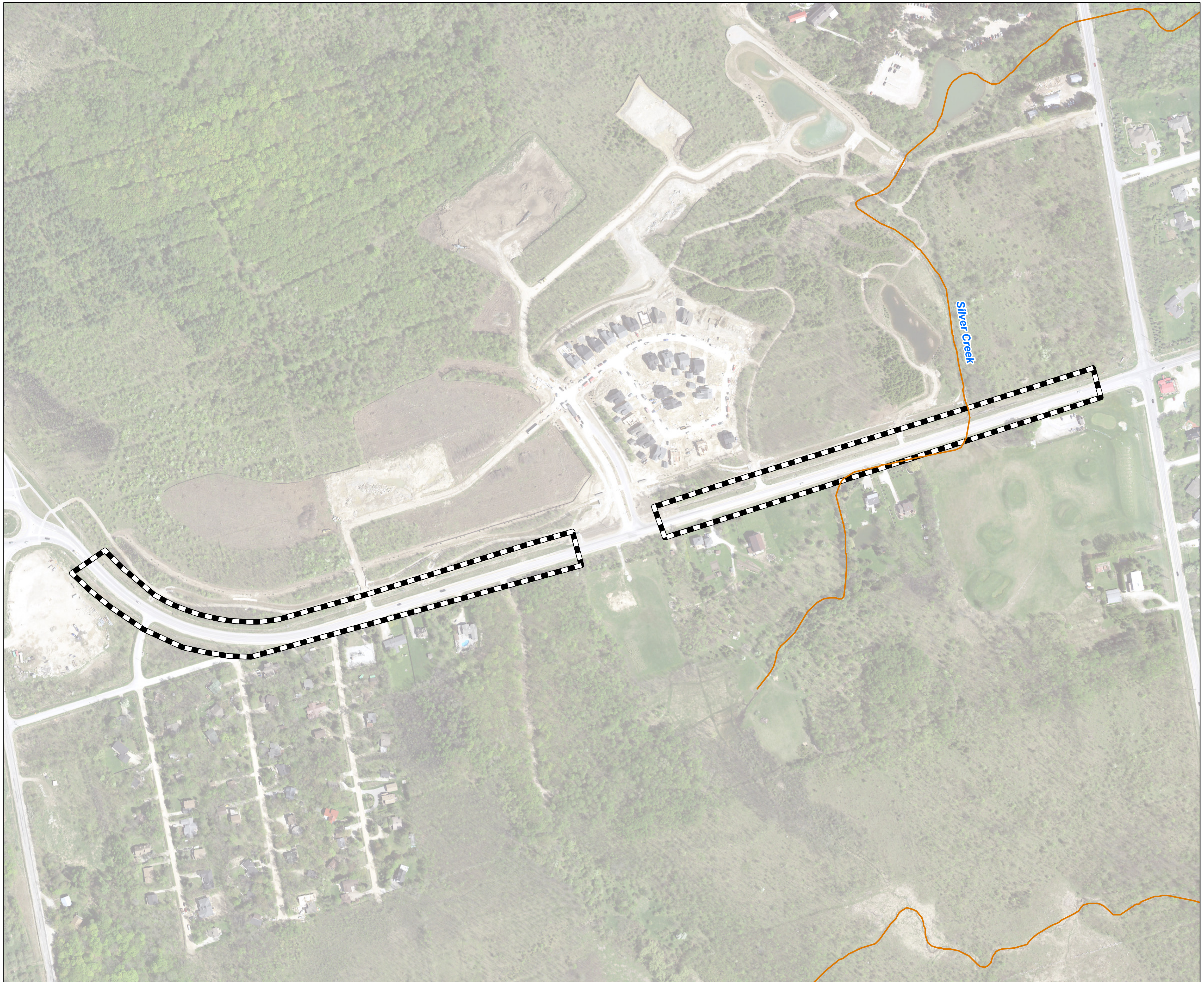
Matthew Moote
Aquatic Ecologist

MM:js

Enclosure(s) Figure 1. Aquatic Habitat

cc: Deanna De Forest, Senior Environmental Assessment Coordinator, R.J. Burnside & Associates

52076_Grey Road 19 EA_Aquatic Memo
2/19/2021 2:48 PM



Watercourse (Cool)

Study Area

Sources:

1. Ministry of Natural Resources and Forestry, © Queen's Printer for Ontario.
2. Natural Resources Canada © Her Majesty the Queen in Right of Canada.

Disclaimer:

R.J. Burnside & Associates Limited and the above mentioned sources and agencies are not responsible for the accuracy of the spatial, temporal, or other aspects of the data represented on this map. It is recommended that users confirm the accuracy of the information represented.

This map is the product of a Geographic Information System (GIS). As such, the data represented on this map may be subject to updates and future reproductions may not be identical.

Datum: North American 1983 CSRS	
Coord. System: NAD 1983 CSRS UTM Zone 17N	
Projection: Transverse Mercator	
Central Meridian: 81°0'0.00"W	
False Easting: 500,000m	False Northing: 0m
Page Orientation: 0°	Scale Factor: 0.99960

N

Grid North

0 50 100 150 200

Metres

BURNSIDE

Client

GREY COUNTY

Figure Title

GREY ROAD 19 ENVIRONMENTAL ASSESSMENT

AQUATIC CONDITIONS

Drawn	Checked	Date	Figure No.
MD	MM	2021/02/02	1
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CULTURAL HERITAGE REPORT:
EXISTING CONDITIONS AND PRELIMINARY IMPACT ASSESSMENT

GREY ROAD 19
MUNICIPAL CLASS ENVIRONMENTAL ASSESSMENT

TOWN OF BLUE MOUNTAINS
COUNTY OF GREY, ONTARIO

FINAL REPORT

Prepared for:

R.J. Burnside and Associates Limited
128 Wellington Street West Suite 301
Barrie ON L4N 8J6

ASI File: 20CH-177

January 2021 (Revised July and September 2022)

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CULTURAL HERITAGE REPORT:
EXISTING CONDITIONS AND PRELIMINARY IMPACT ASSESSMENT

GREY ROAD 19
MUNICIPAL CLASS ENVIRONMENTAL ASSESSMENT

TOWN OF THE BLUE MOUNTAINS
COUNTY OF GREY, ONTARIO

EXECUTIVE SUMMARY

ASI was contracted by R.J. Burnside and Associates Limited, on behalf of the County of Grey, to conduct a Cultural Heritage Report as part of the Grey Road 19 Municipal Class Environmental Assessment. The project involves the road improvements for Grey Road 19 between the intersection of Grey Road 19 / Simcoe Road 34 / Grey Road 21 and Mountain Road and the roundabout at Grey Road 19 / Grey Road 119 / Gord Canning Drive. The study area includes the right of way plus 50 meters, excluding the intersections of Grey Road 19 / Simcoe Road 34 / Grey Road 21 and Mountain Road, the roundabout at Grey Road 10/ Grey Road 119/ Gord Canning Drive, and the roundabout at Grey Road 19 and Crosswinds Boulevard. The study area is in the Town of Blue Mountains, County of Grey, and is generally bounded by rural residences near ski hills and resorts and undeveloped woodlands.

The purpose of this report is to present an inventory of known and potential built heritage resources (BHRs) and cultural heritage landscapes (CHLs), identify existing conditions of the project study area, provide a preliminary impact assessment, and propose appropriate mitigation measures. A January 2021 draft submission included the Existing Conditions component of the assessment and was updated to include the Preliminary Impact Assessment when preliminary designs were available for review in July 2022.

The results of background historical research and a review of secondary source material, including historical mapping, indicate a study area with a rural land use history dating back to the early nineteenth century. A review of federal, provincial, and municipal registers, inventories, and databases revealed that there are no previously identified features of cultural heritage value within or adjacent to the Grey Road 19 study area. One additional feature of potential cultural heritage value was identified during the fieldwork (CHL 1). A review of the preliminary design determined that there are no anticipated impacts to the one identified cultural heritage landscape.

Based on the results of the assessment, the following recommendations have been developed:

1. Construction activities and staging should be suitably planned and undertaken to avoid impacts to the identified cultural heritage landscape (CHL 1). Suitable mitigation including establishing no-go zones with fencing and issuing instructions to construction crews to avoid the cultural heritage landscape should be considered to mitigate any unintended impacts.

2. To ensure the frame barn directly east of the residence at 796054 Grey Road 19 (CHL 1) is not adversely impacted during construction, baseline vibration monitoring should be undertaken during detailed design. Should this advance monitoring assessment conclude that the any structures will be subject to vibrations, a vibration monitoring plan should be prepared and implemented as part of the detailed design phase of the project to lessen vibration impacts related to construction.

3. Should future work require an expansion of the study area then a qualified heritage consultant should be contacted in order to confirm the impacts of the proposed work on potential heritage resources.

4. This report should be submitted by the proponent to heritage staff at the Town of the Blue Mountains, the County of Grey, the Ministry of Heritage, Sport, Tourism, and Culture Industries, and any other relevant stakeholder with an interest in this project.

PROJECT PERSONNEL

Senior Project Manager:	Annie Veilleux, MA, CAHP Senior Cultural Heritage Specialist | Manager - Cultural Heritage Division
Project Coordinator:	Katrina Thach, Hon. BA Archaeologist | Project Coordinator - Environmental Assessment Division
Project Manager:	John Sleath, MA Cultural Heritage Specialist | Project Manager - Cultural Heritage Division
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Report Production:	John Sleath
Graphics Production:	Peter Bikoulis, PhD Archaeologist | GIS Technician - Operations Division
	Robin Latour, BA, MPhil Archaeologist | Geomatics Specialist - Operations Division
Report Reviewer(s):	Kirstyn Allam, BA (Hon), Dip. Heritage Conservation Cultural Heritage Technician | Technical Writer and Researcher - Cultural Heritage Division
	Annie Veilleux

QUALIFIED PERSONS INVOLVED IN THE PROJECT

Annie Veilleux, M.A., C.A.H.P.
Senior Cultural Heritage Specialist, Manager - Cultural Heritage Division

The Senior Project Manager for this Cultural Heritage Report is **Annie Veilleux** (M.A., C.A.H.P.), who is a Senior Cultural Heritage Specialist and Manager of the Cultural Heritage Division. She was responsible for: overall project scoping and approach; development and confirmation of technical findings and study recommendations; application of relevant standards, guidelines and regulations; and implementation of quality control procedures. Annie is academically trained in the fields of cultural landscape theory, history, archaeology, and collections management and has over 15 years of experience in the field of cultural heritage resource management. This work has focused on the identification and evaluation of cultural heritage resources, both above and below ground. Annie has managed and conducted numerous built heritage and cultural heritage landscape assessments, heritage recordings and evaluations, and heritage impact assessments as required for Environmental Assessments and Planning projects throughout the Province of Ontario. Annie has extensive experience leading and conducting research for large-scale heritage planning studies, heritage interpretation programs, and projects requiring comprehensive public and Indigenous engagement programs. She is fully bilingual in English and French and has served as a French language liaison on behalf of Archaeological Services Inc. Annie is a member of the Ontario Archaeological Society, the National Trust for Canada, I.C.O.M.O.S. Canada, and I.A.P.2 Canada. She is also a professional member in good standing of the Canadian Association of Heritage Professionals.

John Sleath, M.A.
Cultural Heritage Specialist, Project Manager - Cultural Heritage Division
The Project Manager for this Cultural Heritage Report is **John Sleath** (MA), who is a Cultural Heritage Specialist and Project Manager within the Cultural Heritage Division with ASI. He was responsible for the day-to-day management activities, including scoping of research activities and site surveys and drafting of study findings and recommendations. John has worked in a variety of contexts within the field of cultural heritage resource management for the past 13 years, as an archaeologist and as a cultural heritage professional. In 2015 John began working in the Cultural Heritage Division researching and preparing a multitude of cultural heritage assessment reports and for which he was responsible for a variety of tasks including: completing archival research, investigating built heritage and cultural heritage landscapes, report preparation, historical map regression, and municipal consultation. Since 2018 John has been a project manager responsible for a variety of tasks required for successful project completion. This work has allowed John to engage with stakeholders from the public and private sector, as well as representatives from local municipal planning departments and museums. John has conducted heritage assessments across Ontario, with a focus on transit and rail corridor infrastructure including bridges and culverts.

GLOSSARY

Term	**Definition**
Adjacent	"contiguous properties as well as properties that are separated from a heritage property by narrow strip of land used as a public or private road, highway, street, lane, trail, right-of-way, walkway, green space, park, and/or easement or as otherwise defined in the municipal official plan" (Ministry of Tourism, Culture and Sport, 2010).
Built Heritage Resource (BHR)	"…a building, structure, monument, installation or any manufactured remnant that contributes to a property's cultural heritage value or interest as identified by a community, including an Indigenous community. Built heritage resources are located on property that may be designated under Parts IV or V of the *Ontario Heritage Act*, or that may be included on local, provincial, federal and/or international registers" (Government of Ontario, 2020, p. 41).
Cultural Heritage Landscape (CHL)	"…a defined geographical area that may have been modified by human activity and is identified as having cultural heritage value or interest by a community, including an Indigenous community. The area may include features such as buildings, structures, spaces, views, archaeological sites or natural elements that are valued together for their interrelationship, meaning or association. Cultural heritage landscapes may be properties that have been determined to have cultural heritage value or interest under the *Ontario Heritage Act*, or have been included on federal and/or international registers, and/or protected through official plan, zoning by-law, or other land use planning mechanisms" (Government of Ontario, 2020, p. 42).
Cultural Heritage Resource	Includes above-ground resources such as built heritage resources and cultural heritage landscapes, and built or natural features below-ground including archaeological resources (Government of Ontario, 2020).
Known Cultural Heritage Resource	A known cultural heritage resource is a property that has recognized cultural heritage value or interest. This can include a property listed on a Municipal Heritage Register, designated under Part IV or V of the *Ontario Heritage Act*, or protected by a heritage agreement, covenant or easement, protected by the *Heritage Railway Stations Protection Act or* the *Heritage Lighthouse Protection Act*, identified as a Federal Heritage Building, or located within a UNESCO World Heritage Site (Ministry of Tourism, Culture and Sport, 2016).
Impact	Includes negative and positive, direct and indirect effects to an identified cultural heritage resource. Direct impacts include destruction of any, or part of any, significant heritage attributes or features and/or unsympathetic or incompatible alterations to an identified resource. Indirect impacts include, but are not limited to, creation of shadows, isolation of heritage attributes, direct or indirect obstruction of significant views, change in land use, land disturbances (Ministry of Tourism and Culture, 2006). Indirect impacts also include potential vibration impacts

	(See Section 2.5 for complete definition and discussion of potential impacts).
Mitigation	Mitigation is the process of lessening or negating anticipated adverse impacts to cultural heritage resources and may include, but are not limited to, such actions as avoidance, monitoring, protection, relocation, remedial landscaping, and documentation of the cultural heritage landscape and/or built heritage resource if to be demolished or relocated.
Potential Cultural Heritage Resource	A potential cultural heritage resource is a property that has the potential for cultural heritage value or interest. This can include properties/project area that contain a parcel of land that is the subject of a commemorative or interpretive plaque, is adjacent to a known burial site and/or cemetery, is in a Canadian Heritage River Watershed, or contains buildings or structures that are 40 or more years old (Ministry of Tourism, Culture and Sport, 2016).
Significant	With regard to cultural heritage and archaeology resources, significant means “resources that have been determined to have cultural heritage value or interest. Processes and criteria for determining cultural heritage value or interest are established by the Province under the authority of the *Ontario Heritage Act.* While some significant resources may already be identified and inventoried by official sources, the significance of others can only be determined after evaluation” (Government of Ontario, 2020, p. 51).
Vibration Zone of Influence	Area within a 50 m buffer of construction-related activities in which there is potential to affect an identified cultural heritage resource. A 50 m buffer is applied in the absence of a project-specific defined vibration zone of influence based on existing secondary source literature and direction provided from the MHSTCI (Carman et al., 2012; Crispino & D’Apuzzo, 2001; P. Ellis, 1987; Rainer, 1982; Wiss, 1981). This buffer accommodates the additional threat from collisions with heavy machinery or subsidence (Randl, 2001).

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1.0 INTRODUCTION

1.1 Report Purpose

ASI was contracted by R.J. Burnside and Associates Limited, on behalf of the County of Grey, to conduct a Cultural Heritage Report as part of the Grey Road 19 Municipal Class Environmental Assessment. The purpose of this report is to present an inventory of known and potential built heritage resources (BHRs) and cultural heritage landscapes (CHLs), identify existing conditions of the project study area, provide a preliminary impact assessment, and propose appropriate mitigation measures. A January 2021 draft submission included the Existing Conditions component of the assessment and was updated to include the Preliminary Impact Assessment when preliminary designs were available for review in July 2022.

1.2 Project Overview

The Grey Road 19 Municipal Class Environmental Assessment involves the road improvements for Grey Road 19 between the intersection of Grey Road 19 / Simcoe Road 34 / Grey Road 21 and Mountain Road and the roundabout at Grey Road 19 / Grey Road 119 / Gord Canning Drive. The study area includes the right of way plus 50 meters, excluding the intersections of Grey Road 19 / Simcoe Road 34 / Grey Road 21 and Mountain Road, the roundabout at Grey Road 10/ Grey Road 119/ Gord Canning Drive, and the roundabout at Grey Road 19 and Crosswinds Boulevard.

1.3 Description of Study Area

The Existing Conditions portion of this Cultural Heritage Report prepared in January 2021 focused on the project study area with an additional 50 m buffer (Figure 1). This project study area has been defined as inclusive of those lands that may contain BHRs or CHLs that may be subject to direct or indirect impacts as a result of the proposed undertaking. The project study area was refined prior to completing the Preliminary Impact Assessment in July 2022 to include a 25 metre setback from all intersections, including the proposed roundabout at the centre of the study area to service the residential subdivision under construction to the north of Grey Road 19 at Crosswinds Boulevard (Figure 2). While the proposed undertaking and the preferred alternative for this EA omits a 25 metre setback from the intersections, the study area assessed in this Cultural Heritage Report includes the entire portion of Grey Road 19 depicted in Figure 1 due to the inclusion of a 50 metre buffer. The study area is in the Town of Blue Mountains, County of Grey, and is generally bounded by rural residences near ski hills and resorts and undeveloped woodlands.

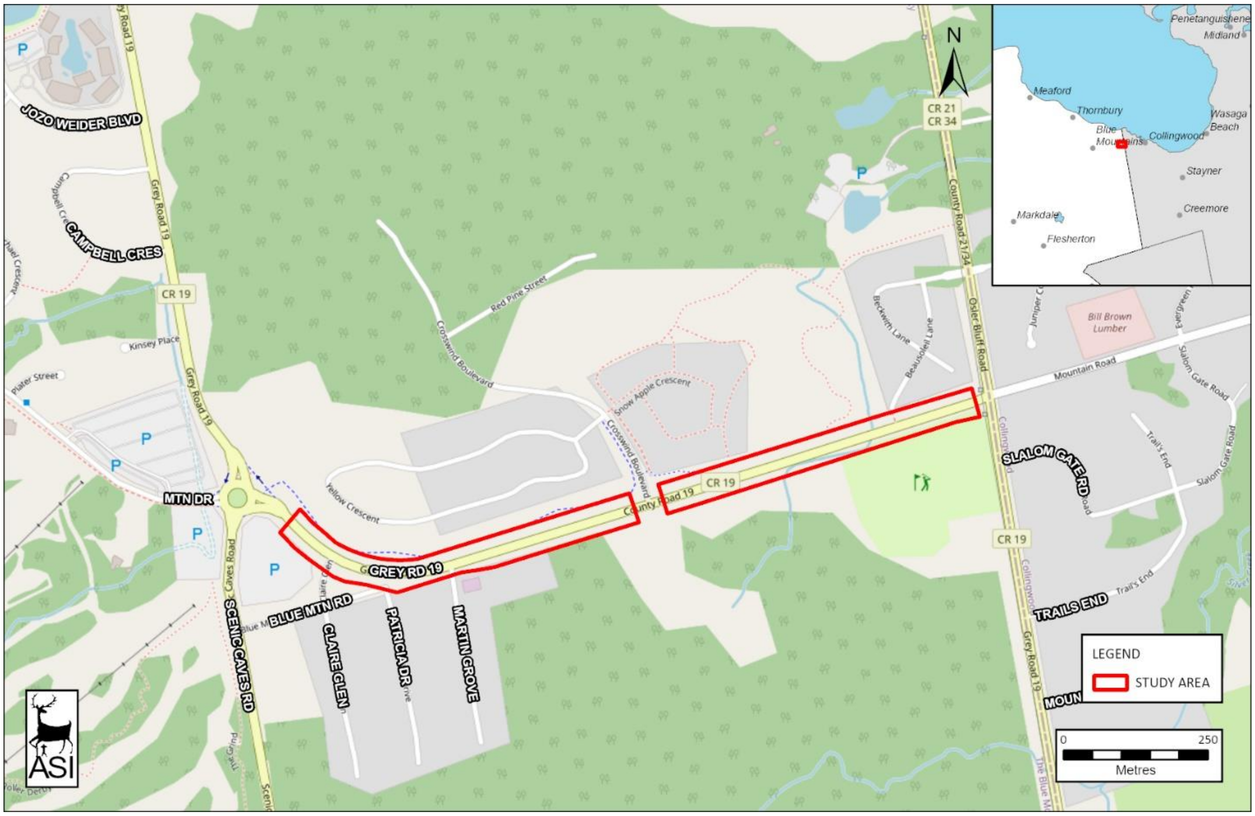

Figure 1: Location of the study area

Base Map: ©OpenStreetMap and contributors, Creative Commons-Share Alike License (CC-BY-SA)

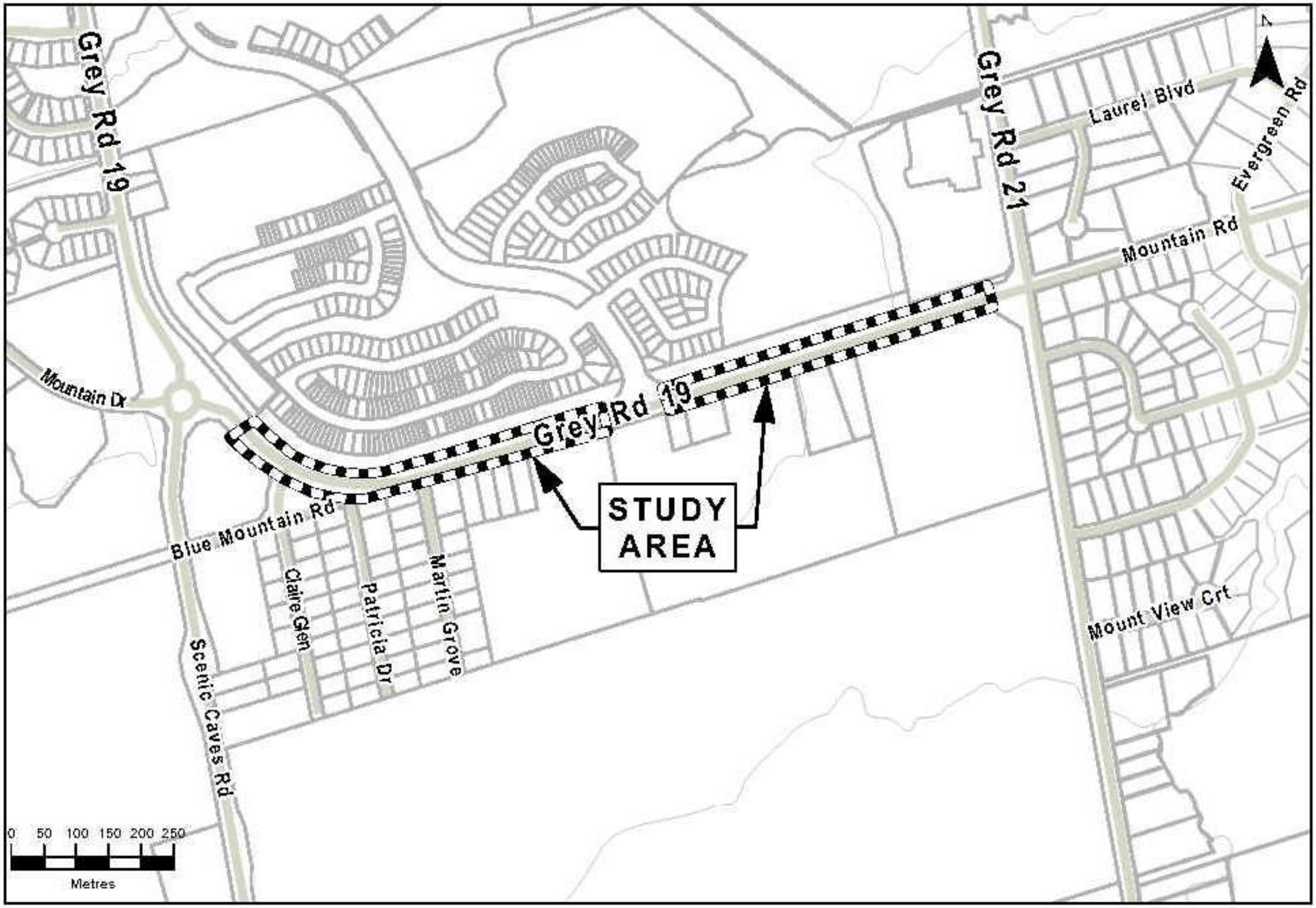

Figure 2: The Grey Road 19 Municipal Class EA Study Area (provided by R.J. Burnside and Associates Ltd.)

2.0 BUILT HERITAGE RESOURCE AND CULTURAL HERITAGE LANDSCAPE ASSESSMENT CONTEXT

2.1 Regulatory Requirements

The *Ontario Heritage Act (O.H.A.)* (Ontario Heritage Act, R.S.O. c. O.18, 1990 [as Amended in 2021], 1990) is the primary piece of legislation that determines policies, priorities and programs for the conservation of Ontario's heritage. There are many other provincial acts, regulations and policies governing land use planning and resource development that support heritage conservation, including:

- The *Planning Act* (Planning Act, R.S.O. 1990, c. P.13, 1990), which states that "conservation of features of significant architectural, cultural, historical, archaeological or scientific interest" (cultural heritage resources) is a "matter of provincial interest". The *Provincial Policy Statement* (Government of Ontario, 2020), issued under the *Planning Act*, links heritage conservation to long-term economic prosperity and requires municipalities and the Crown to conserve significant cultural heritage resources.
- The *Environmental Assessment Act* (Environmental Assessment Act, R.S.O., 1990), which defines "environment" to include cultural conditions that influence the life of humans or a community. Cultural heritage resources, which includes archaeological resources, built heritage resources and cultural heritage landscapes, are important components of those cultural conditions.

The Ministry of Heritage, Sport, Tourism and Culture Industries (hereafter "The Ministry") is charged under Section 2.0 of the O.H.A. with the responsibility to determine policies, priorities, and programs for the conservation, protection, and preservation of the heritage of Ontario. The Ministry of Tourism, Culture and Sport (now administered by M.H.S.T.C.I.) published *Standards and Guidelines for Conservation of Provincial Heritage Properties* (Ministry of Tourism, Culture and Sport, 2010) (hereinafter "*Standards and Guidelines*"). These *Standards and Guidelines* apply to properties the Government of Ontario owns or controls that have "cultural heritage value or interest" (C.H.V.I.). The *Standards and Guidelines* provide a series of guidelines that apply to provincial heritage properties in the areas of identification and evaluation; protection; maintenance; use; and disposal. For the purpose of this report, the *Standards and Guidelines* provide points of reference to aid in determining potential heritage significance in identification of built heritage resources and cultural heritage landscapes. While not directly applicable for use in properties not under provincial ownership, the *Standards and Guidelines* are regarded as best practice for guiding heritage assessments and ensure that additional identification and mitigation measures are considered.

Similarly, the *Ontario Heritage Tool Kit* (Ministry of Culture, 2006) provides a guide to evaluate heritage properties. To conserve a built heritage resource or cultural heritage landscape, the *Ontario Heritage Tool Kit* states that a municipality or approval authority may require a heritage impact assessment and/or a conservation plan to guide the approval, modification, or denial of a proposed development.

2.2 Municipal Heritage Policies

The study area is located within the Town of the Blue Mountains in the County of Grey. Policies relating to cultural heritage resources were reviewed from the following sources:

- *Town of The Blue Mountains Official Plan* (Town of the Blue Mountains, 2016)
- *County of Grey Official Plan* (County of Grey, 2019)
- *The Town of Blue Mountains Cultural Heritage Landscape Report* (Envision, 2009)
- The Niagara Escarpment Commission's (NEC) *Niagara Escarpment Plan* (NEP) (Niagara Escarpment Commission, 2020)

2.3 Identification of Built Heritage Resources and Cultural Heritage Landscapes

This Cultural Heritage Report follows guidelines presented in the *Ontario Heritage Tool Kit* (Ministry of Culture, 2006) and *Criteria for Evaluating Potential for Built Heritage Resources and Cultural Heritage Landscapes* (Ministry of Tourism, Culture and Sport, 2016). The objective of this report is to present an inventory of known and potential BHRs and CHLs, and to provide a preliminary understanding of known and potential BHRs and CHLs located within areas anticipated to be directly or indirectly impacted by the proposed project.

In the course of the cultural heritage assessment process, all potentially affected BHRs and CHLs are subject to identification and inventory. Generally, when conducting an identification of BHRs and CHLs within a study area, three stages of research and data collection are undertaken to appropriately establish the potential for and existence of BHRs and CHLs in a geographic area: background research and desktop data collection; field review; and identification.

Background historical research, which includes consultation of primary and secondary source research and historical mapping, is undertaken to identify early settlement patterns and broad agents or themes of change in a study area. This stage in the data collection process enables the researcher to determine the presence of sensitive heritage areas that correspond to nineteenth- and twentieth-century settlement and development patterns. To augment data collected during this stage of the research process, federal, provincial, and municipal databases and/or agencies are consulted to obtain information about specific properties that have been previously identified and/or designated as having cultural heritage value. Typically, resources identified during these stages of the research process are reflective of particular architectural styles or construction methods, associated with an important person, place, or event, and contribute to the contextual facets of a particular place, neighbourhood, or intersection.

A field review is then undertaken to confirm the location and condition of previously identified BHRs and CHLs. The field review is also used to identify potential BHRs or CHLs that have not been previously identified on federal, provincial, or municipal databases or through other appropriate agency data sources.

During the cultural heritage assessment process, a property is identified as a potential BHR or CHL based on research, the MHSTCI screening tool, and professional expertise. In addition, use of a 40-year-old benchmark is a guiding principle when conducting a preliminary identification of BHRs and CHLs. While identification of a resource that is 40 years old or older does not confer outright heritage significance, this benchmark provides a means to collect information about resources that may retain heritage value. Similarly, if a resource is slightly younger than 40 years old, this does not preclude the resource from having cultural heritage value or interest.

2.4 Background Information Review

To make an identification of previously identified known or potential BHRs and CHLs within the study area, the following resources were consulted as part of this Cultural Heritage Report.

2.4.1 Review of Existing Heritage Inventories

A number of resources were consulted in order to identify previously identified BHRs and CHLs within the study area. These resources, reviewed on 2 December 2020, include:

- The *Ontario Heritage Act Register* (Ontario Heritage Trust, n.d.b);
- The inventory of Ontario Heritage Trust easements (Ontario Heritage Trust, n.d.a);
- The *Places of Worship Inventory* (Ontario Heritage Trust, n.d.c);
- *Ontario Heritage Plaque Database* (Ontario Heritage Trust, n.d.d);
- Database of known cemeteries/burial sites curated by the Ontario Genealogical Society (Ontario Genealogical Society, n.d.);
- *Canada's Historic Places* website (Parks Canada, n.d.a);
- *Directory of Federal Heritage Designations* (Parks Canada, n.d.b);
- Canadian Heritage River System (Canadian Heritage Rivers Board and Technical Planning Committee, n.d.); and,
- United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage Sites (U.N.E.S.C.O. World Heritage Centre, n.d.).

2.4.2 Review of Previous Heritage Reporting

Additional cultural heritage studies undertaken within parts of the study area available for review as part of this assessment include:

- *Town of the Blue Mountains Cultural Heritage Landscape Assessment Study* (Envision, 2009)

2.4.3 Stakeholder Data Collection

The following individuals, groups, and/or organizations were contacted to gather information on known and potential BHRs and CHLs, active and inactive cemeteries, and areas of identified Indigenous interest within the study area:

- The Town of the Blue Mountains (email communication with general inquiry portal on the Town's website on 8 December 2020). A response on 9 December 2020 confirmed that there are no municipally listed or designated properties within or adjacent to the study area. However, the study area was noted as being in close proximity to two seventeenth-century Indigenous villages and crossed a long-used indigenous spiritual center. Contact information for Andrea Williams, Craiglieth Heritage Depot Museum Curator was provided.
- Andrea Williams, Craigleith Heritage Depot Museum Curator (email communication 9 December 2020). A response provided information on an identified feature of Indigenous spiritual

importance located in the nearby Scenic Caves. Addition information on this feature of Indigenous interest and the associated pathways nearby was provided, and are included in Section 4.2.

- The MHSTCI (email communication 8 December 2020)[1]. Email correspondence confirmed that there are no additional previously identified heritage resources, Provincial Heritage Properties, or concerns regarding the study area.
- The Ontario Heritage Trust (email communications 8 December 2020). A response indicated that there are no conservation easements or Trust-owned properties within or adjacent to the study area.

2.5 Preliminary Impact Assessment Methodology

To assess the potential impacts of the undertaking, identified BHRs and CHLs are considered against a range of possible negative impacts, based on the *Ontario Heritage Tool Kit InfoSheet #5: Heritage Impact Assessments and Conservation Plans* (Ministry of Tourism and Culture, 2006). These include:

- Direct impacts:
  - Destruction of any, or part of any, significant heritage attributes or features; and
  - Alteration that is not sympathetic, or is incompatible, with the historic fabric and appearance.
- Indirect impacts
  - Shadows created that alter the appearance of a heritage attribute or change the viability of a natural feature or plantings, such as a garden;
  - Isolation of a heritage attribute from its surrounding environment, context or a significant relationship;
  - Direct or indirect obstruction of significant views or vistas within, from, or of built and natural features;
  - A change in land use such as rezoning a battlefield from open space to residential use, allowing new development or site alteration to fill in the formerly open spaces; and
  - Land disturbances such as a change in grade that alters soils, and drainage patterns that adversely affect an archaeological resource.

Indirect impacts from construction-related vibration have the potential to negatively affect BHRs or CHLs depending on the type of construction methods and machinery selected for the project and proximity and composition of the identified resources. Potential vibration impacts are defined as having potential to affect an identified BHRs and CHLs where work is taking place within 50 m of features on the property. A 50 m buffer is applied in the absence of a project-specific defined vibration zone of influence based on existing secondary source literature and direction provided from the MHSTCI (Carman et al., 2012; Crispino & D'Apuzzo, 2001; P. Ellis, 1987; Rainer, 1982; Wiss, 1981). This buffer accommodates any additional or potential threat from collisions with heavy machinery or subsidence (Randl, 2001).

Several additional factors are also considered when evaluating potential impacts on identified BHRs and CHLs. These are outlined in a document set out by the Ministry of Culture and Communications (now MHSTCI) and the Ministry of the Environment entitled *Guideline for Preparing the Cultural Heritage Resource Component of Environmental Assessments* (1992) and include:

[1] Contacted at registrar@ontario.ca.

- Magnitude: the amount of physical alteration or destruction which can be expected;
- Severity: the irreversibility or reversibility of an impact;
- Duration: the length of time an adverse impact persists;
- Frequency: the number of times an impact can be expected;
- Range: the spatial distribution, widespread or site specific, of an adverse impact; and
- Diversity: the number of different kinds of activities to affect a heritage resource.

The proposed undertaking should endeavor to avoid adversely affecting known and potential BHRs and CHLs and interventions should be managed in such a way that identified significant cultural heritage resources are conserved. When the nature of the undertaking is such that adverse impacts are unavoidable, it may be necessary to implement alternative approaches or mitigation strategies that alleviate the negative effects on identified BHRs and CHLs. Mitigation is the process of lessening or negating anticipated adverse impacts to cultural heritage resources and may include, but are not limited to, such actions as avoidance, monitoring, protection, relocation, remedial landscaping, and documentation of the BHR or CHL if to be demolished or relocated.

Various works associated with infrastructure improvements have the potential to affect BHRs and CHLs in a variety of ways, and as such, appropriate mitigation measures for the undertaking need to be considered.

3.0 SUMMARY OF HISTORICAL DEVELOPMENT WITHIN THE STUDY AREA

This section provides a brief summary of historical research and a description of identified above-ground cultural heritage resources that may be affected by the proposed undertaking.

A review of available primary and secondary source material was undertaken to produce a contextual overview of the study area, including a general description of physiography, Indigenous land use, and Euro-Canadian settlement

3.1 Physiography

The study area is within the Niagara Escarpment, one of the most prominent features in southern Ontario, which extends from the Niagara River to the northern tip of the Bruce Peninsula, continuing through the Manitoulin Islands (Chapman and Putnam 1984:114-122). Vertical cliffs along the brow mostly outline the edge of the dolostone of the Lockport and Amabel Formations, which the slopes below are carved in red shale. Flanked by landscapes of glacial origin, the rock-hewn topography stands in striking contrast, and its steep-sided valleys are strongly suggestive of non-glacial regions. From Queenston, on the Niagara River, westward to Ancaster, the escarpment is a simple topographic break separating the two levels of the Niagara Peninsula. The Niagara Escarpment is a designated UNESCO World Biosphere Reserve.

Directly west of the study area the Niagara Escarpment is visible as a prominent landform, known locally as the Blue Mountains and commonly used for downhill skiing in the winter. The Blue Mountains in particular, and the Niagara Escarpment in general, as been instrumental in shaping human settlement, industry, cosmology, and recreation in the area for millennia.

3.2 Indigenous Land Use and Settlement

Southern Ontario has been occupied by human populations since the retreat of the Laurentide glacier approximately 13,000 years ago, or 11,000 Before the Common Era (B.C.E.) (Ferris, 2013).[2] During the Paleo period (c. 11,000 B.C.E. to 9,000 B.C.E.), groups tended to be small, nomadic, and non-stratified. The population relied on hunting, fishing, and gathering for sustenance, though their lives went far beyond subsistence strategies to include cultural practices including but not limited to art and astronomy. Fluted points, beaked scrapers, and gravers are among the most important artifacts to have been found at various sites throughout southern Ontario, and particularly along the shorelines of former glacial lakes. Given the low regional population levels at this time, evidence concerning Paleo-Indian period groups is very limited (C. J. Ellis & Deller, 1990).

Moving into the Archaic period (c. 9,000 B.C.E. to 1,000 B.C.E.), many of the same roles and responsibilities continued as they had for millennia, with groups generally remaining small, nomadic, and non-hierarchical. The seasons dictated the size of groups (with a general tendency to congregate in the spring/summer and disperse in the fall/winter), as well as their various sustenance activities, including fishing, foraging, trapping, and food storage and preparation. There were extensive trade networks which involved the exchange of both raw materials and finished objects such as polished or ground stone tools, beads, and notched or stemmed projectile points. Furthermore, mortuary ceremonialism was evident, meaning that there were burial practices and traditions associated with a group member's death (C. J. Ellis et al., 2009; C. J. Ellis & Deller, 1990).

The Woodland period (c. 1,000 B.C.E. to 1650 C.E.) saw several trends and aspects of life remain consistent with previous generations. Among the more notable changes, however, was the introduction of pottery, the establishment of larger occupations and territorial settlements, incipient horticulture, more stratified societies, and more elaborate burials. Later in this period, settlement patterns, foods, and the socio-political system continued to change. A major shift to agriculture occurred in some regions, and the ability to grow vegetables and legumes such as corn, beans, and squash ensured long-term settlement occupation and less dependence upon hunting and fishing. This development contributed to population growth as well as the emergence of permanent villages and special purpose sites supporting those villages. Furthermore, the socio-political system shifted from one which was strongly kinship based to one that involved tribal differentiation as well as political alliances across and between regions (Birch & Williamson, 2013; Dodd et al., 1990; C. J. Ellis & Deller, 1990; Williamson, 1990).

The Tionontaté were closely related to the Huron-Wendat and lived in the area west of Huronia within the current Town of The Blue Mountains, Grey County, Ontario. The seventeenth-century French explorers who encountered these peoples dubbed them the Petun, or "tobacco people," due to their reputation of growing large amounts of tobacco. They lived in large palisaded villages (averaging 1.7 ha),

[2] While many types of information can inform the precontact settlement of Ontario, such as oral traditions and histories, this summary provides information drawn from archaeological research conducted in southern Ontario over the last century.

temporary hunting and fishing camps, cabin sites, and small hamlets with a material culture characterized by globular-shaped ceramic vessels, ceramic pipes, bone/antler awls and beads, ground and chipped stone tools, and copper objects. The population peaked at approximately 30,000 people during the late fifteenth century, however by the early sixteenth century Tionontaté territory contracted and the north shore of Lake Ontario was almost abandoned. (Garrad, 2014; Ramsden, 1990, pp. 363–378; Warrick, 2000, pp. 446–454, 2008).

According to the *Blue Mountains Cultural Heritage Landscape Report* (Envision 2009):

> About 350 years ago, the Petun, or Tionontati First Nations people lived in a chain of villages on the slopes of the escarpment between Creemore and Craigleith. They lived in longhouses and planted corn, beans, pumpkins, squash and tobacco.
>
> The Native village of Ekarenniondi, 'the rock that stands out', home of the Hurons (Petun Tribe), was located near what is now known as the Scenic Caves. In 1649, the Seneca warriors killed most of the Petun. The survivors fled into the Beaver Valley and eventually into Kansas and Oklahoma, where they eventually formed the Wyandot Nation.
> The Town of The Blue Mountains has over 85 archeological sites. The most significant are: Haney-Cook, the Plater-Martin, and the Plater-Fleming. The Haney Cook (BcHb-27) site once consisted of two First Nations villages located south of the Scenic Caves, dating back to 1600 A.D. The site location is interpreted as the location where Samuel de Champlain met the Odawa Kiskakon in 1616 A.D.
>
> Subsequently the two villages moved south of the Scenic Caves to Craigleith to sites now referred to as the Plater- Martin and Plater- Fleming archeological sites. The Plater-Martin (BdHb-1) site was occupied between the 1630s-1650s and was the capital of the Petun Deer Nation. The village functioned as the trading hub between Petun, Huron, Odawa, Neutral and Algonquin peoples. St. Matthew, the name given to this village by the Jesuits, was the location of the formation and starting point of the south migration of the Wyandot Nation. Nearby, the village of St. Simon and St. Jude, as named by the Jesuits, was occupied between 1630-1650s by Petun and Odawa tribes, and later on provided shelter for Huron refugees from Ossasane. This village is now referred to as the Plater-Fleming (BdHb-2) archeological site.
>
> The Ekarenniondi Villages, discovered by Samuel de Champlain in 1616 were distinguished by the French and the earliest stories of Ekarenniondi were recorded in 1636.

The arrival of European trade goods in the sixteenth century, Europeans themselves in the seventeenth century, and increasing settlement efforts in the eighteenth century all significantly impacted traditional ways of life in Southern Ontario. Over time, war and disease contributed to death, dispersion, and displacement of many Indigenous peoples across the region. The Euro-Canadian population grew in both numbers and power through the eighteenth and nineteenth centuries and treaties between colonial administrators and First Nations representatives began to be negotiated. The study area is within the Nottawasaga Purchase, or Treaty No. 18 of the Upper Canada Land Surrenders.

The study area is located in the traditional territory of the Saugeen Ojibway Nation (SON), the collective name for the Saugeen Ojibway First Nation and the Chippewas of Nawash Unceded First Nation, known as *Anishnaabekiing*, which includes the Saugeen Peninsula (or Bruce Peninsula), the waters and islands of Lake Huron and Georgian Bay surrounding the Saugeen Peninsula, and extends south to include the Maitland River watershed and east to include the Nottawasaga River watershed in part of Grey, Bruce, Huron, Perth, Wellington, Dufferin, and Simcoe Counties (Saugeen Ojibway Nation, 2011). Ojibway chiefs granted approximately 1.5 million acres of land in an effort to secure a land base on Manitoulin Island along the shores of Lake Huron and southern Georgian Bay to the Crown with the signing of the 1818 Lake Simcoe-Nottawasaga Treaty No. 18 and the 1836 “Saugeen Tract Agreement” Treaty #45 ½, (Crown-Indigenous Relations and Northern Affairs, 2016a, 2016b). The encroachment of Euro-Canadian settlement did not lessen and in 1847 Queen Victoria issued a Royal Declaration in order to support the rights of the SON. The Proclamation also established strict rules for the purchased and surrender of Indigenous lands in Canada. The Declaration confirmed that the Bruce Peninsula belonged to the SON. Additional acts were passed in 1850 and 1851 in order to protect lands from squatters and loggers but these documents did little to stem the tide of Euro-Canadian settlement. By the 1850s the remaining lands included Chief’s Point, Saugeen Reserve (Owen Sound), Colpoy’s Bay Reserve (Big Bay), Cape Croker Indian Reserve No. 27, the Fishing Islands in Lake Huron, Cape Hurd Islands, and three islands at the entrance of Colpoy’s Bay. Between 1885 and 1899, several islands were surrendered including the Fishing Islands and Cape Hurd Islands of Lake Huron. Griffith, Hay, and White Cloud Islands of Georgina Bay were also surrendered. In 1994, the SON launched a land claim for part of their traditional territory, claiming breach of trust by the Crown in failing to meet its obligations to protect Aboriginal lands. The claim seeks the return of lands still retained by the Crown and for financial compensation for other lands. The claim has yet to be resolved (Chippewas of Nawash Unceded First Nation, 2014; Saugeen Ojibway Nation, 2011).

3.3 Historical Euro-Canadian Township Survey and Settlement

The first Europeans to arrive in the area were transient merchants and traders from France and England, who followed Indigenous pathways and set up trading posts at strategic locations along the well-traveled river routes. All of these occupations occurred at sites that afforded both natural landfalls and convenient access, by means of the various waterways and overland trails, into the hinterlands. Early transportation routes followed existing Indigenous trails, both along the lakeshore and adjacent to various creeks and rivers (ASI 2006). Early European settlements occupied similar locations as Indigenous settlements as they were generally accessible by trail or water routes and would have been in locations with good soil and suitable topography to ensure adequate drainage.

Historically, the study area is located in the Former Township of Collingwood, County of Grey in part of Lots 15 and 16, Concession 1.

3.3.1 County of Grey

Grey County was surveyed between 1833 and 1857, with Charles Rankin performing the first survey work. Rankin is also considered one of the first Euro-Canadian inhabitants in the county, and settled in St. Vincent Township in 1834. Rankin surveyed Garafraxa Road (modern-day Highway 6) in 1937 as a colonization road, which stretched from Fergus in the south to modern-day Owen Sound in the north, and opened large tracts of the county for settlement. Additional roadways including The Durham Road (surveyed in 1848-49), the Old Mail or Government Road (surveyed in 1849), and the Sydenham Road (surveyed in 1850) connected Owen Sound and the county with other urban centers and spurred development and settlement. The county derived its name from Earl Grey, the British Colonel Secretary from 1846 to 1852 (Mika & Mika, 1981).

The arrival of railroads including the Grey and Bruce Railroad in 1873, the Wellington and Georgian Bay Railroad in 1882, and the Stratford and Wiarton Railroad in 1882 opened the county up to further trade with larger industrial and commercial centers like Orangeville and Toronto, which increased settlement and development in Owen Sound at the mouth of the Sydenham River on Georgian Bay (Mika & Mika, 1981).

Grey County features rolling and hilly areas within the Niagara Escarpment in the northern portion of the county on the southern shores of Georgian Bay. The county is bound on the west by Bruce County, on the east by Simcoe County, and on the south by Wellington County. The principle river drainages in the county are the Beaver, Bighead, and Sydenham Rivers that drain north into Georgian Bay and the Saugeen River that drains west into Lake Huron (Mika & Mika, 1981).

3.3.2 Township of Collingwood

The Township of Collingwood is in the northeastern portion of Grey County on the southern shores of Georgian Bay. The Blue Mountains, part of the Niagara Escarpment, are located in the center of the township and define the geography and physiography of the area. The township was surveyed by Charles Rankin in 1833, and was the first township be surveyed in Grey County. Originally named Alta by Rankin, the name was officially changed to Collingwood in honour of Lord Cuthbert Collingwood, a British Admiral. The principal settlement in the township was Thornbury, which was ceded to become an incorporated Town in 1887. Other notable settlements in the Township include Clarksburg, Banks, Craigleith, and Ravenna (Mika & Mika, 1977).

The Town of the Blue Mountains was official formed in 1998 with the amalgamation of the Township of Collingwood and the Town of Thornbury (The Blue Mountains Public Library, 2020).

3.4 Review of Historical Mapping

The 1880 Grey Supplement in the *Illustrated Atlas of the Dominion of Canada* (Belden, 1880) was examined to determine the presence of historical features within the study area during the nineteenth century (Figure 3).

It should be noted, however, that not all features of interest were mapped systematically in the Ontario series of historical atlases. For instance, they were often financed by subscription limiting the level of detail provided on the maps. Moreover, not every feature of interest would have been within the scope of the atlases. The use of historical map sources to reconstruct or predict the location of former features within the modern landscape generally begins by using common reference points between the various sources. The historical maps are geo-referenced to provide the most accurate determination of the location of any property on a modern map. The results of this exercise can often be imprecise or even contradictory, as there are numerous potential sources of error inherent in such a process, including differences of scale and resolution, and distortions introduced by reproduction of the sources.

Historically, the study area is located on Lots 15 and 16, Concession 1 in the Township of Collingwood, County of Grey. Nineteenth-century mapping does not provide any details of historical property owners or historical features in the study area. Grey Road 19 is depicted in similar alignment to later mapping in the eastern portion of the study area, however it is depicted as continuing directly westward to the intersection with Scenic Caves Road rather than diverting to the north as it does in later mapping. Scenic Caves Road (119) is depicted as a winding roadway that follows the local topography of the Niagara Escarpment to the southwest of the study area. Highway 21/19, the eastern limit of the study area, is depicted as the boundary between the Township of Collingwood in the County of Grey and the Township of Nottawasaga in the County of Simcoe. The Village of Craigleith is depicted to the northwest of the study area on the shores of Georgian Bay.

In addition to nineteenth-century mapping, historical topographic mapping and aerial photographs from the twentieth century were examined. This report presents maps and aerial photographs from 1941, 1954, and 1993 (Figure 4 to Figure 6). These do not represent the full range of maps consulted for the purpose of this study but were judged to cover the full range of land uses that occurred in the area during this period.

The 1941 NTS Map (Department of National Defence, 1941) depicts the study area in generally a similar rural context as earlier mapping, with Grey Road 19 following a straight alignment between Scenic Caves Road (119) and Highway 21/19. Two farmsteads are depicted on the north of Grey Road 19, and one is depicted to the south within the study area. The community of Mair Mills is located to the east of the intersection of Grey Road 19 and Highway 21/19 where a small creek crosses the roadway. To the west of the study area the topographical map depicts the dramatic change in topographic relief associated with the Niagara Escarpment. Scenic Caves Road (119) meanders to accommodate this change in topography, with ‘The Caves’ noted to the southeast of the study area.

The 1954 Aerial Photograph (Hunting Survey Corporation Limited, 1954) and the 1993 NTS Sheet (Department of Energy, Mines and Resources, 1990) (Figure 5 and Figure 6) depict the study area in a rural context to the immediate west of the boundary of Grey and Simcoe Counties.

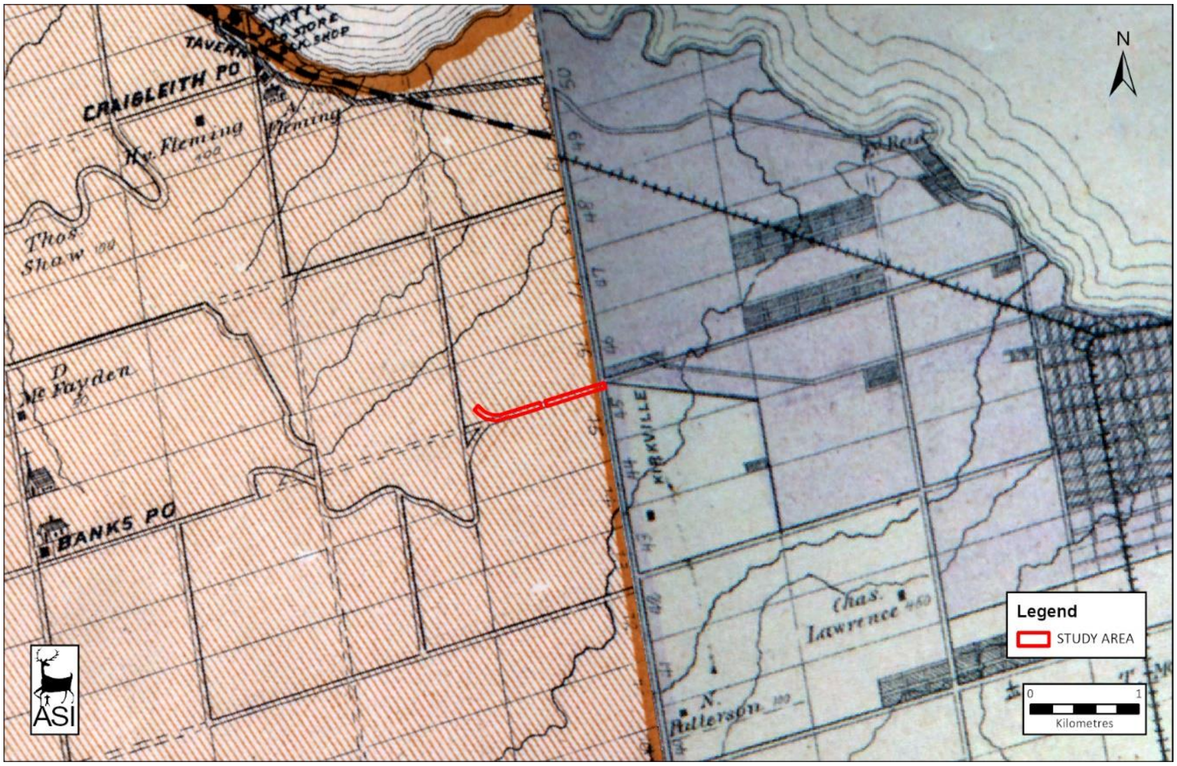

Figure 3: The study area overlaid on the 1880 Illustrated Historical Atlas of the County of Grey

Base Map: (Belden, 1880)

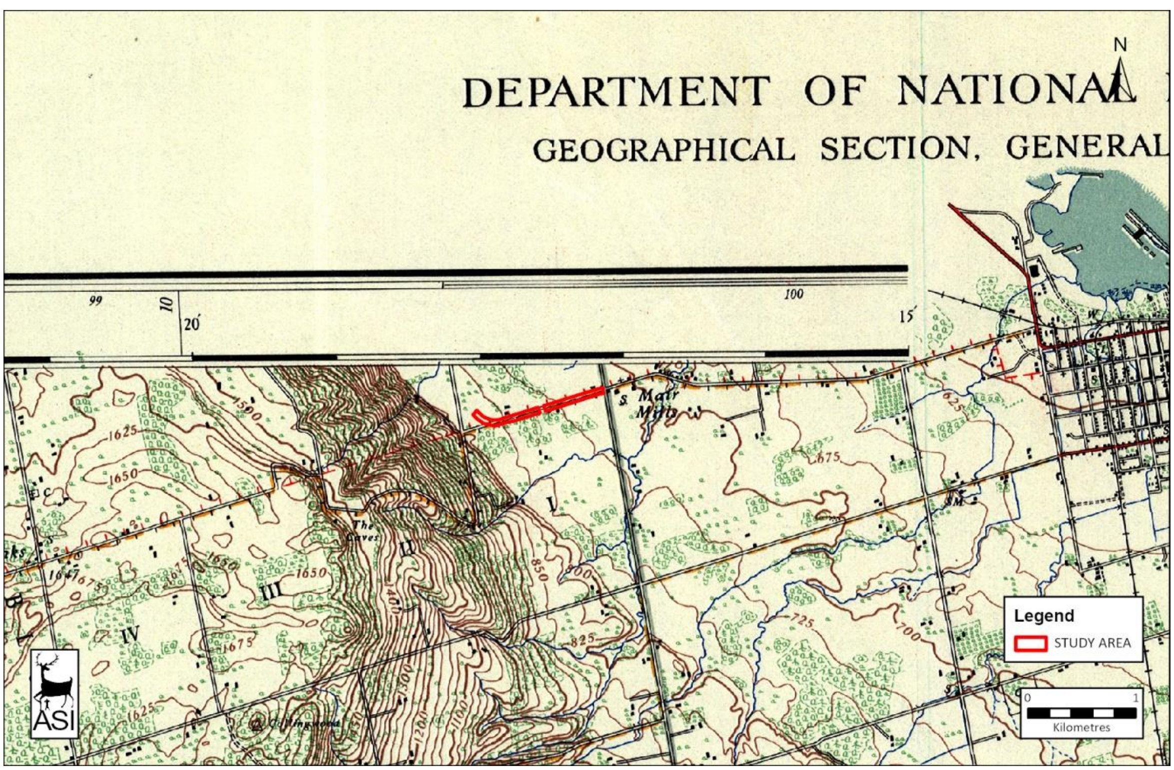

Figure 4: The study area overlaid on the 1941 topographic map of Collingwood

Base Map: (Department of National Defence, 1941)

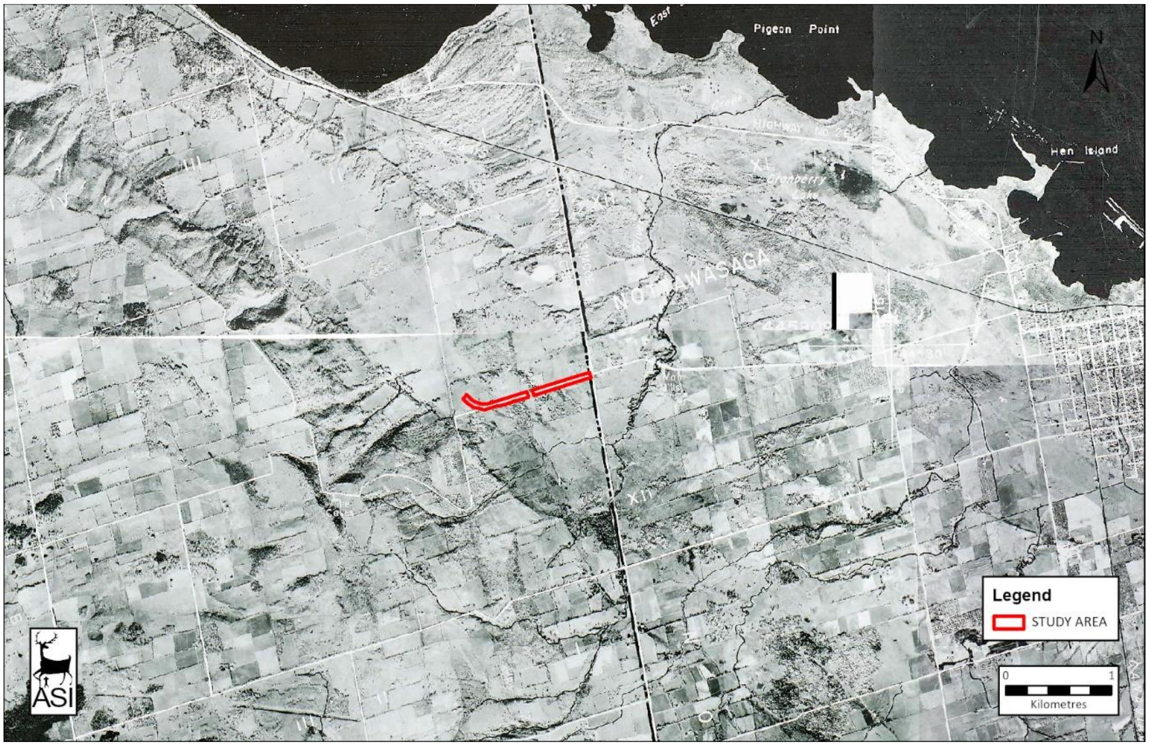

Figure 5: The study area overlaid on the 1954 aerial photograph of Southern Ontario
Base Map: Hunting Survey Corporation Ltd. 1954

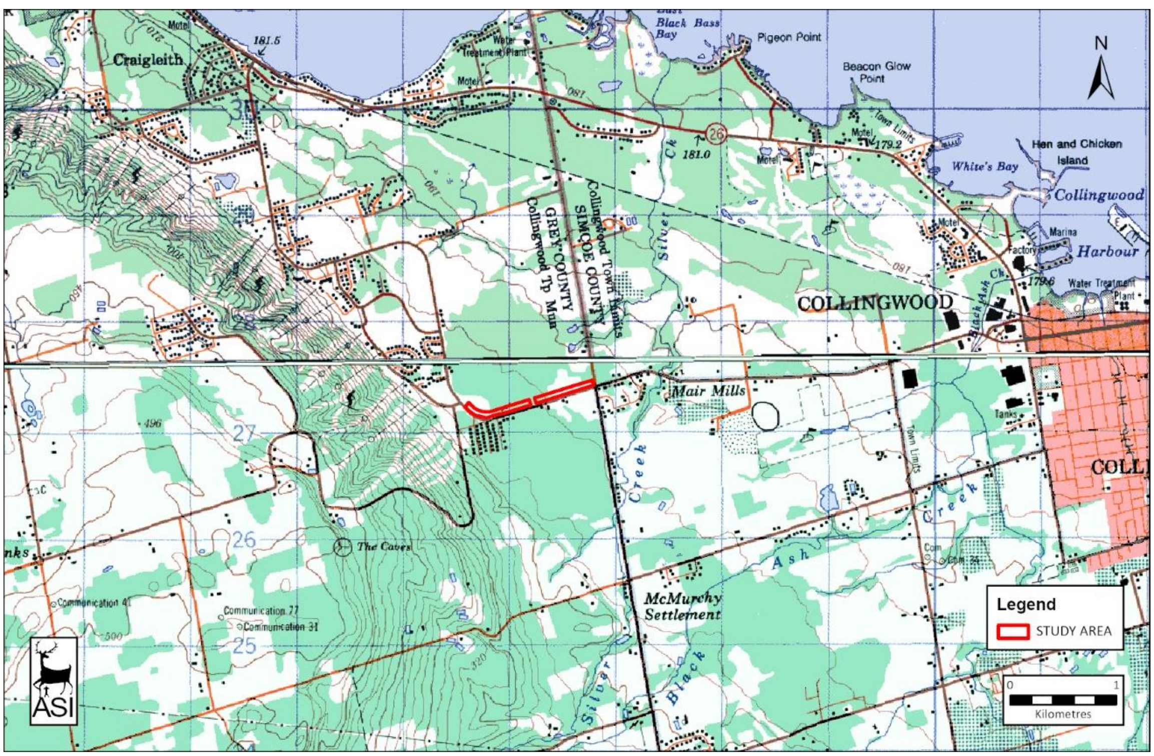

Figure 6: The study area overlaid on the 1993 NTS map of Collingwood
Base Map: (Department of Energy, Mines and Resources, 1990)

4.0 EXISTING CONDITIONS

4.1 Description of Field Review

A field review of the study area was undertaken by Martin Cooper of ASI, on 19 November 2020 to document the existing conditions of the study area from existing rights-of-way. The existing conditions of the study area are described below and captured in Plate 1 to Plate 9. Identified cultural heritage resources are discussed in Section 4.2 and are mapped in Figure 7 and Figure 8 of this report.

The study area is located in a generally rural residential context centered on Grey Road 9 between but excluding the intersections of Grey Road 19 / Simcoe Road 34 / Grey Road 21 and Mountain Road, the roundabout at Grey Road 10/ Grey Road 119/ Gord Canning Drive, and the roundabout at Grey Road 19 and Crosswinds Boulevard. Within the study area, Grey Road 19 is a two-lane undivided roadway that lacks curbs and sidewalks, and features gravel shoulders. Grey Road 19 generally follows an east-west orientation, but diverts to the north west of Martins Grove Road towards the intersection with a roundabout past the western limit of the study area.

The area adjacent to the northern limit of the study area is generally bound by undeveloped woodlands in the east and early twenty-first century residential subdivisions to the west. The area to the south of the roadway features a golf driving range at the west, wooded areas and rural residences on large lots in the centre, and more dense residential developments to the west on Martins Grove Road. A nineteenth-century barn is located in the central portion of the study area and was associated with a residence, however the residence was not observed during field review and appears to have been demolished.

Plate 1: Grey Road 19 in the western portion of the study area, looking northwest from Claire Glen.

Plate 2: Grey Road 19 in the western portion of the study area, looking southeast. Note the bike trail at left.

Plate 3: Grey Road 19 looking west towards Martins Grove. Note the Niagara Escarpment at rear.

Plate 4: Twenty-first century residences north of Grey Road 19, looking north.

Plate 5: Entrance to Windfall Subdivision in the central portion of the study area, looking north.

Plate 6: Grass area adjacent to barn in the central portion of the study area, looking south.

Plate 7: Driving range in the southeast portion of the study area, looking southeast.

Plate 8: Grey Road 19, looking west from the northeastern portion of the study area. Note the recreational trail at right.

Plate 9: Grey Road 19, looking east towards the intersection with Simcoe Road 34 / Grey Road 21 and Mountain Road.

4.2 Identification of Known and Potential Built Heritage Resources and Cultural Heritage Landscapes

Based on the results of the background research and field review, one cultural heritage landscape was identified within and/or adjacent to the Grey Road 19 Municipal Class EA study area. A cultural heritage landscape number has been assigned to this resource (CHL 1). A detailed inventory of this cultural heritage landscape within the study area is presented in Table 1 and mapping of this feature is provided in Figure 7 and Figure 8 of this report.

Consultation with Andrea Williams, Craigleith Heritage Depot Museum Curator, included information on an identified feature of Indigenous spiritual importance located in the nearby Scenic Caves (email communication 9 December 2020). This nearby feature of a projecting rock, known as Ekarenniondi, which means “where there is a point of rocks which projects or stands out” in Huron-Wendat, and was said to be the marker of the path to the Village of Souls in Petun spiritual traditions (Garrad, 1998). According to a 1636 account by the Jesuit priest Father Jean de Brébeuf, the Petun had several legends regarding the journey after death into the afterlife as a journey down a well-worn path to the Village of Souls, which was located near modern-day Blue Mountain based on geographical descriptions. Ekarenniondi is also tied to the legend of Oscotarach, also known as the Watcher or head-piercer, who prepares bodies for their journey to the Village of Souls (Garrad, 1998). The physical rock that is known as Ekarenniondi and Oscotarach is believed to be located in the nearby Scenic Caves (Garrad, 1998), approximately 1.5 km from the study area (Figure 8). While not immediately identifiable in a specific geographical context, the area surrounding the Scenic Caves and Ekarenniondi, and between the caves and modern-day Blue Mountain, may have been part of the path to the Village of the Souls as described in Petun spiritual traditions. Based on a review of topographic mapping and an understanding that there were a number of Indigenous trails in the area (Envision, 2009), the traditional pathway to Ekarenniondi may have followed the base of the escarpment, in the approximate location of current Gord Canning Drive west of the study area, and then continued north to reach the village in what is now Craigleith. These paths and the associated sacred landscape may be considered to hold special significance to Indigenous groups. Additional information regarding the Indigenous land use of the study area environs is included in the Stage 1 Archaeological Assessment (ASI, 2021).

Table 1: Inventory of Known and Potential Built Heritage Resources and Cultural Heritage Landscapes within the Study Area

Feature ID	Type of Property	Address or Location	Heritage Status and Recognition	Description of Property and Known or Potential CHVI	Photographs/ Digital Image
CHL-1	Remnant Farmscape	Directly east of residence at 796054 Grey Road 19, PLAN 950 PT LOT 63 RP;16R2789 PART 1	Potential CHL – Identified during field review/desktop research	The property is a remnant agricultural landscape with a late nineteenth-century barn with gable roof and fieldstone foundation. The property is approximately 24 acres in size and features established trails leading to a several small agricultural fields. The agricultural areas appear to be scattered on high points of ground on the property that is otherwise wet and wooded. The frame barn is associated with pasture lands to the east adjacent to Grey Road 19. The barn appears to be associated with the residence immediately to the west at 796054 Grey Road 19, although this residence is on a different property parcel. 1941 NTS Mapping depicts a residence and barn in the location of the subject property (Figure 4). The residence was located on the far west of the property, however a review of historical satellite images suggests it was demolished prior to 2009. The property is located at the west side of Grey Road 19, an historically-surveyed roadway.	 East and north elevation of the frame barn, looking southwest from Grey Road 19  Pasture to the east of the frame barn, looking southeast from Grey Road 19

Figure 7: Location of Potential Cultural Heritage Resources and Photographic Plates in the Grey Road 19 Municipal Class EA Study Area

Figure 8: Location of the Scenic Caves southwest of the study area. Note the topographical prominence of the Niagara Escarpment depicted by contour lines.

5.0 PRELIMINARY IMPACT ASSESSMENT

5.1 Description of Proposed Undertaking

The proposed undertaking for the Grey Road 19 Municipal Class Environmental Assessment involves the road improvements for Grey Road 19 between the intersection of Grey Road 19 / Simcoe Road 34 / Grey Road 21 and Mountain Road and the roundabout at Grey Road 19 / Grey Road 119 / Gord Canning Drive. The study area includes the right of way plus 50 meters, excluding the intersections of Grey Road 19 / Simcoe Road 34 / Grey Road 21 and Mountain Road, the roundabout at Grey Road 10/ Grey Road 119/ Gord Canning Drive, and the roundabout at Grey Road 19 and Crosswinds Boulevard. The preferred alternative for these road improvements include this general area, however omit a of 25 metre setback from the centerline of each intersection (Figure 9).

Following a review of the preliminary design for the proposed undertaking in July 2022 and communication with R.J. Burnside and Associates Inc., it was confirmed that the proposed road improvements are confined to the existing Grey Road 19 right-of-way, and that no land acquisition or encroachment is anticipated (R.J. Burnside and Associates Inc. email communication 22 June 2022). Preliminary designs of the proposed Grey Road 19 improvements depicted in Figure 10 also include proposed roundabout designs at the eastern limit of the study area and in the center of the study area at Crosswinds Boulevard to service a residential subdivision that is under construction north of Grey Road 19. These roundabouts are being designed and constructed by other proponents as part of other projects (R.J. Burnside and Associates Inc. email communication 29 June 2022) and as such, their impacts are not assessed as part of this undertaking. The scope of the preliminary design that is included as part of the Grey Road 19 improvements and assessed in this report is limited to the study area with 25 metre setback from intersections as depicted in Figure 9, with an additional 50 metre buffer applied to account for potential indirect impacts.

Figure 9: The Grey Road 19 Project Area depicting 25 metre setbacks from intersections (provided by R.J. Burnside and Associates Ltd.)

Figure 10: The Preferred Alternative for the Grey Road 19 Project and the location of CHL 1

5.2 Analysis of Potential Impacts

Table 2 outlines the potential impacts on the identified CHL within the study area.

Table 2: Preliminary Impact Assessment and Recommended Mitigation Measures

Feature ID	Location/Name	Type and Description of Potential/Anticipated Impact	Mitigation Strategies
CHL 1	Directly east of residence at 796054 Grey Road 19, PLAN 950 PT LOT 63 RP;16R2789 PART 1	No direct impacts are anticipated as the proposed road improvements will be confined to the existing Grey Road 19 right-of-way adjacent to the identified cultural heritage landscape. The frame barn on CHL 1 is located approximately 35 metres from the proposed undertaking, and therefore potential impacts due to construction related vibrations are anticipated.	Construction activities and staging should be suitably planned and undertaken to avoid impacts to CHL 1. Suitable mitigation including establishing no-go zones with fencing and issuing instructions to construction crews to avoid the cultural heritage landscape should be considered to mitigate any unintended impacts. Undertake engineering assessment during detail design to determine potential vibration impacts.

No direct, adverse impacts to the identified CHL are anticipated as a result of the proposed Grey Road 19 improvements.

Construction activities and staging should be suitably planned and undertaken to avoid impacts to CHL 1. Suitable mitigation including establishing no-go zones with fencing and issuing instructions to construction crews to avoid the cultural heritage landscape should be considered to mitigate any unintended impacts.

Indirect impacts to CHL 1 may occur as a result of its location adjacent to the proposed alignment. To ensure the frame barn directly east of residence at 796054 Grey Road 19 (CHL 1) is not adversely impacted during construction, baseline vibration monitoring should be undertaken during detailed design. Should this advance monitoring assessment conclude that the any structures will be subject to vibrations, a vibration monitoring plan should be prepared and implemented as part of the detailed design phase of the project to lessen vibration impacts related to construction.

6.0 RESULTS AND MITIGATION RECOMMENDATIONS

The results of background historical research and a review of secondary source material, including historical mapping, indicate a study area with a rural land use history dating back to the early nineteenth century. A review of federal, provincial, and municipal registers, inventories, and databases revealed that there are no previously identified features of cultural heritage value within or adjacent to the Grey

Road 19 Municipal Class EA study area. One additional feature, a barn, was identified during the fieldwork (CHL 1).

6.1 Key Findings

- One potential cultural heritage landscape, a remnant agricultural landscape with a barn (CHL 1), was identified during field review adjacent to the study area.

- This identified cultural heritage landscape has the potential to retain historical and contextual associations with land use patterns in the Town of the Blue Mountains and more specifically is representative of the early rural settlement along Grey Road 19, a nineteenth century rural roadway.

Results of Preliminary Impact Assessment

- No direct impacts to the one potential cultural heritage landscape (CHL 1) are anticipated as a result of the preferred alternative.

- The preferred alternative has the potential to result in indirect impacts to the one potential cultural heritage landscape (CHL 1) due to potential construction-related vibrations.

- Potential indirect impacts to CHL 1 can be mitigated through establishing no-go zones and issuing instructions to construction crews to avoid the CHL and by completing baseline vibration monitoring to prevent or lessen vibration impacts related to construction.

6.2 Recommendations

Based on the results of the assessment, the following recommendations have been developed:

1. Construction activities and staging should be suitably planned and undertaken to avoid impacts to the identified cultural heritage landscape (CHL 1). Suitable mitigation including establishing no-go zones with fencing and issuing instructions to construction crews to avoid the cultural heritage landscape should be considered to mitigate any unintended impacts.

2. To ensure the frame barn directly east of the residence at 796054 Grey Road 19 (CHL 1) is not adversely impacted during construction, baseline vibration monitoring should be undertaken during detailed design. Should this advance monitoring assessment conclude that the any structures will be subject to vibrations, a vibration monitoring plan should be prepared and implemented as part of the detailed design phase of the project to lessen vibration impacts related to construction.

3. Should future work require an expansion of the study area then a qualified heritage consultant should be contacted in order to confirm the impacts of the proposed work on potential heritage resources.

4. This report should be submitted by the proponent to heritage staff at the Town of the Blue Mountains, the County of Grey, the Ministry of Heritage, Sport, Tourism, and Culture Industries, and any other relevant stakeholder with an interest in this project.

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STAGE 1 ARCHAEOLOGICAL ASSESSMENT
GREY ROAD 19
LOTS 15-16 & CON 1
(FORMER TOWNSHIP OF COLLINGWOOD, COUNTY OF GREY)
TOWN OF THE BLUE MOUNTAINS, COUNTY OF GREY, ONTARIO

ORIGINAL REPORT

Prepared for:

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Archaeological Licence #P380 (Cooper)
Ministry of Heritage, Sport, Tourism and Culture Industries PIF# P380-0084-2020
ASI File: 20EA-210

7 January 2021

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Stage 1 Archaeological Assessment
Grey Road 19
Lots 15-16 & Con 1
(Former Township of Collingwood, County of Grey)
Town of the Blue Mountains, County of Grey, Ontario

EXECUTIVE SUMMARY

ASI was contracted by R.J. Burnside & Associates Limited to conduct a Stage 1 Archaeological Assessment (Background Research and Property Inspection) as part of the Grey Road 19 Municipal Class Environmental Assessment in the Town of the Blue Mountains, County of Grey. This project involves proposed road improvements for Grey Road 19 between the intersection of Grey Road 19 / Simcoe Road 34 / Grey Road 21 and Mountain Road and the roundabout at Grey Road 19 / Grey Road 119 / Gord Canning Drive. The Study Area includes the right-of-way plus approximately 10 meters on either side, excluding the intersections of Grey Road 19 / Simcoe Road 34 / Grey Road 21 and Mountain Road and the roundabout at Grey Road 10/ Grey Road 119/ Gord Canning Drive.

The Stage 1 background study determined that no previously registered archaeological sites are located within one kilometre of the Study Area. The Study Area is in proximity to the Niagara Escarpment, recognized internationally as a UNESCO World Biosphere Reserve, and the Scenic Caves which is considered a site of spiritual significance. The property inspection determined that parts of the Study Area exhibits archaeological potential and will require Stage 2 assessment, prior to any proposed construction activities.

In light of these results, the following recommendations are made:

1. The Study Area exhibits archaeological potential. These lands require Stage 2 archaeological assessment by test pit survey at five metre intervals prior to any proposed construction activities;

2. The remainder of the Study Area does not retain archaeological potential on account of deep and extensive land disturbance or being previously assessed. These lands do not require further archaeological assessment; and,

3. Should the proposed work extend beyond the current Study Area, further Stage 1 archaeological assessment should be conducted to determine the archaeological potential of the surrounding lands.

ASI

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Report Reviewer:	Lisa Merritt

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1.0 PROJECT CONTEXT

Archaeological Services Inc. (ASI) was contracted by R.J. Burnside & Associates Limited to conduct a Stage 1 Archaeological Assessment (Background Research and Property Inspection) as part of the Grey Road 19 Municipal Class Environmental Assessment in the Town of the Blue Mountains, County of Grey (Figure 1). This project involves proposed road improvements for Grey Road 19 between the intersection of Grey Road 19 / Simcoe Road 34 / Grey Road 21 and Mountain Road and the roundabout (RAB) at Grey Road 19 / Grey Road 119 / Gord Canning Drive. The Study Area includes the right-of-way (ROW) plus approximately 10 meters on either side, excluding the intersections of Grey Road 19 / Simcoe Road 34 / Grey Road 21 and Mountain Road and the RAB at Grey Road 10/ Grey Road 119/ Gord Canning Drive.

All activities carried out during this assessment were completed in accordance with the *Ontario Heritage Act* (1990, as amended in 2018) and the 2011 *Standards and Guidelines for Consultant Archaeologists* (S & G), administered by the Ministry of Heritage, Sport, Tourism and Culture Industries (MHSTCI 2011), formerly the Ministry of Tourism, Culture and Sport.

1.1 Development Context

All work has been undertaken as required by the *Environmental Assessment Act*, RSO (Ministry of the Environment 1990 as amended 2010) and regulations made under the Act, and are therefore subject to all associated legislation. This project is being conducted in accordance with the Municipal Engineers' Association document *Municipal Class Environmental Assessment* (2000 as amended in 2007, 2011 and 2015).

Authorization to carry out the activities necessary for the completion of the Stage 1 archaeological assessment was granted by R.J. Burnside & Associates Limited on November 4, 2020.

1.2 Historical Context

The purpose of this section, according to the S & G, Section 7.5.7, Standard 1, is to describe the past and present land use and the settlement history and any other relevant historical information pertaining to the Study Area. A summary is first presented of the current understanding of the Indigenous land use of the Study Area. This is then followed by a review of the historical Euro-Canadian settlement history.

1.2.1 Indigenous Land Use and Settlement

Southern Ontario has been occupied by human populations since the retreat of the Laurentide glacier approximately 13,000 years before present (BP) (Ferris 2013). Populations at this time would have been highly mobile, inhabiting a boreal-parkland similar to the modern sub-arctic. By approximately 10,000 BP, the environment had progressively warmed (Edwards and Fritz 1988) and populations now occupied less extensive territories (Ellis and Deller 1990).

Between approximately 10,000-5,500 BP, the Great Lakes basins experienced low-water levels, and many sites which would have been located on those former shorelines are now submerged. This period produces the earliest evidence of heavy wood working tools, an indication of greater investment of labour in felling trees for fuel, to build shelter, and watercraft production. These activities suggest prolonged seasonal residency at occupation sites. Polished stone and native copper implements were being produced by approximately 8,000 BP; the latter was acquired from the north shore of Lake Superior, evidence of extensive exchange networks throughout the Great Lakes region. The earliest evidence for cemeteries dates to approximately 4,500-3,000 BP and is indicative of increased social organization, investment of labour into social infrastructure, and the establishment of socially prescribed territories (Ellis et al. 1990; Ellis et al. 2009; Brown 1995).

Between 3,000-2,500 BP, populations continued to practice residential mobility and to harvest seasonally available resources, including spawning fish. The Woodland period begins around 2,500 BP and exchange and interaction networks broaden at this time (Spence et al. 1990:136, 138) and by approximately 2,000 BP, evidence exists for small community camps, focusing on the seasonal harvesting of resources (Spence et al. 1990:155, 164). By 1,500 BP there is macro botanical evidence for maize in southern Ontario, and it is thought that maize only supplemented people's diet. There is earlier phytolithic evidence for maize in central New York State by 2,300 BP - it is likely that once similar analyses are conducted on Ontario ceramic vessels of the same period, the same evidence will be found (Birch and Williamson 2013:13–15). As is clearly evident in the detailed ethnographies of Anishinaabek populations, winter was a period during which some families would depart from the larger group as it was easier to sustain smaller populations (Rogers 1962). It is generally understood that these populations were Algonquian-speakers during these millennia of settlement and land use.

From the beginning of the Late Woodland period at approximately 1,000 BP, lifeways became more similar to that described in early historical documents. Between approximately 1000-1300 Common Era (CE), the communal site is replaced by the village focused on horticulture. Seasonal disintegration of the community for the exploitation of a wider territory and more varied resource base was still practised (Williamson 1990:317). By 1300-1450 CE, this episodic community disintegration was no longer practised and populations now communally occupied sites throughout the year (Dodd et al. 1990:343). From 1450-1649 CE this process continued with the coalescence of these small villages into larger communities (Birch and Williamson 2013). Through this process, the socio-political organization of the First Nations, as described historically by the French and English explorers who first visited southern Ontario, was developed.

By 1600 CE, the Huron- Wendat communities within Simcoe County had formed the Confederation of Nations encountered by the first European explorers and missionaries. The study area is located in the historical territory of the Tionontate (Petun) who were closely related to the Huron-Wendat. In the 1640s, the traditional enmity between the Haudenosaunee and the Huron-Wendat (and their Algonquian allies such as the Nippissing and Odawa) led to the dispersal of the Huron-Wendat and the Tionontate. Shortly afterwards, the Haudenosaunee established a series of settlements at strategic locations along the trade routes inland from the north shore of Lake Ontario. By the 1690s however, the Anishinaabeg were the only communities with a permanent presence in southern Ontario. From the beginning of the eighteenth century to the assertion of British sovereignty in 1763, there was no interruption to Anishinaabeg control and use of southern Ontario.

The Study Area is located within the traditional territory of the Odawa (Annishinnabeg) and the Saugeen Ojibway Nation (SON). The Odawa were an Algonquian Nation who occupied Bruce County, Grey County and Manitoulin Island. The oral tradition from Nawash and Saugeen suggests that the ancestors of the SON occupied the area as early as 7,500 years ago. The SON are part of the Three Fires Confederacy of Ojibway, Odawa, and Pottawatomi, which is part of the Anishnabek nations that historically occupied the Great Lakes Region.

1.2.2 Treaties

The Study Area is located within the lands of the Lake Simcoe-Nottawasaga Treaty, signed in 1818 by Ojibwa chiefs who granted land along the shores of Lake Huron and southern Georgian Bay to the Crown (AANDC 2016). This was done with the understanding that the Ojibwa (Saugeen) would have continued use of Bruce County and that they would receive annuities for the lands surrendered. Further land was surrendered in the area with the establishment of the Huron Tract in 1825, later to be followed by the surrender of Bruce County to the British through the Treaty of Manitowaning in 1836 (Lee 2004:21; Robertson 1906:11).

1.2.3 Euro-Canadian Land Use: Township Survey and Settlement

Historically, the Study Area is located in the Former Collingwood Township, County of Grey in Lots 15-16 & Concession 1.

The S & G stipulates that areas of early Euro-Canadian settlement (pioneer homesteads, isolated cabins, farmstead complexes), early wharf or dock complexes, pioneer churches, and early cemeteries are considered to have archaeological potential. Early historical transportation routes (trails, passes, roads, railways, portage routes), properties listed on a municipal register or designated under the *Ontario Heritage Act* or a federal, provincial, or municipal historic landmark or site are also considered to have archaeological potential.

For the Euro-Canadian period, the majority of early nineteenth century farmsteads (i.e., those that are arguably the most potentially significant resources and whose locations are rarely recorded on nineteenth century maps) are likely to be located in proximity to water. The development of the network of concession roads and railroads through the course of the nineteenth century frequently influenced the siting of farmsteads and businesses. Accordingly, undisturbed lands within 100 m of an early settlement road are also considered to have potential for the presence of Euro-Canadian archaeological sites.

The first Europeans to arrive in the area were transient merchants and traders from France and England, who followed Indigenous pathways and set up trading posts at strategic locations along the well-traveled river routes. All of these occupations occurred at sites that afforded both natural landfalls and convenient access, by means of the various waterways and overland trails, into the hinterlands. Early transportation routes followed existing Indigenous trails, both along the lakeshore and adjacent to various creeks and rivers (ASI 2006).

Township of Collingwood

The Township of Collingwood is in the northeastern portion of Grey County on the southern shores of Georgian Bay. The Blue Mountains, part of the Niagara Escarpment, are located in the center of the township and define the geography and physiography of the area. The township was surveyed by Charles Rankin in 1833 and was the first township be surveyed in Grey County. Originally named Alta by Rankin, the name was officially changed to Collingwood in honour of Lord Cuthbert Collingwood, a British Admiral. The principal settlement in the township was Thornbury, which was ceded to become an incorporated Town in 1887. Other notable settlements in the Township include Clarksburg, Banks, Craigleith, and Ravenna (Mika and Mika 1977).

The Town of the Blue Mountains was official formed in 1998 with the amalgamation of the Township of Collingwood and the Town of Thornbury (The Blue Mountains Public Library 2020).

1.2.4 Historical Map Review

The 1855 *Map of Grey and Bruce County* (Rankin 1855) and the 1880 *Illustrated Historical Atlas of Grey County* (H. Belden & Co. 1880) were examined to determine the presence of historic features within the Study Area during the nineteenth century (Figures 2-3).

It should be noted, however, that not all features of interest were mapped systematically in the Ontario series of historical atlases, given that they were financed by subscription, and subscribers were given preference with regard to the level of detail provided on the maps. Moreover, not every feature of interest would have been within the scope of the atlases.

In addition, the use of historical map sources to reconstruct/predict the location of former features within the modern landscape generally proceeds by using common reference points between the various sources. These sources are then geo-referenced in order to provide the most accurate determination of the location of any property on historic mapping sources. The results of such exercises are often imprecise or even contradictory, as there are numerous potential sources of error inherent in such a process, including the vagaries of map production (both past and present), the need to resolve differences of scale and resolution, and distortions introduced by reproduction of the sources. To a large degree, the significance of such margins of error is dependent on the size of the feature one is attempting to plot, the constancy of reference points, the distances between them, and the consistency with which both they and the target feature are depicted on the period mapping.

Nineteenth-century mapping does not provide details of historical property owners or historical features in the Study Area. In 1855, the map shows the township of Collingwood divided into lots and concessions. A main historical road followed the edge of Georgian Bay connecting early communities like Thornbury and Collingwood Harbour. A tributary is depicted entering Lot 15, Concession 1 south of the Study Area. By 1880, Grey Road 19 is depicted in similar alignment to later mapping in the eastern portion of the Study Area, however it is depicted as continuing directly westward to the intersection with Scenic Caves Road rather than curving to the north as it does in later mapping. Scenic Caves Road (Grey Road 119) is depicted as a winding roadway that follows the local topography of the Niagara Escarpment to the southwest before straightening in a northward direction west of the Study Area. Highway 21/19, the eastern limit of the Study Area, is depicted as the boundary between the Township of Collingwood in the County of Grey and the Township of Nottawasaga in the County of Simcoe. The community of Kirkville is east of the Study Area. Scenic Caves Road (Grey Road 119) continues in a north and west direction to the Village of Craigleith, which is depicted on the shores of Georgian Bay.

1.2.5 Twentieth-Century Mapping Review

The 1941 National Topographic System (NTS) Collingwood Sheet (Department of National Defence 1941), 1954 aerial photography, and the 1993 NTS Collingwood Sheet (Department of Energy, Mines and Resources 1993) were examined to determine the extent and nature of development and land uses within the Study Area (Figures 4-6).

The 1941 NTS Map depicts the Study Area in a similar rural context as earlier mapping, with Grey Road 19 following a straight alignment between Scenic Caves Road (Grey Road 119) and Highway 21/19. Two farmsteads are depicted on the north of Grey Road 19, and one is depicted to the south within the Study Area. Another three are adjacent the Study Area. The community of Mair Mills is located to the east of the intersection of Grey Road 19 and Highway 21/19 where a small creek crosses the roadway. To the west of the Study Area the topographical map depicts the dramatic change in topographic relief associated with the Niagara Escarpment. Scenic Caves Road (Grey Road 119) meanders to accommodate this change in topography, with 'The Caves' noted to the southeast of the Study Area.

The 1954 aerial photograph depicts the Study Area in a rural context. The 1993 map shows that Grey Road 19 had been diverted northward along its present alignment to meet Gord Canning Drive. Along the former alignment of Grey Road 19, residential development had occurred to the south (now Claire Glen, Patricia Drive, and Martins Grove). Seven structures are shown south of County Road 19 east of this development. The northern side of Grey Road 19 is still rural with the exception of an electric facility.

1.3 Archaeological Context

This section provides background research pertaining to previous archaeological fieldwork conducted within and in the vicinity of the Study Area, its environmental characteristics (including drainage, soils or surficial geology and topography, etc.), and current land use and field conditions. Three sources of information were consulted to provide information about previous archaeological research: the site record forms for registered sites available online from the MHSTCI through "Ontario's Past Portal"; published and unpublished documentary sources; and the files of ASI.

1.3.1 Current Land Use and Field Conditions

A review of available Google satellite imagery since 2009 shows residential development of the Windfall subdivision and entrance at Crossroads Boulevard within the Study Area in 2014 and 2015.

A Stage 1 property inspection was conducted on November 19, 2020 that noted the Study Area is located along Grey Road 19 from east of the RAB at Grey Road 10/ Grey Road 119/ Gord Canning Drive to the Grey Road 19 / Simcoe Road 34 / Grey Road 21 and Mountain Road intersection. Grey Road 19 is a two-lane undivided roadway, which is well developed, with wide gravel shoulders. It lacks curbs and sidewalks, and the roadbed is raised in places. Grey Road 19 generally follows an east-west orientation, but west of Martins Grove Road it diverts to the north towards the RAB past the western limit of the Study Area. Adjacent to the north side of the ROW is a bike path that runs parallel to the road from the traffic circle east to the entrance of the Windfall subdivision at Crossroads Boulevard.

The area adjacent to the northern limit of the Study Area is generally bound by undeveloped woodlands in the east and early twenty-first century residential subdivisions to the west. The area to the south of the roadway features a golf driving range at the west, wooded areas, and rural residences on large lots in the centre, and more dense residential developments to the west on Martins Grove Road. A nineteenth-century barn is located south of the Study Area and was associated with a former residence which appears to have been demolished.

1.3.2 Geography

In addition to the known archaeological sites, the state of the natural environment is a helpful indicator of archaeological potential. Accordingly, a description of the physiography and soils are briefly discussed for the Study Area.

The S & G stipulates that primary water sources (lakes, rivers, streams, creeks, etc.), secondary water sources (intermittent streams and creeks, springs, marshes, swamps, etc.), ancient water sources (glacial lake shorelines indicated by the presence of raised sand or gravel beach ridges, relic river or stream channels indicated by clear dip or swale in the topography, shorelines of drained lakes or marshes, cobble beaches, etc.), as well as accessible or inaccessible shorelines (high bluffs, swamp or marsh fields by the edge of a lake, sandbars stretching into marsh, etc.) are characteristics that indicate archaeological potential.

Water has been identified as the major determinant of site selection and the presence of potable water is the single most important resource necessary for any extended human occupation or settlement. Since water sources have remained relatively stable in Ontario since 5,000 BP (Karrow and Warner 1990:Figure 2.16), proximity to water can be regarded as a useful index for the evaluation of archaeological site potential. Indeed, distance from water has been one of the most commonly used variables for predictive modeling of site location.

Other geographic characteristics that can indicate archaeological potential include: elevated topography (eskers, drumlins, large knolls, and plateaux), pockets of well-drained sandy soil, especially near areas of heavy soil or rocky ground, distinctive land formations that might have been special or spiritual places, such as waterfalls, rock outcrops, caverns, mounds, and promontories and their bases. There may be physical indicators of their use, such as burials, structures, offerings, rock paintings or carvings. Resource areas, including; food or medicinal plants (migratory routes, spawning areas) are also considered characteristics that indicate archaeological potential (S & G, Section 1.3.1).

The Study Area is located within the Clay Plains and Beaches of the Simcoe Lowlands Physiographic Region of southern Ontario (Chapman and Putnam 1984).

The Simcoe Lowlands physiographic region consists of low-lying belts of sand plain, which cover an area of 280,000 hectares, bordering Georgian Bay and Lake Simcoe. The area was once inundated by the waters of glacial Lake Algonquin, inland of the present-day shorelines. Remnant shoreline features (beaches, shorecliffs, bars, etc.) mark the former water level of Lake Algonquin. Topography is generally flat and subsoil consists of variable sand, gravel, silt and clay deposits as formed on the lake bottom (Chapman and Putnam 1984:177-182). Sand plains and beach ridges are glaciolacustrine features and are products of the Late Wisconsian glacial stage (ca. 25,000-10,000 BP). Sand plains are formed in shallow waters and beach ridges mark the former shorelines (Karrow and Warner 1990:5).

To the west is the Niagara Escarpment, one of the most prominent features in southern Ontario, which extends from the Niagara River to the northern tip of the Bruce Peninsula, continuing through the Manitoulin Islands (Chapman and Putnam 1984:114-122). Vertical cliffs along the brow mostly outline the edge of the dolostone of the Lockport and Amabel Formations, which the slopes below are carved in red shale. Flanked by landscapes of glacial origin, the rock-hewn topography stands in striking contrast, and its steep-sided valleys are strongly suggestive of non-glacial regions. From Queenston, on the Niagara River, westward to Ancaster, the escarpment is a simple topographic break separating the two levels of the Niagara Peninsula. The Niagara Escarpment is a designated UNESCO World Biosphere Reserve.

Directly west of the Study Area the Niagara Escarpment, including the Scenic Caves, are visible as a prominent landform, known locally as the Blue Mountains and commonly used for downhill skiing in the winter. The Blue Mountains in particular, and the Niagara Escarpment in general, as been instrumental in shaping human settlement, industry, cosmology, and recreation in the area for millennia.

Figure 7 depicts surficial geology for the Study Area. The surficial geology mapping demonstrates that the Study Area is underlain by stone-poor, sandy silt to silty sand-textured till on Paleozoic terrain, with a shore bluff or scarp through the western portion of the Study Area and beach ridges and near shore bars through the eastern portion (Ontario Geological Survey 2010). A second shore bluff or scarp runs to the west. Soils in the Study Area consist of Kemble silty clay, a brown forest grey-brown podzolic intergrade with imperfect drainage and Morley clay, a dark grey gleisolic with poor drainage (Figure 8).

Silver Creek is southeast of the Study Area. Silver Creek is one of four main creek systems within the Blue Mountain subwatershed that discharge directly into Georgian Bay within the Town of Collingwood. Silver Creek flows from spring-fed tributaries on the Niagara Escarpment and its headwaters are impounded behind a large dam at Lake of the Clouds before cascading downstream through forest Escarpment terrain. It enters the Simcoe Lowlands near Osler Bluff Road, where it flows northward through forest, farm field, and rural residential areas. It then enters coastal wetland, discharging into the Bay north of Highway 26. Significant wetland loss has occurred along the Georgian Bay shoreline due to urban development, and approximately 32 hectares of net subwatershed wetland loss occurred between 2002 and 2008 (Nottawasaga Valley Conservation Authority 2013).

1.3.3 Previous Archaeological Research

In Ontario, information concerning archaeological sites is stored in the Ontario Archaeological Sites Database (OASD) maintained by the MHSTCI. This database contains archaeological sites registered within the Borden system. Under the Borden system, Canada has been divided into grid blocks based on latitude and longitude. A Borden block is approximately 13 km east to west, and approximately 18.5 km north to south. Each Borden block is referenced by a four-letter designator, and sites within a block are numbered sequentially as they are found. The Study Area under review is located in Borden block *BcHb*.

According to the OASD, no previously registered archaeological sites are located within one kilometre of the Study Area (MHSTCI 2020).

According to the background research, three previous reports detail fieldwork within 50 m of the Study Area.

- AMICK Consultants Ltd. (2008: P058-373-2008) conducted a Stage 1-2 AA of Proposed Residential Developments within the Study Area north of County Road 14, from Kinsey Place to Osler Bluff Road. The portions of land that did not consist of previous disturbance or low lying and wet lands were subject to test pit survey at five metre intervals. No archaeological resources were encountered and the property was recommended to be cleared of any further requirement for archaeological fieldwork.

- Archeoworks Inc. (2016: P1016-0066-2015) conducted a Stage 1 AA of Proposed Improvements to the Intersection of Grey Road 19/Grey Road 21 and Grey Road 19/Mountain Road, within the current Study Area. The wooded areas along the northwestern limit beyond the ROW were recommended for Stage 2, however this area was previously cleared by AMICK Consultants Limited.

- ASI (1998: Licence 98-014) conducted a Stage 2 Archaeological Assessment (AA) of the Kofman/Rhind Estates, located at the northeast corner of the Mountain Road and Osler Bluff Road intersection, within 50 metres of the current Study Area. Test pit and pedestrian surveys were conducted at five metre intervals. No cultural material was encountered, and the property was recommended to be free from further archaeological concern.

2.0 FIELD METHODS: PROPERTY INSPECTION

A Stage 1 property inspection must adhere to the S & G, Section 1.2, Standards 1-6, which are discussed below. The entire property and its periphery must be inspected. The inspection may be either systematic or random. Coverage must be sufficient to identify the presence or absence of any features of archaeological potential. The inspection must be conducted when weather conditions permit good visibility of land features. Natural landforms and watercourses are to be confirmed if previously identified. Additional features such as elevated topography, relic water channels, glacial shorelines, well-drained soils within heavy soils and slightly elevated areas within low and wet areas should be identified and documented, if present. Features affecting assessment strategies should be identified and documented such as woodlots, bogs or other permanently wet areas, areas of steeper grade than indicated on topographic mapping, areas of overgrown vegetation, areas of heavy soil, and recent land disturbance such as grading, fill deposits and vegetation clearing. The inspection should also identify and document structures and built features that will affect assessment strategies, such as heritage structures or landscapes, cairns, monuments or plaques, and cemeteries.

The Stage 1 archaeological assessment property inspection was conducted under the field direction of Martin Cooper (P380) of ASI, on November 19, 2020, in order to gain first-hand knowledge of the geography, topography, and current conditions and to evaluate and map archaeological potential of the Study Area. It was a visual inspection from publicly accessible lands/public ROWs only and did not include excavation or collection of archaeological resources. Fieldwork was conducted when the weather conditions were clear with excellent visibility, as per S & G Section 1.2., Standard 2 and the *Winter Archaeology* Technical Bulletin (MHSTCI 2013). The temperature was 15°C and partly cloudy. Field observations are compiled onto the existing conditions of the Study Area in Section 7.0 (Figure 9) and associated photographic plates are presented in Section 8.0 (Plates 1-6).

3.0 ANALYSIS AND CONCLUSIONS

The historical and archaeological contexts have been analyzed to help determine the archaeological potential of the Study Area. Results of the analysis of the Study Area property inspection and background research are presented in Section 3.1.

3.1 Analysis of Archaeological Potential

The S & G, Section 1.3.1, lists criteria that are indicative of archaeological potential. The Study Area meets the following criteria indicative of archaeological potential:

- Water sources: primary, secondary, or past water source (Silver Creek);
- Distinctive land formations (Niagara Escarpment, Scenic Caves);
- Early historic transportation routes (Grey Road 19, Scenic Caves Road, Osler Bluff Road); and
- Proximity to early settlements (Mair Mills)

According to the S & G, Section 1.4 Standard 1e, no areas within a property containing locations listed or designated by a municipality can be recommended for exemption from further assessment unless the area can be documented as disturbed. The Municipal Heritage Register was consulted and no properties within the Study Area are Listed or Designated under the Ontario Heritage Act.

Consultation with Andrea Williams, Craigleith Heritage Depot Museum Curator, as part of the Cultural Heritage Resource Assessment (ASI In Preparation) included information on an identified feature of Indigenous spiritual importance located in the nearby Scenic Caves. This nearby feature of a projecting rock, known as Ekarenniondi, which means "where there is a point of rocks which projects or stands out" in the Huron-Wendat language, and was said to be the marker of the path to the Village of Souls in Petun (Tionontate) mythology (Garrad 1998). According to a 1636 account by the Jesuit priest Father Jean de Brébeuf, the Tionontate had several legends regarding the journey after death into the afterlife as a journey down a well-worn path to the Village of Souls, which was located near modern-day Blue Mountain based on geographical descriptions. Ekarenniondi is also tied to the legend of Oscotarach, also known as the Watcher or head-piercer, who prepares bodies for their journey to the Village of Souls (Garrad 1998). The physical rock that is known as Ekarenniondi and Oscotarach is believed to be located in the nearby Scenic Caves (Garrad 1998), approximately 1.5 km from the Study Area. As the Study Area is in such close proximity to this spiritually-significant rock and landscape, the surrounding landscape would have been part of the solemn spiritual journey to the sacred site and could have included the well-worn path described by Brébeuf as the route to it. The area surrounding this sacred landscape is considered to hold special significance to Indigenous groups and should be recognized as a significant cultural heritage landscape. In addition, the Haney-Cook site (BcHb-27), a important village site, is located approximately 1300 m of the Scenic Caves.

These criteria are indicative of potential for the identification of Indigenous and Euro-Canadian archaeological resources, depending on soil conditions and the degree to which soils have been subject to deep disturbance.

The property inspection determined that parts of the Study Area exhibit archaeological potential. These areas will require Stage 2 archaeological assessment prior to any proposed construction activities. According to the S & G Section 2.1.2, test pit survey is required on terrain where ploughing is not viable, such as wooded areas, properties where existing landscaping or infrastructure would be damaged, overgrown farmland with heavy brush or rocky pasture, and narrow linear corridors up to 10 metres wide (Plates 1, 5; Figure 9: areas highlighted in green).

Part of the Study Area has been previously assessed and does not require further archaeological assessments (Figure 9: areas highlighted in red).

The remainder of the Study Area has been subjected to deep soil disturbance events associated with the construction of the road ROWs, and according to the S & G Section 1.3.2 do not retain archaeological potential (Plates 1-6; Figure 9: areas highlighted in yellow). These areas do not require further survey.

3.2 Conclusions

The Stage 1 background study determined that no previously registered archaeological sites are located within one kilometre of the Study Area. The Study Area is in proximity to the distinctive land formations and site of spiritual significance of the Niagara Escarpment and the Scenic Caves. The property inspection determined that parts of the Study Area exhibit archaeological potential and will require Stage 2 assessment, prior to any proposed construction activities.

4.0 RECOMMENDATIONS

In light of these results, the following recommendations are made:

1. The Study Area exhibits archaeological potential. These lands require Stage 2 archaeological assessment by test pit survey at five metre intervals prior to any proposed construction activities;

2. The remainder of the Study Area does not retain archaeological potential on account of deep and extensive land disturbance or being previously assessed. These lands do not require further archaeological assessment; and,

3. Should the proposed work extend beyond the current Study Area, further Stage 1 archaeological assessment should be conducted to determine the archaeological potential of the surrounding lands.

NOTWITHSTANDING the results and recommendations presented in this study, ASI notes that no archaeological assessment, no matter how thorough or carefully completed, can necessarily predict, account for, or identify every form of isolated or deeply buried archaeological deposit. In the event that archaeological remains are found during subsequent construction activities, the consultant archaeologist, approval authority, and the Cultural Programs Unit of the MHSTCI should be immediately notified.

5.0 ADVICE ON COMPLIANCE WITH LEGISLATION

ASI also advises compliance with the following legislation:

- This report is submitted to the Ministry of Heritage, Sport, Tourism and Culture Industries as a condition of licensing in accordance with Part VI of the *Ontario Heritage Act*, RSO 1990, c 0.18. The report is reviewed to ensure that it complies with the standards and guidelines that are issued by the Minister, and that the archaeological field work and report recommendations ensure the conservation, preservation and protection of the cultural heritage of Ontario. When all matters relating to archaeological sites within the project area of a development proposal have been addressed to the satisfaction of the Ministry of Heritage, Sport, Tourism and Culture Industries, a letter will be issued by the ministry stating that there are no further concerns with regard to alterations to archaeological sites by the proposed development.

- It is an offence under Sections 48 and 69 of the *Ontario Heritage Act* for any party other than a licensed archaeologist to make any alteration to a known archaeological site or to remove any artifact or other physical evidence of past human use or activity from the site, until such time as a licensed archaeologist has completed archaeological field work on the site, submitted a report to the Minister stating that the site has no further cultural heritage value or interest, and the report has been filed in the Ontario Public Register of Archaeology Reports referred to in Section 65.1 of the *Ontario Heritage Act.*

- Should previously undocumented archaeological resources be discovered, they may be a new archaeological site and therefore subject to Section 48 (1) of the *Ontario Heritage Act*. The proponent or person discovering the archaeological resources must cease alteration of the site immediately and engage a licensed consultant archaeologist to carry out archaeological fieldwork, in compliance with sec. 48 (1) of the *Ontario Heritage Act*.

- The *Cemeteries Act*, R.S.O. 1990 c. C.4 and the *Funeral, Burial and Cremation Services Act*, 2002, S.O. 2002, c.33 (when proclaimed in force) require that any person discovering human remains must notify the police or coroner and the Registrar of Cemeteries at the Ministry of Consumer Services.

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7.0 MAPS

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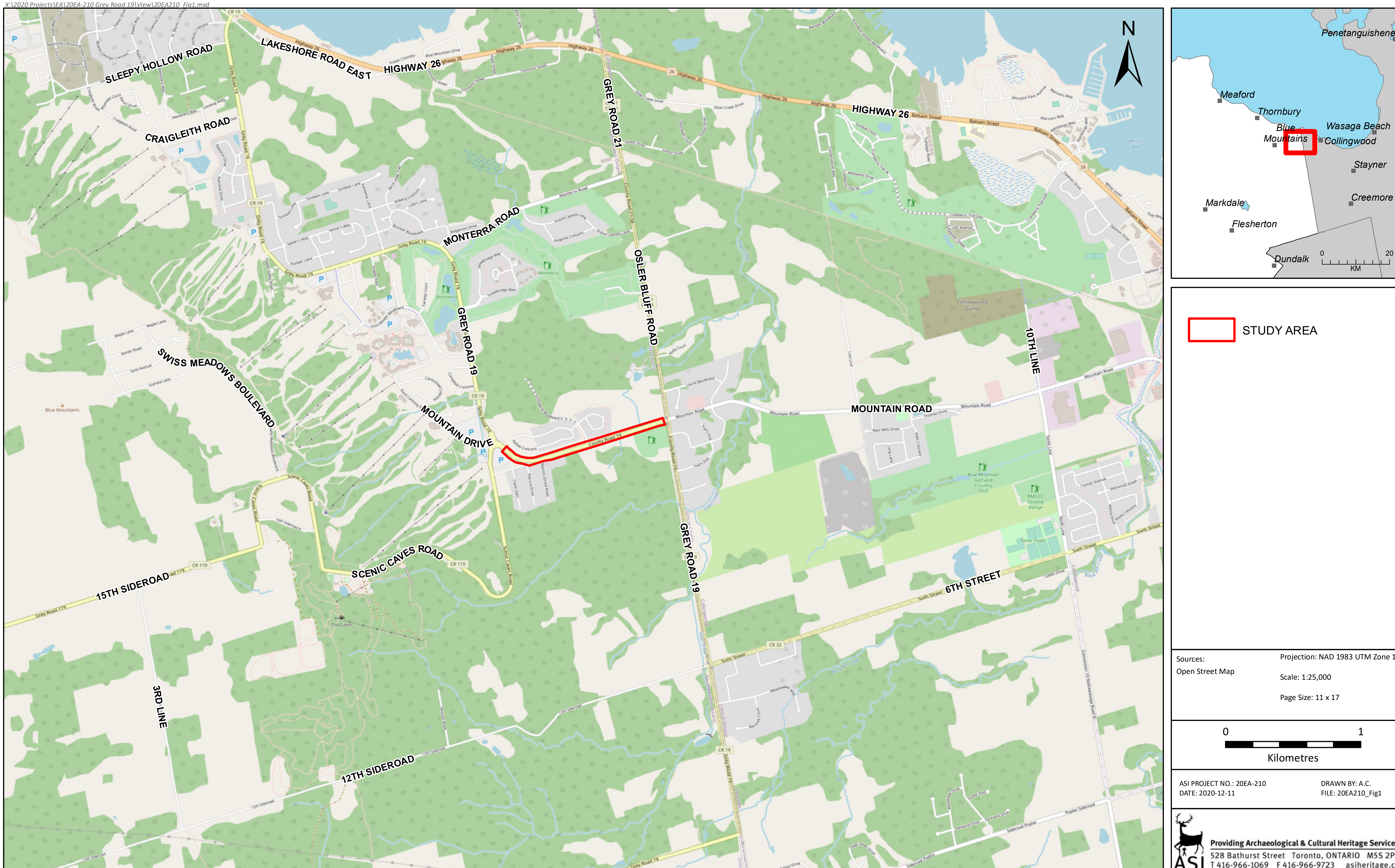

STUDY AREA

Sources:
Open Street Map

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0 1
Kilometres

ASI PROJECT NO.: 20EA-210
DATE: 2020-12-11
DRAWN BY: A.C.
FILE: 20EA210_Fig1

ASI
Providing Archaeological & Cultural Heritage Services
528 Bathurst Street Toronto, ONTARIO M5S 2P9
T 416-966-1069 F 416-966-9723 asiheritage.ca

Figure 1: Grey Road 19 Study Area

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Figure 2: Study Area (Approximate Location) Overlaid on the 1855 Map of Grey and Bruce County

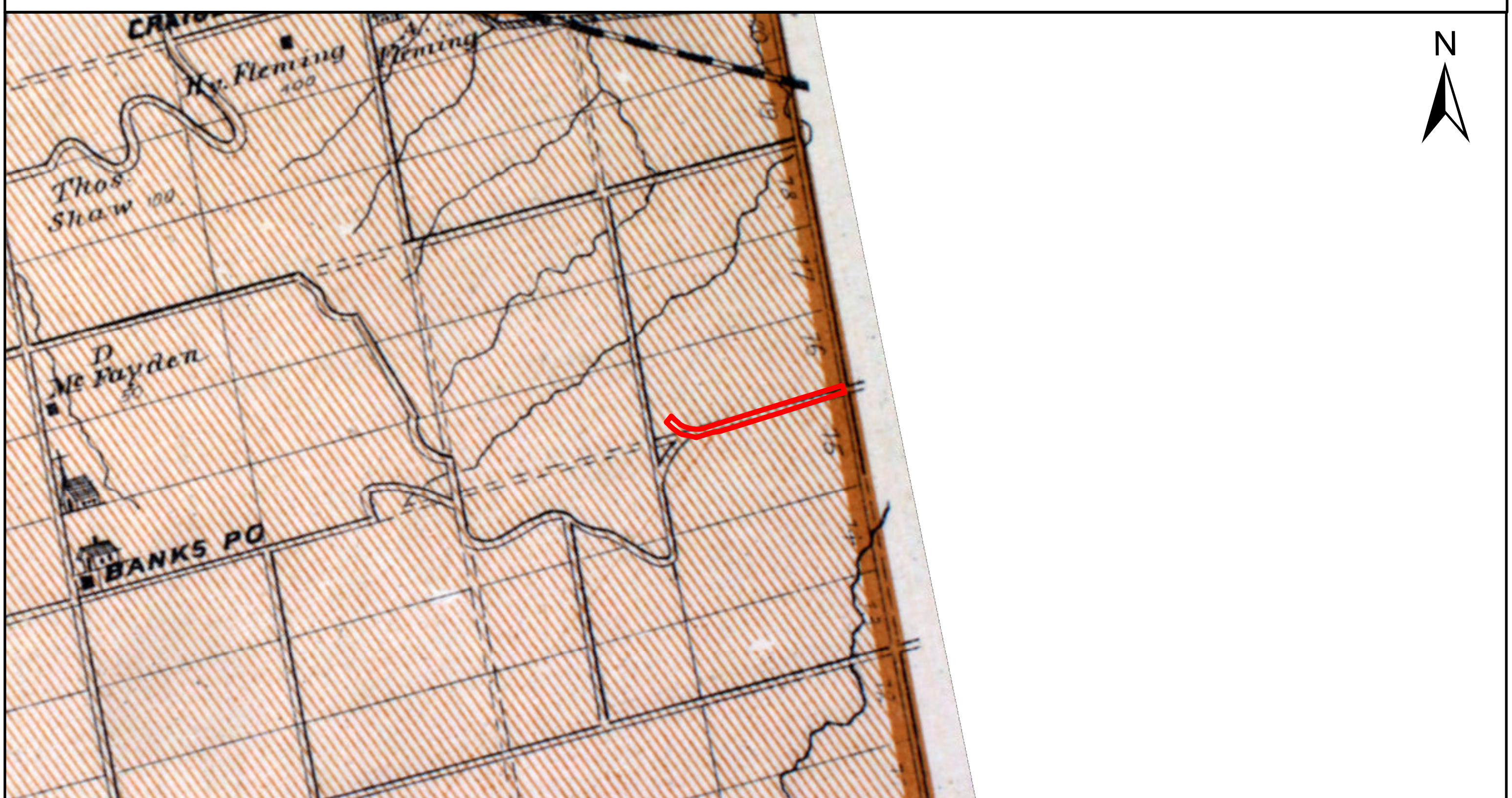

Figure 3: Study Area (Approximate Location) Overlaid on the 1880 Illustrated Historical Atlas of the County of Grey

ASI

STUDY AREA

Sources: 1855 Map of Grey and Bruce County

1880 Illustrated Historical Atlas of the County of Grey

0 1

Kilometers

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Date: 2020-12-18

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Figure 7: Study Area - Surficial Geology

Figure 8: Study Area - Soil Drainage

ASI

Sources: Ontario Geological Survey, 2003 (via MNMD, 2005)

Ontario Ministry of Agriculture and AgriFood (via LIO), 2018

0 200

Meters

Projection: NAD 1983 CSRS UTM Zone 17N
Scale: 1:6,100
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Date: 2020-12-21

Drawn By: cnettleton
File: 8.5x11_Historic_x_2

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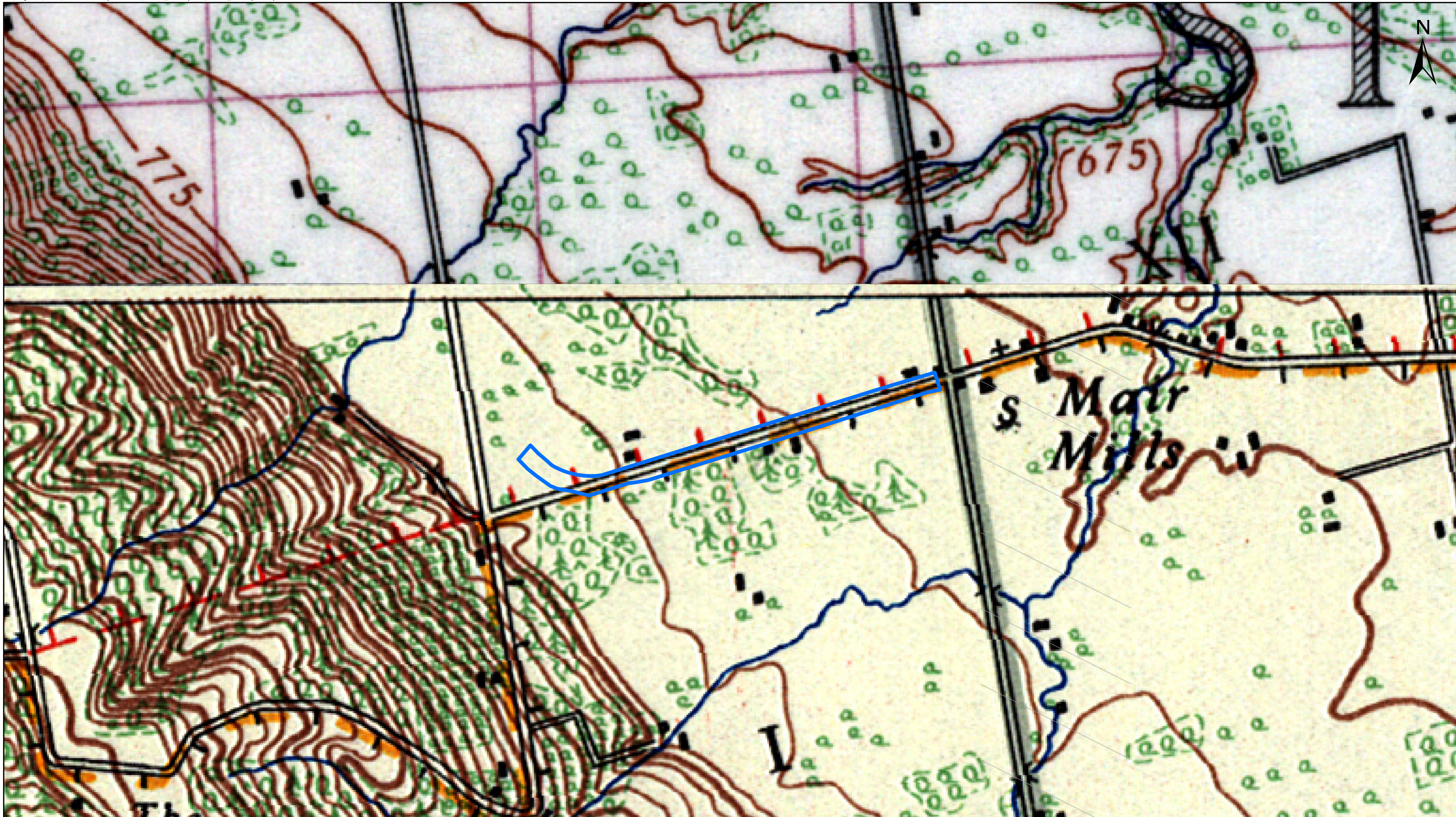

STUDY AREA

ASI

Sources: National Topographic System Collingwood Sheet (1941), Nottawasaga Bay Sheet (1945)

0 500
Metres

Projection: NAD 1983 CSRS UTM Zone 17N
Scale: 1:10,000
Page Size: 11 x 17

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File: 11x17_Landscape

Figure 4: Study Area (Approximate Location) Overlaid on the 1941 NTS Collingwood Sheet and 1945 NTS Nottawasaga Bay Sheet

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Figure 5: Study Area (Approximate Location) Overlaid on the 1954 Aerial Photography

Figure 6: Study Area (Approximate Location) Overlaid on the 1993 NTS Collingwood and Nottawasaga Bay Sheets

ASI

STUDY AREA

Sources: Aerial Survey of Southern Ontario

National Topographic System (1993) Collingwood and Nottawasaga Bay Sheets

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Scale: 1:15,000
Page Size: 8.5 x 11

0 500
Meters

ASI Project No.: 20EA-210
Date: 2020-12-21

Drawn By: cnettleton
File: 8.5x11_Historic_x_2

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STUDY AREA
WATERCOURSE
PHOTO LOCATION AND DIRECTION
DISTURBED: NO POTENTIAL
PREVIOUSLY ASSESSED: NO POTENTIAL
TEST PIT SURVEY REQUIRED

USDA FSA, GeoEye, Maxar

0 150
Metres

Projection: NAD 1983 CSRS UTM Zone 17N
Scale: 1:2,900
Page Size: 11 x 17

ASI Project No.: 20EA-210
Date: 2021-01-05 10:02 AM

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Figure 9: Grey Road 19 - Results of Stage 1

8.0 IMAGES

Plate 1: View of Grey Road 19; Land beyond disturbed road ROW requires Stage 2 test pit survey

Plate 2: View of Grey Road 19; Road and ROW are disturbed, no potential

Plate 3: View of Grey Road 19; Road and ROW are disturbed, no potential. Land beyond disturbed road ROW requires Stage 2 test pit survey

Plate 4: View of Grey Road 19; Road and ROW are disturbed, no potential. Land beyond disturbed road ROW requires Stage 2 test pit survey

Plate 5: View of Grey Road 19; Land beyond disturbed road ROW requires Stage 2 test pit survey

Plate 6: View of Grey Road 19; Road and ROW are disturbed, no potential

Stage 2 Archaeological Assessment
Grey Road 19
Part of Lots 15-16, Concession 1
(Geographical Township of Collingwood, County of Grey)
Town of The Blue Mountains, County of Grey, Ontario

Original Report

Prepared for:

R.J. Burnside & Associates Limited
128 Wellington Street West, Suite 301
Barrie, ON, L4N 8J6

Archaeological Licence: P383 (Williams)

PIF P383-0331-2022

Archaeological Services Inc. File: 22EA-054

29 July 2022

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Executive Summary

Archaeological Services Inc. (ASI) was contracted by R.J. Burnside & Associated Limited, on behalf of the County of Grey, to conduct a 2 Archaeological Assessment for the Grey Road 19 project, in the Town of The Blue Mountains (Figure 1).

A Stage 1 assessment for the Grey Road 19 project was previously completed by ASI in 2021. Background research and a property inspection determined that portions of the Study Area retained archaeological potential and Stage 2 test pit survey was recommended.

The Stage 2 property survey was conducted on June 16, 2022, in accordance with the *Ontario Heritage Act* and the S & G by test pit survey. Approximately 97 percent of the Study Area (3.03 hectares) was determined to have been previously assessed (Archaeological Services Inc., 2021) and did not require Stage 2 survey. An additional 1.6 percent of the Study Area (0.05 hectares) was determined to have been previously disturbed during the construction of Grey Road 19 and the associated ditching and buried utility installation. These areas were not subject to Stage 2 assessment.

The remaining 0.6 percent of the Study Area (0.01 hectares), comprising scrubland, was subject to judgmental test pit survey at 10 metre intervals to confirm previous disturbance. No archaeological resources or intact A-horizon (natural topsoil) were encountered during the Stage 2 survey, and no further archaeological assessment is recommended.

Project Personnel

- **Senior Project Manager**: Lisa Merritt, MSc (P094) Partner, Director, Environmental Assessment Division
- **Division Coordinator**: Katrina Thach, BA Hons (R1225), Associate Archaeologist, Division Coordinator, Environmental Assessment Division
- **Project Administrator**: Catherine Kitchen, BA, Archaeologist, Project Administrator, Environmental Assessment Division
- **Project Director and Project Manager**: Blake Williams, MLitt (P383), Lead Archaeologist, Project Manager, Environmental Assessment Division
- **Field Director**: Brandon Reimer, BA (R1297), Archaeologist, Field Director, Environmental Assessment Division
- **Field Archaeologists**: William Hayward Johns, BDes; Justine Tenzer
- **Report Preparation**: Blake Williams
- **Graphics**: Peter Bikoulis, PhD, Archaeologist, GIS Technician, Operation Division; Jonas Fernandez, MSc (R281), Lead Archaeologist, Manager - Geomatics, Operations Division; Robin Latour, MPhil, PDip, Associate Archaeologist, Geomatics Specialist, Operations Division; Carolyn Nettleton, BA, Archaeologist, GIS Technician, Operation Division
- **Report Review**: Jessica Lytle, MSc (P1066), Lead Archaeologist, Technical Writer and Fieldwork Coordinator, Environmental Assessment Division; Lisa Merritt

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1.0 Project Context

Archaeological Services Inc. (ASI) was contracted by R.J. Burnside & Associates Limited, on behalf of the County of Grey to conduct a Stage 2 Archaeological Assessment as part of the as part of the Grey Road 19 Municipal Class Environmental Assessment in the Town of The Blue Mountains, County of Grey (Figure 1). This project involves improvements for Grey Road 19 from the roundabout at Grey Road 19 / Grey Road 119 / Gord Canning Drive to west of the intersection of Grey Road 19 / Simcoe Road 34 / Grey Road 21 and Mountain Road.

All activities carried out during this assessment were completed in accordance with the *Ontario Heritage Act* (*Ontario Heritage Act*, R.S.O. c. O.18, 1990, as amended in 2021) and the 2011 *Standards and Guidelines for Consultant Archaeologists* (S & G), administered by the Ministry of Heritage, Sport, Tourism and Culture Industries (MHSTCI), formerly the Ministry of Tourism and Culture (MTC, 2011).

1.1 Development Context

All work has been undertaken as required by the *Environmental Assessment Act, RSO* (Environmental Assessment Act, R.S.O., 1990 as amended 2021) and regulations made under the Act, and are therefore subject to all associated legislation. This project is being conducted in accordance with the Municipal Engineers' Association document *Municipal Class Environmental Assessment* (Municipal Class Environmental Assessment, 2000, as amended 2015).

In addition, this Stage 2 assessment has been commissioned to satisfy the recommendations of the previous Stage 1 assessment that was undertaken as part of the Grey Road 19 Municipal Class Environmental Assessment in the Town of the Blue Mountains, County of Grey (ASI 2021).

ASI has been actively engaging with Indigenous communities who have expressed an interest in the archaeological work within the Study Area for this project on behalf of the County of Grey. A detailed account of all First Nations engagement can be found in the *Supplementary Documentation: Indigenous Engagement* document associated with this report.

Authorization to access and carry out all activities necessary for the completion of this Stage 2 assessment was granted by R.J. Burnside & Associates on April 13, 2022.

1.1.1 Treaties and Traditional Territories

The subject property is within the Nottawasaga Purchase (Treaty 18), a provisional agreement sometimes called the Lake Simcoe-Nottawasaga Treaty, signed on October 17, 1818, by representatives of the Government of Upper Canada and the Anishinaabe (Ministry of Indigenous Affairs, 2020; Williams Treaties First Nations, 2021). Treaty 18 encompassed 1,592,000 acres of land between the District of London in the west, Lake Huron in the north, the west limit of the Penetanguishene Purchase (1815) in the east, and the west shore of Lake Simcoe, Cook's Bay, and the Holland River in the northwest. In exchange for the land, the Crown agreed to pay an annual sum of £1200 in goods at the "Montreal price" (Crown-Indigenous Relations and Northern Affairs, 2016; Ministry of Indigenous Affairs, 2020). The Nottawasaga Purchase territory includes the present-day communities of Wasaga, Bradford, and Collingwood.

1.2 Historical Context

A comprehensive review of the precontact Indigenous and Euro-Canadian occupations of the County of Grey is presented in the Stage 1 report (ASI 2021). To summarize, background research indicates that the general vicinity of the Study Area has been attractive to human settlement for thousands of years, primarily by Indigenous people and more recently by Euro-Canadian settlers. Historically, the Study Area corridor is within part of Lots 15-16, Concession 1 in the Geographical Township of Collingwood, County of Grey, Ontario.

1.3 Archaeological Context

This section provides background research pertaining to previous archaeological fieldwork conducted within and in the vicinity of the Study Area, its environmental characteristics (including drainage, soils or surficial geology and topography, etc.), and current land use and field conditions. Three sources of information were consulted to provide information about previous archaeological research: the site record forms for registered sites available online from the MHSTCI through *Ontario's Past Portal*; published and unpublished documentary sources; and the files of ASI.

1.3.1 Current Land Use and Field Conditions

The Study Area is located along Grey Road 19 from east of the roundabout at Grey Road 10 / Grey Road 119 / Gord Canning Drive to the west of Grey Road 19 / Simcoe Road 34 / Grey Road 21 and Mountain Road intersection. Grey Road 19 is a two-lane undivided roadway, which is well developed with low density residential housing, with wide gravel shoulders and ditching. It lacks curbs and sidewalks, and the roadbed is raised in places. Beyond the road right-of-way is densely treed areas, some of which are cedar swamp wetlands.

The Stage 2 survey for the Grey Road 19 project was conducted on June 16, 2022, under the field direction of Brandon Reimer (R1297).

1.3.2 Geography

A comprehensive summary of the geology and physiography of Grey County is presented in the Stage 1 report (ASI 2021, pp. 6–7). To summarize, the Study Area is situated within the Clay Plains and Beaches of the Simcoe Lowlands physiographic region of southern Ontario (Chapman & Putnam, 1984).

The Simcoe Lowlands physiographic region consists of low-lying belts of sand plain, which cover an area of 280,000 hectares, bordering Georgian Bay and Lake Simcoe. The area was once inundated by the waters of glacial Lake Algonquin, inland of the present-day shorelines. Remnant shoreline features (beaches, shorecliffs, bars, etc.) mark the former water level of Lake Algonquin. Topography is generally flat and subsoil consists of variable sand, gravel, silt and clay deposits as formed on the lake bottom (Chapman and Putnam 1984:177-182). Sand plains and beach ridges are glaciolacustrine features and are products of the Late Wisconsian glacial stage (ca. 25,000-10,000 BP). Sand plains are formed in shallow waters and beach ridges mark the former shorelines (Karrow and Warner 1990:5).

To the west is the Niagara Escarpment, one of the most prominent features in southern Ontario, which extends from the Niagara River to the northern tip of the Bruce Peninsula, continuing through the Manitoulin Islands (Chapman and Putnam 1984:114-122). Vertical cliffs along the brow mostly outline the edge of the dolostone of the Lockport and Amabel Formations, which the slopes below are carved in red shale. Flanked by landscapes of glacial origin, the rock-hewn topography stands in striking contrast, and its steep-sided valleys are strongly suggestive of non-glacial regions. From Queenston, on the Niagara River, westward to Ancaster, the escarpment is a simple topographic break separating the two levels of the Niagara Peninsula. The Niagara Escarpment is a designated United Nations Educational, Scientific and Cultural Organization (UNESCO) World Biosphere Reserve.

Directly west of the Study Area the Niagara Escarpment, including the Scenic Caves, are visible as a prominent landform, known locally as the Blue Mountains and commonly used for downhill skiing in the winter. The Blue Mountains in particular, and the Niagara Escarpment in general, as been instrumental in shaping human settlement, industry, cosmology, and recreation in the area for millennia.

The surficial geology mapping demonstrates that the Study Area is underlain by stone-poor, sandy silt to silty sand-textured till on Paleozoic terrain, with a shore bluff or scarp through the western portion of the Study Area and beach ridges and near shore bars through the eastern portion (Ontario Geological Survey, 2010). A second shore bluff or scarp runs to the west. Soils in the Study Area consist of Kemble silty clay, a brown forest grey-brown podzolic intergrade with imperfect drainage and Morley clay, a dark grey gleisolic with poor drainage (Figure 8).

The Study Area is within the Blue Mountain watershed and Silver Creek is located to the southeast of the Study Area. Silver Creek flows from spring-fed tributaries on the Niagara Escarpment and its headwaters are impounded behind a large dam at Lake of the Clouds before cascading downstream through forest Escarpment terrain. It enters the Simcoe Lowlands near Osler Bluff Road, where it flows northward through forest, farm field, and rural residential areas. It then enters coastal wetland, discharging into the Bay north of Highway 26. Significant wetland loss has occurred along the Georgian Bay shoreline due to urban development, and approximately 32 hectares of net subwatershed wetland loss occurred between 2002 and 2008 (Nottawasaga Valley Conservation Authority, 2013).

1.3.3 Previously Registered Archaeological Sites

In Ontario, information concerning archaeological sites is stored in the Ontario Archaeological Sites Database maintained by the MHSTCI. This database contains archaeological sites registered within the Borden system. Under the Borden system, Canada has been divided into grid blocks based on latitude and longitude. A Borden block is approximately 13 kilometres east to west, and approximately 18.5 kilometres north to south. Each Borden block is referenced by a four-letter designator, and sites within a block are numbered sequentially as they are found. The Study Area under review is located in Borden block *BcHb.*

According to the Ontario Archaeological Sites Database, no previously registered are within 50 Metres of the Study Area.

1.3.4 Previous Archaeological Assessments

According to the background research, two previous reports detail fieldwork within 50 metres of the Study Area.

Reports within the Study Area

(ASI 2021) Stage 1 Archaeological Assessment Grey Road 19 Lots 15-16 & Con 1 (Former Township of Collingwood, County of Grey) Town of the Blue Mountains, County of Grey, Ontario. P380-0084-2020. ASI file 20EA-210.

In 2021, ASI conducted a Stage 1 Archaeological Assessment associated with the current project, which overlaps the present Study Area. The report noted that while the majority of the project area was disturbed, some areas with archaeological potential remain. ASI recommended Stage 2 test pit survey at five metre intervals.

Additional Reports within 50 metres of the Study Area

(AMICK Consultants Limited, 2008) Report on the 2008 Stage 1-2 Archaeological Assessment Of [SIC] Propose Residential Developments Part of Lot 16. Concession 1, Geographic Township of Collingwood, Town of Blue Mountains, Grey County. P058-373-2008. Corporate Project # 28107-P.

This report is located on the north side of County Road 19, across the street from the current Study Area. The relevant section of project area was documented as low-lying and wet area during the Stage 1 field inspection. Following the Stage 2 test pit survey to the east, near Osler Bluff Road, the entire property was recommended to be considered cleared of any further requirements of archaeological fieldwork.

2.0 Field Methods

The Stage 2 Study Area comprises of Grey Road 19 from the roundabout at Grey Road 19 / Grey Road 119 / Gord Canning Drive to west of the intersection of Grey Road 19 / Simcoe Road 34 / Grey Road 21 and Mountain Road. Most of this area was noted as disturbed during the Stage 1 assessment test pit survey occurred on of three sections of land south of Grey Road 19 in the Town of Blue Mountains (Figure 1). It measures approximately 1,000 metres by 28 metres in size and covers an area of 3.1 hectares (Figures 1-4).

The Stage 2 property survey was conducted under the field direction of Brandon Reimer (R1297) on June 16, 2022, in accordance with the *Ontario Heritage Act* and the S & G, Section 2. During the field assessments, weather and lighting conditions permitted good visibility and were in accordance with the S & G, Section 2.1, Standard 3. During the time of survey, conditions were seasonal with sunny skies and temperatures of 24 degrees Celsius. Photographs of all field conditions were taken (Images 1-11), and the location and direction of each photograph is mapped in Figures 3-4.

As per Section 2.1 of the S & G, all lands were within areas where ploughing was not possible or viable and therefore subject to test pit survey. According to Section 2.1.2, Standard 2 of the S & G, any undisturbed areas requiring test pit survey within 300 metres of any feature of archaeological potential must be subject to systematic assessment at five metre intervals. Test pits were placed at five metre intervals until disturbance was encountered, and then judgmentally increased to ten metres intervals as per S & G Section 2.1.8. No intact soil profiles were encountered during the test pit survey, therefore judgmental 10 metre intervals were employed to confirm previous disturbance as per S & G Section 2.1.8b.

All test pits were excavated following the S & G Section 2.1.2 Standards 5-9. All test pits were excavated by hand to a minimum of 30 centimetres in diameter and into the first five centimetres of subsoil. Each test pit was examined for stratigraphy, cultural features, and evidence of fill. Test pit fill was screened through six-millimetre mesh to facilitate artifact recovery. Afterwards, all test pits were backfilled, and their locations were recorded on field maps. Any factors that precluded the excavation of test pits (e.g., excessive slope, drainage, exposed bedrock, previous disturbance) were noted, and the areas were mapped and photographed.

Fieldwork was conducted using a Samsung Galaxy S4 tablet running Esri Collector software equipped with a sub-metre Trimble Catalyst Global Navigation Satellite System in conjunction with project mapping provided by the County of Grey to ensure the assessment remained within the Study Area limits.

2.1 Areas of No Archaeological Potential

Approximately 97.8 percent of the Study Area (3.03 hectares) was previously assessed without further recommendations and not subject to Stage 2 assessment as per S & G Section 2.1, Standard 2.c (ASI 2021: P380-0084-2020).

Visual assessment determined that a portion of the Study Area did not retain archaeological potential. Approximately 1.6 percent of the Study Area (0.05 hectares) had been previously subject to deep and extensive ground disturbance and was not subject to Stage 2 survey, as per S & G Section 2.1, Standard 2.b. The lands documented as being previously disturbed have no archaeological potential and include gravel driveways or parking areas, ditches, and locations with buried utilities (Figures 3-4; Images 1-6).

ASI

2.2 Test Pit Survey

The remaining 0.6 percent of the Study Area (0.01 hectares) did not contain natural topsoil (A-horizon) and was subject to judgmental test pit survey at 10 metre intervals to confirm previous disturbance following S & G Section 2.1.8, Standards 1-2. The areas subject to judgmental test pit survey consist of primarily scrubland adjacent to the ditch associated with Grey Road 19 (Figures 3-4; Images 7-11).

Disturbed stratigraphy in the west and eastern sections of the Study Area are characterized by 7-20 centimetres of brown (10YR 4/3) sandy clay laid topsoil containing rock gravel inclusions, atop 20-59 centimetres of a fill layer with light brown sandy clay (10YR 6/2) mottled with gravel. In the western section, 66 centimetres of laid topsoil is underlaid by a dark grayish brown (10YR 4/2) clay fill with gravel inclusions down to the limit of excavation of 100 centimetres (Image 8).

In the eastern section, a brown (10YR 5/3) gravel fill layer with some mottled areas of sandy clay was noted down to the edge of excavation at 20 centimetres (Image 10). The limit of excavation was reached at 40 centimetres when the water table was encountered, and the test pits began to fill with water.

2.3 Stage 2 Assessment Results Summary

A summary of the Stage 2 assessment results for the Grey Road 19 Project can be found in Table 1 below.

Table 1: Stage 2 Survey Results Summary

Survey Method	Area	Description	Images
Not assessed due to previous assessment; no further work recommended	3.03 hectares (97.8 percent)	ASI 2021	Not applicable
Visually assessed as being previously disturbed; no archaeological potential	0.05 hectares (1.6 percent)	Road berm for Grey Road 19 Gravel parking area and driveways; Ditches with nearby buried utilities	1-6
Judgmental test pit survey; 10 metre intervals	0.01 hectares (0.6 percent)	Scrubland	7-11

3.0 Record of Finds

No archaeological resources were encountered during the course of the Stage 2 Archaeological Assessment for the Grey Road 19 project.

3.1 Inventory of Documentary and Material Record

The documentation related to this archaeological assessment will be curated by ASI until such a time that arrangements for their ultimate transfer to Her Majesty the Queen in right of Ontario, or other public institution, can be made to the satisfaction of the project owner(s), the MHSTCI, and any other legitimate interest groups.

Table 2 provides an inventory and location of the documentary and material record for the project in accordance with the S & G, Sections 6.7 and 7.8.2.3.

Table 2: Inventory of Documentary and Material Record

Material	Location	Comments
Digital field notes, field maps, GPS logs, etc.	Archaeological Services Inc., 528 Bathurst Street, Toronto, Ontario, M5S 2P9	Stored in ASI project folder 22EA-054; GPS and digital information stored on ASI network servers
Digital field photography	Same as above	Files stored on ASI network servers
Digital research, analysis, and reporting materials	Same as above	Files stored on ASI network servers

4.0 Analysis and Conclusions

ASI was contracted by R.J. Burnside & Associated Limited, on behalf of the County of Grey, to conduct a 2 Archaeological Assessment for the Grey Road 19 project in the Town of The Blue Mountains (Figure 1). This project involves improvements for Grey Road 19 between the roundabout at Grey Road 19 / Grey Road 119 / Gord Canning Drive to the west of the intersection of Grey Road 19 / Simcoe Road 34 / Grey Road 21 and Mountain Road.

A Stage 1 assessment for the Grey Road 19 project was previously completed by ASI in 2021. Background research and a property inspection determined that portions of the Study Area retained archaeological potential and Stage 2 test pit survey was recommended.

The Stage 2 property survey was conducted on June 16, 2022, in accordance with the *Ontario Heritage Act* and the S & G by test pit survey. Approximately 97 percent of the Study Area (3.03 hectares) was determined to have been previously assessed (ASI 2021) and did not require Stage 2 survey (Figures 3-4).

An additional 1.6 percent (0.05 hectares) of the Study Area was determined to have been previously disturbed during the construction of Grey Road 19 and the associated ditching and buried utility installation (Figures 3-4, Images 1-6). These areas were not subject to Stage 2 assessment. The remaining 0.6 percent of the Study Area (0.01 hectares), comprising scrubland, was subject to judgmental test pit survey at 10 metre intervals to confirm previous disturbance (Figures 3-4; Images 7-11). No archaeological resources or intact A-horizon (natural topsoil) were encountered during the Stage 2 survey, and no further archaeological assessment is recommended.

5.0 Recommendations

In light of these results, the following recommendations are made:

1. The Study Area does not require further archaeological assessment; and

2. Should the proposed work extend beyond the current Study Area, or should changes to the project design or temporary workspace requirements result in the inclusion of previously un-surveyed lands, these lands should be subject to a Stage 2 archaeological assessment.

NOTWITHSTANDING the results and recommendations presented in this study, ASI notes that no archaeological assessment, no matter how thorough or carefully completed, can necessarily predict, account for, or identify every form of isolated or deeply buried archaeological deposit. In the event that archaeological remains are found during subsequent construction activities, the consultant archaeologist, approval authority, and the Archaeology Programs Unit of the MHSTCI should be immediately notified.

The above recommendations are subject to Ministry approval, and it is an offence to alter any archaeological site without MHSTCI concurrence. No grading or other activities that may result in the destruction or disturbance of any archaeological sites are permitted until notice of MHSTCI approval has been received.

6.0 Legislation Compliance Advice

ASI advises compliance with the following legislation:

- This report is submitted to the Ministry of Heritage, Sport, Tourism and Culture Industries as a condition of licensing in accordance with Part VI of the *Ontario Heritage Act*, RSO 2005, c 0.18. The report is reviewed to ensure that it complies with the standards and guidelines that are issued by the Minister, and that the archaeological field work and report recommendations ensure the conservation, preservation, and protection of the cultural heritage of Ontario. When all matters relating to archaeological sites within the project area of a development proposal have been addressed to the satisfaction of the Ministry of Heritage, Sport, Tourism and Culture Industries, a letter will be issued by the Ministry stating that there are no further concerns with regards to alterations to archaeological sites by the proposed development.

- It is an offence under Sections 48 and 69 of the *Ontario Heritage Act* for any party other than a licensed archaeologist to make any alteration to a known archaeological site or to remove any artifact or other physical evidence of past human use or activity from the site, until such time as a licensed archaeologist has completed archaeological field work on the site, submitted a report to the Minister stating that the site has no further cultural heritage value or interest, and the report has been filed in the Ontario Public Register of Archaeology Reports referred to in Section 65.1 of the *Ontario Heritage Act*.

- Should previously undocumented archaeological resources be discovered, they may be a new archaeological site and therefore subject to Section 48 (1) of the *Ontario Heritage Act*. The proponent or person discovering the archaeological resources must cease alteration of the site immediately and engage a licensed consultant archaeologist to carry out archaeological fieldwork, in compliance with sec. 48 (1) of the *Ontario Heritage Act*.

- The *Funeral, Burial and Cremation Services Act*, 2002, S.O. 2002, c.33, requires that any person discovering or having knowledge of a burial site shall immediately notify the police or coroner. It is recommended that the Registrar of Cemeteries at the Ministry of Consumer Services is also immediately notified.

- Archaeological sites recommended for further archaeological field work or protection remain subject to Section 48(1) of the *Ontario Heritage Act* and may not be altered, nor may artifacts be removed from them, except by a person holding an archaeological license.

7.0 Bibliography and Sources

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8.0 Images

Image 1: Raised roadbed and associated ditch; disturbed, no archaeological potential.

Image 2: Channelized ditch and raised roadbed; disturbed, no archaeological potential.

Image 3: Gravel access road and utility boxes; disturbed, no archaeological potential.

Image 4: Ditch, culvert, and buried utilities; disturbed, no archaeological potential.

Image 5: Gravel driveway and ditch; disturbed, no archaeological potential.

Image 6: Gravel driveway, buried utilities and ditch; disturbed, no archaeological potential.

Image 7: Judgemental test pit survey at 10 metre intervals in progress with disturbed area in background.

Image 8: Disturbed test pit profile found during judgemental test pit survey.

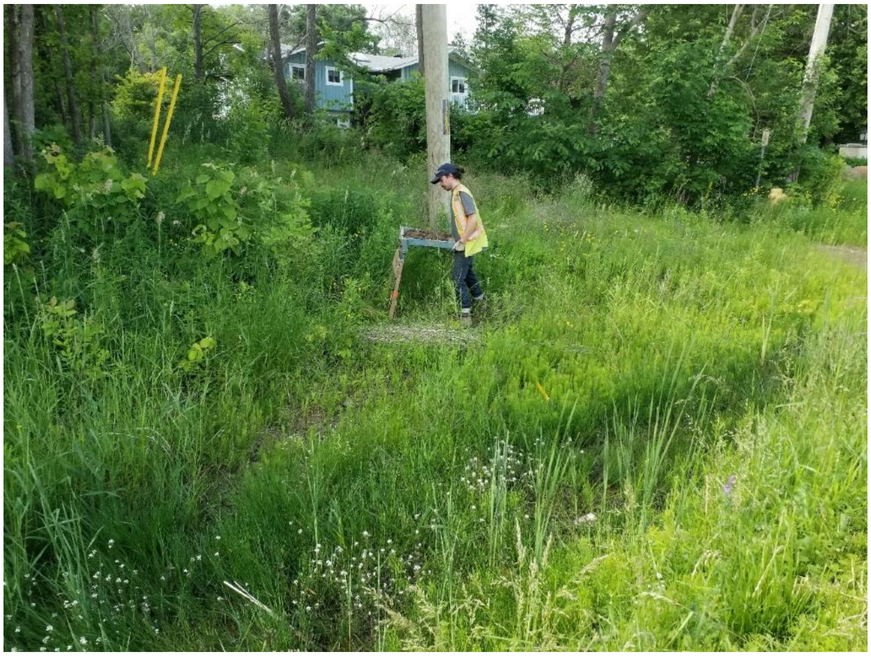

Image 9: Judgemental test pit survey at 10 metre intervals in progress.

Image 10: Disturbed test pit filling with water.

Image 11: Judgemental test pit survey at 10 metre intervals in progress.

9.0 Maps

Figure 1: Location of the Study Area

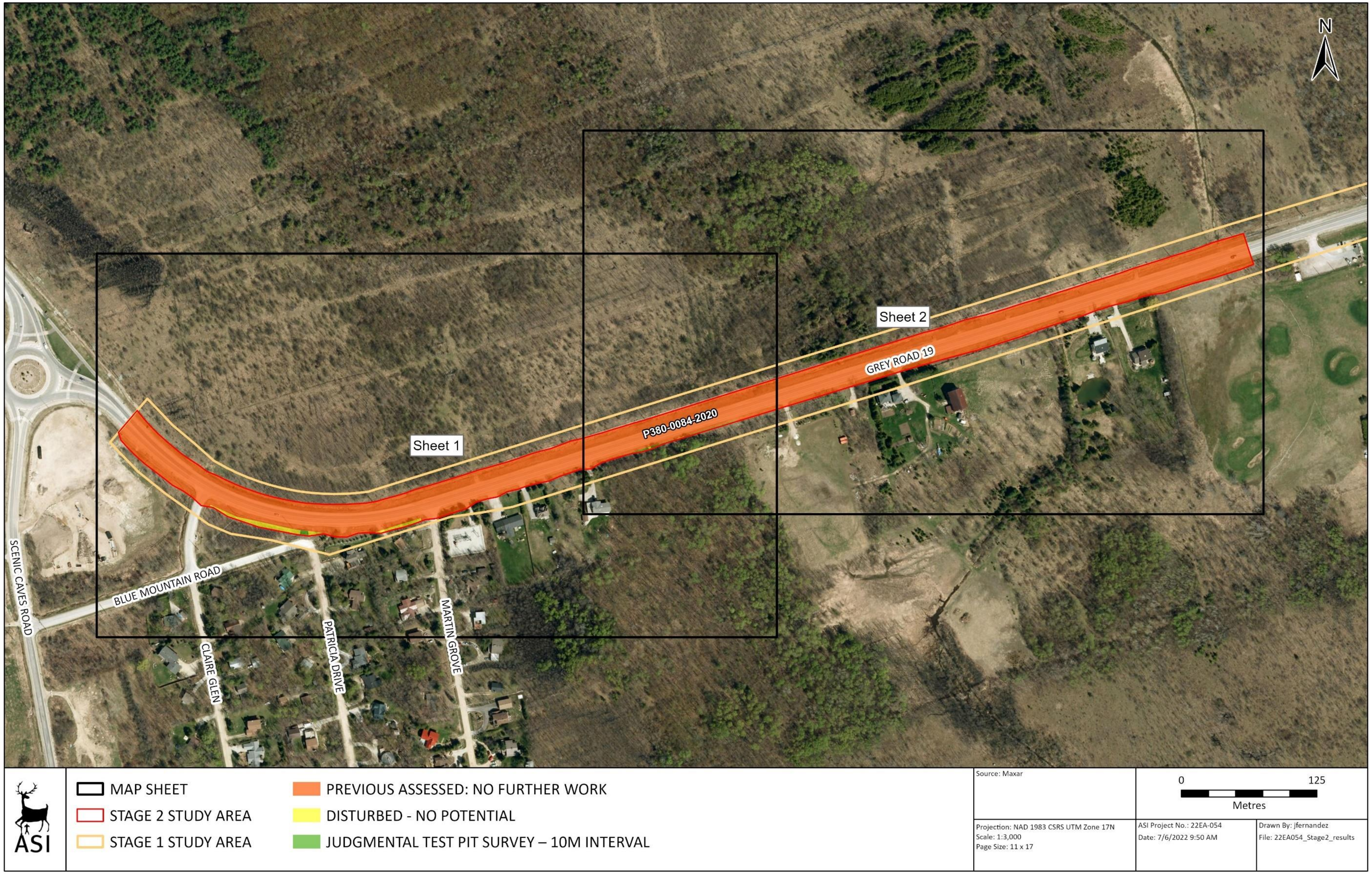

Figure 2: Stage 2 Archaeological Assessment Results for Grey Road 19– Key Plan

Figure 3: Stage 2 Archaeological Assessment Results for Grey Road 19 – Sheet 1

Figure 4: Stage 2 Archaeological Assessment Results for Grey Road 19– Sheet 2

Noise Impact Assessment Report
Grey Road 19 from Scenic Caves Road to Osler Bluff Road
Environmental Assessment, Schedule C

Grey County

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September 2022
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Record of Revisions

Revision	Date	Description
0	Sept 2022	Initial Submission to Grey County

R.J. Burnside & Associates Limited

Report Prepared By:

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BM:clr

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Air & Noise Scientist

Executive Summary

Burnside has prepared a Noise Impact Assessment Report assessing the impacts of the proposed improvements to Grey County Road 19 from Scenic Caves Road to Osler Bluff Road in Grey County.

The traffic data relied upon here was provided by the County and Ontario Traffic Inc.

This report presents the results of a road traffic noise impact assessment conducted using STAMSON. The assessment used 3 Points of Reception (POR) at the plane of window on the most exposed side of the dwelling. All 3 Points of Reception also had a corresponding Outdoor Living Area (OLA) location.

Modelled noise levels were calculated for 3 scenarios: Current, Future No Build and Future Build. The Future No Build scenario represents conditions in the future without proposed road improvements, while the Future Build scenario represents conditions with the proposed road improvement.

The results of this assessment for each of the scenarios were compared to criteria in the Ministry of Transportation (MTO) Noise Guide to determine whether the potential increase in noise levels due to the Future Build scenario would merit mitigation measures under the guideline.

It was determined that no significant increases to traffic noise are expected as a result of the project and therefore no mitigation measures need to be considered.

The determination as to whether mitigation measures need to be considered is based on the difference in predicted sound levels between the Future Build and Future No Build scenarios and comparison with the 65 dBA threshold, which is the MTO established acceptable noise threshold for PORs and OLAs impacted by road widenings. If the difference in the predicted sound levels between the Future Build and Future No Build scenarios is less than 5 dBA and the Future Build predicted sound levels are less than 65 dBA, then mitigation measures do not need to be considered.

For all PORs the future sound levels are equivalent or lower with the implementation of the proposed design, when compared to the Future No Build scenario. The predicted sound levels all PORs remained below the 65 dBA threshold so mitigation is not required.

Table of Contents

Glossary of Terms and Acronyms

AADT	Annual Average Daily Traffic
Burnside	R.J. Burnside & Associates Limited
EA	Environmental Assessment
MECP	Ministry of the Environment, Conservation and Parks
MTO	Ontario Ministry of Transportation
Noise Guide	Ontario Ministry of Transportation Environmental Guide for Noise, October 2006
NSA	Noise Sensitive Aera
OLA	Outdoor Living Area
ORNAMENT	Ontario Road Noise Analysis Method
POR	Point of Reception
POW	Plane of Window
STAMSON	MECP Transportation Noise Modeling Software
Town	The Town of The Blue Mountains
vpd	Vehicles per day
County	Grey County

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1.0 Introduction

Grey County (County) has initiated a Municipal Class Environmental Assessment (EA) to widen Grey Road 19 between Grey Road 21/ Mountain Road and Grey Road 119 / Gord Canning Drive to four lanes to meet the needs of increased traffic demand. The existing and proposed roundabouts in this area are not included in this study.

As part of the EA process, R.J. Burnside & Associates Limited (Burnside) has completed a Noise Study on behalf of the County to identify whether the change in traffic from the proposed Grey Road 19 improvements and widening will significantly change noise levels within the Study Area and vicinity, and if any potential mitigation measures are required.

The Noise Impact Assessment Report investigates the following scenarios:

1. Current Conditions.
2. Future No Build Conditions.
3. Future Build – Proposed Alignment.

The Noise Study has been completed for the three design concepts identified for the redevelopment of Grey Road 19.

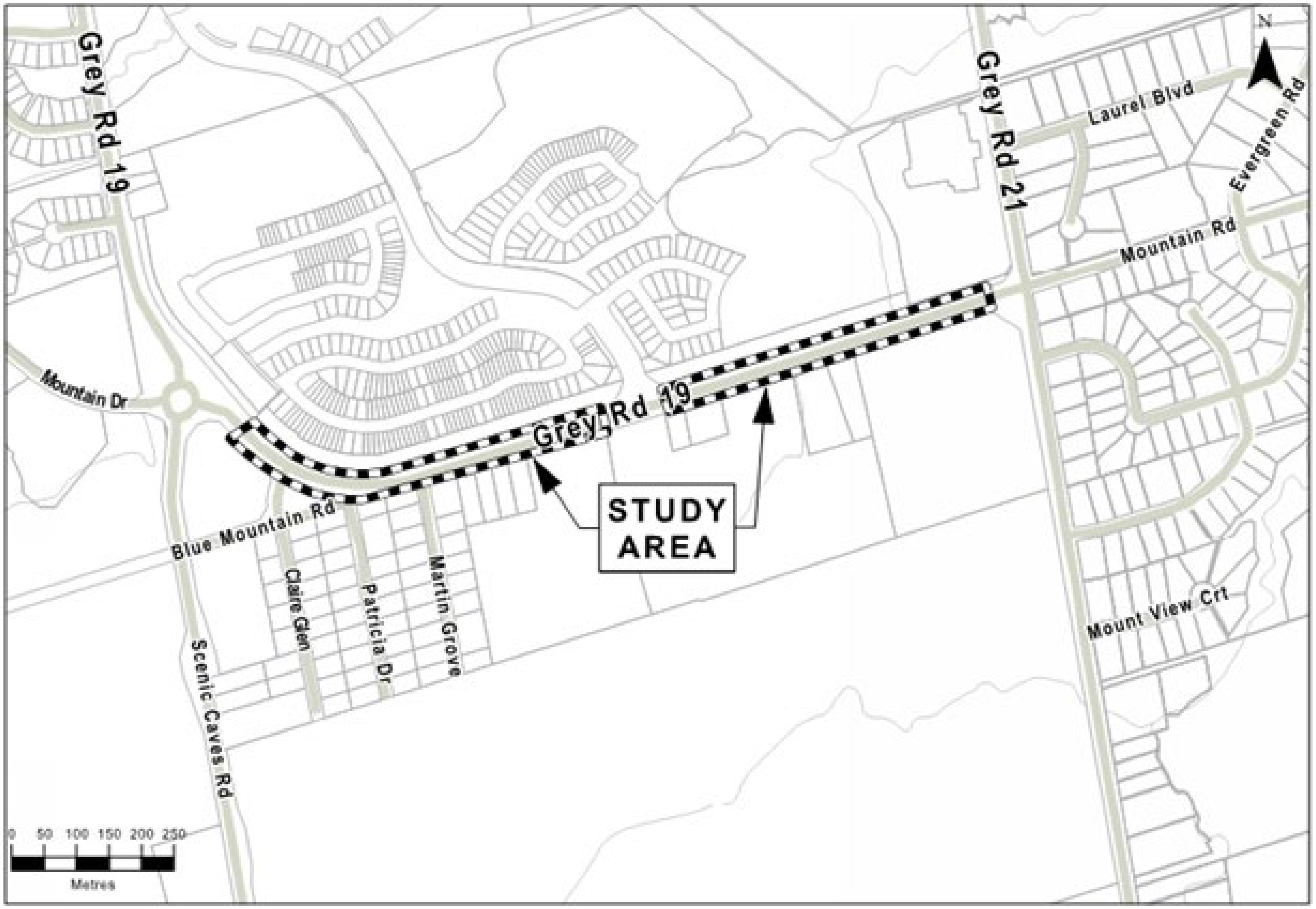
The EA is being completed in accordance with the requirements of a Municipal Class EA, Schedule C undertaking as outlined in the Municipal Engineers Association Municipal Class Environmental Assessment Document (October 2000, as amended 2007, 2011 and 2015), which is an approved process under the Ontario Environmental Assessment Act

2.0 Study Area

As per the Ontario Ministry of Transportation (MTO) Environmental Guide for Noise (Noise Guide) (MTO, 2006), the Study Area for the Grey Road 19 has been determined by calculating the setback distance from Grey Road 19 to the point where there is no predicted increase in noise impacts from Grey Road 19 above the future ambient sound level (150 metres).

The Study Area is Grey Road 19 from Scenic Caves Road to Osler Bluff Road, in the Town of The Blue Mountains, and is illustrated in Figure 1.

Figure 1: Study Area Grey Road 19 from Scenic Caves Road to Osler Bluff Road



3.0 Noise Assessment

3.1 Sensitive Receptors

A Noise Sensitive Area (NSA) is defined as a group of one or more properties that are considered to be a noise sensitive land use. An NSA groups all sensitive receptors in an area that are exposed to similar noise influences.

The Point of Reception (POR) or Outdoor Living Area (OLA) assessed for each NSA is the most exposed receptor in the NSA. For PORs the location taken is the most exposed façade, for OLAs the location taken is 3 m off of the centre of the façade best interpreted as the start of the OLA area such as a backyard.

The "most exposed side" of the most exposed dwelling in each NSA must be assessed according to the MTO Noise Guide. The most exposed side refers to the closest side of the dwelling unit even if there is no Outdoor Living Area (OLA) associated with this side and without the shielding of the building. However, required mitigation measures (if applicable) should be based on sound levels predicted at the OLA.

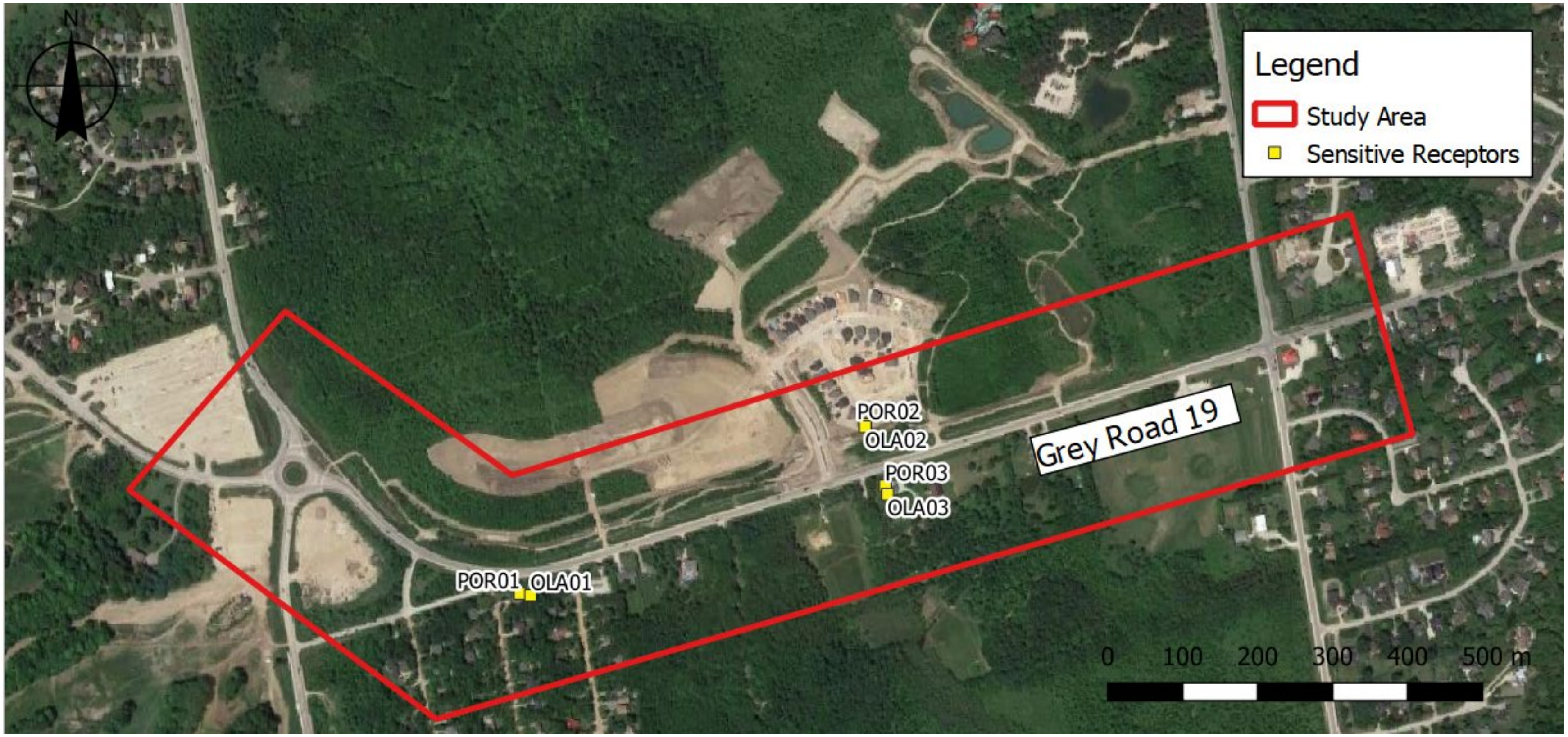
Noise sensitive land use, as described by the Ministry of the Environment, Conservation and Parks (MECP, 2013), means:

- A property of a person that accommodates a dwelling and includes a legal nonconforming residential use.
- A property of a person that accommodates a building used for a noise sensitive commercial purpose.
- A property of a person that accommodates a building used for a noise sensitive institutional purpose.

Based on aerial imagery there are three areas of residential land uses near Grey Road 19 that are considered to be noise sensitive land uses. These three NSAs are conservatively represented by three receptors, all of which have an associated OLA, for a total of six calculations. There are no commercial or institutional purpose sensitive land uses within the Study Area.

Figure 2 illustrates all sensitive receptors for all the NSAs within the Study Area.

Figure 2: Sensitive Receptors



3.2 Noise Impact Assessment Criteria

Grey Road 19 is a major road under the jurisdiction of Grey County. The Town of The Blue Mountains and Grey County do not have a noise policy concerning road improvements. In the absence of municipal guidelines, reliance was made on the provincial MTO Noise Guide.

According to the MTO Noise Guide, where an increase in sound level is predicted, mitigation measures may be required as summarized in Table 1.

Table 1: Mitigation Effort Required for the Projected Noise Level with the Proposed Improvements above the Ambient

Change in Noise Level Above Ambient/Projected Noise Levels with Proposed Improvements	Mitigation Effort Required
< 5 dBA[1] change AND < 65 dBA	• None
≥ 5 dBA change OR ≥ 65 dBA	• Investigate noise control measures on Right-of-Way. • Introduce noise control measures within Right-of-Way and mitigate to ambient if technically, economically and administratively feasible. • Noise control measures, where introduced, should achieve a minimum of 5 dBA attenuation, over first row receivers.

Mitigation measures, if applicable, must attempt to achieve levels that otherwise would be experienced without the proposed project if technically, economically, and administratively feasible.

3.3 Noise Impact Assessment Methodology

In order to determine the potential noise impact, future predicted sound levels with and without the proposed road improvements were compared for the POW and OLA locations, which coincides with the most exposed side of the noise sensitive receptors. Sound levels were predicted using traffic noise prediction model ORNAMENT (Ontario Road Noise Analysis Method), implemented through the STAMSON (version 5.04) computer program as required by MECP and MTO.

[1]dBA (A-weighted decibel) is an expression of the relative loudness of sounds in air as perceived by the human ear.

The sound levels were predicted based on the Annual Average Daily Traffic (AADT) value as required by the MTO for three scenarios: Present, Future No Build, and Future Build. The future scenarios are based on forecasted traffic (to 2031).

The Future No Build scenario represents conditions in the future without proposed road improvements, while the Future Build scenario represents conditions with the proposed road improvement.

3.4 Traffic Data

Traffic data for this report was obtained from the County. Truck percentage data was obtained from Ontario Traffic Inc’s turning counts for the peak hour.

The County’s traffic counts for February 2020 indicate an eastbound AADT of 6,637 vehicles per day (vpd) and a westbound AADT of 6,561 vpd. This is combined for a total AADT of 13,198 vpd.

To get the 2021 (Present) AADT levels a growth rate of 1%[2] was assumed and applied for 1 year to get an AADT of 13,330 vpd. To get the 2031 (Future Build and Future No Build) AADT a growth rate of 1% was assumed and applied for 11 years to get 14,725 vpd. It is assumed that the proposed upgrades to Grey Road 19 will not impact the future traffic levels. Therefore, the following AADT levels are used for this study:

Present AADT (2020): 13,330 vpd

Future Build AADT (2031): 14,725 vpd

Future No Build AADT (2031): 14,725 vpd

Ontario Traffic Inc’s Traffic counts report that the medium truck percentage use is 12.5%, whereas the heavy truck percentage use is 0.5%.

Relevant excerpts of the raw traffic data are provided in Appendix A.

Table 2: STAMSON Grey Road 19 Traffic Inputs for the Road Widening Alternative

Scenario	AADT [1]	Day Night Split [2]	Posted Speed Limit (kph) [3]	% of Medium Trucks [1]	% of Heavy Trucks [1]
Full Study Area: POR01 to POR03, OLA01 to OLA03					
Present	13,330	90 / 10	60	12.5 %	0.5 %
Future No Build	14,725	90 / 10	60	12.5 %	0.5 %
Future Build	14,725	90 / 10	60	12.5 %	0.5 %
As per the Intersection Count Report. [2] The day-night traffic volume was split 90/10 as per STAMSON Technical Document recommendation. [3] As per most recent Google Street View at time of report preparation. *2% road gradient was assumed for all calculations.					

[2] As per Burnside’s Phase 1 Traffic Study for Grey County Road 19

3.5 Results

The MECP provides the following table of impacts and how they should be interpreted:

Table 3: Interpretation of Adjusted Impact Level.

Adjusted Impact Level	Impact Rating
0-2.99 dB	Insignificant
3-4.99 dB	Noticeable
5-9.99 dB	Significant
10+dB	Very Significant

The predicted sound levels and the expected change in sound levels due to the worst-case proposed road improvements (road widening) are summarized in Table 4 and sample noise modelling printouts can be found in Appendix B. All sound levels are predicted for the daytime as the MTO criteria is designed for OLAs which are not expected to be used during the nighttime hour. As all roads in this assessment have been estimated to have a 90/10 daytime-nighttime traffic split, the nighttime impacts at all receptors will be significantly lower than the reported daytime results.

Table 4: Predicted Daytime Sound Levels for Future No Build and Future Build Scenarios.

POR ID - Location	Current Conditions Sound Levels (2021)	Future Sound Levels for No Build Scenario (2031)	Future Sound Levels for Build Scenario (2031)	Change due to Proposed Road Improvement (Future Build – Future No Build)
	Leq (16hr) (dBA)	Leq (16hr) (dBA)	Leq (16hr) (dBA)	(dB)
POR01 – 101 Patricia Drive	62	62	62	0
OLA01– 101 Patricia Drive	63	63	63	0
POR02 – 150 Snow Apple Crescent	57	57	57	0
OLA02 – 150 Snow Apple Crescent	56	57	57	0
POR03 – 796054 Grey Road 19	63	63	62	-1
OLA03 – 796054 Grey Road 19	49	50	49	-1

In Table 4, the difference between the sound levels for the “Current Conditions” and “Future No Build Scenario” are all caused by the increase in traffic from population growth. Some receptors do not show any increase because the values are rounded, and the change is less than 1 dBA.

In Table 4, the difference between the sound levels for the “Future No Build Scenario” and “Future Build Scenario” are due to the change in alignment of the road. An increase in sound level occurs when the road moves closer to the receptor while the sound level decreases where the road moves further from the receptor. However, the decrease in distance did not cause an increase in sound level of a full 1 dBA for any receptors. It should be noted that in a few cases there were acoustically insignificant increases of less than 1 dBA. These changes are entirely the results of small changes to the roadway centerline. It is a standard practice in the acoustic engineering field that calculated sound levels rounded be to the nearest whole number when reported.

As shown in Table 4, of the 6 locations modelled, only two locations show a change in the sound levels and both were less than 1 dB. For all of the PORs and OLAs, there are no acoustically significant shifts in the road centerline alignment proposed for the future build case; therefore, there is no change in the sound levels between the Future Build and Future No Build cases.

In addition, none of the predicted sound levels exceed the MTO criteria of 65 dBA. Therefore, the Study Area does not need any further assessment and no mitigation is required for the Future Build case.

It should be noted that the calculations methods of the MTO criteria do not allow for consideration of a few factors which could increase the experienced sound levels at the PORs. Such factors include increase in true driving speed from the better road quality or decrease of congestion. As the MTO criteria requires the posted speed limit be used in the calculation these effects are not captured by the model.

4.0 Conclusions

If the proposed improvements to Grey Road 19 are constructed, the increase in sound levels expected throughout the Study Area will be less than 5 dBA and no receptor will be exposed to sound levels of 65 dBA or higher; therefore, mitigation measures are not recommended following the guidance in the MTO noise guide.

The determination as to whether mitigation measures need to be considered is based on the difference in predicted sound levels between the Future Build and Future No Build scenarios and comparison with the 65 dBA sound level threshold, which is the Ministry of Transportation established acceptable noise threshold for PORs and OLAs impacted by road widenings. If the difference in the predicted sound levels between the Future Build and Future No Build scenarios is less than 5 dBA and the Future Build predicted sound levels are less than 65 dBA, then mitigation measures do not need to be considered. For all PORs considered the future sound levels are equivalent with the implementation of the proposed design, and the predicted level is under 65 dBA.

It should be noted that predicted Future Build and Future No Build sound levels increase for only 2 PORs relative to the predicted existing sound levels when the sound levels were rounded to the nearest decibel. This increase is attributable to the growth in the expected traffic volumes. This increase was 1 dB in both instances. Increases in sound levels from the existing state are not considered in the mitigation evaluation process designed by the MTO.

Based on the MECP interpretation of the noise impact levels, the noise impact due to the proposed improvements to Grey Road 19 are considered to be insignificant.

5.0 References

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Ministry of Transportation (MTO). Environmental Guide for Noise. October 2006.

Ministry of the Environment (MOE). Environmental Noise Guideline. Stationary and Transportation Sources – Approval and Planning. Publication NPC-300., August 2013.

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Burnside

[The Difference is our People]

Appendix A

Traffic Data

For Project:	Grey Road 19 - Feb 2020				
Project Notes:					
Location/Name:	Westbound				
Report Generated:	02-21-2020	11:34			
Speed Intervals	1 km/h				
Time Intervals	Instant				
Traffic Report From	02-07-2020	14:00:00	through	02-19-2020	11:59:59
85th Percentile Speed	74 km/h				
85th Percentile Vehicles	66462				
Max Speed	144 km/h	on	02-18-2020	18:03:18	
Total Vehicles	78191				
AADT:	6561				

Volumes - weekly counts

	Time	5 Day	7 Day
Average Daily		4858	5904
AM Peak	11:00	402	438
PM Peak	04:00	557	629

Speed

Speed Limit: 60

85th Percentile Speed: 74

Average Speed: 65.42

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Count over limit	11126	8764	5426	3314	7672	10635	13163
% over limit	76.0	90.0	90.6	74.0	82.9	67.5	71.8
Avg Speeder	69.4	70.1	70.2	67.9	69.2	68.3	69.0

For Project:	Grey Road 19 - Feb 2020				
Project Notes:					
Location/Name:	Eastbound				
Report Generated:	02-21-2020	11:34			
Speed Intervals	1 km/h				
Time Intervals	Instant				
Traffic Report From	02-07-2020	14:00:00	through	02-19-2020	11:59:59
85th Percentile Speed	73 km/h				
85th Percentile Vehicles	67227				
Max Speed	147 km/h	on	02-10-2020	10:37:36	
Total Vehicles	79092				
AADT:	6637				

Volumes - weekly counts

	Time	5 Day	7 Day
Average Daily		5082	5997
AM Peak	08:00	542	562
PM Peak	04:00	447	564

Speed

Speed Limit: 60

85th Percentile Speed: 73

Average Speed: 65.88

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Count over limit	11246	8578	6304	3845	9160	11403	12802
% over limit	83.9	88.1	91.0	79.0	83.1	67.6	78.7
Avg Speeder	68.6	69.1	69.5	68.4	68.4	67.4	67.8

Class Counts

Ontario Traffic Inc.
TRAFFIC MONITORING SERVICES & PRODUCTS

Project #20-005 - RJ Burnside & Associates

Intersection Count Report

Intersection:	Grey Rd 19 & Crosswinds Blvd
Municipality:	Blue Mountains
Count Date:	Jan 18, 2020
Site Code:	2000500006
Count Categories:	Cars, Medium Trucks, Heavy Trucks, Pedestrians
Count Period:	15:00-18:00
Weather:	Clear

Ontario Traffic Inc.
TRAFFIC MONITORING SERVICES & PRODUCTS

Peak Hour Summary

Intersection: Grey Rd 19 & Crosswinds Blvd
Count Date: Jan 18, 2020
Period: 15:00 - 18:00

Peak Hour Data (15:15 - 16:15)

Start Time	North Approach Crosswinds Blvd						South Approach						East Approach Grey Rd 19						West Approach Grey Rd 19						Total Vehicles
	Left	Thru	Right	U-Turn	Peds	Total	Left	Thru	Right	U-Turn	Peds	Total	Left	Thru	Right	U-Turn	Peds	Total	Left	Thru	Right	U-Turn	Peds	Total	
15:15	1		6	0	0	7					0			148	8	0	0	156	10	183		0	0	193	356
15:30	3		6	0	0	9					0			145	6	0	0	151	4	160		0	0	164	324
15:45	6		5	0	0	11					0			156	8	0	0	164	9	175		0	0	184	359
16:00	1		12	0	0	13					0			150	8	0	0	158	8	149		0	0	157	328
Grand Total	**11**		**29**	**0**	**0**	**40**					**0**	**0**		**599**	**30**	**0**	**0**	**629**	**31**	**667**		**0**	**0**	**698**	**1367**
Approach %	27.5		72.5	0		-						-		95.2	4.8	0		-	4.4	95.6		0		-	
Totals %	0.8		2.1	0		2.9						0		43.8	2.2	0		46	2.3	48.8		0		51.1	
PHF	**0.46**		**0.6**	**0**		**0.77**						**0**		**0.96**	**0.94**	**0**		**0.96**	**0.78**	**0.91**		**0**		**0.9**	**0.95**
Cars	8		22	0		30						0		516	25	0		541	27	591		0		618	1189
% Cars	72.7		75.9	0		75						0		86.1	83.3	0		86	87.1	88.6		0		88.5	87
Medium Trucks	3		7	0		10						0		79	5	0		84	4	73		0		77	171
% Medium Trucks	27.3		24.1	0		25						0		13.2	16.7	0		13.4	12.9	10.9		0		11	12.5
Heavy Trucks	0		0	0		0						0		4	0	0		4	0	3		0		3	7
% Heavy Trucks	0		0	0		0						0		0.7	0	0		0.6	0	0.4		0		0.4	0.5
Peds					0	-					0	-					0	-					0	-	0
% Peds					0	-					0	-					0	-					0	-	

Appendix B

Sample Calculations

```
STAMSON 5.0        SUMMARY REPORT        Date: 30-04-2021 14:22:59
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: ola1fb.te            Time Period: Day/Night 16/8 hours
Description: OLA 1 - Future Build


Road data, segment # 1: Grey Rd 19 (day/night)
----------------------------------------------
Car traffic volume  : 11529/1281  veh/TimePeriod  *
Medium truck volume :  1657/184   veh/TimePeriod  *
Heavy truck volume  :    66/7     veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     2 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  13198
    Percentage of Annual Growth        :   1.00
    Number of Years of Growth          :  11.00
    Medium Truck % of Total Volume     :  12.50
    Heavy Truck  % of Total Volume     :   0.50
    Day (16 hrs) % of Total Volume     :  90.00

Data for Segment # 1: Grey Rd 19 (day/night)
--------------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  24.00 / 24.00  m
Receiver height           :   1.50 / 1.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

↑
Result summary (day)
--------------------

                    !  source  !   Road   !  Total
                    !  height  !   Leq    !   Leq
                    !   (m)    !  (dBA)   !  (dBA)
--------------------+----------+----------+----------
 1.Grey Rd 19       !     0.84 !    63.25 !    63.25
--------------------+----------+----------+----------
                      Total                  63.25 dBA

↑
Result summary (night)
```

----

	source height (m)	Road Leq (dBA)	Total Leq (dBA)
1.Grey Rd 19	0.83	56.69	56.69
Total			56.69 dBA

↑

TOTAL Leq FROM ALL SOURCES (DAY): 63.25
(NIGHT): 56.69

↑

↑

```
STAMSON 5.0        SUMMARY REPORT        Date: 30-04-2021 14:23:40
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: ola1fnb.te           Time Period: Day/Night 16/8 hours
Description: OLA 1 - Future No Build


Road data, segment # 1: Grey Rd 19 (day/night)
----------------------------------------------
Car traffic volume  : 11529/1281  veh/TimePeriod  *
Medium truck volume :  1657/184   veh/TimePeriod  *
Heavy truck volume  :    66/7     veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     2 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  13198
    Percentage of Annual Growth        :   1.00
    Number of Years of Growth          :  11.00
    Medium Truck % of Total Volume     :  12.50
    Heavy Truck  % of Total Volume     :   0.50
    Day (16 hrs) % of Total Volume     :  90.00

Data for Segment # 1: Grey Rd 19 (day/night)
--------------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  24.00 / 31.00  m
Receiver height           :   1.50 / 1.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

↑
Result summary (day)
--------------------

                    !  source  !   Road   !  Total
                    !  height  !   Leq    !   Leq
                    !   (m)    !  (dBA)   !  (dBA)
--------------------+----------+----------+----------
 1.Grey Rd 19       !     0.84 !    63.25 !    63.25
--------------------+----------+----------+----------
                      Total                  63.25 dBA

↑
Result summary (night)
```

----

	source height (m)	Road Leq (dBA)	Total Leq (dBA)
1.Grey Rd 19	0.83	54.85	54.85
Total			54.85 dBA

↑

TOTAL Leq FROM ALL SOURCES (DAY): 63.25
(NIGHT): 54.85

↑

↑

```
STAMSON 5.0        SUMMARY REPORT        Date: 30-04-2021 14:24:34
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: ola1p.te             Time Period: Day/Night 16/8 hours
Description: OLA 1 - Present


Road data, segment # 1: Grey Rd 19 (day/night)
----------------------------------------------
Car traffic volume  : 10437/1160  veh/TimePeriod  *
Medium truck volume :  1500/167   veh/TimePeriod  *
Heavy truck volume  :    60/7     veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     2 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  13198
    Percentage of Annual Growth        :   1.00
    Number of Years of Growth          :   1.00
    Medium Truck % of Total Volume     :  12.50
    Heavy Truck  % of Total Volume     :   0.50
    Day (16 hrs) % of Total Volume     :  90.00

Data for Segment # 1: Grey Rd 19 (day/night)
--------------------------------------------
Angle1   Angle2           : -70.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  24.00 / 24.00  m
Receiver height           :   1.50 / 1.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

↑
Result summary (day)
--------------------

                    !  source  !   Road   !  Total
                    !  height  !   Leq    !   Leq
                    !   (m)    !  (dBA)   !  (dBA)
--------------------+----------+----------+----------
 1.Grey Rd 19       !     0.84 !    62.61 !    62.61
--------------------+----------+----------+----------
                      Total                   62.61 dBA

↑
Result summary (night)
```

----

	source height (m)	Road Leq (dBA)	Total Leq (dBA)
1.Grey Rd 19	0.85	56.11	56.11
Total			56.11 dBA

🡅

TOTAL Leq FROM ALL SOURCES (DAY): 62.61
(NIGHT): 56.11

🡅

🡅

```
STAMSON 5.0        SUMMARY REPORT        Date: 19-04-2021 16:39:52
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: por1fb.te            Time Period: Day/Night 16/8 hours
Description: POR01 - Future Build


Road data, segment # 1: Grey Rd 19 (day/night)
----------------------------------------------
Car traffic volume  : 11529/1281  veh/TimePeriod  *
Medium truck volume :  1657/184   veh/TimePeriod  *
Heavy truck volume  :    66/7     veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     2 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  13198
    Percentage of Annual Growth        :   1.00
    Number of Years of Growth          :  11.00
    Medium Truck % of Total Volume     :  12.50
    Heavy Truck  % of Total Volume     :   0.50
    Day (16 hrs) % of Total Volume     :  90.00

Data for Segment # 1: Grey Rd 19 (day/night)
--------------------------------------------
Angle1   Angle2           : -70.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  30.20 / 30.20  m
Receiver height           :   4.50 / 4.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

↑
Result summary (day)
--------------------

                    !  source  !   Road   !  Total
                    !  height  !   Leq    !   Leq
                    !   (m)    !  (dBA)   !  (dBA)
--------------------+----------+----------+----------
 1.Grey Rd 19       !     0.84 !    61.70 !    61.70
--------------------+----------+----------+----------
                      Total                    61.70 dBA

↑
Result summary (night)
```

----

	source height (m)	Road Leq (dBA)	Total Leq (dBA)
1.Grey Rd 19	0.83	55.14	55.14
Total			55.14 dBA

🡅

TOTAL Leq FROM ALL SOURCES (DAY): 61.70
(NIGHT): 55.14

🡅
🡅

```
STAMSON 5.0        SUMMARY REPORT        Date: 19-04-2021 15:15:58
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: por1fnb.te           Time Period: Day/Night 16/8 hours
Description: POR01 - Future No Build


Road data, segment # 1: Grey Rd 19 (day/night)
----------------------------------------------
Car traffic volume  : 11529/1281  veh/TimePeriod  *
Medium truck volume :  1657/184   veh/TimePeriod  *
Heavy truck volume  :    66/7     veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     2 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  13198
    Percentage of Annual Growth       :   1.00
    Number of Years of Growth         :  11.00
    Medium Truck % of Total Volume    :  12.50
    Heavy Truck  % of Total Volume    :   0.50
    Day (16 hrs) % of Total Volume    :  90.00

Data for Segment # 1: Grey Rd 19 (day/night)
--------------------------------------------
Angle1   Angle2           : -70.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  27.00 / 27.00  m
Receiver height           :   4.50 / 4.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

🡅
Result summary (day)
--------------------

                    !  source  !   Road   !  Total
                    !  height  !   Leq    !   Leq
                    !   (m)    !  (dBA)   !  (dBA)
--------------------+----------+----------+----------
 1.Grey Rd 19       !     0.84 !    62.47 !    62.47
--------------------+----------+----------+----------
                      Total                  62.47 dBA

🡅
Result summary (night)
```

----

	source height (m)	Road Leq (dBA)	Total Leq (dBA)
1.Grey Rd 19	0.83	55.91	55.91
Total			55.91 dBA

🡅

TOTAL Leq FROM ALL SOURCES (DAY): 62.47
(NIGHT): 55.91

🡅

🡅

```
STAMSON 5.0        SUMMARY REPORT        Date: 19-04-2021 15:13:56
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: por1p.te             Time Period: Day/Night 16/8 hours
Description: POR01 - Present Traffic


Road data, segment # 1: Grey Rd 19 (day/night)
----------------------------------------------
Car traffic volume  : 10437/1160  veh/TimePeriod  *
Medium truck volume :  1500/167   veh/TimePeriod  *
Heavy truck volume  :    60/7     veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     2 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  13198
    Percentage of Annual Growth        :   1.00
    Number of Years of Growth          :   1.00
    Medium Truck % of Total Volume     :  12.50
    Heavy Truck  % of Total Volume     :   0.50
    Day (16 hrs) % of Total Volume     :  90.00

Data for Segment # 1: Grey Rd 19 (day/night)
--------------------------------------------
Angle1   Angle2           : -70.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  27.00 / 27.00  m
Receiver height           :   4.50 / 4.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00

↑
Result summary (day)
--------------------

                    !  source  !   Road   !  Total
                    !  height  !   Leq    !   Leq
                    !   (m)    !  (dBA)   !  (dBA)
--------------------+----------+----------+----------
 1.Grey Rd 19       !     0.84 !    62.04 !    62.04
--------------------+----------+----------+----------
                      Total                    62.04 dBA

↑
Result summary (night)
```

```
----------------------

                    !  source  !   Road   !  Total
                    !  height  !   Leq    !   Leq
                    !   (m)    !  (dBA)   !  (dBA)
--------------------+----------+----------+----------
 1.Grey Rd 19       !     0.85 !    55.54 !    55.54
--------------------+----------+----------+----------
                      Total                    55.54 dBA

🡅



TOTAL Leq FROM ALL SOURCES (DAY): 62.04
                         (NIGHT): 55.54
🡅
🡅
```

Air Quality Impact Assessment Report Grey Road 19 from Scenic Caves Road to Osler Bluff Road Environmental Assessment

Grey County

R.J. Burnside & Associates Limited
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September 2022
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R.J. Burnside & Associates Limited

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Number: 100525360
Limitations: Outdoor environmental air quality and noise impact assessment and mitigation functional design for residential, traffic and industrial, except oil and gas, large chemical process plants and large storage tank facilities.
Association of Professional Engineers of Ontario

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Air & Noise Scientist
KZ:clr

Report Reviewed By:

Harvey Watson, P.Eng.
Manager, Air & Noise

Executive Summary

Grey County (County) has initiated a Municipal Class Environmental Assessment (EA) to investigate the proposed improvements to Grey Road 19 from Scenic Caves Road to Osler Bluff Road. This Air Quality Impact Assessment (AQIA) was completed as part of the EA Study in order to understand the impacts of the proposed road widening on local air quality.

Based on the forecasted traffic volumes, future predicted air quality levels with and without the road widening were compared to the existing air quality levels to understand the impact of a potential road improvement on local air quality. Typical contaminants from automobile exhaust were evaluated including particulate matter (PM2.5 and PM10), total suspended particulates (TSP), nitrogen dioxide (NO_2), carbon monoxide (CO), 1,3-butadiene, benzene, acrolein, acetaldehyde, and formaldehyde.

Air quality modelling was performed for above contaminants for the existing, and two future scenarios. The existing scenario results show the current (2021) impact of the local roads. The Future No Build scenario predicts emissions due to traffic in the vicinity of the Study Area for the future (2031) without the proposed road widening. The Future Build scenario predicts future (2031) emissions with the proposed road widening. The impacts were assessed on 0.5-hour, 1-hour, 8-hour, 24-hour and annual basis depending on the criterion averaging period. Modelled impacts for the road were added to the background measurements recorded by the Ministry of Environment, Conservation and Parks (MECP) for all three scenarios in order to understand the total cumulative effects of the proposed road widening on local air quality.

The results of the dispersion modelling show that the predicted ground level concentrations at all sensitive receptor locations were below the applicable MECP criteria.

Based on the comparison of predicted cumulative concentrations between Future Build and Future No Build scenarios, it was determined that the change is very small and the impact on local air quality due to Grey Road 19 widening is negligible.

The selected sensitive receptors were chosen to represent all the receptors in the vicinity of the Study Area. All other receptors are expected to experience the same or smaller impact due to the proposed road widening.

A potential Greenhouse Gas emission effect from the proposed road widening was determined to be insignificant on a regional scale. The total annual emissions are expected to be well below 0.01% of the provincial levels. Similarly, the local impact is negligible.

Table of Contents

Tables

Figures

Appendices

Glossary of Terms and Acronyms

AAQC	Ambient Air Quality Criteria
AADT	Annual Average Daily Traffic
AQIA	Air Quality Impact Assessment
CAL3QHCR	Air Dispersion Model for Predicting Air Quality Impacts Near Roadways
Burnside	R.J. Burnside & Associates Limited
CAAQS	Canadian Ambient Air Quality Standards
CAC	Criteria Air Contaminant
CO	Carbon Monoxide
CO_2e	Carbon Dioxide equivalent
ECCC	Environmental and Climate Change Canada
EA	Environmental Assessment
GHG	Greenhouse Gas
County	Grey County
MECP	Ministry of the Environment, Conservation, and Parks
MOVES	Motor Vehicle Emission Simulator
MTO	Ministry of Transportation
MTO Guide	Ministry of Transportation “Environmental Guide for Assessing and Mitigating the Air Quality Impacts and Greenhouse Gas Emissions of Provincial Transportation Projects” (2012)
NAPS	National Air Pollution Surveillance
NO	Nitric Oxide
NO_2	Nitrogen Dioxide
NO_x	Nitrogen Oxides
O_3	Ozone
OTAQ	Office of Transportation and Air Quality
PM	Particulate Matter
PM2.5	Particulate Matter < 2.5 μm in diameter
PM10	Particulate Matter < 10 μm in diameter
SO_2	Sulphur Dioxide
TSP	Total Suspended Particulate Matter
US EPA	United States Environmental Protection Agency
VOC	Volatile Organic Compounds

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1.0 Introduction

Grey County (County) has initiated a Municipal Class Environmental Assessment (EA) to investigate the proposed improvements to Grey Road 19 from Scenic Caves Road to Osler Bluff Road.

As part of the EA process, R.J. Burnside & Associates (Burnside) has completed an Air Quality Impact Assessment (AQIA) to identify whether the change in traffic as a result of Grey Road 19 improvement will significantly change air quality within the Study Area, and if any potential mitigation measures are required.

1.1 Study Area

The Study Area covers a 1.3 km stretch of Grey Road 19 from Scenic Caves Road to Osler Bluff Road in The Blue Mountains, Ontario. It is generally bordered by existing residential areas and lands designated for future development. The Study Area is shown in Figure 1.

1.2 Sensitive Receptors

The air quality effects due to the proposed Grey Road 19 widening were predicted at selected sensitive receptors. The Ministry of Transportation (MTO) in their Guide "Ministry of Transportation Environmental Guide for Assessing and Mitigating the Air Quality Impacts and Greenhouse Gas Emissions of Provincial Transportation Projects" (MTO Guide) (MTO, 2020) defines sensitive receptors as:

- Residences

It also defines critical receptors as:

- Hospitals
- Retirement homes
- Childcare centres
- Schools and similar institutional buildings

Residential properties are located on the south and north sides of Grey Road 19. Three residential properties were selected as representative sensitive receptors within the Study Area. Representative dwellings were selected at various locations along Grey Road 19 that were closest to the road. The impact at all other sensitive locations within the Study Area is expected to be similar or lower than at the selected one as all other receptors are located further away from the road. All sensitive receptor locations are summarized in Table 1 and shown in Figure 2. There are no critical receptors in the Study Area.

Table 1: Sensitive Receptor Locations

ID	Address	Easting	Northing	Receptor Description
R1	102 Martins Grove, The Blue Mountains	555852	4927104	1.5-storey house
R2	150 Snow Apple Crescent, The Blue Mountains	556273	4927331	2-storey house
R3	796054 Grey Road 19, The Blue Mountains	556299	4927238	2-storey house

Figure 1: Study Area

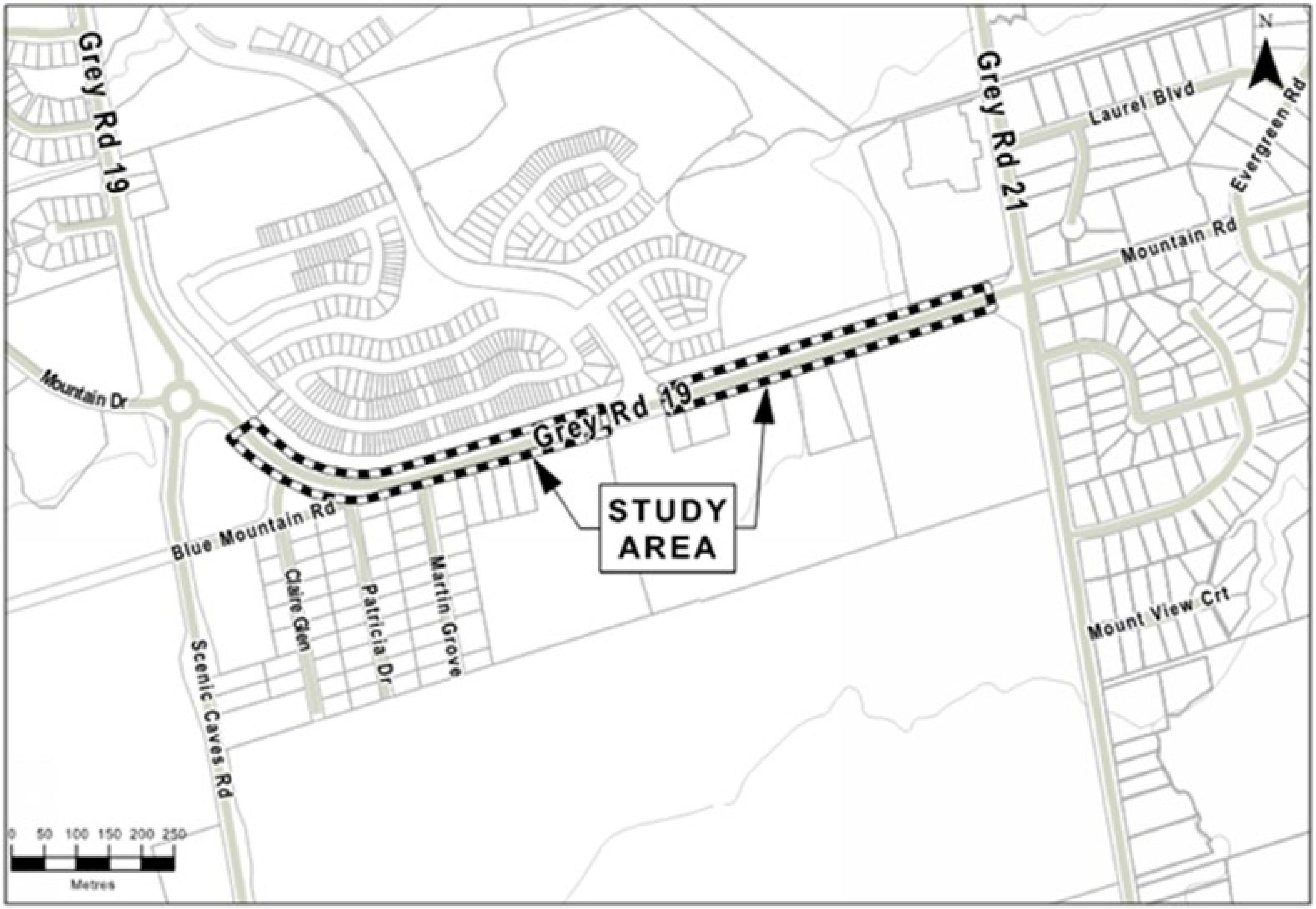
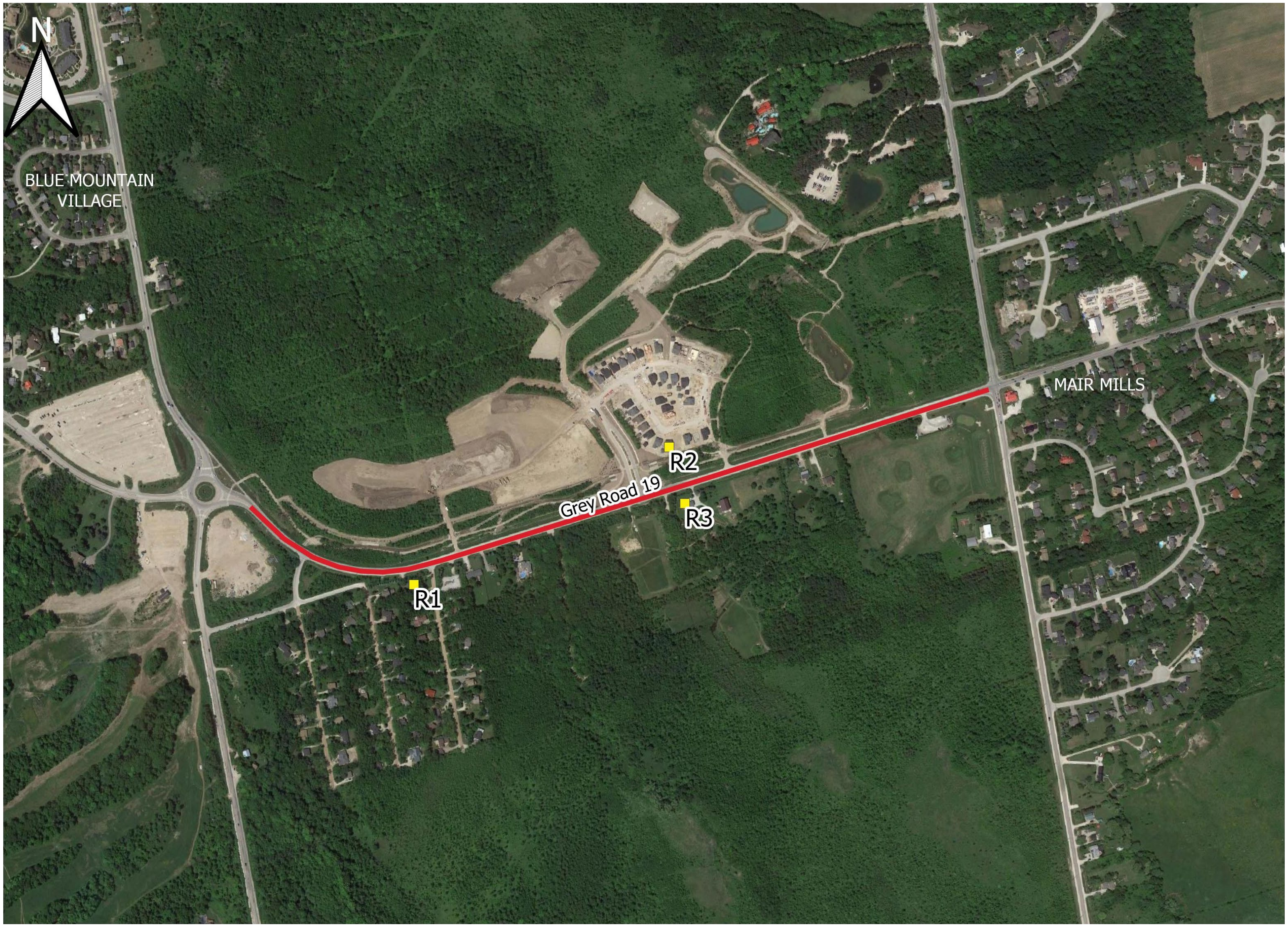


Figure 2: Sensitive Receptors



1.3 Potential Pollutants

Transportation related contaminants are emitted due to fuel combustion, brake wear, tire wear, and road dust. According to the MTO Guide, the Criteria Air Contaminants (CAC) and Volatile Organic Compounds (VOC) most relevant to transportation are:

- Carbon Monoxide (CO)
- Nitrogen Dioxide (NO_2)
- Total Suspended Particulate Matter (TSP)
- Particulate Matter 10 µm or less in diameter (PM10)
- Particulate Matter 2.5 µm or less in diameter (PM2.5)
- Selected VOCs (benzene, 1,3-butadiene, formaldehyde, acetaldehyde, and acrolein)

CACs are the common pollutants found in ambient air associated with environmental effects such as smog and acid rain and cause a variety of health effects. They include Particulate Matter (PM), Sulphur Dioxide (SO_2), Nitrogen Oxides (NO_x), Carbon Monoxide (CO), and Ozone (O3). CACs come from a variety of sources and are mainly the products of fossil fuel combustion and industrial processes.

VOCs are compounds that have a high vapour pressure and can easily evaporate into the air. They occur naturally and are also produced by human activities such as cleaning, painting, etc. They are common indoors, where concentrations are typically higher than outdoors.

All of the above contaminants, except ozone, are considered primary air pollutant, i.e., they are directly emitted to the atmosphere. Ozone is formed in the atmosphere through photochemical reaction between NO_x and VOCs; therefore, it is considered a secondary pollutant. According to the MTO Guide, its photochemical production from its precursors takes at least a few hours, which almost always ensures its transport out of the local environment. Considering this time delay, ozone was not included in this assessment.

1.4 Greenhouse Gas

Greenhouse Gases (GHGs) contribute to climate change by trapping heat within the earth's atmosphere. The major gases include carbon dioxide, methane, and nitrous oxide although there are many other gases that behave in a similar way. Burning of fossil fuels is the major source of GHGs.

A GHG impact assessment on a regional scale was completed as part of this AQIA. Total annual emissions were based on the annual vehicle kilometres travelled within the Study Area.

Annual emissions were compared to the total provincial emissions due to transportation sector to estimate the magnitude of the effect of Grey Road 19 widening.

Provincial emissions were taken from the most recent Environment and Climate Change Canada (ECCC) National Inventory Report on Greenhouse Gases (ECCC, 2020) for the 2018 calendar year.

2.0 Existing Ambient Air Quality Conditions

2.1 Climate

The ambient air monitoring station in the Town of The Blue Mountains (ToTBM), Ontario was used to assess the climate in the vicinity of the Study Area. The Thornbury Slama air monitoring station is located about 17 km northwest of the Study Area in the ToTBM.

The ToTBM has a humid continental climate characterized with warm and humid summers and cool winters. Local climate conditions were obtained from Environment and Climate Change Canada's Thornbury Slama meteorological station (Station ID 611HBEC, Latitude 44°34'25.032" N, Longitude 80°29'07.068" W).

According to the Canadian Climate Normals (calendar years 1981 to 2010) for this station, the mean annual temperature is estimated at 7.0°C. The warmest month of the year is July with an average temperature of 19.8°C and the coldest month is January with an average temperature of -6.3°C.

The Thornbury Slama meteorological station recorded a total average annual precipitation (snow and rain) of 992 mm, 725 mm of which was rain. Precipitation is distributed throughout the year, with most of the rain occurring between May and November. The maximum mean monthly rainfall is 95.9 mm and occurs in September.

Climate Normals for the Thornbury Slama station are summarized in Table 2 below.

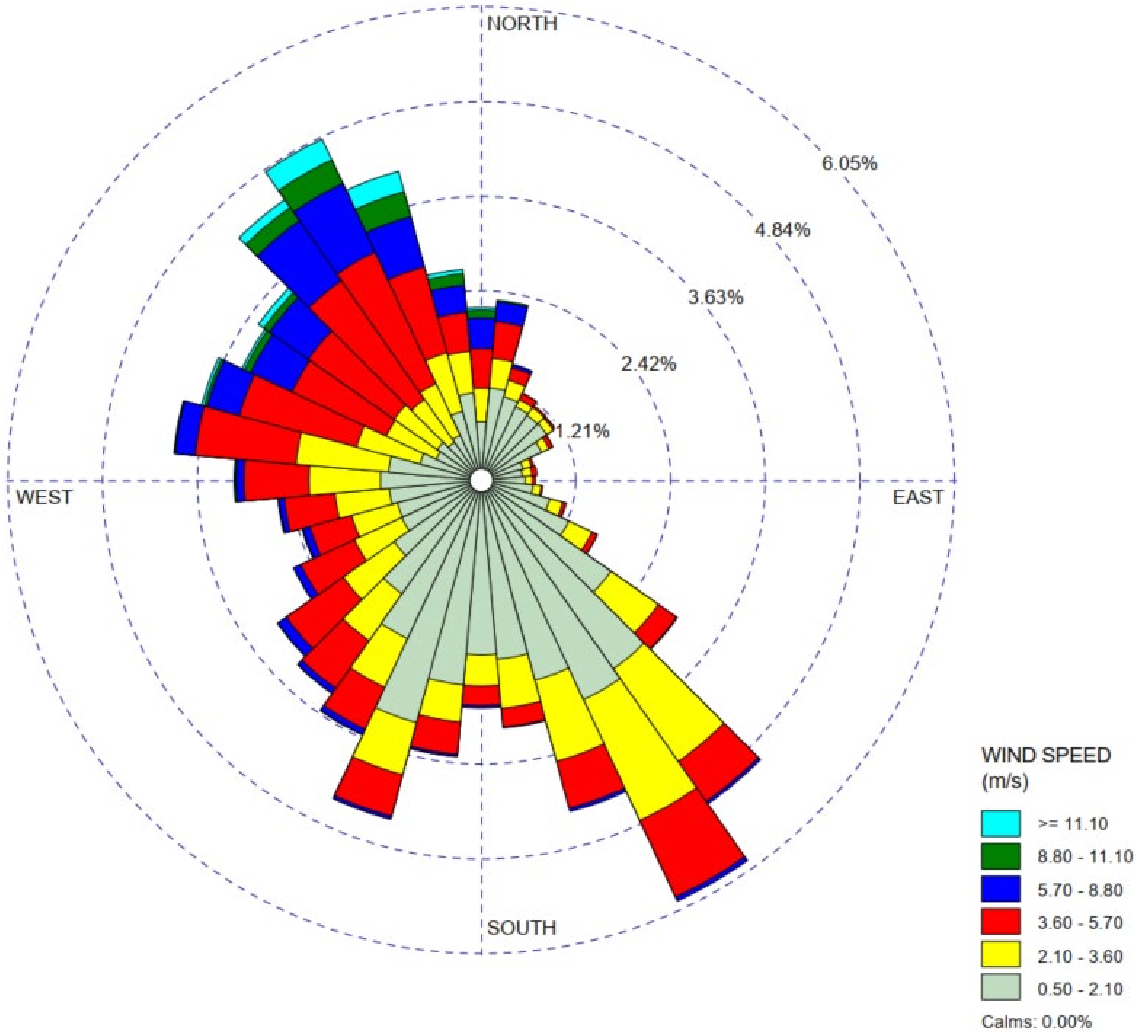
Table 2: Thornbury Slama Meteorological Station Climate Normals (1981-2010)

Meteorological Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Daily Average Temperature (°C)	-6.3	-5.4	-1.5	5.5	11.5	16.7	19.8	19.2	15.5	9.1	3.1	-2.7	7
Daily Maximum Temperature (°C)	-2.6	-1.5	2.9	10.2	16.6	22	24.8	24	20.1	13.2	6.5	0.6	11.4
Daily Minimum Temperature (°C)	-9.9	-9.3	-5.8	0.9	6.2	11.4	14.8	14.3	10.8	4.9	-0.3	-5.9	2.7
Rainfall (mm)	20.9	19.4	36.7	57.4	82.7	79.1	72.1	78.2	95.9	84	70.4	28.5	725
Snowfall (cm)	79.1	49	27.4	7.9	0	0	0	0	0	3.3	29.2	70.8	267
Precipitation (mm)	100	68.4	64	65.3	82.7	79.1	72.1	78.2	95.9	87.3	99.6	99.4	992

Station Climate ID: 611HBEC; Latitude: 44°34'25.032" N, Longitude: 80°29'07.068" W
Elevation: 213.40 m

The MECP provided the meteorological data set (Station ID 61430) used in this AQIA. This data set covers the 2016 to 2020 calendar years. Based on the provided data, the average wind speed at the station was 2.89 m/s. The dominant wind direction was southeast with frequent winds from northwest. A wind rose depicting the relative frequency of wind directions including wind speeds is provided in Figure 3. The meteorological data set was used in the dispersion model (CAL3QHCR) to predict the concentration levels at selected sensitive receptors as described in Section 1.2.

Figure 3: Wind Rose



2.2 Ambient Air Quality

The MECP and National Air Pollution Surveillance (NAPS) stations in close proximity to the Study Area were reviewed to ensure the most representative background concentration would be selected. Not all contaminant concentrations are available at every station; therefore, a total of four stations were selected to fully characterize the background concentrations in the vicinity of the Study Area.

Two MECP stations were selected to represent PM2.5, NO_2, and CO. MECP Barrie station was the nearest available station with the most recent data for PM2.5 and NO_2, while the nearest station with CO data was determined to be Toronto West. Two NAPS stations were selected to represent background concentrations for 1,3-butadiene, benzene, acetaldehyde, acrolein, and formaldehyde.

The most recent data for 1,3-butadiene and benzene was used from Newmarket station.

There was no recent or measured in closed proximity data for acetaldehyde, acrolein, nor formaldehyde; therefore, data for 2001-2005 collected at Junction Triangle station in Toronto was used in this assessment.

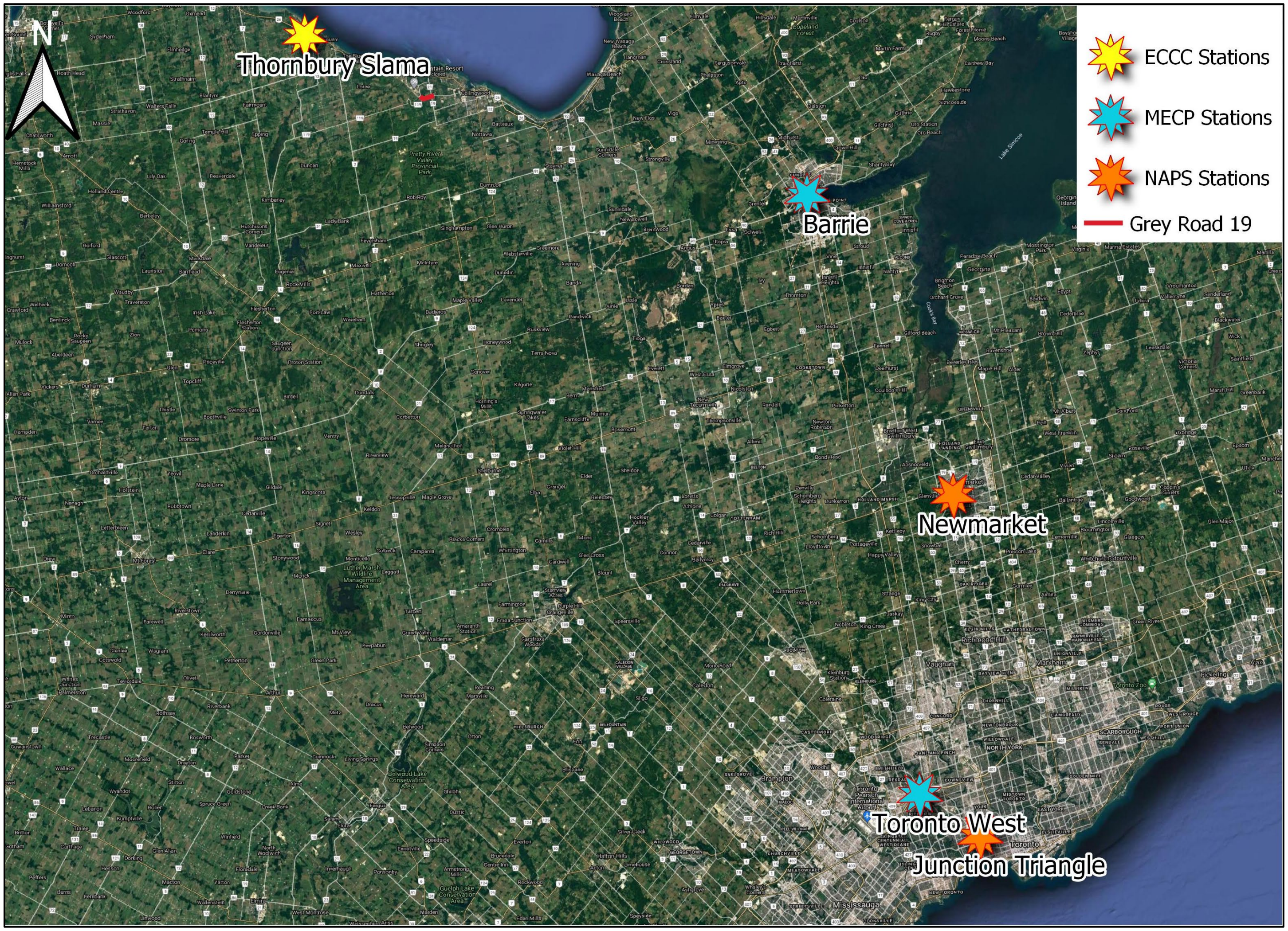
The stations and the most recent full five years of available data are summarized in Table 3.

The locations of the selected stations are shown in Figure 4.

Table 3: Ambient Monitoring Stations Summary

Contaminant	Station ID	Station Location	Year
PM2.5	MECP 47045	83 Perry Street, Barrie, ON	2016-2019
NO2	MECP 47045	83 Perry Street, Barrie, ON	2016-2019
CO	MECP 35125	125 Resources Road, Toronto, ON	2013-2017
1,3-Butadiene	NAPS 65101	Eagle St. & McCaffrey Rd., Newmarket, ON	2015-2019
Benzene	NAPS 65101	Eagle St. & McCaffrey Rd., Newmarket, ON	2015-2019
Acetaldehyde	NAPS 60418	Toronto Perth/Ruskin (Junction Triangle)	2001-2005
Acrolein	NAPS 60418	Toronto Perth/Ruskin (Junction Triangle)	2001-2005
Formaldehyde	NAPS 60418	Toronto Perth/Ruskin (Junction Triangle)	2001-2005

Figure 4: Meteorological and Ambient Monitoring Stations



Summary of background concentrations 90th percentile[1], maximum and average values for all contaminants is provided in Table 4.

Table 4: Background Data Summary

Contaminant	CAS#	Averaging period	90th Percentile (µg/m³)	Maximum (µg/m³)	Average (µg/m³)
CO	630-08-0	1-hr	412	1,912.2	288
		8-hr	378	918	289
NO_2	11104-93-1	1-hr	29.7	120.3	13.4
		24-hr	25.0	64.1	13.4
		Annual	n/a	8.1	7.1
PM2.5	-	24-hr	14.3	30.6	7.6
		Annual	n/a	7.6	7.2
PM10	-	24-hr	26.6	56.6	14.1
TSP	-	24-hr	47.8	101.9	25.3
		Annual	n/a	25.3	24.1
1,3-Butadiene	106-99-0	24-hr	0.04	0.11	0.02
		Annual	n/a	0.030	0.020
Acetaldehyde	75-07-0	0.5-hr	n/a	n/a	n/a
		24-hr	3.30	5.58	1.95
Acrolein	107-02-8	1-hr	n/a	n/a	n/a
		24-hr	0.20	1.17	0.12
Benzene	71-43-2	24-hr	0.57	2.48	0.32
		Annual	n/a	0.43	0.32
Formaldehyde	50-00-0	24-hr	6.48	11.24	3.66

Notes:
- Acrolein concentrations are provided on a daily basis, thus hourly values could not be determined.
- PM10 concentrations based on PM2.5/PM10 ratio of 0.54 (Lall, 2004).
- TSP concentrations based on PM2.5/TSP ratio of 0.30 (Lall, 2004).

Fine particulate matter is associated with major health effects compared to larger particles. Due to their small size, they can penetrate deep into lungs. MECP monitoring stations record only background concentrations of PM2.5. Since PM10 and TSP background concentrations were not available, values were calculated based on monitored PM2.5 concentrations. Mean ratios of PM2.5/PM10=0.54±0.14, and PM2.5/TSP=0.30±0.11 derived by Lall et al (2004) were used to calculate 90th percentile, maximum and average concentrations of PM10 and TSP.

[1] 90th percentile of monitoring data is typically considered a conservative estimate of background air quality. 90th percentile is the level below which 90% of all the observed values occur.

This method is used throughout the province to predict PM10 and TSP concentrations when the only measured values are for PM2.5. The MECP considers this method to be acceptable.

2.3 Air Quality Assessment Criteria

Ontario regulates contaminants released into the environment in order to limit and even reduce concentrations of harmful substances in the atmosphere and to protect the environment and human health. As part of this regulation, the MECP has developed a number of sources of criteria as described below.

Ambient air criteria for contaminants associated with road traffic emissions were taken from Ontario's Ambient Air Quality Criteria (AAQC) developed by the MECP and is summarized in Table 5. According to the MECP "an AAQC is a desirable concentration of a contaminant in air, based on protection against adverse effects on health or the environment". The Canadian Ambient Air Quality Standards (CAAQS) were used for nitrogen dioxide and PM2.5 criteria (CCME, 2017). All criteria are summarized in the table below.

Table 5: Representative Contaminants and Air Quality Criteria

Contaminant	CAS#	Averaging Period	AAQC[1] (μg/m³)	CAAQS[2] 2020 (μg/m³)	CAAQS[2] 2025 (μg/m³)	Limiting Effect
CO	630-08-0	1-hr	36,200			Health
		8-hr	15,700			Health
NO_2	10102-44-0	1-hr	400	113 (60 ppb)	79 (42 ppb)	Health
		24-hr	200			Health
		Annual		32 (17 ppb)	23 (12 ppb)	Health
PM2.5	-	24-hr	30	27		Health
		Annual		8.8		Health
PM10	-	24-hr	50			Health
TSP	-	24-hr	120			Visibility
		Annual	60			Visibility
1,3-Butadiene	106-99-0	24-hr	10			Health
		Annual	2			Health
Acetaldehyde	75-07-0	0.5-hr	500			Health
		24-hr	500			Health
Acrolein	107-02-8	1-hr	4.5			Health
		24-hr	0.4			Health
Benzene	71-43-2	24-hr	2.3			Health
		Annual	0.45			Health
Formaldehyde	50-00-0	24-hr	65			Health

Notes:
[1] AAQC - Ontario's Ambient Air Quality Criteria
[2] CAAQS - Canadian Ambient Air Quality Standards

The sum of Nitrogen Dioxide (NO_2) and Nitric Oxide (NO) is considered Nitrogen Oxides (NO_x). Emissions of NO_x consist mainly of NO; however, NO is converted to NO_2 in the ambient air. NO_2 has an adverse effect at much lower concentrations than NO according to Ontario's Ambient Air Quality Criteria publication. Therefore, the AAQC is based on the NO_2 concentration.

As a conservative assumption for this assessment, it was assumed that all NO is converted to NO_2.

3.0 Local Air Quality Assessment

Transportation is one of the largest sources of air pollution in Canada according to Environment and Climate Change Canada (ECCC).

The exhaust from the vehicles due to fuel combustion contains pollutants that might be harmful to human health and the environment. The main contaminants include particulate matter, nitrogen dioxide, and carbon monoxide. However, there are many more contaminants associated with transportation. The magnitude of the emissions and the predicted change of those emissions due to proposed road widening were also evaluated in this AQIA.

3.1 Methodology

Following the MTO Guide, three scenarios were assessed for Grey Road 19 widening, to evaluate the existing and future conditions with and without the proposed improvements. Those scenarios assessed the future impact without the widening and future impact with the widening. The three scenarios are referred to as “Current”, “Future No Build” and “Future Build”, respectively.

The scenarios used the following information:

- Current (2021) Scenario:
  - Existing traffic volumes
  - Existing crossroads
  - Grey Road 19 without widening
- Future No Build (2031) Scenario:
  - Projected 2031 traffic volumes
  - Incorporated roundabouts
  - Grey Road 19 without widening
- Future Build (2031) Scenario:
  - Projected 2031 traffic volumes
  - Incorporated roundabouts
  - Grey Road 19 with widening

Ground level contaminant concentrations were predicted for all contaminants of interest for the three scenarios. Predicted values were added to the existing background ambient concentrations. The resulting cumulative concentrations were compared to the applicable criteria and the magnitude of the impact of the proposed road widening was determined.

For the future scenarios, background concentrations were assumed to remain the same. Based on data collected at the MECP ambient monitoring stations, concentrations of the key pollutants such as NO_2, PM2.5, and some VOCs such as benzene and 1,3-butadiene decreased over the last 10 years between 11% and 51% (MECP, 2021). Assuming this trend will continue in the future, using current background values for the future scenario is a conservative approach.

3.2 Emission Factors

Transportation related emissions are associated with fuel combustion, brake wear, tire wear, as well as re-suspended road dust.

Emission factors for fuel combustion, brake wear and tire wear were estimated using Motor Vehicle Emission Simulator (MOVES) developed by the United States Environmental Protection Agency (US EPA) Office of Transportation and Air Quality (OTAQ). This emission modeling system estimates emissions for mobile sources covering a broad range of pollutants and conditions including the variety of vehicles (cars vs. trucks), ambient temperature, and vehicle speed.

The summary of emission factors is provided in Appendix B. Weighted emission factors were derived based on the speed limit and vehicle type distribution for each road segment.

MOVES does not provide an emission factor for TSP. The exhaust emission factor for PM10 was used for TSP because the US EPA has observed from the emissions test results that more than 97% of tailpipe particulate matter is PM10 or less.

Particulate emissions due to re-suspended road dust were estimated using the latest US EPA methodology for paved roads (US EPA, 2011). As a result, the total emission factors for particulate matter were a sum of tail pipe, brake wear, tire wear and road dust emission factors.

3.3 Traffic

Traffic volumes were provided by the County for the morning (a.m.) and evening (p.m.) rush hours as well as annual average daily traffic (AADT) based on 2020 calendar year. Due to the higher expected traffic volume, the p.m. rush hour represents the worst-case scenario and was selected as a basis for this assessment.

Eastbound and westbound traffic counts were added, and total numbers were used in the assessment. A 1% growth rate was applied to estimate traffic as of 2021.

The percentage of heavy vehicles was obtained from Ontario Traffic Inc. turning counts for the peak hour. It was assumed that this percentage will remain the same in the future scenarios. Current and future traffic volumes are summarized in Appendix A.

There are four intersections within the Study Area. No intersection is currently controlled by the traffic lights. Two of the intersections is projected to become roundabouts in the future independently of the proposed Grey Road 19 widening.

3.4 Air Dispersion Modelling

Dispersion modelling to determine maximum pollutant concentration was completed in accordance with the MTO Guide. The modelled impacts of contaminant emissions are assessed as 0.5-hour, 1-hour, 8-hour, 24-hour, and annual concentrations to match the appropriate criteria.

The appropriate model to assess the maximum impact is the US EPA CAL3QHCR model. The CAL3QHCR model estimates ground level air pollutant concentrations near roads from both moving and idling vehicles.

A site-specific meteorological data set was provided by the MECP for use with this AQIA. The CAL3QHCR ready meteorological data set covers the dates from January 1, 2016 to December 31, 2020.

The hourly data includes many factors, which affect the dispersion of air contaminants including wind speed, wind direction, temperature, mixing height and stability category.

As noted in Section 1.2, three sensitive receptors along Grey Road 19 were selected for this assessment.

The model is developed to incorporate the area road network and associated characteristics such as road width, traffic volume, and travel speed.

3.5 Modelling Results

The impact of the proposed Grey Road 19 widening was assessed based on the predicted ground level concentrations at the selected sensitive receptors within the Study Area as shown in Figure 2 and existing background concentrations as monitored at MECP and NAPS stations.

Predicted ground level concentrations at the sensitive receptors with the highest predicted levels are summarized for each contaminant and averaging period in Table 6 through Table 8.

Detailed results for all sensitive receptors are provided in Appendix C.

The highest concentrations were predicted at the Receptors R1 or R3. Both receptors are located closer to the road than R2.

The results are presented by contaminant and include background concentration (90th percentile or average for annual concentrations), maximum predicted concentration, receptor at which the maximum concentration occurs and cumulative concentrations (background plus predicted concentration). The predicted and cumulative concentrations are compared against applicable criteria.

Table 6 shows the maximum impact of the current traffic including the amount contributed by the roads within the Study Area and background levels. Table 7 shows the same information for the future scenario assuming that the widening was not undertaken (Future No Build). Table 8 shows the same information for the future scenario assuming that the widening of Grey Road 19 is implemented (Future Build).

Table 6 through Table 8 show that the contribution from Grey Road 19 including the proposed widening is relatively small compared to the background values except for NO_2 and TSP.

The cumulative concentrations predicted within the Study Area for all contaminants are below their applicable criteria as shown in the above-mentioned tables.

Table 6: Maximum Predicted Concentrations – Current Scenario

Contaminant	Averaging Period	Criteria (µg/m³)	Background Concentration (µg/m³)	Sensitive Receptor	Predicted Maximum Concentration (µg/m³)	Predicted % of Criteria	Cumulative Concentration (µg/m³)	Cumulative % of Criteria
CO	1-hr	36,200	412.20	R1	133.67	0.37%	545.87	1.5%
	8-hr	15,700	378.42	R1	64.18	0.41%	442.60	2.8%
NO2	1-hr	79	29.70	R1	40.38	51.11%	70.08	88.7%
	24-hr	200	24.98	R3	12.66	6.33%	37.64	18.8%
	Annual	23	8.15	R3	2.63	11.44%	10.78	46.9%
PM2.5	24-hr	27	14.34	R3	2.07	7.66%	16.41	60.8%
	Annual	8.8	7.60	R3	0.43	4.89%	8.03	91.3%
PM10	24-hr	50	26.56	R3	7.67	15.34%	34.23	68.5%
TSP	24-hr	120	47.81	R3	31.28	26.07%	79.09	65.9%
	Annual	60	25.34	R3	6.51	10.84%	31.85	53.1%
1,3-Butadiene	24-hr	10	0.04	R3	0.004	0.04%	0.04	0.4%
	Annual	2.0	0.03	R3	0.001	0.04%	0.03	1.5%
Acetaldehyde	0.5-hr	500	3.30	R1	0.181	0.04%	3.48	0.7%
	24-hr	500	3.30	R3	0.047	0.01%	3.34	0.7%
Acrolein	1-hr	4.5	0.20	R1	0.024	0.53%	0.23	5.1%
	24-hr	0.4	0.20	R3	0.008	1.88%	0.21	52.9%
Benzene	24-hr	2.3	0.57	R3	0.024	1.05%	0.59	25.8%
	Annual	0.45	0.43	R3	0.005	1.12%	0.43	95.7%
Formaldehyde	24-hr	65	6.48	R3	0.110	0.17%	6.59	10.1%

Notes:
- *90^{th} percentile used as background concentrations for 1-hr, 8-hr, and 24-hr averaging periods.*
- *Average annual values use as background concentrations for annual averaging periods.*
- *24-hour 90^{th} percentile used as background concentrations for acrolein 1-hour and acetaldehyde 0.5-hr averaging periods.*

Table 7: Maximum Predicted Concentrations – Future No Build Scenario

Contaminant	Averaging Period	Criteria (µg/m^3)	Background Concentration (µg/m^3)	Sensitive Receptor	Predicted Maximum Concentration (µg/m^3)	Predicted % of Criteria	Cumulative Concentration (µg/m^3)	Cumulative % of criteria
CO	1-hr	36,200	412.20	R1	146.72	0.41%	558.92	1.5%
	8-hr	15,700	378.42	R1	72.50	0.46%	450.93	2.9%
NO2	1-hr	79	29.70	R1	44.32	56.11%	74.03	93.7%
	24-hr	200	24.98	R3	12.42	6.21%	37.41	18.7%
	Annual	23	8.15	R2	2.69	11.68%	10.84	47.1%
PM2.5	24-hr	27	14.34	R3	2.03	7.52%	16.37	60.6%
	Annual	8.8	7.60	R2	0.44	4.99%	8.04	91.4%
PM10	24-hr	50	26.56	R3	7.53	15.06%	34.09	68.2%
TSP	24-hr	120	47.81	R3	30.71	25.59%	78.51	65.4%
	Annual	60	25.34	R2	6.64	11.07%	31.98	53.3%
1,3-Butadiene	24-hr	10	0.04	R3	0.004	0.04%	0.04	0.4%
	Annual	2.0	0.03	R2	0.001	0.04%	0.03	1.5%
Acetaldehyde	0.5-hr	500	3.30	R1	0.199	0.04%	3.49	0.7%
	24-hr	500	3.30	R3	0.046	0.01%	3.34	0.7%
Acrolein	1-hr	4.5	0.20	R1	0.026	0.59%	0.23	5.1%
	24-hr	0.4	0.20	R3	0.007	1.85%	0.21	52.9%
Benzene	24-hr	2.3	0.57	R3	0.024	1.03%	0.59	25.8%
	Annual	0.45	0.43	R2	0.005	1.14%	0.43	95.7%
Formaldehyde	24-hr	65	6.48	R3	0.108	0.17%	6.59	10.1%

Notes:

- *90th percentile used as background concentrations for 1-hr, 8-hr, and 24-hr averaging periods.*
- *Average annual values use as background concentrations for annual averaging periods.*
- *24-hour 90th percentile used as background concentrations for acrolein 1-hour and acetaldehyde 0.5-hr averaging periods.*

Table 8: Maximum Predicted Concentrations – Future Build Scenario

Contaminant	Averaging Period	Criteria (µg/m^3)	Background Concentration (µg/m^3)	Sensitive Receptor	Predicted Maximum Concentration (µg/m^3)	Predicted % of Criteria	Cumulative Concentration (µg/m^3)	Cumulative % of criteria
CO	1hr	36,200	412.20	R1	140.53	0.39%	552.73	1.5%
	8hr	15,700	378.42	R1	71.36	0.45%	449.79	2.9%
NO2	1hr	79	29.70	R1	42.45	53.74%	72.16	91.3%
	24hr	200	24.98	R3	13.15	6.58%	38.14	19.1%
	Annual	23	8.15	R3	2.95	12.83%	11.10	48.3%
PM2.5	24hr	27	14.34	R1	1.68	6.22%	16.02	59.3%
	Annual	8.8	7.60	R3	0.48	5.48%	8.09	91.9%
PM10	24hr	50	26.56	R3	7.97	15.94%	34.53	69.1%
TSP	24hr	120	47.81	R3	32.51	27.09%	80.32	66.9%
	Annual	60	25.34	R3	7.29	12.16%	32.64	54.4%
1,3-Butadiene	24hr	10	0.04	R3	0.004	0.04%	0.04	0.4%
	Annual	2.0	0.03	R3	0.001	0.05%	0.03	1.5%
Acetaldehyde	0.5hr	500	3.30	R1	0.191	0.04%	3.49	0.7%
	24hr	500	3.30	R3	0.049	0.01%	3.34	0.7%
Acrolein	1hr	4.5	0.20	R1	0.025	0.56%	0.23	5.1%
	24hr	0.4	0.20	R3	0.008	1.95%	0.21	53.0%
Benzene	24hr	2.3	0.57	R3	0.025	1.09%	0.59	25.8%
	Annual	0.45	0.43	R3	0.006	1.25%	0.43	95.8%
Formaldehyde	24hr	65	6.48	R3	0.114	0.18%	6.60	10.1%

Notes:
- *90th percentile used as background concentrations for 1-hr, 8-hr, and 24-hr averaging periods.*
- *Average annual values use as background concentrations for annual averaging periods.*
- *24-hour 90th percentile used as background concentrations for acrolein 1-hour and acetaldehyde 0.5-hr averaging periods.*

The maximum annual PM2.5 concentrations are predicted to be slightly above 90% of the criteria. The annual average background concentration for PM2.5 is at 86% of the criterion. Since the prediction of the annual PM2.5 concentration is the result of adding the average background value to the maximum modelled value, the contribution of PM2.5 contaminants due the traffic in the Study Area is a small fraction of the cumulative concentration (less than 4%).

According to Air Quality in Ontario 2018 Report (MECP, 2021), fine particulate matter decreased 11% from 2009 to 2018. Considering the general trend in Ontario, average annual background concentrations, and the very small contribution due to the roads within the Study Area, it is reasonable to expect that cumulative PM2.5 concentrations will remain below their annual criteria within the Study Area in the future.

Similar to PM2.5, annual benzene concentrations are predicted to be around 96% of the annual criteria. The high concentrations are mainly due to the high background values. The contribution from the roads within the Study Area is only 1% for all three scenarios.

The elevated background benzene concentration is not isolated to the Grey County area but observed across the Province of Ontario. Improvements to address benzene levels are being dealt with at a national and provincial level that in turn improves air quality at a local level. According to the Air Quality in Ontario 2018 Report (MECP, 2021), over the 10-year period from 2009 to 2018, benzene concentrations have decreased by 27%.

Table 6 through Table 8 show the maximum overall predicted concentrations. These concentrations are typically predicted at the Receptors R1 and R3. As mentioned earlier, both receptors are closer to Grey Road 19 than Receptor R2.

Table 9 shows a comparison of all the impacts for all three assessed scenarios – Current, Future No Build, and Future Build. The results show an overall impact at all receptors for the Future Build scenario over the Future No Build scenario is less than 2.5%.

The highest increase is observed for NO_2, which is 2.4% for the annual averaging period.

The change for all other contaminants is shown to be around 2% and less.

Table 9: Comparison of Impact from Three Scenarios (Cumulative Concentrations)

Contaminant	Averaging Period	Criteria (µg/m³)	Current Concentration (µg/m³)	Future No Build Concentration (µg/m³)	Future Build Concentration (µg/m³)	Current % of Criteria	Future No Build % of Criteria	Future Build % of Criteria	Change in Impact from Future No Build over Build Scenario
CO	1-hr	36,200	545.87	558.92	552.73	1.5%	1.5%	1.5%	-1.1%
	8-hr	15,700	442.60	450.93	449.79	449.79	2.9%	2.9%	-0.3%
NO2	1-hr	79	70.08	74.03	72.16	72.16	93.7%	91.3%	-2.6%
	24-hr	200	37.64	37.41	38.14	38.14	18.7%	19.1%	1.9%
	Annual	23	10.78	10.84	11.10	11.10	47.1%	48.3%	2.4%
PM2.5	24-hr	27	16.41	16.37	16.02	16.02	60.6%	59.3%	-2.2%
	Annual	8.8	8.03	8.04	8.09	8.09	91.4%	91.9%	0.5%
PM10	24-hr	50	34.23	34.09	34.53	34.53	68.2%	69.1%	1.3%
TSP	24-hr	120	79.09	78.51	80.32	80.32	65.4%	66.9%	2.2%
	Annual	60	31.85	31.98	32.64	32.64	53.3%	54.4%	2.0%
1,3-Butadiene	24-hr	10	0.04	0.04	0.04	0.04	0.4%	0.4%	0.6%
	Annual	2.0	0.03	0.03	0.03	0.03	1.5%	1.5%	0.3%
Acetaldehyde	0.5-hr	500	3.48	3.49	3.49	3.49	0.7%	0.7%	-0.2%
	24-hr	500	3.34	3.34	3.34	3.34	0.7%	0.7%	0.1%
Acrolein	1-hr	4.5	0.23	0.23	0.23	0.23	5.1%	5.1%	-0.5%
	24-hr	0.4	0.21	0.21	0.21	0.21	52.9%	53.0%	0.2%
Benzene	24-hr	2.3	0.59	0.59	0.59	0.59	25.8%	25.8%	0.2%
	Annual	0.45	0.43	0.43	0.43	0.43	95.7%	95.8%	0.1%
Formaldehyde	24-hr	65	6.59	6.59	6.60	6.60	10.1%	10.1%	0.1%

4.0 Regional Air Quality Assessment

The assessment of emission impacts associated with the proposed widening of Grey Road 19 on a regional scale was based on the annual GHG emissions.

Annual emissions were calculated using emission factors summarized in Table 10.

Table 10: Emission Factors for Energy Mobile Combustion Sources

Vehicles	Emission Factors (g/L fuel)		
	CO_2	CH_4	N_2O
Gasoline	2,307	0.33	0.28
Diesel	2,681	0.10	0.15

Source: National Inventory Report 1990-2018: Greenhouse Gas Sources and Sinks in Canada. Part 2, Table A6-13: Emission Factors for Energy Mobile Combustion Sources.

Typical vehicle fuel consumption was taken from the Summary Report of Canadian Vehicle Survey (Natural Resources Canada, 2009).

Auto manufacturers are continuously looking for ways to improve their vehicle fuel efficiency; therefore, the actual emissions for both current and future scenarios are expected to be even lower than the calculated 2009 fuel consumption.

An average light vehicle (gasoline) was assumed to consume 10.7 L/100 km. An average truck (diesel) was assumed to consume 28.9 L/100 km. Based on the AADT and the length of each road segment within the Study Area; total kilometers travelled were estimated to calculate GHG emissions.

Annual expected GHG emissions for existing and future conditions are summarized in Table 11.

Annual concentrations for all GHGs including total CO_2 equivalent are estimated to be well below 0.01% of the provincial GHG levels associated with road transportation sector. Therefore, the impact of the proposed road widening on GHG emissions is considered to be negligible.

Table 11: Annual GHG Emissions within the Study Area

Contaminant	Annual Emissions (tonnes/year)							Annual Emissions (percentage of Provincial)		
	Current Scenario	Future – No Build	Increase from Current to Future No Build	Future Scenario Build	Increase from Current to Future Build	Increase from No Build to Build[2]	Total Provincial[1]	Current Scenario	Future No Build Scenario	Future Build Scenario
CO_2	19.778	21.937	2.160	21.937	2.160	0.000	47,400,000	<0.01%	<0.01%	<0.01%
CH_4	0.002	0.002	0.000	0.002	0.000	0.000	3,000	<0.01%	<0.01%	<0.01%
N_2O	0.002	0.002	0.000	0.002	0.000	0.000	3,000	<0.01%	<0.01%	<0.01%
Total CO_2e[2]	20.417	22.647	2.230	22.647	2.230	0.000	48,400,000	<0.01%	<0.01%	<0.01%

Notes:
[1] National Inventory Report 1990-2018: Greenhouse Gas Sources and Sinks in Canada. Part 3, Table A11-13: 2018 GHG Emissions Summary for Ontario.
[2] Total CO_2e is calculated by converting greenhouse gases into CO_2 equivalents using global warming potential (CO_2 equivalent factor) and adding together.

Detailed GHG calculations for Current, Future No Build, and Future Build scenarios are provided in Appendix D.

5.0 Conclusions

The results of the dispersion modelling show that the predicted ground level concentrations at all sensitive receptor locations are expected to be below the applicable MECP criteria.

Based on the comparison of predicted cumulative concentrations between Future Build and Future No Build scenarios, it was determined that the change is very small and the impact on local air quality due to Grey Road 19 widening is negligible.

The selected sensitive receptors were chosen to represent all the receptors in the vicinity of the Study Area. All other receptors are expected to experience the same or smaller impact due to the proposed road widening.

Potential air quality effects associated with the construction stage is expected to be temporary and localized to the surrounding area.

It is recommended to monitor dust levels during the construction stage and apply mitigation measures, such as water application, if needed to reduce the effect on surrounding residences.

6.0 References

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Appendix A

BURNSIDE

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Appendix A

Traffic Volumes

For Project:	Grey Road 19 - Feb 2020				
Project Notes:					
Location/Name:	Eastbound				
Report Generated:	02-21-2020	11:34			
Speed Intervals	1 km/h				
Time Intervals	Instant				
Traffic Report From	02-07-2020	14:00:00	through	02-19-2020	11:59:59
85th Percentile Speed	73 km/h				
85th Percentile Vehicles	67227				
Max Speed	147 km/h	on	02-10-2020	10:37:36	
Total Vehicles	79092				
AADT:	6637				

Volumes - weekly counts

	Time	5 Day	7 Day
Average Daily		5082	5997
AM Peak	08:00	542	562
PM Peak	04:00	447	564

Speed

Speed Limit:	60
85th Percentile Speed:	73
Average Speed:	65.88

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Count over limit	11246	8578	6304	3845	9160	11403	12802
% over limit	83.9	88.1	91.0	79.0	83.1	67.6	78.7
Avg Speeder	68.6	69.1	69.5	68.4	68.4	67.4	67.8

Class Counts

For Project:	Grey Road 19 - Feb 2020				
Project Notes:					
Location/Name:	Westbound				
Report Generated:	02-21-2020	11:34			
Speed Intervals	1 km/h				
Time Intervals	Instant				
Traffic Report From	02-07-2020	14:00:00	through	02-19-2020	11:59:59
85th Percentile Speed	74 km/h				
85th Percentile Vehicles	66462				
Max Speed	144 km/h	on	02-18-2020	18:03:18	
Total Vehicles	78191				
AADT:	6561				

Volumes - weekly counts

	Time	5 Day	7 Day
Average Daily		4858	5904
AM Peak	11:00	402	438
PM Peak	04:00	557	629

Speed

Speed Limit:	60
85th Percentile Speed:	74
Average Speed:	65.42

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Count over limit	11126	8764	5426	3314	7672	10635	13163
% over limit	76.0	90.0	90.6	74.0	82.9	67.5	71.8
Avg Speeder	69.4	70.1	70.2	67.9	69.2	68.3	69.0

Ontario Traffic Inc.
TRAFFIC MONITORING SERVICES & PRODUCTS

Project #20-005 - RJ Burnside & Associates

Intersection Count Report

Intersection:	Grey Rd 19 & Crosswinds Blvd
Municipality:	Blue Mountains
Count Date:	Jan 18, 2020
Site Code:	2000500006
Count Categories:	Cars, Medium Trucks, Heavy Trucks, Pedestrians
Count Period:	15:00-18:00
Weather:	Clear

Ontario Traffic Inc.
TRAFFIC MONITORING SERVICES & PRODUCTS

Peak Hour Summary

Intersection: Grey Rd 19 & Crosswinds Blvd
Count Date: Jan 18, 2020
Period: 15:00 - 18:00

Peak Hour Data (15:15 - 16:15)

Start Time	North Approach Crosswinds Blvd						South Approach						East Approach Grey Rd 19						West Approach Grey Rd 19						Total Vehicles
	Left	Thru	Right	U-Turn	Peds	Total	Left	Thru	Right	U-Turn	Peds	Total	Left	Thru	Right	U-Turn	Peds	Total	Left	Thru	Right	U-Turn	Peds	Total	
15:15	1		6	0	0	7					0			148	8	0	0	156	10	183		0	0	193	356
15:30	3		6	0	0	9					0			145	6	0	0	151	4	160		0	0	164	324
15:45	6		5	0	0	11					0			156	8	0	0	164	9	175		0	0	184	359
16:00	1		12	0	0	13					0			150	8	0	0	158	8	149		0	0	157	328
Grand Total	**11**		**29**	**0**	**0**	**40**					**0**	**0**		**599**	**30**	**0**	**0**	**629**	**31**	**667**		**0**	**0**	**698**	**1367**
Approach %	27.5		72.5	0		-						-		95.2	4.8	0		-	4.4	95.6		0		-	
Totals %	0.8		2.1	0		2.9						0		43.8	2.2	0		46	2.3	48.8		0		51.1	
PHF	**0.46**		**0.6**	**0**		**0.77**						**0**		**0.96**	**0.94**	**0**		**0.96**	**0.78**	**0.91**		**0**		**0.9**	**0.95**
Cars	8		22	0		30						0		516	25	0		541	27	591		0		618	1189
% Cars	72.7		75.9	0		75						0		86.1	83.3	0		86	87.1	88.6		0		88.5	87
Medium Trucks	3		7	0		10						0		79	5	0		84	4	73		0		77	171
% Medium Trucks	27.3		24.1	0		25						0		13.2	16.7	0		13.4	12.9	10.9		0		11	12.5
Heavy Trucks	0		0	0		0						0		4	0	0		4	0	3		0		3	7
% Heavy Trucks	0		0	0		0						0		0.7	0	0		0.6	0	0.4		0		0.4	0.5
Peds					0	-					0	-					0	-					0	-	0
% Peds					0	-					0	-					0	-					0	-	

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Appendix B

Emission Factors

Table B 1: Emission Factors for Free Flow Links

Road	Weighted Emission Factors (g/VMT[1])									
	CO	NOx	PM2.5	PM10	TSP	1,3-Butadiene	Acetaldehyde	Acrolein	Benzene	Formaldehyde
Grey Road 19	1.36	0.41	0.07	0.25	1.01	0.00013	0.0015	0.00024	0.0008	0.0036

[1] VMT - Vehicle Metre Travelled

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Appendix C

Modelling Results

Appendix C

Table C1: Predicted CO Ground Level Concentrations - Current Scenario

Receptor ID	1-hr					8-hr				
	Background 90th percentile, µg/m^3	Maximum Concentration, µg/m^3	Maximum Concentration plus Background, µg/m^3	Criteria, µg/m^3	% of Criteria	Background 90th percentile, µg/m^3	Maximum Concentration, µg/m^3	Maximum Concentration plus Background, µg/m^3	Criteria, µg/m^3	% of Criteria
R1	412.2	133.7	545.9	36,200	1.5%	378.4	64.2	442.6	15,700	2.8%
R2	412.2	48.7	460.9	36,200	1.3%	378.4	33.3	411.7	15,700	2.6%
R3	412.2	107.3	519.5	36,200	1.4%	378.4	62.7	441.1	15,700	2.8%

Table C2: Predicted CO Ground Level Concentrations - Future No Build Scenario

Receptor ID	1-hr					8-hr				
	Background 90th percentile, µg/m^3	Maximum Concentration, µg/m^3	Maximum Concentration plus Background, µg/m^3	Criteria, µg/m^3	% of Criteria	Background 90th percentile, µg/m^3	Maximum Concentration, µg/m^3	Maximum Concentration plus Background, µg/m^3	Criteria, µg/m^3	% of Criteria
R1	412.2	146.7	558.9	36,200	1.5%	378.4	72.5	450.9	15,700	2.9%
R2	412.2	64.8	477.0	36,200	1.3%	378.4	39.3	417.8	15,700	2.7%
R3	412.2	108.6	520.8	36,200	1.4%	378.4	59.3	437.7	15,700	2.8%

Table C3: Predicted CO Ground Level Concentrations - Future Build Scenario

Receptor ID	1-hr					8-hr				
	Background 90th percentile, µg/m^3	Maximum Concentration, µg/m^3	Maximum Concentration plus Background, µg/m^3	Criteria, µg/m^3	% of Criteria	Background 90th percentile, µg/m^3	Maximum Concentration, µg/m^3	Maximum Concentration plus Background, µg/m^3	Criteria, µg/m^3	% of Criteria
R1	412.2	140.5	552.7	36,200	1.5%	378.4	71.4	449.8	15,700	2.9%
R2	412.2	61.2	473.4	36,200	1.3%	378.4	41.4	419.8	15,700	2.7%
R3	412.2	100.5	512.7	36,200	1.4%	378.4	60.3	438.7	15,700	2.8%

Table C4: Predicted NO2 Ground Level Concentrations - Current Scenario

Receptor ID	1-hr					24-hr					Annual				
	Background 90th percentile, μg/m³	Maximum Concentration, μg/m³	Maximum Concentration plus Background, μg/m³	Criteria, μg/m³	% of Criteria	Background 90th percentile, μg/m³	Maximum Concentration, μg/m³	Maximum Concentration plus Background, μg/m³	Criteria, μg/m³	% of Criteria	Background average, μg/m³	Maximum Concentration, μg/m³	Maximum Concentration plus Background, μg/m³	Criteria, μg/m³	% of Criteria
R1	29.7	40.4	70.1	79	88.7%	25.0	9.3	34.3	200	17.2%	7.1	2.3	9.4	23	41.0%
R2	29.7	14.7	44.4	79	56.2%	25.0	6.4	31.4	200	15.7%	7.1	2.3	9.4	23	41.1%
R3	29.7	32.4	62.1	79	78.6%	25.0	12.7	37.6	200	18.8%	7.1	2.6	9.7	23	42.4%

Table C5: Predicted NO2 Ground Level Concentrations - Future No Build Scenario

Receptor ID	1-hr					24-hr					Annual				
	Background 90th percentile, μg/m³	Maximum Concentration, μg/m³	Maximum Concentration plus Background, μg/m³	Criteria, μg/m³	% of Criteria	Background 90th percentile, μg/m³	Maximum Concentration, μg/m³	Maximum Concentration plus Background, μg/m³	Criteria, μg/m³	% of Criteria	Background average, μg/m³	Maximum Concentration, μg/m³	Maximum Concentration plus Background, μg/m³	Criteria, μg/m³	% of Criteria
R1	29.7	44.3	74.0	79	93.7%	25.0	10.6	35.6	200	17.8%	7.1	2.6	9.7	23	42.3%
R2	29.7	19.6	49.3	79	62.4%	25.0	7.6	32.6	200	16.3%	7.1	2.7	9.8	23	42.6%
R3	29.7	32.8	62.5	79	79.1%	25.0	12.4	37.4	200	18.7%	7.1	2.7	9.8	23	42.6%

Table C6: Predicted NO2 Ground Level Concentrations - Future Build Scenario

Receptor ID	1-hr					24-hr					Annual				
	Background 90th percentile, μg/m³	Maximum Concentration, μg/m³	Maximum Concentration plus Background, μg/m³	Criteria, μg/m³	% of Criteria	Background 90th percentile, μg/m³	Maximum Concentration, μg/m³	Maximum Concentration plus Background, μg/m³	Criteria, μg/m³	% of Criteria	Background average, μg/m³	Maximum Concentration, μg/m³	Maximum Concentration plus Background, μg/m³	Criteria, μg/m³	% of Criteria
R1	29.7	42.5	72.2	79	91.3%	25.0	10.3	35.3	200	17.6%	7.1	2.7	9.8	23	42.6%
R2	29.7	18.5	48.2	79	61.0%	25.0	8.0	33.0	200	16.5%	7.1	2.9	10.1	23	43.7%
R3	29.7	30.4	60.1	79	76.0%	25.0	13.2	38.1	200	19.1%	7.1	3.0	10.1	23	43.8%

Table C7: Predicted PM2.5 Ground Level Concentrations - Current Scenario

Receptor ID	1-hr					Annual				
	Background 90th percentile, $\mu g/m^3$	Maximum Concentration, $\mu g/m^3$	Maximum Concentration plus Background, $\mu g/m^3$	Criteria, $\mu g/m^3$	% of Criteria	Background average, $\mu g/m^3$	Maximum Concentration, $\mu g/m^3$	Maximum Concentration plus Background, $\mu g/m^3$	Criteria, $\mu g/m^3$	% of Criteria
R1	14.3	1.5	15.9	27	58.8%	7.2	0.4	7.6	8.8	86.4%
R2	14.3	1.1	15.4	27	57.1%	7.2	0.4	7.6	8.8	86.4%
R3	14.3	2.1	16.4	27	60.8%	7.2	0.4	7.7	8.8	87.0%

Table C8: Predicted PM2.5 Ground Level Concentrations - Future No Build Scenario

Receptor ID	1-hr					Annual				
	Background 90th percentile, $\mu g/m^3$	Maximum Concentration, $\mu g/m^3$	Maximum Concentration plus Background, $\mu g/m^3$	Criteria, $\mu g/m^3$	% of Criteria	Background average, $\mu g/m^3$	Maximum Concentration, $\mu g/m^3$	Maximum Concentration plus Background, $\mu g/m^3$	Criteria, $\mu g/m^3$	% of Criteria
R1	14.3	1.7	16.1	27	59.5%	7.2	0.4	7.7	8.8	87.0%
R2	14.3	1.2	15.6	27	57.7%	7.2	0.4	7.7	8.8	87.1%
R3	14.3	2.0	16.4	27	60.6%	7.2	0.4	7.7	8.8	87.1%

Table C9: Predicted PM2.5 Ground Level Concentrations - Future Build Scenario

Receptor ID	1-hr					Annual				
	Background 90th percentile, $\mu g/m^3$	Maximum Concentration, $\mu g/m^3$	Maximum Concentration plus Background, $\mu g/m^3$	Criteria, $\mu g/m^3$	% of Criteria	Background average, $\mu g/m^3$	Maximum Concentration, $\mu g/m^3$	Maximum Concentration plus Background, $\mu g/m^3$	Criteria, $\mu g/m^3$	% of Criteria
R1	14.3	1.7	16.0	27	59.3%	7.2	0.4	7.7	8.8	87.1%
R2	14.3	1.3	15.6	27	58.0%	7.2	0.5	7.7	8.8	87.6%
R3	14.3	1.6	15.9	27	59.0%	7.2	0.5	7.7	8.8	87.6%

Table C10: Predicted PM10 Ground Level Concentrations - Current Scenario

Receptor ID	24-hr				
	Background 90th percentile, µg/m^3	Maximum Concentration, µg/m^3	Maximum Concentration plus Background, µg/m^3	Criteria, µg/m^3	% of Criteria
R1	26.6	5.6	32.2	50	64.4%
R2	26.6	4.0	30.6	50	61.1%
R3	26.6	7.7	34.2	50	68.5%

Table C11: Predicted PM10 Ground Level Concentrations - Future No Build Scenario

Receptor ID	24-hr				
	Background 90th percentile, µg/m^3	Maximum Concentration, µg/m^3	Maximum Concentration plus Background, µg/m^3	Criteria, µg/m^3	% of Criteria
R1	26.6	6.4	33.0	50	65.9%
R2	26.6	4.6	31.2	50	62.3%
R3	26.6	7.5	34.1	50	68.2%

Table C12: Predicted PM10 Ground Level Concentrations - Future Build Scenario

Receptor ID	24-hr				
	Background 90th percentile, µg/m^3	Maximum Concentration, µg/m^3	Maximum Concentration plus Background, µg/m^3	Criteria, µg/m^3	% of Criteria
R1	26.6	6.2	32.8	50	65.6%
R2	26.6	4.9	31.4	50	62.8%
R3	26.6	8.0	34.5	50	69.1%

Table C13: Predicted TSP Ground Level Concentrations - Current Scenario

Receptor ID	24-hr					Annual				
	Background 90th percentile, µg/m³	Maximum Concentration, µg/m³	Maximum Concentration plus Background, µg/m³	Criteria, µg/m³	% of Criteria	Background average, µg/m³	Maximum Concentration, µg/m³	Maximum Concentration plus Background, µg/m³	Criteria, µg/m³	% of Criteria
R1	47.8	23.0	70.8	120	59.0%	24.1	5.7	29.8	60	49.7%
R2	47.8	16.4	64.2	120	53.5%	24.1	5.8	29.9	60	49.8%
R3	47.8	31.3	79.1	120	65.9%	24.1	6.5	30.6	60	51.0%

Table C14: Predicted TSP Ground Level Concentrations - Future No Build Scenario

Receptor ID	24-hr					Annual				
	Background 90th percentile, µg/m³	Maximum Concentration, µg/m³	Maximum Concentration plus Background, µg/m³	Criteria, µg/m³	% of Criteria	Background average, µg/m³	Maximum Concentration, µg/m³	Maximum Concentration plus Background, µg/m³	Criteria, µg/m³	% of Criteria
R1	47.8	26.1	73.9	120	61.6%	24.1	6.5	30.6	60	50.9%
R2	47.8	18.8	66.6	120	55.5%	24.1	6.6	30.7	60	51.2%
R3	47.8	30.7	78.5	120	65.4%	24.1	6.6	30.7	60	51.2%

Table C15: Predicted TSP Ground Level Concentrations - Future Build Scenario

Receptor ID	24-hr					Annual				
	Background 90th percentile, µg/m³	Maximum Concentration, µg/m³	Maximum Concentration plus Background, µg/m³	Criteria, µg/m³	% of Criteria	Background average, µg/m³	Maximum Concentration, µg/m³	Maximum Concentration plus Background, µg/m³	Criteria, µg/m³	% of Criteria
R1	47.8	25.4	73.2	120	61.0%	24.1	6.6	30.7	60	51.2%
R2	47.8	19.8	67.6	120	56.3%	24.1	7.3	31.4	60	52.3%
R3	47.8	32.5	80.3	120	66.9%	24.1	7.3	31.4	60	52.3%

Table C16: Predicted 1,3-Butadiene Ground Level Concentrations - Current Scenario

Receptor ID	24-hr					Annual				
	Background 90th percentile, µg/m^3	Maximum Concentration, µg/m^3	Maximum Concentration plus Background, µg/m^3	Criteria, µg/m^3	% of Criteria	Background average, µg/m^3	Maximum Concentration, µg/m^3	Maximum Concentration plus Background, µg/m^3	Criteria, µg/m^3	% of Criteria
R1	0.039	0.0030	0.042	10	0.4%	0.020	0.0008	0.021	2	1.0%
R2	0.039	0.0021	0.041	10	0.4%	0.020	0.0008	0.021	2	1.0%
R3	0.039	0.0041	0.043	10	0.4%	0.020	0.0009	0.021	2	1.0%

Table C17: Predicted 1,3-Butadiene Ground Level Concentrations - Future No Build Scenario

Receptor ID	24-hr					Annual				
	Background 90th percentile, µg/m^3	Maximum Concentration, µg/m^3	Maximum Concentration plus Background, µg/m^3	Criteria, µg/m^3	% of Criteria	Background average, µg/m^3	Maximum Concentration, µg/m^3	Maximum Concentration plus Background, µg/m^3	Criteria, µg/m^3	% of Criteria
R1	0.039	0.0034	0.042	10	0.4%	0.020	0.0008	0.021	2	1.0%
R2	0.039	0.0025	0.041	10	0.4%	0.020	0.0009	0.021	2	1.0%
R3	0.039	0.0040	0.043	10	0.4%	0.020	0.0009	0.021	2	1.0%

Table C18: Predicted 1,3-Butadiene Ground Level Concentrations - Future Build Scenario

Receptor ID	24-hr					Annual				
	Background 90th percentile, µg/m^3	Maximum Concentration, µg/m^3	Maximum Concentration plus Background, µg/m^3	Criteria, µg/m^3	% of Criteria	Background average, µg/m^3	Maximum Concentration, µg/m^3	Maximum Concentration plus Background, µg/m^3	Criteria, µg/m^3	% of Criteria
R1	0.039	0.0033	0.042	10	0.4%	0.020	0.0009	0.021	2	1.0%
R2	0.039	0.0026	0.041	10	0.4%	0.020	0.0010	0.021	2	1.0%
R3	0.039	0.0042	0.043	10	0.4%	0.020	0.0010	0.021	2	1.0%

Table C19: Predicted Acetaldehyde Ground Level Concentrations - Current Scenario

Receptor ID	0.5-hr					24-hr				
	Background 90th percentile, µg/m³	Maximum Concentration, µg/m³	Maximum Concentration plus Background, µg/m³	Criteria, µg/m³	% of Criteria	Background 90th percentile, µg/m³	Maximum Concentration, µg/m³	Maximum Concentration plus Background, µg/m³	Criteria, µg/m³	% of Criteria
R1	3.30	0.181	3.48	500	0.7%	3.30	0.034	3.33	500	0.7%
R2	3.30	0.066	3.36	500	0.7%	3.30	0.024	3.32	500	0.7%
R3	3.30	0.145	3.44	500	0.7%	3.30	0.047	3.34	500	0.7%

Table C20: Predicted Acetaldehyde Ground Level Concentrations - Future No Build Scenario

Receptor ID	0.5-hr					24-hr				
	Background 90th percentile, µg/m³	Maximum Concentration, µg/m³	Maximum Concentration plus Background, µg/m³	Criteria, µg/m³	% of Criteria	Background 90th percentile, µg/m³	Maximum Concentration, µg/m³	Maximum Concentration plus Background, µg/m³	Criteria, µg/m³	% of Criteria
R1	3.30	0.199	3.49	500	0.7%	3.30	0.039	3.34	500	0.7%
R2	3.30	0.088	3.38	500	0.7%	3.30	0.028	3.32	500	0.7%
R3	3.30	0.147	3.44	500	0.7%	3.30	0.046	3.34	500	0.7%

Table C21: Predicted Acetaldehyde Ground Level Concentrations - Future Build Scenario

Receptor ID	0.5-hr					24-hr				
	Background 90th percentile, µg/m³	Maximum Concentration, µg/m³	Maximum Concentration plus Background, µg/m³	Criteria, µg/m³	% of Criteria	Background 90th percentile, µg/m³	Maximum Concentration, µg/m³	Maximum Concentration plus Background, µg/m³	Criteria, µg/m³	% of Criteria
R1	3.30	0.191	3.49	500	0.7%	3.30	0.038	3.33	500	0.7%
R2	3.30	0.083	3.38	500	0.7%	3.30	0.030	3.33	500	0.7%
R3	3.30	0.136	3.43	500	0.7%	3.30	0.049	3.34	500	0.7%

Table C22: Predicted Acrolein Ground Level Concentrations - Current Scenario

Receptor ID	1-hr					24-hr				
	Background 90th percentile, µg/m^3	Maximum Concentration, µg/m^3	Maximum Concentration plus Background, µg/m^3	Criteria, µg/m^3	% of Criteria	Background 90th percentile, µg/m^3	Maximum Concentration, µg/m^3	Maximum Concentration plus Background, µg/m^3	Criteria, µg/m^3	% of Criteria
R1	0.204	0.0240	0.228	4.50	5.1%	0.204	0.0055	0.210	0.40	52.4%
R2	0.204	0.0087	0.213	4.50	4.7%	0.204	0.0039	0.208	0.40	52.0%
R3	0.204	0.0193	0.223	4.50	5.0%	0.204	0.0075	0.212	0.40	52.9%

Table C23: Predicted Acrolein Ground Level Concentrations - Future No Build Scenario

Receptor ID	1-hr					24-hr				
	Background 90th percentile, µg/m^3	Maximum Concentration, µg/m^3	Maximum Concentration plus Background, µg/m^3	Criteria, µg/m^3	% of Criteria	Background 90th percentile, µg/m^3	Maximum Concentration, µg/m^3	Maximum Concentration plus Background, µg/m^3	Criteria, µg/m^3	% of Criteria
R1	0.204	0.0263	0.231	4.50	5.1%	0.204	0.0063	0.210	0.40	52.6%
R2	0.204	0.0116	0.216	4.50	4.8%	0.204	0.0045	0.209	0.40	52.2%
R3	0.204	0.0195	0.224	4.50	5.0%	0.204	0.0074	0.212	0.40	52.9%

Table C24: Predicted Acrolein Ground Level Concentrations - Future Build Scenario

Receptor ID	1-hr					24-hr				
	Background 90th percentile, µg/m^3	Maximum Concentration, µg/m^3	Maximum Concentration plus Background, µg/m^3	Criteria, µg/m^3	% of Criteria	Background 90th percentile, µg/m^3	Maximum Concentration, µg/m^3	Maximum Concentration plus Background, µg/m^3	Criteria, µg/m^3	% of Criteria
R1	0.204	0.0252	0.229	4.50	5.1%	0.204	0.0061	0.210	0.40	52.6%
R2	0.204	0.0110	0.215	4.50	4.8%	0.204	0.0048	0.209	0.40	52.2%
R3	0.204	0.0180	0.222	4.50	4.9%	0.204	0.0078	0.212	0.40	53.0%

Table C25: Predicted Benzene Ground Level Concentrations - Current Scenario

Receptor ID	24-hr					Annual				
	Background 90th percentile, μg/m^3	Maximum Concentration, μg/m^3	Maximum Concentration plus Background, μg/m^3	Criteria, μg/m^3	% of Criteria	Background average, μg/m^3	Maximum Concentration, μg/m^3	Maximum Concentration plus Background, μg/m^3	Criteria, μg/m^3	% of Criteria
R1	0.569	0.0178	0.586	2.3	25.5%	0.316	0.0044	0.320	0.45	71.1%
R2	0.569	0.0126	0.581	2.3	25.3%	0.316	0.0045	0.320	0.45	71.1%
R3	0.569	0.0241	0.593	2.3	25.8%	0.316	0.0050	0.321	0.45	71.3%

Table C26: Predicted Benzene Ground Level Concentrations - Future No Build Scenario

Receptor ID	24-hr					Annual				
	Background 90th percentile, μg/m^3	Maximum Concentration, μg/m^3	Maximum Concentration plus Background, μg/m^3	Criteria, μg/m^3	% of Criteria	Background average, μg/m^3	Maximum Concentration, μg/m^3	Maximum Concentration plus Background, μg/m^3	Criteria, μg/m^3	% of Criteria
R1	0.569	0.0202	0.589	2.3	25.6%	0.316	0.0050	0.321	0.45	71.3%
R2	0.569	0.0145	0.583	2.3	25.4%	0.316	0.0051	0.321	0.45	71.3%
R3	0.569	0.0237	0.592	2.3	25.8%	0.316	0.0051	0.321	0.45	71.3%

Table C27: Predicted Benzene Ground Level Concentrations - Future Build Scenario

Receptor ID	24-hr					Annual				
	Background 90th percentile, μg/m^3	Maximum Concentration, μg/m^3	Maximum Concentration plus Background, μg/m^3	Criteria, μg/m^3	% of Criteria	Background average, μg/m^3	Maximum Concentration, μg/m^3	Maximum Concentration plus Background, μg/m^3	Criteria, μg/m^3	% of Criteria
R1	0.569	0.0196	0.588	2.3	25.6%	0.316	0.0051	0.321	0.45	71.3%
R2	0.569	0.0153	0.584	2.3	25.4%	0.316	0.0056	0.321	0.45	71.4%
R3	0.569	0.0251	0.594	2.3	25.8%	0.316	0.0056	0.321	0.45	71.4%

Table C28: Predicted Formaldehyde Ground Level Concentrations - Current Scenario

Receptor ID	24-hr				
	Background 90th percentile, µg/m^3	Maximum Concentration, µg/m^3	Maximum Concentration plus Background, µg/m^3	Criteria, µg/m^3	% of Criteria
R1	6.48	0.081	6.56	65	10.1%
R2	6.48	0.058	6.54	65	10.1%
R3	6.48	0.110	6.59	65	10.1%

Table C29: Predicted Formaldehyde Ground Level Concentrations - Future No Build Scenario

Receptor ID	24-hr				
	Background 90th percentile, µg/m^3	Maximum Concentration, µg/m^3	Maximum Concentration plus Background, µg/m^3	Criteria, µg/m^3	% of Criteria
R1	6.48	0.092	6.57	65	10.1%
R2	6.48	0.066	6.55	65	10.1%
R3	6.48	0.108	6.59	65	10.1%

Table C30: Predicted Formaldehyde Ground Level Concentrations - Future Build Scenario

Receptor ID	24-hr				
	Background 90th percentile, µg/m^3	Maximum Concentration, µg/m^3	Maximum Concentration plus Background, µg/m^3	Criteria, µg/m^3	% of Criteria
R1	6.48	0.089	6.57	65	10.1%
R2	6.48	0.070	6.55	65	10.1%
R3	6.48	0.114	6.60	65	10.1%

BURNSIDE

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Appendix D

GHG Impact

Appendix D

Table D1: Annual GHG Emissions - Current Scenario

Road Segment	Daily Traffic (vpd)	Percent Cars (%)	Percent Large Vehicles (%)	Segment Length, m	CO_2, tonnes/yr	CH_4, tonnes/yr	N_2O, tonnes/yr
					Emissions, tonnes/ year		
Grey Road 19	13,330	87%	13%	1,288	19.778	0.002	0.002
				Total	**19.778**	**0.002**	**0.002**

Table D2: Annual GHG Emissions - Future No Build Scenario

Road	Daily Traffic (vpd)	Percent Cars (%)	Percent Large Vehicles (%)	Segment Length, m	CO_2, tonnes/yr	CH_4, tonnes/yr	N_2O, tonnes/yr
					Emissions, tonnes per year		
Grey Road 19	14,725	87%	13%	1,294	21.937	0.002	0.002
				Total	**21.937**	**0.002**	**0.002**

Table D3: Annual GHG Emissions - Future Build Scenario

Road	Daily Traffic (vpd)	Percent Cars (%)	Percent Large Vehicles (%)	Segment Length, m	CO_2, tonnes/yr	CH_4, tonnes/yr	N_2O, tonnes/yr
					Emissions, tonnes per year		
Grey Road 19	14,725	87%	13%	1,294	21.937	0.002	0.002
				Total	**21.937**	**0.002**	**0.002**