I. Natural Environment Existing Conditions Report

Kanata Light Rail Transit Planning and Environmental Assessment

Natural Environment Existing Conditions Report

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1. INTRODUCTION

The City of Ottawa (herein known as the "City") has retained Parsons to undertake a Planning and Environmental Assessment Study to fulfill the requirements of Ontario's Transit Project Assessment Process (TPAP) for the Kanata Light Rail Transit Extension (herein known as the "Kanata LRT") project in accordance with Regulation 231/08 under Ontario's *Environmental Assessment Act*. The City will plan, develop, consult, and file this transit project with the Ministry of the Environment and Climate Change (MOECC). The City will have charge of this project as it evolves and moves through the TPAP process, following the responsibilities and obligations identified in Regulation 231/08 during the planning stages, implementation and operation of the preferred undertaking described herein.

The purpose for the Kanata LRT extension is to expand and improve the current rapid transit network to accommodate existing and future travel demand. The proposed project would include the extension of Confederation Line approximately 11 kilometers (km) west from Moodie Drive to Hazeldean Road, with eight stations (**Figure 1, Appendix A**). Most of the alignment is within a corridor identified for rapid transit in previous studies. An exclusive LRT right-of-way is required to provide a fast and reliable transit service.

1.1. UNDERSTANDING OF THE OBJECTIVES

The purpose of the Natural Environment Existing Conditions report is to:

- Provide an understanding of the natural environment existing conditions within the study area
- Document existing vegetation communities, wildlife habitat, aquatic features, and other significant natural features
- Describe the sensitivities of vegetation communities, aquatic and wildlife habitats, and other significant features; including an assessment of habitat suitability for potential Species at Risk (SAR) and provincially rare species

For this report, the study area includes the area within 120 m of the Kanata LRT preferred alignment from Moodie Drive to Hazeldean Road (**Figure 1, Appendix A**).

This report describes the results of background review and field investigations completed November 24 and 28, 2017, as well as April 11, 2018. The intent of these studies was to generally characterize the existing conditions within the study area and identify potential areas of concern. Future studies should be undertaken once specific design information is available to confirm these findings and address any site specific and species-specific concerns following appropriate protocols.

2. ENVIRONMENTAL POLICY CONTEXT

2.1. CITY OF OTTAWA OFFICAL PLAN

The Official Plan (OP) provides a vision for the future growth of the City and policy framework to guide its physical development within the planning horizon (to 2031). The City of Ottawa OP was first approved in 2003 and is updated every 5 years with the most recent amendments approved by council in 2013. The scope of this report is limited to the natural environment and discussion with respect to land use designations related to the natural environment as per the OP.

2.1.1. NATURAL HERITAGE SYSTEM

A natural heritage system is a "*system of connected … green and natural areas that provide ecological function over larger periods of time and enable movement of species*" (MNR 2010). The natural heritage system for the study area is illustrated on Schedule L3 of the OP (City of Ottawa 2013) and is formed from interconnected and unique habitats that fill ecological roles necessary for the continued health of the natural environment in the City. These interconnected natural features meet the definitions outlined in Section 2.4.2 of the OP (City of Ottawa 2013) and may include:

- Provincially Significant Wetlands
- Significant Habitat of Endangered and Threatened Species
- Significant Woodlands
- Wetlands found in association with Significant Woodlands
- Significant Valleylands
- Significant Wildlife Habitat
- Life Science Areas of Natural and Scientific Interest (ANSI)
- Earth Science Areas of Natural and Scientific Interest (ANSI)
- Urban Natural Features
- Forest Remnants and Corridors identified through planning or environmental studies
- Groundwater features identified through surface or subsurface hydrogeologic investigations
- Surface water features including headwaters, rivers, streams, lakes, seepage areas and associated riparian areas, including fish habitat

The natural heritage system is afforded protection through a variety of means, including policies for specific land use designations and subwatershed plans. The study area contains the following OP designations as shown on Schedule B of the 2013 OP:

- General Urban Area
- Major Open Space
- Agricultural Resource Area
- Natural Environment Area
- Greenbelt Employment and Institutional Area
- Greenbelt Rural
- Urban Natural Features
- Mixed Use Centre
- Town Centre
- Urban Employment Area
- Carp River Restoration Policy Area Overlay

2.2. NATIONAL CAPITAL COMMISSION GREENBELT

The National Capital Commission (NCC) Greenbelt is a 20,000-hectare (ha) greenspace that includes farm, forest, and wetlands surrounding Ottawa's urban core that is 75% owned and 100% managed by the NCC (NCC 2017). The natural environment is the primary focus of the NCC with respect to the Greenbelt. Preserving core natural areas and links, as well as expanding the Greenbelt through acquisition of select areas adjacent to the Greenbelt (including areas within the current study area) are key objectives of the NCC's Greenbelt Master Plan (NCC 2013). As it relates to planning for infrastructure, the plan's goal is for no net loss to ecological or overall Greenbelt integrity.

2.3. SPECIES AT RISK AND SPECIES OF CONSERVATION CONCERN

Legislation at the provincial and federal levels identify species that are extinct, extirpated, endangered, threatened, or of special concern and provide appropriate levels of protection for at risk species and/or their habitat.

2.3.1. SPECIES AT RISK ACT

Species at Risk status for federally listed species is legislated by the Government of Canada, based on scientific information provided by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). COSEWIC provides a recommendation that is reviewed by Environment and Climate Change Canada (ECCC). Species can be listed as Schedule 1, 2, or 3. Schedule 1 extirpated (defined if a recovery strategy has recommended its reintroduction to Canada), endangered or threatened species are afforded protection of critical habitat on federal lands under the SARA, if the recovery strategy has recommended its reintroduction. However, prohibitions on the destruction of critical habitat does not automatically apply once critical habitat is identified but rather if the federal government has taken the appropriate measures to bring the SARA prohibitions into force. For all species, the critical habitat prohibitions of SARA apply on federal lands only through an order under Section 58 of SARA, and on non-federal lands through an order under Section 61.

SARA also provides protection of individuals and residences of aquatic species and migratory birds protected under the *Migratory Birds Convention Act* (MBCA), if they are listed as either extirpated, endangered, or threatened and whether these species occur on federal and/or non-federal lands. Individuals and residences of all other species listed as extirpated, endangered, or threatened only receive protection on federal lands. Environmental Assessment projects, such as the Kanata LRT are required under Subsection 79(2) of SARA to identify Species at Risk or critical habitat that is likely to be affected by the project and ensure that measures are taken to avoid, reduce, or monitor those adverse effects. The measures taken must be consistent with any applicable recovery strategy or action plan under SARA. Section 79 also applies to <u>all</u> species listed on Schedule 1, including those listed as <u>special concern.</u>

If it is known that an activity may contravene SARA, a permit will be required but only issued if the purpose of the proposed activity is for; a) scientific research relating to the conservation of the species and conducted by qualified persons; b) the activity benefits the species or is required to enhance its chance of survival in the wild; or c) affecting the species is incidental to carry out the activity. Permit pre-conditions must also be met to ensure that all reasonable alternatives have been considered, all feasible measure will be taken to minimize impacts and the activity will not jeopardize the survival or recovery of the species.

2.3.2. ONTARIO ENDANGERED SPECIES ACT, 2007

The Ontario *Endangered Species Act* (ESA) prohibits the killing or harming of species identified as endangered or threatened on the Species at Risk in Ontario (SARO) List in Ontario Regulation 230/08.

Section 10 of the ESA prohibits the damage or destruction of the habitat of species classified as endangered or threatened.

Under the ESA, "habitat" is defined as either an area on which a species depends directly or indirectly to carry on its life processes based on the general definition in clause 2(1)(b) of the ESA or the area prescribed for the species in a habitat regulation [clause 2(1)(a)]. A habitat regulation can prescribe an area as the habitat of the species through the description of boundaries, features of an area, or by describing the area in any other manner.

2.3.3. PROVINCIAL RANKS AND SPECIES OF CONSERVATION CONCERN

Significant species are considered globally, nationally, and provincially. In Ontario, this includes species that are provincially rare with a Provincial S-ranks of S1 to S3 or listed as endangered, threatened, or special concern as discussed above in Sections 2.1.1 and 2.1.2.

Provincial ranks (S-ranks) are used by the Natural Heritage Information Centre (NHIC) to set protection priorities for rare species and vegetation communities (NHIC 2017a). S-ranks are based on the number of occurrences in Ontario and have no legal status and offer no protections to the species. By comparing the global and provincial ranks, the status, rarity and importance of conservation needs can be determined. MNRF tracks species with provincial ranks of S1 to S3 as they are considered Species of Conservation Concern (SCC). Provincial S-ranks are defined as follows:

- S1: Critically imperiled; usually fewer than 5 occurrences
- S2: Imperiled; usually fewer than 20 occurrences
- S3: Vulnerable; usually fewer than 100 occurrences
- S4: Apparently secure; uncommon but not rare, usually more than 100 occurrences
- S5: Secure; common, widespread and abundant
- S-rank followed by “?” indicates the rank is uncertain due to lack of data
- S-rank followed by “B” indicates a breeding occurrence for birds
- S-rank followed by “N” indicates a non-breeding occurrence for birds

The potential for a SAR or SCC to occur within or adjacent to the study area can be assessed by comparing preferred habitat types to existing conditions as documented in the background review and field investigations. SAR/SCC with preferred suitable habitat in the study area are considered likely to be present. SAR/SCC with no preferred suitable habitat within or adjacent to the study area are assumed absent.

2.4. MIGRATORY BIRDS CONVENTION ACT

The *Migratory Birds Convention Act* (MBCA) is legislation administered by the ECCC, which provides protection and management direction for migratory birds, their eggs, and their nests listed in the Act. The Act prohibits the disturbance, destruction, take and killing of migratory birds listed in the Act. To protect nesting migratory birds, no work is permitted to proceed that would result in the destruction of active nests (nests with eggs or young birds), or the wounding or killing of bird species protected under the MBCA and/or Regulations under the MBCA. Construction activities should be scheduled to occur outside of the overall bird nesting season of April 1st to August 31st to avoid contravention of the MBCA.

Permits may be issued by ECCC under the MBCA allowing the disturbance, destruction, take and killing of migratory birds or their nests for scientific or agricultural purposes. Allowable purposes for issuing a permit under the MBCA do not include industrial or construction activities.

2.5. FISHERIES ACT

The *Fisheries Act* is managed by Fisheries and Oceans Canada (DFO). Changes to the federal *Fisheries Act* enacted in 2012 and implemented in 2013 focused on managing threats to sustainability and productivity of commercial, recreational, and Aboriginal fisheries in Canada. Its goal was also to provide enhanced compliance and protection tools to enable cross-agency partnerships and better protection of fisheries in Canada (DFO 2013).

The updated *Fisheries Act,* as it relates to this project includes a prohibition against causing *serious harm to fish* that support or are part of a commercial, recreational, or Aboriginal fishery (Section 35 of the Act), flow and fish passage provisions (Sections 20 and 21 of the Act), and a regulatory decision-making framework (Section 6.0 and 6.1 of the Act).

The importance of fisheries within Canadian culture spans generations and continues to provide significant economic, environmental, and cultural value. Fisheries have been affected by anthropogenic activities and continue to be impacted by human activities which destroy or degrade habitat, alter water flow regimes, introduce invasive species, cause over harvesting of fish, and pollution of the waters needed to support healthy fisheries.

The project may affect fisheries and therefore the City of Ottawa is responsible under the *Fisheries Act* to:

- understand the potential impacts of the project on fish and fish habitat
- avoid and mitigate potential impacts to fish and fish habitat the extent possible
- seek authorization from the Minister of Fisheries and Oceans when avoidance and mitigation do not sufficiently reduce the projects likelihood to cause serious harm to fish

Updates to the *Fisheries Act* have led to the development of guidance materials and an online self-assessment process for understanding the potential project-related impacts on fish and/or fish habitat (e.g., Fisheries Protection Policy Statement, Request for Review, Pathways of Effects for routine activities) and determining whether the project will cause serious harm to fish. DFO interprets serious harm to fish as death of fish, permanent alteration of fish habitat, or destruction of fish habitat (DFO 2013).

Projects that cannot avoid causing serious harm to fish will require *Fisheries Act Authorization* from DFO prior to undertaking the work. Under the updated *Fisheries Act* any project requiring Authorization must provide site-specific details with respect to habitat losses and must offset those losses through a mutually agreed upon Habitat Offsetting Plan (e.g., creation/improvement of fish habitat).

3. METHODOLOGY

3.1. AGENCY CONSULTATION

The study area is located within the jurisdictions of MNRF Kemptville district, Mississippi Valley Conservation Authority (MVCA), and the Rideau Valley Conservation Authority (RVCA). An information request for existing conditions information related to the greater study area was submitted to the MNRF on April 6, 2017 (Appendix B). A response was received from Jane Devlin, Management Biologist on August 2, 2017. Information provided by the MNRF included potential SAR, Areas of Natural and Scientific Interest (ANSI), Provincially Significant Wetland (PSW), and locally significant wetlands if known to occur within or adjacent to the study area. Information on aquatic resources were also provided and included watercourse thermal regimes, habitat sensitivity, and work-in-water timing guidelines.

MVCA and RVCA have been engaged throughout the study as part of the Agency Consultation Group and have provided feedback and information towards the selection of a preferred design.

Agency correspondence has been documented and is provided in Appendix B.

3.2. BACKGROUND REVIEW

The ecological existing conditions have been described based on desktop review of publicly available information and correspondence with relevant agencies. Several resources were used to provide context for the documentation of the natural features including:

- National Capital Commission (NCC) Greenbelt Master Plan (NCC 2013)
- City of Ottawa Protocol for Wildlife Protection During Construction (City of Ottawa 2015)
- Urban Natural Areas Environmental Evaluation Study (Muncaster and Brunton 2005 Muncaster and Brunton 2006)
- Amy MacPherson, Species at Risk in Ottawa – as of June 13, 2017 (MacPherson 2017)

On-line databases queried for species at risk, provincially rare species, and significant natural features included that of the following:

- Department of Fisheries and Oceans Canada (DFO) Species at Risk Mapping (DFO 2016)
- Ontario Ministry of Agriculture, Food, and Rural Affairs (OMAFRA) Drainage Classification Mapping (OMAFRA 2017)
- Ontario Ministry of Natural Resources and Forestry (MNRF)
  - Natural Heritage Information Centre (NHIC 2017a and NHIC 2017b)
  - Land Information Ontario (LIO) Make a Topographic Map (MNRF 2014a)
- *Species at Risk Act* (SARA), Schedule 1 (Government of Canada 2002)
- Species at Risk in Ontario (SARO) List (MNRF 2017)
- The 2nd Ontario Breeding Bird Atlas (OBBA) (Cadman et. al. 2007)
- Ontario Reptile and Amphibian Atlas (ORAA) (Ontario Nature 2017)
- Atlas of the Mammals of Ontario (AMO) (Dobbyn 1994)
- MVCA Mapping GeoPortal (MVCA 2017)
- RVCA Mapping GeoPortal (RVCA 2017)
- City of Ottawa
  - Official Plan (City of Ottawa 2013)
  - GeoOttawa Mapping database (City of Ottawa 2017)

3.3. FIELD DATA COLLECTION

Parsons conducted field investigations within the Kanata LRT study area on November 24 and November 28, 2017. Additional field investigations were undertaken on April 11, 2018. Natural heritage features assessed included that of vegetation communities, wildlife habitat, SAR screening, and aquatic habitat. For properties where permission to access was granted, field investigations were conducted within and throughout the entire properties. Incidental wildlife observations were documented during time of field investigations.

3.3.1. VEGETATION COMMUNITIES

Vegetation community mapping within the study area followed the Ecological Land Classification (ELC) system for southern Ontario (Lee *et. al*. 1998). The majority of vegetation communities from Eagleson/March Road to Hazeldean Road were delineated based on aerial photography interpretation with subsequent field verification and inventory. Due to limited access to some properties within 120 m of the proposed Kanata LRT alignment, vegetation communities were delineated based on aerial photograph interpretation and classified to Community Series level (i.e. units that are normally visible and consistently recognizable on air-photos) (Lee *et. al.* 1998).

Scientific nomenclature, English colloquial names, and scientific binomials of plant species generally followed Newmaster *et. al.* (2005), with updates taken from published volumes of the Flora of North America Editorial Committee (2000+ accessed 2015) and Michigan Flora Online (2015).

3.3.2. WILDLIFE AND WILDLIFE HABITAT

3.3.2.1. Significant Wildlife Habitat

The MNRF provides guidelines, tools and a decision support system to help with the complex task of identifying and designating Significant Wildlife Habitat (SWH). These aids are documented in three separate resources: *Significant Wildlife Habitat Technical Guide* (MNR 2000), *Significant Wildlife Habitat Mitigation Support Tool* (MNRF 2014b), and *Significant Wildlife Habitat Criteria Schedules for Ecoregion 6E* (MNRF 2015).

There are four categories of significant wildlife habitat: seasonal concentration areas, migration corridors, rare or specialized habitats and SCC. Species and their habitats that are already protected as threatened or endangered under the ESA are not considered in the assessment of SWH.

To determine candidate SWH within the study area, field investigations followed and consulted with the SWHTG (2000) and *SWH Criteria Schedules for Ecoregion 6E* (MNRF 2015). Investigations focused on features that may be associated with transportation corridors and urban landscapes, which include: bat maternity colonies, snake hibernacula, turtle nesting and wintering areas. Candidate SWH encountered was documented.

3.3.2.2. Fish and Fish Habitat

Existing fisheries community and habitat information for some of the watercourse features in the study area is available through existing studies and on-line databases. The existing fisheries communities were identified through background information collection from available sources. Site visits were undertaken on April 11, 2018, to generally characterize the existing fish habitat within the study area and confirm the findings of the background information.

4. EXISTING ECOLOGICAL CONDITIONS

4.1. BACKGROUND DATA

4.1.1. PHYSIOGRAPHY AND VEGETATION

The study area is located within the Kemptville Ecodistrict 6E-12. This area consists of limestone plain and sandstone bedrock covered with sand, silt, lime clay, and loam soils. The north and west boundaries in which the study area occurs includes portions of the Russell and Prescott Sand Plains and the Edwardsburg Sand Plain (Henson and Brodribb 2005).

Natural vegetation cover within Ecodistrict 6E-12 is primarily composed of forest and swamp along with other wetlands and alvar communities to a lesser degree (Henson and Brodribb 2005). Common forest species that are characteristic for this region include sugar maple (*Acer saccharum*), red maple (*Acer rubrum*), ash species (Fraxinus sp.), and American beech (*Fagus grandifolia*) to name a few. Alvars that are present in the area are considered high-quality occurrences but are relatively uncommon (Crins *et. al*. 2009).

4.1.2. NATURAL HERITAGE FEATURES

The Kanata LRT study area is a mixed-use area, comprising of agricultural lands, residential and commercial properties with small pockets of natural areas (e.g., thickets, meadows, and woodland communities). The study area from Moodie Drive to March Road consists of the NCC Greenbelt. This area is composed of agricultural, recreation, forested, and idle land uses. The study area from March Road to Hazeldean Road is predominately an urban environment with residential, commercial, and institutional developments. The background review and correspondence with the Kemptville district MNRF identified designated natural areas occurring within 120 m of the preferred alignment and are listed below (**Figure 2-1 to 2-8**).

4.1.2.1. Significant Woodland

Two significant woodlands are within or in proximity to the study area. One significant woodland is located within the NCC Greenbelt and Wesley Clover Park Campground, north of Highway 417 between Moodie Drive and March Road (Delcan 2013) (**Figure 2-1, Appendix A**). This area has also been designated a Natural Link within the Greenbelt Master Plan (NCC 2013). The other is also located within the NCC Greenbelt and Stony Swamp, south of Highway 417. The edge of the significant woodland is within 120 m of the preferred alignment but not within the immediate Project footprint (Pers. comm. MacPherson 2018). This section of significant woodland has been designated a Core Natural Area within the Greenbelt Master Plan (NCC 2013).

4.1.2.2. Significant Valleylands

Two significant valleylands occur within the study area. One significant valleyland is located north of Highway 417 and west of Huntmar Drive within Feedmill Creek. The other significant valleyland crosses Huntmar Drive, just north of Hazeldean Road within Poole Creek (Delcan 2012) (**Figure 2-3 and 2-4, Appendix A**).

4.1.2.3. Areas of Natural and Scientific Interest

Areas of Natural and Scientific Interest (ANSIs) are lands and waters with features that are important for natural heritage protection, appreciation, scientific study or education. Three are known to occur within the study area (**Figures 2-1 to 2-2, Appendix A**). They include:

- Queensway Roadcut Earth Science ANSI – sections of Nepean (Potsdam) sandstone/formation were found within the Queensway roadcut (Highway 417) approximately 2 km east of Eagleson/March Road. These sections occur north and south of the Queensway (Highway 417) are about 760 m in length, with thickness ranging from 0.6 – 7 m.
- Queensway Extension Sandstone Earth Science ANSI – this feature displays a series of great exposures showing characteristics of the Nepean Formation. It is located immediately east of Terry Fox Drive interchange on Highway 417.

- Stony Swamp Candidate Life Science ANSI – contains four locally significant drainage systems: Watts Creek, Carp River, Stillwater Creek, and Graham Creek. This area covers 1377.2 ha containing the Stony Swamp Conservation Area, which is a floristically diverse site with 745 recorded species of vascular plants (Brunton 1992).

4.1.2.4. Wetlands

No provincially significant wetlands (PSWs) occurred within or adjacent to the study area, however unevaluated wetlands do occur adjacent to the study area. Portions of the Stony Swamp PSW Complex are the closest PSW to the study area and are located approximately 400 meters south of Highway 417 between March Road and Moodie Drive.

4.1.2.5. Urban Natural Areas and Urban Natural Features

The City of Ottawa undertook the Urban Natural Areas Environmental Evaluation Study (UNAEES,Muncaster and Brunton 2005, Muncaster and Brunton 2006) in conjunction with the Greenspace Master Plan (City of Ottawa 2006a). The purpose of the UNAEES was to identify woodlands, wetlands and ravines throughout the City of Ottawa urban area and evaluate their environmental significance. The UNAEES has been approved by the City Council and adopted into the City's OP (2013) as these lands are deemed ecologically valuable within the City. Those Urban Natural Areas (UNA) worthy of protection and/or acquisition were assessed using strategic guidelines set forth within the Urban Natural Features Strategy (City of Ottawa 2006b). Those UNAs identified as priority areas that are worthy of protection include; high and moderate-rate sites, natural features currently in City ownership (which includes sites with low environmental rating), recognized planning status, and promote environmental stewardship on privately-owned lands with a low environmental rating (City of Ottawa 2006b). A total of 40 UNAs were re-designated to Urban Natural Features (UNF) based on this strategy. UNFs are shown on Schedule B of the OP (2013) as land use designations.

Two UNAs evaluated with High or Moderate significance were identified within or adjacent to the study area and one unevaluated UNA (Palladium Interchange) was identified. Poole Creek North of Hazeldean is the only UNF in the study area targeted for preservation in the Urban Natural Features Strategy (City of Ottawa 2006) (**Appendix A**). Therefore, this feature has been designated as a UNF on Schedule B of the OP, which involves an absolute prohibition on development and zoned environmental protection (City of Ottawa 2006).

- Kanata Town Centre Core Park (UNA) – This area has been ranked as highly significant and contains upland woodland with meadow and bedrock outcrops. Small marsh and wetlands also occur throughout.
- North of Maple Grove (UNA) – This area has been ranked as moderately significant and contains regenerating agricultural fields regenerating into young woodlands and wetlands over limestone bedrock.
- Palladium Interchange (UNA) – This area has not yet been evaluated.
- Poole Creek North of Hazeldean (UNF) – This area has been ranked as moderately significant and contains a valleyland containing extensive marsh and wooded slopes.

4.1.2.6. Official Plan Designations and Summary of Natural Features

The Natural Heritage System for the City of Ottawa is composed of City's OP environmental designations of Significant Wetlands, Natural Environment Areas, Rural Natural Features, Urban Natural Features, as well as well as natural links of stream and wooded corridors (City of Ottawa 2013). The Natural Heritage System shown on Schedule L3 of the OP has been identified to occur and traverses the study area in three distinct sections (Figure 2-1, City of Ottawa 2013). Other natural environment land use designations also apply to the study area and contains the additional OP environmental designations as shown on Schedule B (City of Ottawa 2013):

- Greenbelt Rural: part of the Greenbelt policy and includes permitted activities of farming, forestry, recreation, etc.
- Natural Environment Area: lands that hold a high environmental value with components of wetlands, significant woodlands, and wildlife habitat. Designated lands are protected and preserved to ensure inherent function of natural features.

- Agricultural Resource Area: lands with nutrient-rich soils ideal for cash crops and livestock farms. The City's intent is to protect this resource for future generations and limit development in such areas.
- Carp River Restoration Policy Area Overlay: the purpose of the restoration policy is to recognize that proposed channel modifications and restoration works may occur, and development is allowed but numerous conditions must be met beforehand.
- Major Open Space: large parks, parkway corridors, and corridors reserved for rapid-transit and major roads. This is a key component to the Greenspace Network within the City.

As some natural areas discussed above have several land use designations, **Table 1** below summarizes the areas that occur within 120 m of the preferred alignment and their corresponding designations.

Table 1. Summary of Natural Heritage Designations

Natural Heritage Feature	Designation	Source/Schedule
Natural Heritage System	NCC Greenbelt Core Natural Area Natural Link Natural Environment Area	NCC (2013) City of Ottawa (2013) Schedule L3 and Schedule B
Significant Woodland	NCC Greenbelt Core Natural Area Natural Link Natural Heritage System Natural Environment Area	NCC (2013) City of Ottawa (2013) Schedule L3 and Schedule B
Significant Valleyland	Natural Heritage System Major Open Space	City of Ottawa (2013) Schedule L3 and Schedule B
Queensway Roadcut	Earth Science ANSI NCC Greenbelt Natural Environment Area	MNRF (2017) City of Ottawa (2013) Schedule L3 and Schedule B
Queensway Extension Sandstone	Earth Science ANSI	MNRF (2017)
Stony Swamp	Candidate Life Science ANSI Significant Woodland Provincially Significant Wetland Natural Heritage System NCC Greenbelt and Core Natural Area Natural Environment Area	MNRF (2017) City of Ottawa (2013) Schedule L3 and Schedule B; NCC (2013)
Kanata Town Centre Core Park	Urban Natural Area	Muncaster and Brunton (2005)
North of Maple Grove	Urban Natural Area	Muncaster and Brunton (2005)
Palladium Interchange	Urban Natural Area	Muncaster and Brunton (2006)
Poole Creek North of Hazeldean	Urban Natural Feature	Muncaster and Brunton (2006)

Natural Heritage Feature	Designation	Source/Schedule
		City of Ottawa (2013) and Schedule B

4.1.3. SPECIES AT RISK AND SPECIES OF CONSERVATION CONCERN

A review of online resources (e.g., wildlife atlas records, NHIC database) identified 24 SAR with historical occurrence records that overlap with the study area, either within 1 km (as per NHIC) or 10 km (as per wildlife atlas records) of the study area. The MNRF have confirmed the records of 16 of these species, as well as an additional 12 SAR with potential to occur within or adjacent to the greater study area. Results of Parsons search of available wildlife atlases and background documents are provided in Table C2, Appendix C. This table includes a complete list of all species identified along with their corresponding federal, provincial SAR and/or SCC designations.

4.1.3.1. Species at Risk Screening

A screening was completed for SAR identified as potentially occurring in the study area. The screening for potential SAR and SCC was based on the observed existing conditions and the identified presence of suitable habitat within the study area. Screening for SAR has been completed through the use existing available wildlife databases, consultation with the MNRF, DFO SAR Mapping, and City of Ottawa resources. The results of the SAR screening are shown in Table C3, Appendix C. A discussion of species identified as having potential to be present within the study area and/or confirmed to be present through other field studies follows below. A total of 12 species listed as threatened or endangered have potential to occur within the study area, as well as 12 species of special concern.

Butternut (*Juglans cinerea*)

Butternut is designated as endangered under the ESA and the SARA. Suitable habitat is present within the study area and four healthy Butternut trees were documented during field investigations. The area surrounding Poole Creek is known to contain more than 1,000 Butternut trees (personal communication with Amy MacPherson, City of Ottawa, October 23, 2018). In Ontario, Butternut generally grows alone or in small groups in deciduous forests, in moist soil; intolerant of shade. Response received from the MNRF indicates the potential for them to be present.

American Eel (*Anguilla rostrata*)

The American Eel is designated as endangered under the ESA but has no status under the SARA. Suitable habitat is present within the study area as it has a broad diversity of habitats from large lakes to small rivers (SARO 2018). Response received from the MNRF and records of occurrence from NHIC indicates the potential for them to be present. Mississippi Valley Conservation captured a single American Eel in Poole Creek in 2018 (personal communication with Amy MacPherson, City of Ottawa, October 23, 2018).

Western Chorus Frog (*Pseudacris triseriata*)

Western Chorus Frog is not at risk under the ESA, however is designated as threatened under the SARA. Western Chorus Frog is an amphibian species only protected on federal lands. There are federal lands containing suitable habitat present within the study area. Suitable habitat may include roadside ditches or temporary ponds in fields; swamps or wet meadows; woodland or open country with cover and moisture; small ponds and temporary pools. They require vernal (non-permanent) pools for breeding.

Blanding's Turtle (*Emydoidea blandingii*)

Blanding's Turtle is designated as threatened under the ESA and the SARA. There is suitable habitat present within the study area. Critical habitat features include wetlands, watercourses, and water bodies within 2 km of any occurrence record, plus upland terrestrial habitat up to 240 m from those features. Quiet lakes, streams and wetlands with abundant emergent vegetation is also suitable, however they are also known to travel across upland forests to reach wetlands. Response received from the MNRF indicates the potential for them to be present. Recent observations of this species have been recorded in the Upper Poole Creek corridor, in the Carp River downstream of the study area, and in a wetland north of the Wesley Clover Park equestrian centre (personal communication with Amy MacPherson, City of Ottawa, October 23, 2018).

Bank Swallow (*Riparia riparia*)

Bank Swallow is designated as threatened under the ESA and the SARA. This species receives protection on private, provincial and federal lands. In addition, individuals, nests, and eggs, are protected under the MBCA. There is suitable habitat present within the study area. Bank Swallows prefer to build nests near water in steep sand, dirt, or gravel banks, in burrows dug near the top of the bank, including road embankments and potentially excavated soil piles at construction sites. Response received from the MNRF indicates the potential for them to be present and records confirm their presence in the 2005 OBBA.

Barn Swallow (*Hirundo rustica*)

Barn Swallow is designated as threatened under the ESA and the SARA. This species receives protection on private, provincial and federal lands. In addition, individuals, nests, and eggs, are protected under the MBCA. There is suitable habitat present within the study area. Barn Swallows are frequently found foraging over farmlands or rural areas. They prefer to nest in cliffs, caves, rock niches, buildings or other man-made structures (including bridges and culverts). They could typically be found feeding in open country near a body of water. Response received from the MNRF indicates the potential for them to be present and records confirm their presence in the 2005 OBBA.

Bobolink (*Dolichonyx oryzivorus*)

Bobolink is designated as threatened under the ESA and the SARA. This species receives species and habitat protection on private, provincial and federal lands. In addition, individuals, nests, and eggs, are protected under the MBCA. There is suitable habitat present within the study area. Bobolink prefer large, open expansive grasslands (>10 ha) with dense ground cover as they build their nests on the ground. Response received from the MNRF indicates the potential for them to be present and records confirm their presence in the 2005 OBBA and the NHIC database. Bobolink was observed within the southern portion of the study area and documented in Muncaster (2007a and 2007b) and TSH (2006). The presence of Bobolink was also discussed within *West Transitway Connection: Terry Fox Drive to Fernbank Road Environmental Project Report* (Delcan 2012).

Eastern Meadowlark (*Sturnella magna*)

Eastern Meadowlark is designated threatened under the ESA and the SARA. This species receives protection on private, provincial and federal lands. In addition, individuals, nests, and eggs, are protected under the MBCA. There is suitable habitat present within the study area. Eastern Meadowlark prefers open grassy meadows at least ≥ 5 ha in size as well as farmland, pastures, and hayfields with elevated singing perches. The Eastern Meadowlark will also inhabit cultivated lands and weedy areas with trees, such as old orchards adjacent to open grassy areas. Response received from the MNRF indicates the potential for them to be present and records confirm their presence in the 2005 OBBA and the NHIC database. Eastern Meadowlark was observed within the southern portion of the study area and documented in Muncaster (2007a and 2007b) and TSH (2006). The presence of Eastern Meadowlark was also discussed within *West Transitway Connection: Terry Fox Drive to Fernbank Road Environmental Project Report* (Delcan 2012).

Little Brown Myotis (*Myotis lucifugus*)

Little Brown Myotis is designated as endangered under the ESA and the SARA. There is suitable habitat present within the study area. They prefer to roost in hollow trees or buildings, feeding primarily in wetlands and forest edges. Response received from the MNRF indicates the potential for them to be present.

Eastern Small-footed Myotis (*Myotis leibii*)

This bat species is designated as endangered under the ESA and SARA. There is suitable habitat present within the study area. They roost in a variety of habitats such as, rock outcrops, hollow trees and other structures. This species of bat change roosting locations daily (SARO 2018). Response received from the MNRF indicates the potential for them to be present.

Tri-colored Bat (*Perimyotis subflavus*)

This bat species is designated as endangered under the ESA and SARA. There is suitable habitat present within the study area. They typically inhabit forested areas where it forms day roosts and maternity colonies in mature forests. Occasionally it occupies barns or other structures. This species of bat is very rare with scattered distribution (SARO 2018). Response received from the MNRF indicates the potential for them to be present.

Northern Myotis (*Myotis septentrionalis*)

Northern Myotis is designated as endangered under the ESA and the SARA. There is suitable habitat present within the study area. They prefer to roost under loose bark in hollow trees. They will hunt within forests, particularly below the canopy. Response received from the MNRF indicates the potential for them to be present.

Species of Special Concern

The following are species that have potential to be present within the study area through field investigations and the presence of preferred habitat, as well as through consultation with the MNRF and search of available wildlife databases. The following species are designated as special concern under one or both the ESA and SARA. As species of special concern, there is no protection under these acts for the species listed, however, some receive protection under alternative Acts (e.g. MBCA and/or *Fish and Wildlife Conservation Act*). In addition, their presence may indicate significant wildlife habitat as discussed in **Section 4.2.2**. In the future, these species may be "up-listed" to threatened or endangered under the ESA and/or the SARA in which case they would be afforded protection. Therefore, SAR potential should be re-evaluated during the next phase of the project.

- Monarch
- West Virginia White
- River Redhorse
- Bridle Shiner
- Snapping Turtle

- Eastern Milksnake
- Common Nighthawk
- Red-headed Woodpecker
- Eastern Wood-pewee
- Wood Thrush
- Golden-winged Warbler
- Grasshopper Sparrow

4.2. FIELD INVESTIGATIONS

Results of field investigations are discussed below and include a summary of vegetation communities as well as wildlife and wildlife habitat occurrences.

4.2.1. VEGETATION COMMUNITIES

Sixteen natural vegetation communities occur within the Kanata LRT study area. Other constructed areas consisted of agricultural lands interspersed with residential dwellings, commercial, industrial, and institutional areas. Parklands, trails, and storm-water management ponds were also common adjacent to developed lands. The natural vegetation communities inventoried are discussed below in **Table 2** and displayed in **Figure 3-1 to 3-8, Appendix A**. ELC field forms (**Appendix D**) were created for each vegetation unit along with the corresponding plant list (**Table C1, Appendix C**).

No vegetation communities within the study area are provincially at risk or rare. A total of 71 vascular plant species were recorded and the majority of plants inventoried were common to widespread throughout Ontario. Twenty-eight of those species are considered exotic plants. However, four live butternuts (endangered) were observed within the Feedmill Creek riparian area (i.e. FOD7-3: Fresh-Moist Lowland Deciduous Forest) adjacent to the proposed preferred alignment (**Figure 3-4, Appendix A**).

Table 2. Ecological Land Classification (ELC) vegetation communities within the Kanata LRT study area

ELC Type	Community Description
Deciduous Forest (FOD)	
FOD4 Dry-Fresh Deciduous Forest Ecosite Inclusion: CUT1-1	This vegetation community was a young forest abundant with ironwood (*Ostrya virginiana*), basswood (*Tilia americana*) and white elm (*Ulmus americana*). European buckthorn (*Rhamnus cathartica*) and staghorn sumac (*Rhus typhina*) was occasional throughout the understorey. Where observed, the ground layer contained garlic mustard (*Alliaria petiolate*), dandelion (*Taraxacum officinale*), various grasses, and pussytoe species (*Antennaria* species). A small inclusion of a sumac cultural thicket was present adjacent to the Highway 417 right-of-way.
FOD5-6 Dry-Fresh Sugar Maple-Basswood Deciduous Forest Type	This vegetation community was dominant with basswood in the canopy and sub-canopy, followed by sugar maple (*Acer saccharum*) and rare occurrences of white pine (*Pinus strobus*). The understorey and ground layer was heavily dominated by red raspberry (*Rubus idaeus*) and common agrimony (*Agrimonia gryposepala*).
FOD7-3 Fresh-Moist Lowland Deciduous Forest Type Complex: MAM2-2	This community is primarily a riparian zone with the Feedmill Creek meandering throughout. A complex of reed-canary grass meadow marsh was adjacent to the creek, thereby transitioning to a lowland forest. The canopy and sub-canopy within the forest was dominated by willow species (*Salix* species), followed by white elm, Manitoba maple (*Acer negundo*) and ash species (*Fraxinus* species). European buckthorn, red-osier dogwood (*Cornus sericea*) and common reed (*Phragmites australis*) were abundant within the understorey layer. Whereas the ground layer was abundant with reed-canary grass (*Phalaris arundinacea*), wild carrot (*Daucus carota*), and goldenrod species (*Solidago* species). The community to the far west was dominate with willow species, however as the community headed east it slowly transitioned to a canopy dominated with Manitoba maple. Four butternuts (*Juglans cinerea*) occurred within the western portion of this vegetation community.
FOD9-3 Fresh-Moist Bur Oak Deciduous Forest Type	This vegetation community was mature in age with many large cavity trees present. The canopy was co-dominant with bur oak (*Quercus macrocarpa*), basswood, sugar maple, and white poplar (*Populus alba*). European buckthorn was dominant in the sub-canopy and understorey, followed by white elm, ash species, and riverbank grape (*Vitis riparia*). Common periwinkle (*Vinca minor*) was prevalent in the ground layer with an abundant amount of deadfall/logs of various sizes.
Mixed Forest (FOM)	
FOM1 Dry-Fresh Oak-Pine Mixed Forest Ecosite	Due to access restrictions, this vegetation community was assessed from the roadside. The canopy and sub-canopy composition was variable throughout but abundant with Eastern white pine (*Pinus strobus*), Eastern white cedar (*Thuja occidentalis*), red oak (*Quercus rubra*), poplar species (*Populus spp*), and ash species (*Fraxinus spp*). The understorey and ground layer were not visible.
FOM4 Dry-Fresh White Cedar Mixed Forest Ecosite	This vegetation community was mature in age and the canopy was co-dominant with Eastern white cedar, ash species, poplar species, and sugar maple. Other frequently occurring canopy and sub-canopy tree species included that of white elm, white birch (*Betula papyrifera*), and basswood (*Tilia americana*). Red raspberry (*Rubus idaeus*) and Christmas fern (*Polystichum acrostichoides*), to name a few, were both present within the understorey and ground layer.
Coniferous Forest (FOC)	
FOC2-2 Dry-Fresh White Cedar Coniferous Forest Type	The canopy within this vegetation community was dominant with eastern white cedar. No other vascular plants were observed due to access restrictions.
FOCM5 Naturalized Coniferous Hedge-row	This vegetation community occurred as narrow strips adjacent to Highway 417 and consisted of white spruce (*Picea glauca*) and Eastern white cedar.
Cultural Meadow (CUM)	
CUM1 Mineral Cultural Meadow Ecosite	This vegetation community was the most common throughout the study area. It occurred as a complex with other vegetation units or as its own unit depending on size of community. Due to recent development and urban intensification, these areas experienced recent disturbance with the occurrence of pioneer plant species. The ground layer was variable in species abundance and consisted of reed-canary grass, common reed, wild carrot, Canada thistle (*Cirsium arvense*), teasel (*Dipsacus fullonum*), and grass species to name to a few.
CUM1-1 Dry-Moist Old Field Meadow Type Inclusion: MAM2-2 and SWT2	This vegetation community contained regeneration species with rare occurrences of standing trees such as Manitoba maple. Reed-canary grass, goldenrod species, and wild carrot was abundant within the understorey. The ground layer consisted of various grass species, Canada thistle, and lesser occurrences of common milkweed (*Asclepias syriaca*).

ELC Type	Community Description
	The meadow community north of Hazeldean Road contained two inclusions of reed-canary meadow marsh as well as a mineral thicket swamp abundant with grey dogwood (*Cornus racemosa*), red-osier dogwood, and willow species.
Cultural Thicket (CUT)	
CUT1-1 Sumac Cultural Thicket Type	This vegetation community occurred intermittently throughout the study area and was present either as an inclusion to some communities or on its own dependent on size. Staghorn sumac was thereby the dominant species.
CUW1 Mineral Cultural Woodland Ecosite Inclusion: CUM1, CUT1, and MAS2-1	Three units of cultural woodland occurred throughout the study area and contained variable species ranging in dominance. Overall, the canopy consisted of bur oak, basswood, white elm, sugar maple, and Manitoba maple with rare occurrences of white pine, eastern white cedar (*Thuja occidentalis*), and spruce species (*Picea* species). The understorey in all three units contained an abundance of European buckthorn and staghorn sumac. While wild carrot, goldenrod species, reed-canary grass, and cow vetch (*Vicia cracca*) was prevalent throughout the ground layer. Due to recent disturbance of urban intensification, the vegetation community was part of a mosaic landscape and for the most part was surrounded by parklands, stormwater management ponds, and trails. As such, cultural meadow, thicket, and cattail marsh communities were complexed throughout.
Meadow Marsh (MAM)	
MAM2 Mineral Meadow Marsh Ecosite Inclusion: CUW1 Complex: CUM1	This vegetation community was highly disturbed as active construction was occurring adjacent to the east of property. Due to the development of a storm water pond, the community was mixed with cultural woodland and meadow. Rare occurrences of canopy trees were present and consisted of willow species, white pine, poplar species, and white elm. The sub-canopy had occasional occurrences of European buckthorn, grey dogwood, and staghorn sumac. The understorey and ground layer were abundant with reed-canary grass, common reed, narrow-leaved cattail (*Typha angustifolia*), purple loosestrife (*Lythrum salicaria*), and wild carrot.
MAM2-2 Reed-canary Grass Mineral Meadow Marsh Type	This vegetation community occurred intermittently throughout the study area and were either present as an inclusion to some communities or on its own dependent on size. Reed-canary grass was therefore dominant, followed by common reed, purple loosestrife, and wild carrot.
Shallow Marsh (MAS)	
MAS2-1 Cattail Mineral Shallow Marsh Type	This vegetation community occurred throughout the study area in small wet pockets or adjacent to open aquatic features. Narrow-leaved cattail (*Typha angustifolia*) and broad-leaved cattail (*Typha latifolia*) was most prevalent.
MAS2-2 Bulrush Mineral Shallow Marsh Type	This vegetation community contained an abundant amount of rush and bulrush species (*Juncus* and *Scirpus* species), followed by various grass species. Due to the seasonal timing of the survey, no standing water was observed.

4.2.2. WILDLIFE AND WILDLIFE HABITAT

The background data review identified SAR and SCC with potential to occur within the study area and are listed in **Section 3.1.3.** Incidental observations of wildlife were recorded during field investigations. Wildlife encountered included wildlife species common to urbanized areas, such as: Northern Harrier (*Circus hudsonius*), American Crow (*Corvus brachyrhynchos)*, Black-capped Chickadee (*Poecile atricapillus*), Canada Goose (*Branta canadensis*), Common Raven (*Corvus corax*), Dark-eyed Junco (*Junco hyemalis*), Great Blue Heron (*Ardea Herodias*), Mallard (*Anas platyrhynchos*), Rock Pigeon (*Columba livia*), White-breasted Nuthatch (*Sitta carolinensis*), Killdeer (*Charadrius vociferous*), Red-winged Blackbird (*Agelaius phoeniceus*), Song Sparrow (*Melospiza melodia*), and Porcupine (*Erethizon dorsatum*). Tracks and trails of White-tailed Deer (*Odocoileus virginianus)*, Rabbit (*Sylvilagus sp.*), Raccoon (*Procyon lotor*), and Coyote (*Canis latrans*) were also observed. One active Canada Goose nest was observed during the April 11th field visit within the shallow water feature, located on **Figure 3-2**.

The following sections discusses the results for wildlife and wildlife habitat that may have potential to interact with the study area which includes the assessment of candidate significant wildlife habitat.

4.2.2.1. Significant Wildlife Habitat

Seasonal Concentration Areas

Seasonal wildlife concentration areas contain relatively high densities of a species at specific periods in their life cycle and/or during a particular season. Seasonal concentration areas tend to be relatively small in relation to the area of habitat used at other times of the year and include: waterfowl/shorebird stopover and staging areas, raptor winter roosts, bat and reptile hibernacula/wintering areas, bat maternity colonies and stopover areas, bird nesting colonies, passerine/butterfly migration concentrations, and deer yards.

The following potential candidate habitat for Seasonal Concentration Areas was identified within the study area during field investigations:

- Waterfowl Stopover and Staging Areas (Terrestrial and Aquatic): Field investigations documented agricultural fields within the study area that may experience spring flooding/sheet water from mid-March to May. Marshes and watercourses also traverse throughout the study area. Both habitats provide foraging habitat for migrating waterfowl. The MNRF information request response also indicated a non-sensitive waterfowl staging area within the greater study area, beyond 120 m of the preferred alignment. However, the agency did not provide a location at this time. Based on field investigation results of suitable habitat, there is potential for this area to occur within 120 m of the preferred alignment.
- Raptor Wintering Area: Field investigations documented a combination of forest communities adjacent to meadow communities that are >20 ha in size. This candidate feature is present within the Natural Heritage System between Moodie Drive and March Road.
- Bat Maternity Colonies: Field investigations documented forested communities throughout the study area with potential to contain suitable cavity trees for roosting and maternal bats.
- Turtle Wintering: Open aquatic features with permanent water is present within the study area. There is potential for all watercourses to provide habitat for wintering individuals.
- Reptile Hibernacula: Field investigations documented numerous rock crevices and exposed bedrock with cracks throughout the study area. The Queensway Roadcut Earth ANSI also holds potential to house hibernating snakes as the area is composed of broken and fissured rock. Personal communication with Amy MacPherson (2018) identified a known snake hibernaculum near a City pathway connecting Canadian Shield Avenue to Gray Crescent (Figure 3-6). This area is beyond 120 m of the preferred alignment.
- Colonially-nesting Bird Breeding Habitat (Bank and Cliff) and (Ground for Brewer's Blackbird): Field investigations documented rock cut cliffs along Highway 417, eroding banks within Poole Creek as well as exposed soil banks within cultural meadow communities, habitats suitable for these species. Brewer's Blackbird is not known to occur in eastern Ontario and will no longer be considered in this report per direction from the City of Ottawa (personal communication with Amy MacPherson, City of Ottawa on October 23, 2018).
- Deer Yarding Areas: The MNRF information request response identified a non-sensitive Stratum 1 deer yarding area. However, the agency did not provide a location and has potential to occur within the study area,

Rare or Specialized Habitat

Rare habitats provide for vegetation communities that are considered rare in the province. Communities that are assigned an S-rank of S1 to S3 (extremely rare to rare-uncommon) as defined by the NHIC could qualify and include areas with slopes, sand, alvar, old growth, savannah, and prairie.

Specialized habitats are areas supporting wildlife species with very specific habitat requirements, areas with exceptionally high species or community diversity, or areas that provide habitat that greatly increases a species' likelihood of survival. Such areas include: nesting habitat for waterfowl, raptors, area-sensitive birds, and turtles. Amphibian breeding habitat and the presence of seeps/spring has also been addressed.

The following potential candidate Seasonal Concentration Areas were identified within the study area during field investigations:

- Waterfowl Nesting Area: Field investigations documented upland habitats adjacent to wetland habitats throughout the study area which may provide for suitable nesting.
- Woodland Raptor Nesting Area: Field investigations documented forested communities that are >30 ha in size with an interior habitat of >10 ha. This candidate feature is present within the Natural Heritage System between Moodie Drive and March Road.
- Turtle Nesting Area: Field investigations documented areas of exposed soil adjacent to watercourses and wetland habitat. Suitable turtle nesting areas were also present in the form of road shoulders where loose sand and/or exposed gravel occur.
- Amphibian Breeding Habitat: Stormwater management ponds, wetlands and temporary pools of water within forested communities are present within the study area and may provide habitat for breeding amphibians.
- Woodland Area-sensitive Breeding Bird Habitat: An interior mature forest that is >30 ha is present within the study area and may provide habitat for woodland breeding birds.

Habitat for Species of Conservation Concern

This category includes species that are considered provincially rare (S1-S3, SH) or are listed as Special Concern due to substantial population declines in Ontario. It does not include habitats of Endangered or Threatened species identified under the ESA (2007). It does however include nesting habitat for marsh, open country, and shrub birds.

Special concern and rare wildlife species that have been reported from this area by either MNRF, NHIC, or OBBA and for which suitable habitat is present within the study area for: Snapping Turtle, Common Nighthawk, Red-headed Woodpecker, Eastern Wood-pewee, Wood Thrush, Golden-winged Warbler, and Grasshopper Sparrow.

Animal Movement Corridors

Animal movement corridors are defined as habitats that essentially link two or more wildlife habitats and enable wildlife to safely move from one habitat to another as a response to seasonal habitat requirements, which differ from species to species (MNR 2000). This category includes amphibian and deer movement corridors.

Although MNRF response did not indicate animal movement corridors, there is opportunity for wildlife movement of white-tailed deer throughout the study area as a non-sensitive Stratum 1 deer yarding area was identified. Also, other transient species such as Blanding's Turtle have potential to move between areas of natural and agricultural lands north and south of Highway 417 where the CNR rail line crosses Corkstown Road under Highway 417. A potential corridor may occur connecting Shirley's Bay to the north and Stony Swamp to the south.

All candidate features require a significance evaluation to determine if confirmed SWH is present within the study area. Once functional design and preferred alignment has been finalized for Kanata LRT, candidate SWH can be further refined at that time.

4.3. AQUATIC ENVIRONMENT

4.3.1. SURFACE WATER

Five watercourse features and associated drains were identified within the Kanata LRT study area. The study area falls within the jurisdiction of the MVCA and RVCA including features in the Carp River subwatershed (i.e., Poole Creek, Feedmill Creek, unnamed tributaries), Watts Creek subwatershed, and the Stillwater Creek subwatershed. (**Figure 1, Appendix A).**

4.3.1.1. Carp River System

The Carp River watershed occurs entirely within the City of Ottawa, its 42 km length drains 306 km^2 (Niblett 2016). The Carp River flows north through the study area and eventually enters the Ottawa River in Fitzroy Harbour, Ontario. As early as 15 years ago the Carp River was considered "degraded" and classified as a warm-water system (Robinson Consultants Inc. 2004). The City of Ottawa undertook the Carp River, Poole Creek and Feedmill Creek Restoration which involves "change to the channel as well as the following design elements: increased sinuosity; reduction in channel cross-section;

creation of ponds and deltas; "nested" channels; varied substrate; riparian vegetation planting" (City of Ottawa 2018). Carp River restoration south of Highway 417 commenced in March 2013 and restoration work north of Highway 417 is expected to be completed in 2018.

The alignment crosses the Carp River and four of its tributaries (i.e., Feedmill Creek, Poole Creek, two unnamed tributaries) at the west end of the study area and in the area of the on-going restoration works.

Feedmill Creek

This tributary to the Carp River is classified as a cool-water system, however water temperatures in Feedmill Creek may support cold water fish species (City of Ottawa 2016). Twelve fish species are known to occur in this cool-water watercourse. Cool-water systems are a relative rarity in the City of Ottawa and typically more sensitive to disturbance (City of Ottawa 2012).

Poole Creek

The upper reaches of Poole Creek (e.g., upstream of Hazeldean Road) are classified as a cool-water system, while the lower reaches near the confluence with the Carp River are warm-water. Twenty-one fish species are known to occur in this system. This creek has been identified as significant due to its cool-water designation which is rare in the City of Ottawa and such systems are most sensitive to disturbance (City of Ottawa 2011, City of Ottawa 2012).

The upper reaches of Poole Creek are cold-water habitats known to support cold-water species such as Brown Trout and Mottled Sculpin. Brown Trout has been stocked upstream of Sweetham Drive approximately 1.5km upstream of the study area. They were not stocked elsewhere due to thermal restrictions for that species (MVCA 2009). For this reason, this species is unlikely to occur within the study area.

This creek has been identified as significant due to its cool-water designation which is rare in the City of Ottawa and such systems are most sensitive to disturbance (City of Ottawa 2011, City of Ottawa 2012). Personal communication with Amy MacPherson (2018) identified a recent capture of American Eel in Poole Creek.

Unnamed Tributaries to the Carp River

The alignment crosses an unnamed tributary of the Carp River at Hazeldean Road and another unnamed tributary of the Carp River at the southern edge of the Canadian Tire Centre on Huntmar Drive.

4.3.1.2. Watts Creek System

The Watts Creek watershed contains two main watercourses – Watts Creek and the Kizell Drain. The upper reaches of Watts Creek flow through highly urbanized areas south of Highway 417 before crossing the highway and entering NCC and Department of National Defense (DND) lands, eventually outletting to the Ottawa River at Shirley's Bay. Watts Creek is classified as a cool-water system known to contain 20 fish species including historical records of Bridle Shiner (*Notropis bifrenatus*), a special concern species (Dilllon Consulting Limited 1999). Bridle Shiner are not known to occur north of the Rideau River at Highway 416 (personal communication with Amy MacPherson, Planner, City of Ottawa), suggesting this observation may be an error or the range of Bridle Shiner was historically larger. Northern pike (*Esox lucius*) juveniles have also been observed within Watts Creek, suggesting that areas suitable for spawning may be nearby (MVCA 2014).

Electrofishing surveys were completed along approximately 2 km of Watts Creek on NCC lands from just north of the highway to the CN rail line north of the highway. Three sites were sampled, and the results suggest that species diversity and total numbers of fish are greater downstream of the study area compared to a site within 200 m of the study area (Stamplecoskie and Cooke 2011).

4.3.1.3. Stillwater Creek System

Stillwater Creek originates in Stony Swamp (a PSW) and is classified as a cool-water system containing cool-warm water features downstream of the study area. The creek passes through NCC agricultural lands, conservation lands, and a residential area north of Highway 417 before outflowing into the Ottawa River at Britannia Bay. The area between Corkstown Road and Moodie Drive is within the study area and contains some of the lowest temperatures and may be indicative of ground water inputs. This creek has historically supported 41 fish species (RVCA 2015).

The three permanent tributaries of Stillwater Creek join the mainstem north of Highway 417 (Canadian Environmental Assessment Agency 2018).

4.3.2. FISH AND FISH HABITAT

The study area contains Carp River, Poole Creek, Feedmill Creek, Stillwater Creek, and Watts Creeks which collectively contain a diverse mix of warm and cool water generalist species that are moderately to highly tolerant of degraded habitats (Table 3, TSH 2006, Muncaster 2007a and 2007b, Stamplecoskie and Cooke 2011).

Table 3. Fish species occurrences within the Kanata LRT study area.

Common Name (*Scientific Name*)	Carp River[1]	Poole Creek[2, 6, 7]	Feedmill Creek[2]	Stillwater Creek[3]	Watts Creek[4]	MNRF[5]
Banded killifish (*Fundulus diaphanous*)	X			X	X	X
Blackchin shiner (*Notropis heterodon*)				X	X	
Black crappie (*Pomoxis nigromaculatus*)				X		
Blacknose shiner (*Notropis heterolepis*)	X	X	X	X		X
Blacknose dace (*Rhinichthys atratulus*)	X	X	X			X
Bluegill (*Lepomis macrochirus*)				X		
Bluntnose minnow (*Pimephales notatus*)	X	X	X	X		X
Brassy minnow (*Hybognathus hankinsoni*)	X	X	X	X		
Bridle Shiner (*Notropis bifrenatus*)		d				X
Brook stickleback (*Culaea inconstans*)	X	X	X	X	X	X
Brown bullhead (*Ameiurus nebulosus*)	X			X		X
Brown Trout (*Salmo trutta*)		X				
Burbot (*Lota lota*)				X		
Carps and Minnows (Cyprinidae)				X		X
Central mudminnow (*Umbra limi*)	X	X	X	X	X	X
Common carp (*Cyprinus carpio*)				X		X
Common shiner (*Luxilus cornutus*)	X	X	X	X	X	
Creek chub (*Semotilus atromaculatus*)	X	X	X	X	X	X
Cottus species				X		
Emerald shiner (*Notropis atherinoides*)	X			X		X
Etheostoma species				X		
Fathead minnow (*Pimephales promelas*)	X	X	X	X		
Finescale dace (*Chrosomus neogaeus*)	X	X		X		
Golden shiner (*Notemigonus crysoleucas*)	X	X	X	X		
Iowa darter (*Etheostoma olmstedi*)	X	X	X			
Largemouth bass (*Micropterus salmoides*)				X		
Lepomis species				X		
Logperch (*Percina caprodes*)			X	X		
Longnose dace (*Rhinichthys cataractae*)				X	X	
Mimic shiner (*Notrpos volucellus*)				X		
Minnow hybrid				X		
Mottled sculpin (*Cottus bairdi*)		X	X	X		
Muskellunge (*Esox masquinongy*)				X		
Northern Hog Sucker (*Hypentelium nigricans*)						X

Common Name (*Scientific Name*)	Carp River[1]	Poole Creek[2, 6, 7]	Feedmill Creek[2]	Stillwater Creek[3]	Watts Creek[4]	MNRF[5]
Northern redbelly dace (*Chrosomus eos*)	X	X	X	X		
Northern pike (*Esox lucius*)		X		X	X	X
Pearl dace (*Margariscus margarita*)	X		X	X		
Pumpkinseed (*Lepomis gibbosus*)	X	X	X	X	X	X
Rock bass (*Ambloplites rupestris*)	X	X	X	X		X
Rhinichthys species				X		
Smallmouth bass (*Micropterus dolomieu*)						X
Silver redhorse (*Moxostoma anisurum*)						X
Spotfin shiner (*Cyprinella spiloptera*)				X		
Spottail shiner (*Notropis hudsonius*)				X		
Tessellated darter (*Etheostoma olmstedi*)	X	X	X			
Yellow bullhead (*Ictalurus natalis*)				X		
Yellow perch (*Perca flavescens*)				X	X	X
Walleye (*Stizostedin vitreum*)			X			X
White sucker (*Catastomus commersonii*)	x	X	X	X	X	X

Table sources: [1](TSH 2006), [2](Muncaster 2007a and 2007b), [3](RVCA 2015), [4](Stamplecoskie and Cooke 2011), [5][MNRF (Information Request) 2017], [6]Pers. comm. MacPherson 2018), [7]((MVCA 2009).

An MNRF response to an information request identified non-sensitive spawning habitat within the study area for the following species:

- Brown Bullhead (*Ictalurus nebulosus*)
- Common Carp (*Cyprinus carpio*)
- Northern Pike (*Esox lucius*)
- Pumpkinseed (*Lepomis gibbosus*)
- Silver Redhorse (*Moxostoma anisurum*)
- Smallmouth Bass (*Micropterus dolomieu*)
- Walleye (*Sander vitreus*)

The MNRF also identified non-sensitive fish nursery habitat within the study area for the following species:

- Banded Killifish (*Fundulus diaphanus*)
- Blacknose Shiner (*Notropis heterolepis*)
- Bluntnose Minnow (*Pimephales notatus*)
- Brook Stickleback (*Culaea inconstans*)
- Carps and Minnows (Cyprinidae)
- Central Mudminnow (*Umbra limi*)
- Creek Chub (Semotilus atromaculatus)
- Eastern Blacknose Dace (*Rhinichthys atratulus*)
- Emerald Shiner (*Notropis atherinoides*)
- Northern Hog Sucker (*Hypentelium nigricans*)
- Pumpkinseed (*Lepomis gibbosus*)
- Rock Bass (*Ambloplites rupestris*)
- Sunfishes (*Centrarchidae*)
- White Sucker (*Catostomus commersonni*)
- Yellow Perch (*Perca flavescens*)

The MNRF responses are based on an extensive study area identified during the preliminary stages of this project.

4.3.3. GROUNDWATER FEATURES

Investigations to document groundwater features were not undertaken as part of this study, however groundwater input indicators were observed on Stillwater Creek north of Highway 417 and east of Moodie Drive (RVCA 2015). The cool waters of Watts Creek may be related to groundwater inputs (MVCA 2014).

A description of subsurface water and hydrogeological conditions was developed by Golder Associates Corporation ("Golder") through desktop review and applying local knowledge gained from past studies (Golder Associates 2018). Assumptions were made by Golder Associates where existing information was limited. Groundwater information, whether known or assumed, is summarized below (Golder Associates 2018).

- Groundwater level is approximately 1-2 m below the level of Corkstown Road in the vicinity of the at-grade CN rail crossing
- Groundwater conditions near the Watts Creek crossing at March Road suggest the near surface groundwater is at or near grade, while artesian groundwater is indicated within glacial till deposits below 30 m depth
- Groundwater conditions at Kanata Town Station are approximately 3-4 m below the existing ground surface and become shallower west of the Kanata Town Station (approximately 1-2 m)
- Groundwater level at Kanata Avenue, north of Highway 417, is at the underlaying bedrock surface (1-2 m below grade)
- Groundwater north of Highway 417 from Kanata Avenue to Terry Fox Drive (and Terry Fox Station) is approximately 2-4 metres below existing ground surface
- Groundwater north of the Feedmill Creek crossing in the vicinity of Huntmar Drive is assumed to be close to grade.

5. IDENTIFIED CONSTRAINTS

This report documents the natural environment existing conditions within and adjacent to the Kanata LRT project study area. Based on the findings of this existing conditions report, the following natural heritage features should be considered when evaluating impacts of a preferred design and in the development of mitigation measures to be considered before, during, and after construction. To guide future evaluations of a final design/alignment, natural environmental constraints have been identified and are listed below:

- Two significant woodlands have been identified within the study area. One is located within the Natural Heritage System between Moodie Drive and March Road and the other within the NCC Greenbelt and Stony Swamp, south of Highway 417. Impact to these areas should be minimized to the extent possible.
- Two significant valleylands have been identified within the study area and are located within the Feedmill Creek and Poole Creek Natural Heritage System. Further consultation with MVCA is recommended to discuss potential permitting that may be required should encroachment be required at both sites. If changes to Poole or Feedmill valleylands are proposed, the City of Ottawa's Natural Systems Unit should be consulted.
- Four individual Butternut trees (endangered) were confirmed present within the study area and located within the deciduous forest, north of Highway 417 (**Figure 3-4, Appendix A**). Permits and/or approvals may need to be obtained to avoid contravention of the ESA (and SARA if on federal lands). If the proposed work will impact Butternut trees, completion of Butternut Health Assessments and consultation with the MNRF during the next phases of the project will be required.
- Twelve threatened and/or endangered species under the ESA and/or SARA have the potential to occur within the study area. For some of these species, such as Butternut, bats, Bobolink, and Eastern Meadowlark, additional targeted surveys may be required to determine presence/absence within the study area. If the proposed work will impact these species, permitting/approval/authorization through relevant agencies (e.g. MOECC, MNRF, NCC) may be required. Preventative measures and best practices should be employed to mitigate potential impacts of the project on these species.
- Additionally, 12 species listed as special concern under the ESA and/or SARA have the potential to occur within the study area. These species should be considered when identifying preventative measures and best practices to be employed to mitigate potential impacts of the project.
- Waterways within the study area are known to contain common and diverse fish communities which may be impacted by construction activities. If the proposed work will impact fish or fish habitat, a DFO Self-Assessment should be completed, with appropriate mitigation measures, to determine whether further consultation with DFO will be required.
- Candidate significant wildlife habitat is currently present within the study area. Depending on the finalized alignment of the Kanata LRT Extension and timing of design, candidate features that are within 120 m from proposed works may need further site investigations to evaluate the significance of wildlife habitat. Further consultation with MNRF during subsequent phases of the project is recommended to determine further site assessments.
- One potential wildlife movement corridor has been identified where the CNR rail line passes through Corkstown Road under Highway 417. During construction and operation of the Kanata LRT, wildlife habitat connectivity should be maintained or enhanced using best practices at this location and throughout the project footprint.

6. CLOSURE

This report has been produced considering known natural environment existing conditions and regulatory requirements at the time this report was completed. Natural heritage features within the study area consist of various fragmented forests, cultural meadows and thickets, as well as wetland communities of meadow and shallow marsh. All vegetation communities have been influenced by urban intensification and occur as a landscape mosaic throughout.

One SAR was observed and includes that of four individual Butternut trees (ranked as endangered provincially and federally). No other SAR, provincially rare species, or rare vegetation communities were observed. Five watercourses transect the study area and include: Stillwater Creek, Watts Creek, Carp River, Feedmill Creek, and Poole Creek, which support diverse fish communities.

An impact assessment should be undertaken upon completion of the final design. The impact assessment should evaluate potential impacts of the project on the environment and recommend mitigation measures/best practices to and/or eliminate potential impacts. Consultation with relevant agencies (i.e. MECP, MNRF, NCC, RVCA, and MVCA) will be required. In the case that considerable time passes (i.e. 10 years) before construction or final design occurs, the Kanata LRT Extension study area should be reassessed to determine if there are any changes to the natural heritage features and/or potential impacts identified above.

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APPENDIX A: Figures

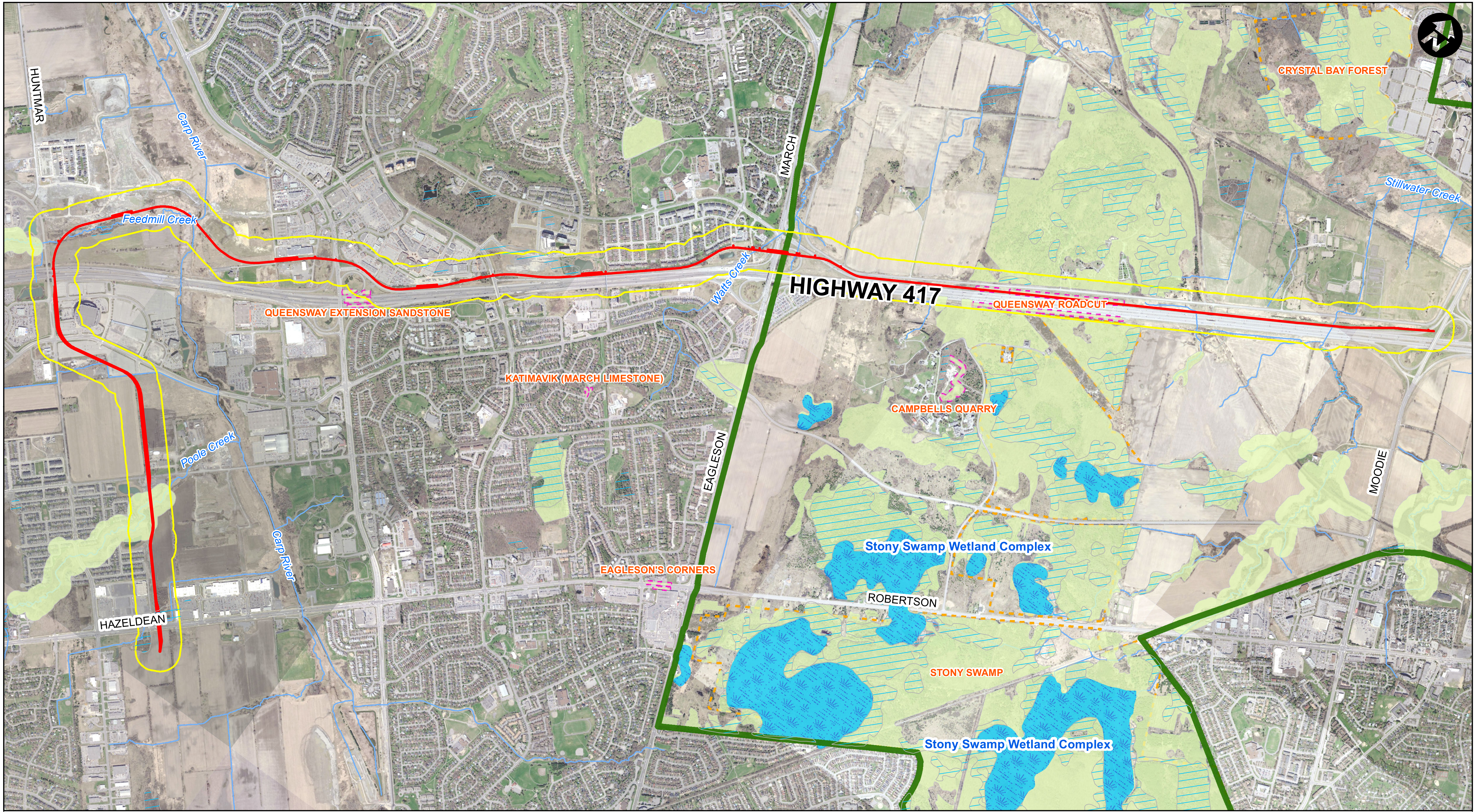
Legend

- Stations
- LRT Alignment
- 120m Alignment Buffer
- Watercourse

DRAFT

0 0.5 1 2 Kilometers

Figure 1
Kanata Light Rail Transit (Moodie Drive to Palladium Drive) – Study Area



Legend

120m Alignment Buffer
Greenbelt
Watercourse

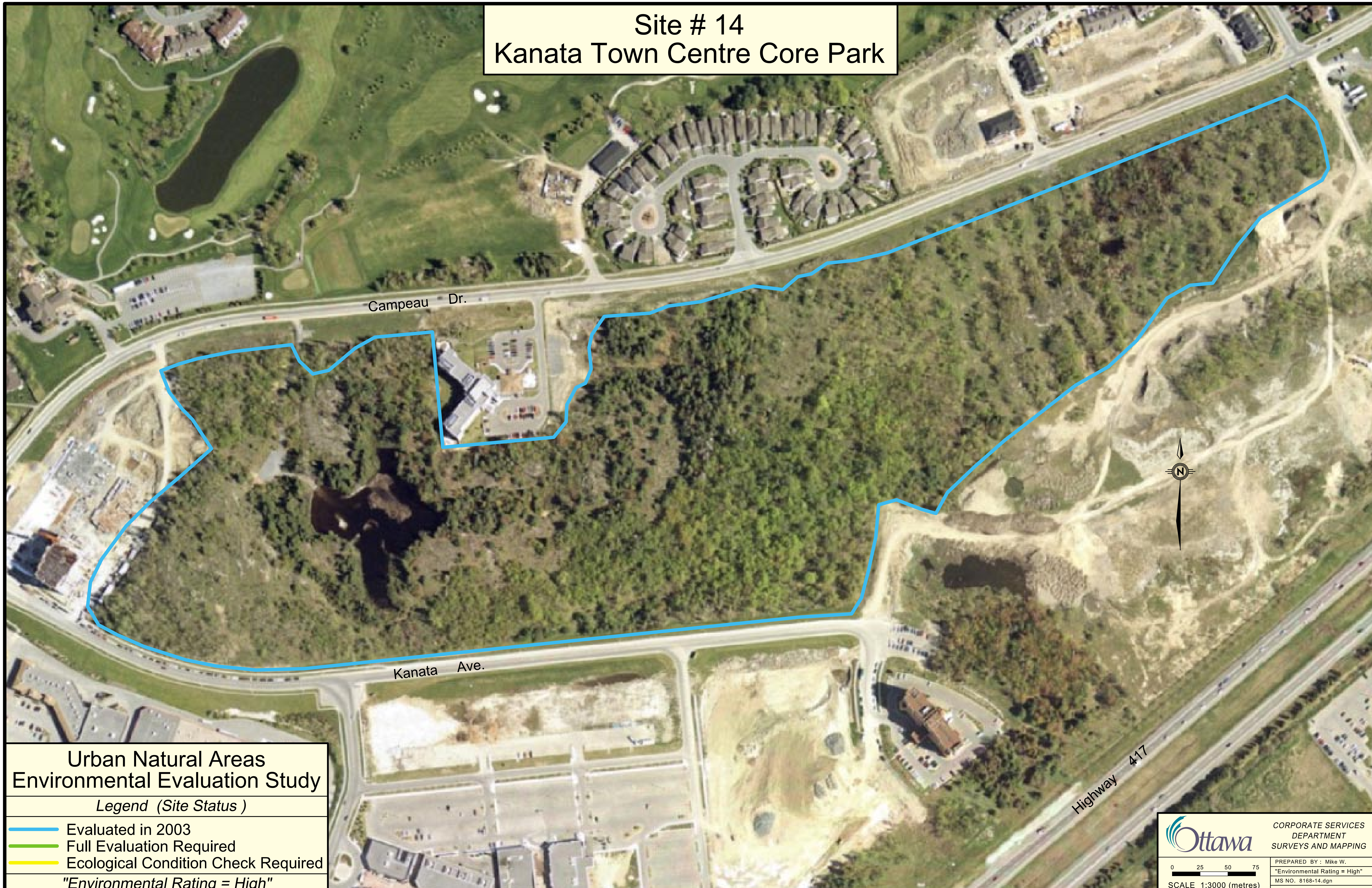
Areas of Natural and Scientific Interest (ANSI)

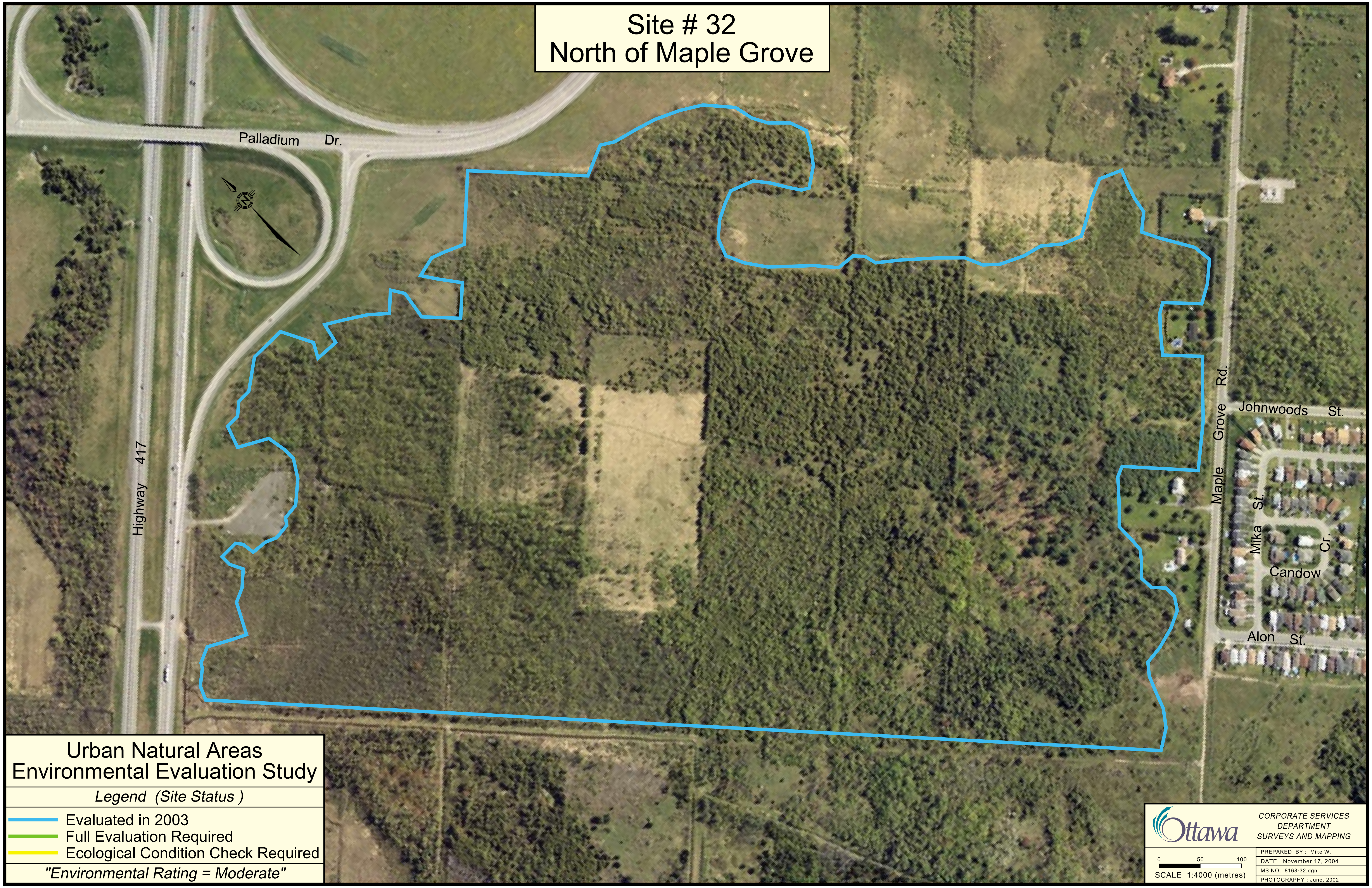
ANSI
Candidate ANSI

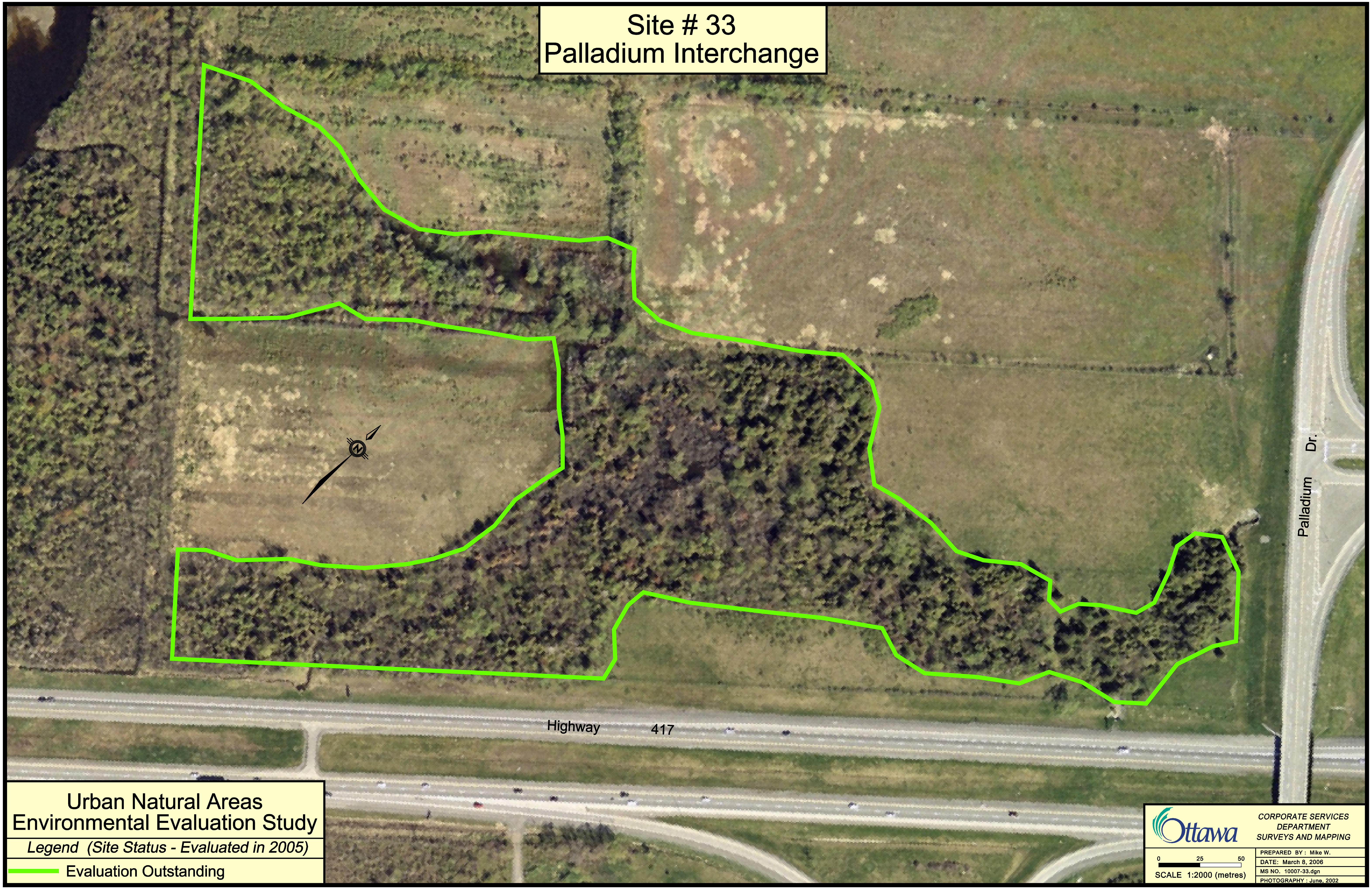
Provincially Significant Wetland
Unevaluated Wetlands
Natural Heritage System

Figure 2-1: Natural Features Records Review
Kanata LRT (Moodie Drive to Hazeldean Road)
Planning and Environmental Assessment Study

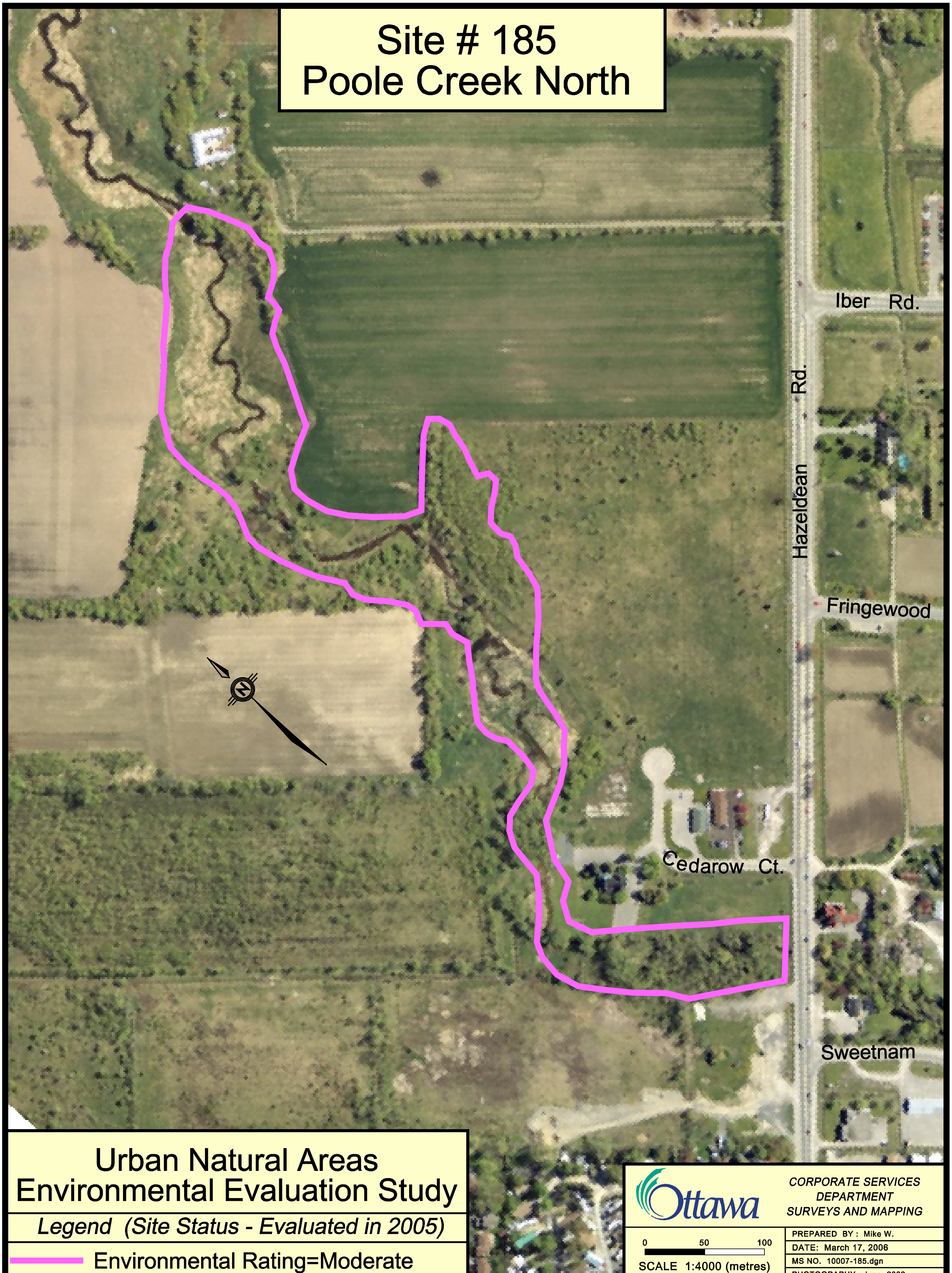
0 0.5 1 2 Kilometers


Site # 14
Kanata Town Centre Core Park
Campeau Dr.
Kanata Ave.
Highway 417
N
Urban Natural Areas Environmental Evaluation Study
Legend (Site Status)
Evaluated in 2003
Full Evaluation Required
Ecological Condition Check Required
"Environmental Rating = High"
Ottawa
CORPORATE SERVICES DEPARTMENT
SURVEYS AND MAPPING
0 25 50 75
SCALE 1:3000 (metres)
PREPARED BY : Mike W.
"Environmental Rating = High"
MS NO. 8168-14.dgn
PHOTOGRAPHY : June, 2002


Site # 32
North of Maple Grove
Palladium Dr.
Highway 417
Maple Grove Rd.
Johnwoods St.
Mika St.
Candow Cr.
Alon St.
Urban Natural Areas
Environmental Evaluation Study
Legend (Site Status)
Evaluated in 2003
Full Evaluation Required
Ecological Condition Check Required
"Environmental Rating = Moderate"
Ottawa
CORPORATE SERVICES
DEPARTMENT
SURVEYS AND MAPPING
0 50 100
SCALE 1:4000 (metres)
PREPARED BY : Mike W.
DATE: November 17, 2004
MS NO. 8168-32.dgn
PHOTOGRAPHY : June, 2002



Site # 33
Palladium Interchange
Palladium Dr.
Highway 417
Urban Natural Areas
Environmental Evaluation Study
Legend (Site Status - Evaluated in 2005)
Evaluation Outstanding
Ottawa
CORPORATE SERVICES DEPARTMENT SURVEYS AND MAPPING
0 25 50
SCALE 1:2000 (metres)
PREPARED BY : Mike W.
DATE: March 8, 2006
MS NO. 10007-33.dgn
PHOTOGRAPHY : June, 2002


Site # 185
Poole Creek North
Iber Rd.
Hazeldean Rd.
Fringewood
Cedarow Ct.
Sweetnam
Urban Natural Areas
Environmental Evaluation Study
Legend (Site Status - Evaluated in 2005)
Environmental Rating=Moderate
Ottawa
CORPORATE SERVICES
DEPARTMENT
SURVEYS AND MAPPING
0
50
100
SCALE 1:4000 (metres)
PREPARED BY : Mike W.
DATE: March 17, 2006
MS NO. 10007-185.dgn
PHOTOGRAPHY : June, 2002

PARSONS

0 250 500 750 1,000

Meters

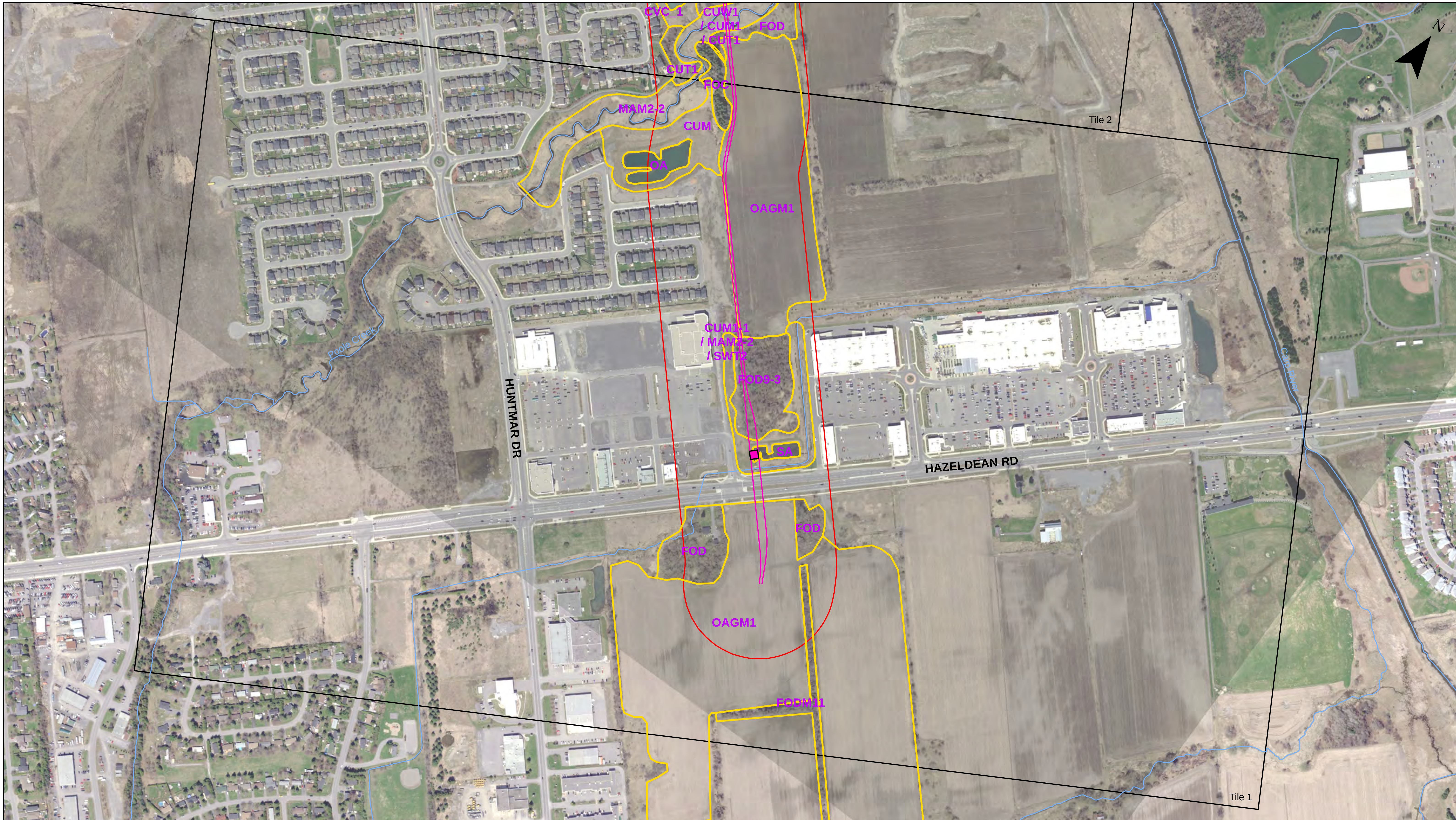
Legend

- ELC Polygon
- Study Area
- Tile Boundary
- Animal Den
- Butternut Tree
- Deer Trail
- Potential Snake Hibernacula
- Potential Turtle Wintering/Nesting
- Stations
- LRT Alignment
- Light Maintenance and Storage Facility
- Watercourse

Ottawa

Kanata LRT (Moodie Drive to Hazeldean Road) Planning and Environmental Assessment Study

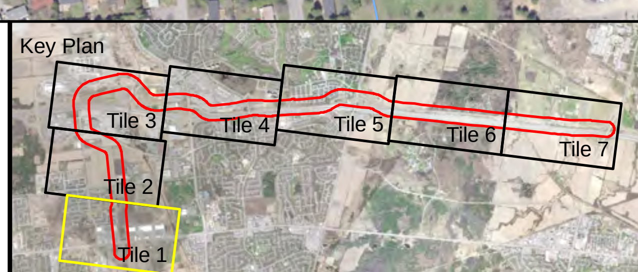
Figure 3-1: Ecological Land Classification Overview



PARSONS

0 40 80 160 240

Meters



Legend

- ELC Polygon
- Study Area
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- Butternut Tree
- Deer Trail
- Potential Snake Hibernacula
- Potential Turtle Wintering/Nesting
- Stations
- LRT Alignment
- Light Maintenance and Storage Facility
- Watercourse

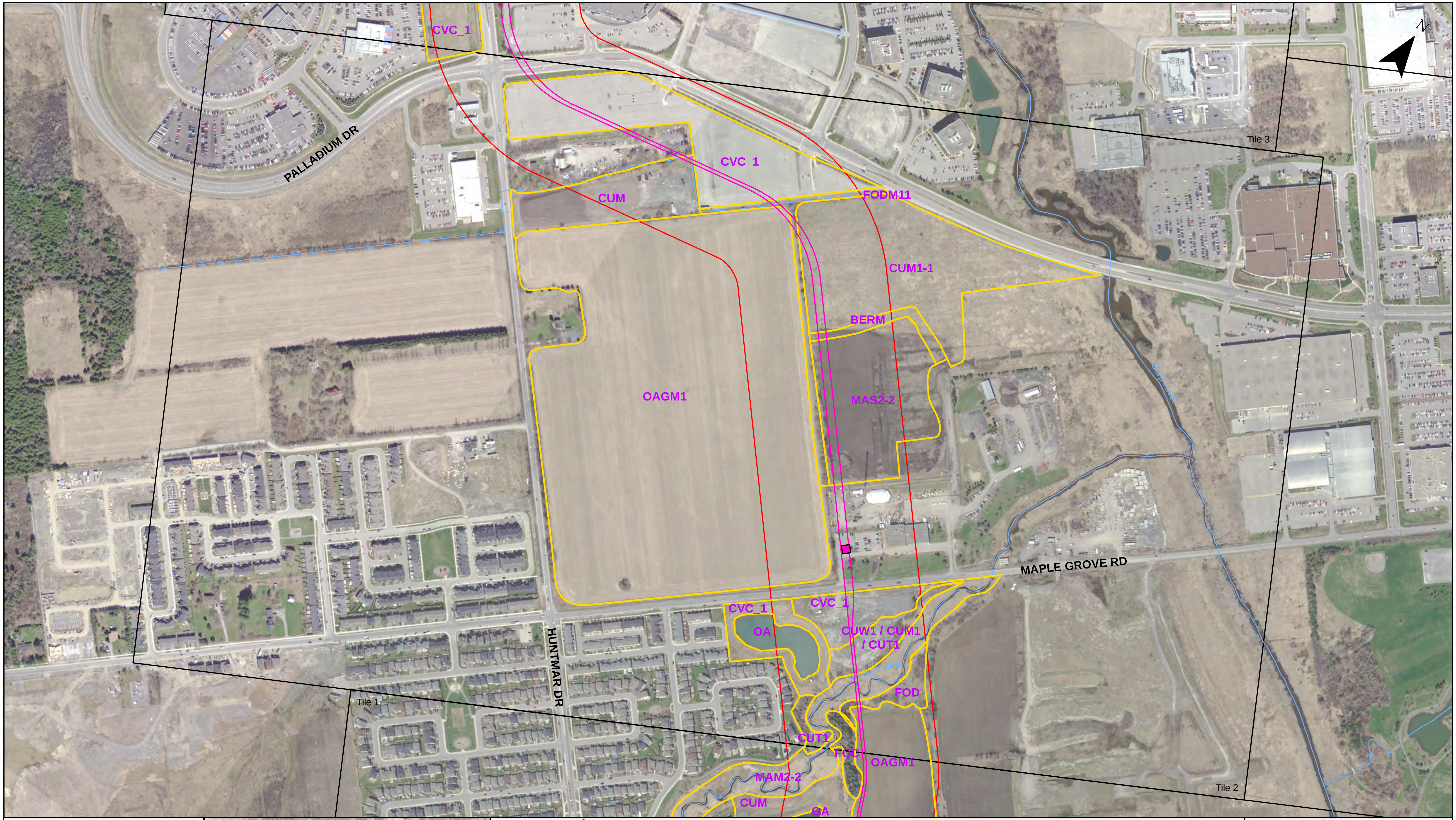
ELC Codes/Names

FOC: Coniferous Forest
FOC2-2: Dry-Fresh White Cedar Coniferous Forest Type
FOCM5: Naturalized Coniferous Hedge-row Ecosite
FOM: Mixed Forest
FOM1: Dry-Fresh Oak-Pine Mixed Forest Ecosite
FOM4: Dry-Fresh White Cedar Mixed Forest Ecosite
FOD: Deciduous Forest
FOD4: Dry-Fresh Upland Deciduous Forest Ecosite
FOD5-6: Dry-Fresh Sugar Maple-Basswood Deciduous Forest Type
FOD7-2: Fresh-Moist Ash Lowland Deciduous Forest Type
FOD7-3: Fresh-Moist Willow Lowland Deciduous Forest Type
FOD9-3: Fresh-Moist Bur Oak Deciduous Forest Type
FODM11: Naturalized Deciduous Hedge-row Ecosite
OAGM1: Annual Row Crops
OAGM4: Open Pasture
TAGM1: Coniferous Plantation
SWT2: Mineral Thicket Swamp Ecosite
MAM: Meadow Marsh
MAM2: Mineral Meadow Marsh Ecosite
MAM2-2: Reed-Canary Grass Mineral Meadow Marsh Type
MAS2-1: Cattail Mineral Shallow Marsh Type
MAS2-2: Bulrush Mineral Shallow Marsh Type
OA: Open Aquatic
SA: Shallow Water
CUM: Cultural Meadow
CUM1: Mineral Cultural Meadow Ecosite
CUM1-1: Dry-Moist Old Field Meadow Type
CUT1: Mineral Cultural Thicket Ecosite
CUT1-1: Sumac Cultural Thicket Type
CUW: Cultural Woodland
CUW1: Mineral Cultural Woodland Ecosite
CGL: Green Lands
CVC_1: Business Sector

Ottawa

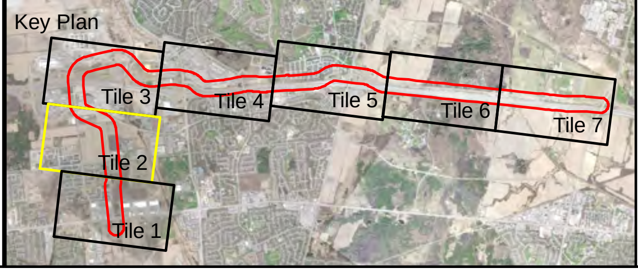
Kanata LRT (Moodie Drive
to Hazeldean Road)
Planning and Environmental
Assessment Study

Figure 3-2: Ecological Land Classification



PARSONS

0 40 80 160 240
Meters



Legend

- ELC Polygon
- Study Area
- Tile Boundary
- Animal Den
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MAM2: Mineral Meadow Marsh Ecosite
MAM2-2: Reed-Canary Grass Mineral Meadow Marsh Type
MAS2-1: Cattail Mineral Shallow Marsh Type
MAS2-2: Bulrush Mineral Shallow Marsh Type
OA: Open Aquatic
SA: Shallow Water
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CUT1: Mineral Cultural Thicket Ecosite
CUT1-1: Sumac Cultural Thicket Type
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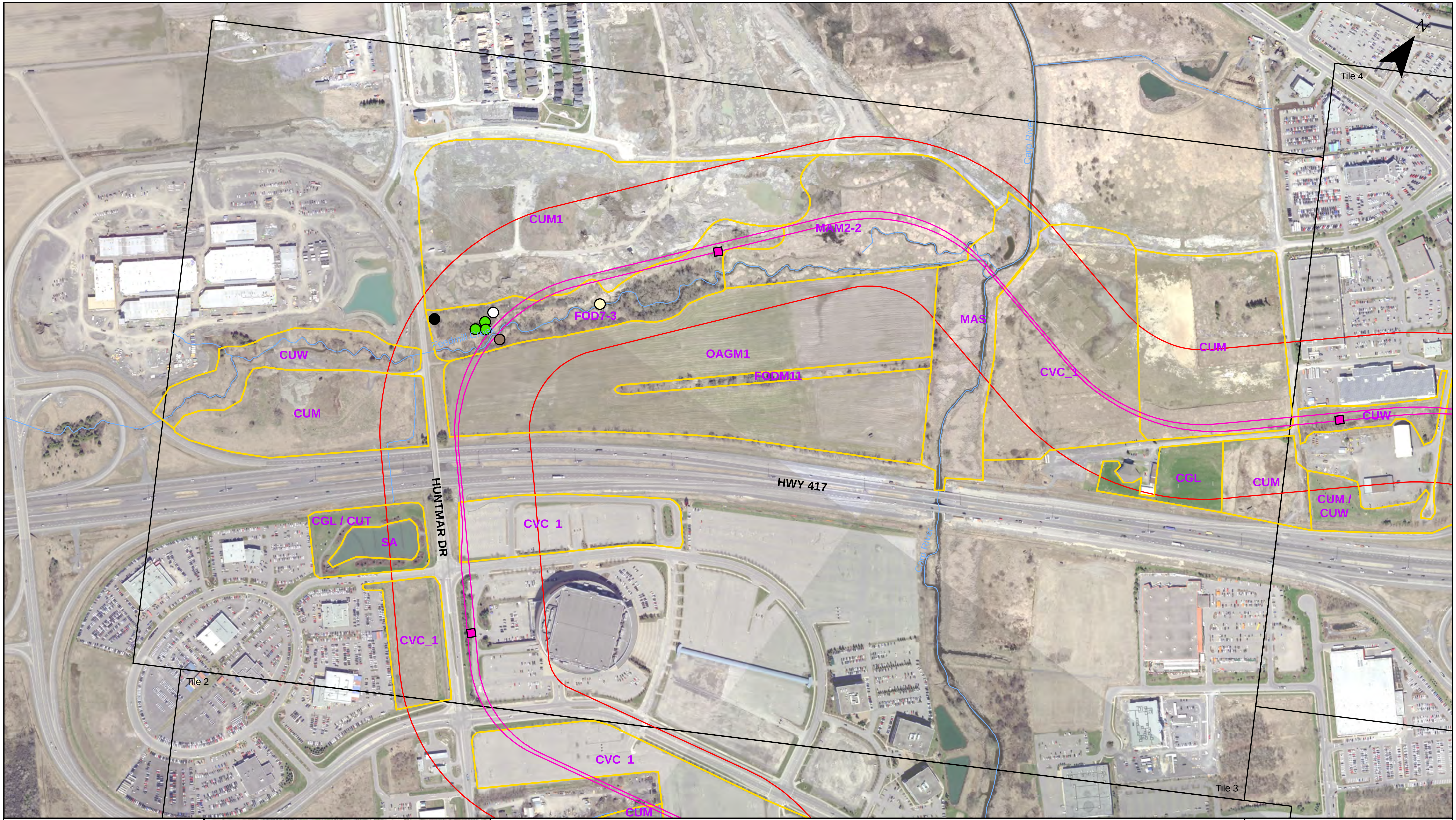
CVC_1: Business Sector

Ottawa

Kanata LRT (Moodie Drive to Hazeldean Road) Planning and Environmental Assessment Study

Figure 3-3: Ecological Land Classification

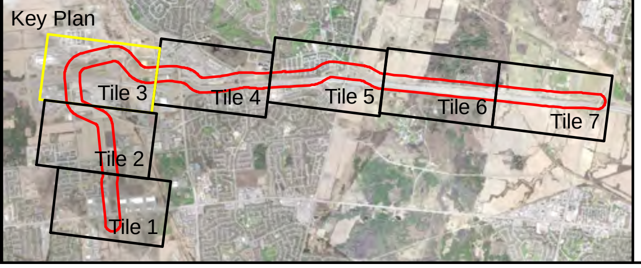


PARSONS

0 40 80 160 240

Meters

Key Plan



Legend

- ELC Polygon
- Study Area
- Tile Boundary
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MAM2: Mineral Meadow Marsh Ecosite
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MAS2-2: Bulrush Mineral Shallow Marsh Type
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CUM1: Mineral Cultural Meadow Ecosite
CUM1-1: Dry-Moist Old Field Meadow Type
CUT1: Mineral Cultural Thicket Ecosite
CUT1-1: Sumac Cultural Thicket Type
CUW: Cultural Woodland
CUW1: Mineral Cultural Woodland Ecosite
CGL: Green Lands
CVC_1: Business Sector

Ottawa

Kanata LRT (Moodie Drive to Hazeldean Road) Planning and Environmental Assessment Study

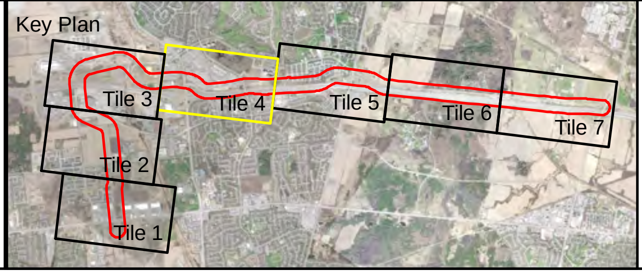
Figure 3-4: Ecological Land Classification

PARSONS

0 40 80 160 240

Meters

Key Plan



Legend

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OAGM4: Open Pasture
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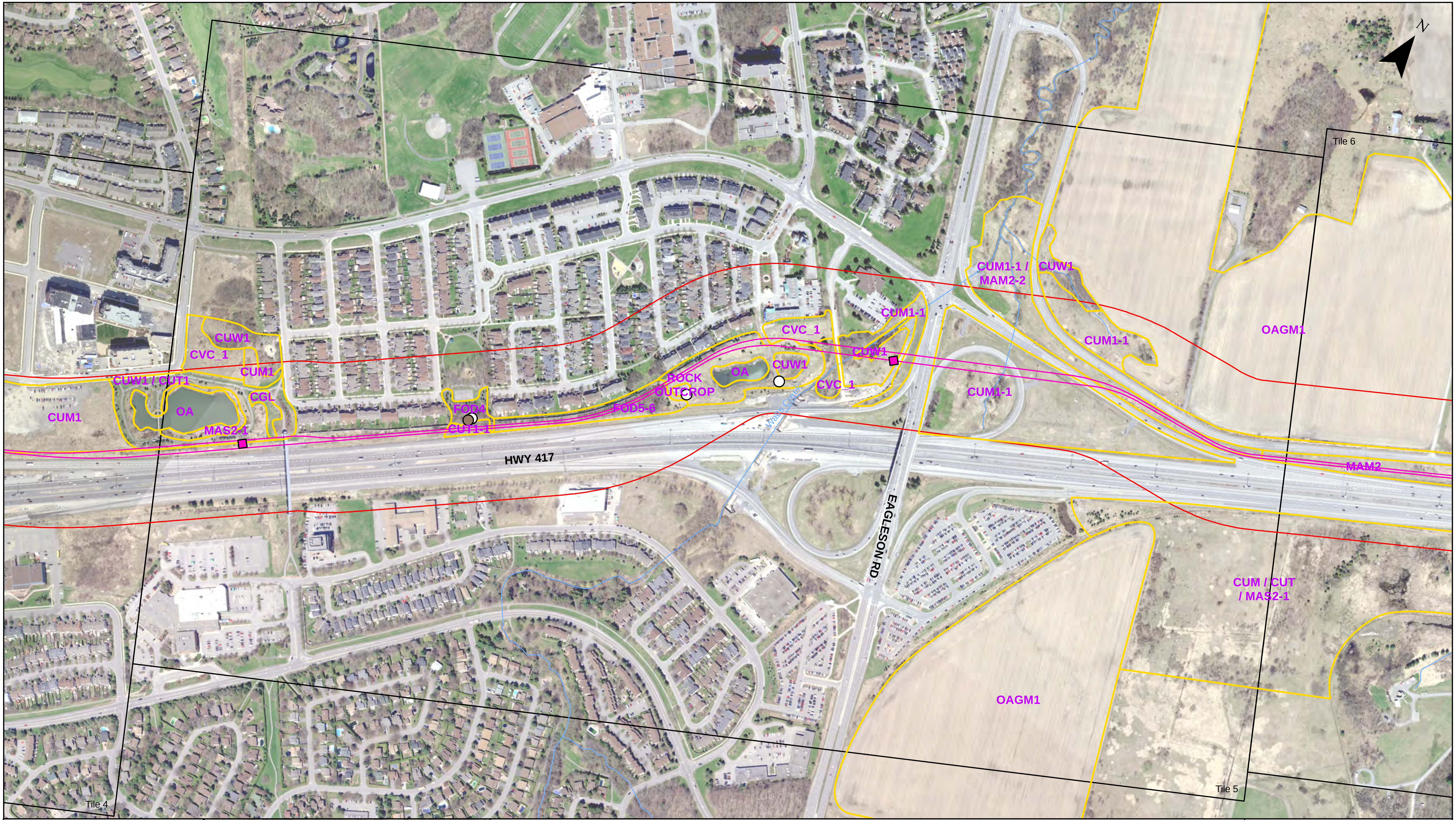
MAM2: Mineral Meadow Marsh Ecosite
MAM2-2: Reed-Canary Grass Mineral Meadow Marsh Type
MAS2-1: Cattail Mineral Shallow Marsh Type
MAS2-2: Bulrush Mineral Shallow Marsh Type
OA: Open Aquatic
SA: Shallow Water
CUM: Cultural Meadow
CUM1: Mineral Cultural Meadow Ecosite
CUM1-1: Dry-Moist Old Field Meadow Type
CUT1: Mineral Cultural Thicket Ecosite
CUT1-1: Sumac Cultural Thicket Type
CUW: Cultural Woodland
CUW1: Mineral Cultural Woodland Ecosite
CGL: Green Lands
CVC_1: Business Sector

Ottawa

Kanata LRT (Moodie Drive to Hazeldean Road) Planning and Environmental Assessment Study

Figure 3-5: Ecological Land Classification



PARSONS

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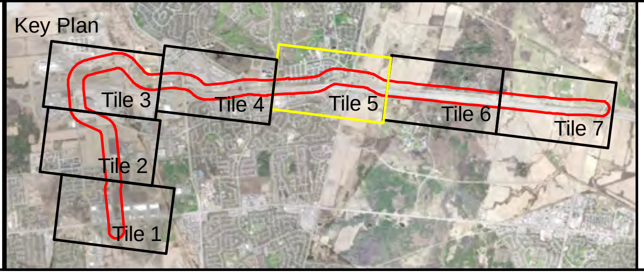
Meters

Key Plan



Legend

- ELC Polygon
- Study Area
- Tile Boundary
- Animal Den
- Butternut Tree
- Deer Trail
- Potential Snake Hibernacula
- Potential Turtle Wintering/Nesting
- Stations
- LRT Alignment
- Light Maintenance and Storage Facility
- Watercourse

ELC Codes/Names

FOC: Coniferous Forest
FOC2-2: Dry-Fresh White Cedar Coniferous Forest Type
FOCM5: Naturalized Coniferous Hedge-row Ecosite
FOM: Mixed Forest
FOM1: Dry-Fresh Oak-Pine Mixed Forest Ecosite
FOM4: Dry-Fresh White Cedar Mixed Forest Ecosite
FOD: Deciduous Forest
FOD4: Dry-Fresh Upland Deciduous Forest Ecosite
FOD5-6: Dry-Fresh Sugar Maple-Basswood Deciduous Forest Type
FOD7-2: Fresh-Moist Ash Lowland Deciduous Forest Type
FOD7-3: Fresh-Moist Willow Lowland Deciduous Forest Type
FOD9-3: Fresh-Moist Bur Oak Deciduous Forest Type
FODM11: Naturalized Deciduous Hedge-row Ecosite
OAGM1: Annual Row Crops
OAGM4: Open Pasture
TAGM1: Coniferous Plantation
SWT2: Mineral Thicket Swamp Ecosite
MAM: Meadow Marsh
MAM2: Mineral Meadow Marsh Ecosite
MAM2-2: Reed-Canary Grass Mineral Meadow Marsh Type
MAS2-1: Cattail Mineral Shallow Marsh Type
MAS2-2: Bulrush Mineral Shallow Marsh Type
OA: Open Aquatic
SA: Shallow Water
CUM: Cultural Meadow
CUM1: Mineral Cultural Meadow Ecosite
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CUT1-1: Sumac Cultural Thicket Type
CUW: Cultural Woodland
CUW1: Mineral Cultural Woodland Ecosite
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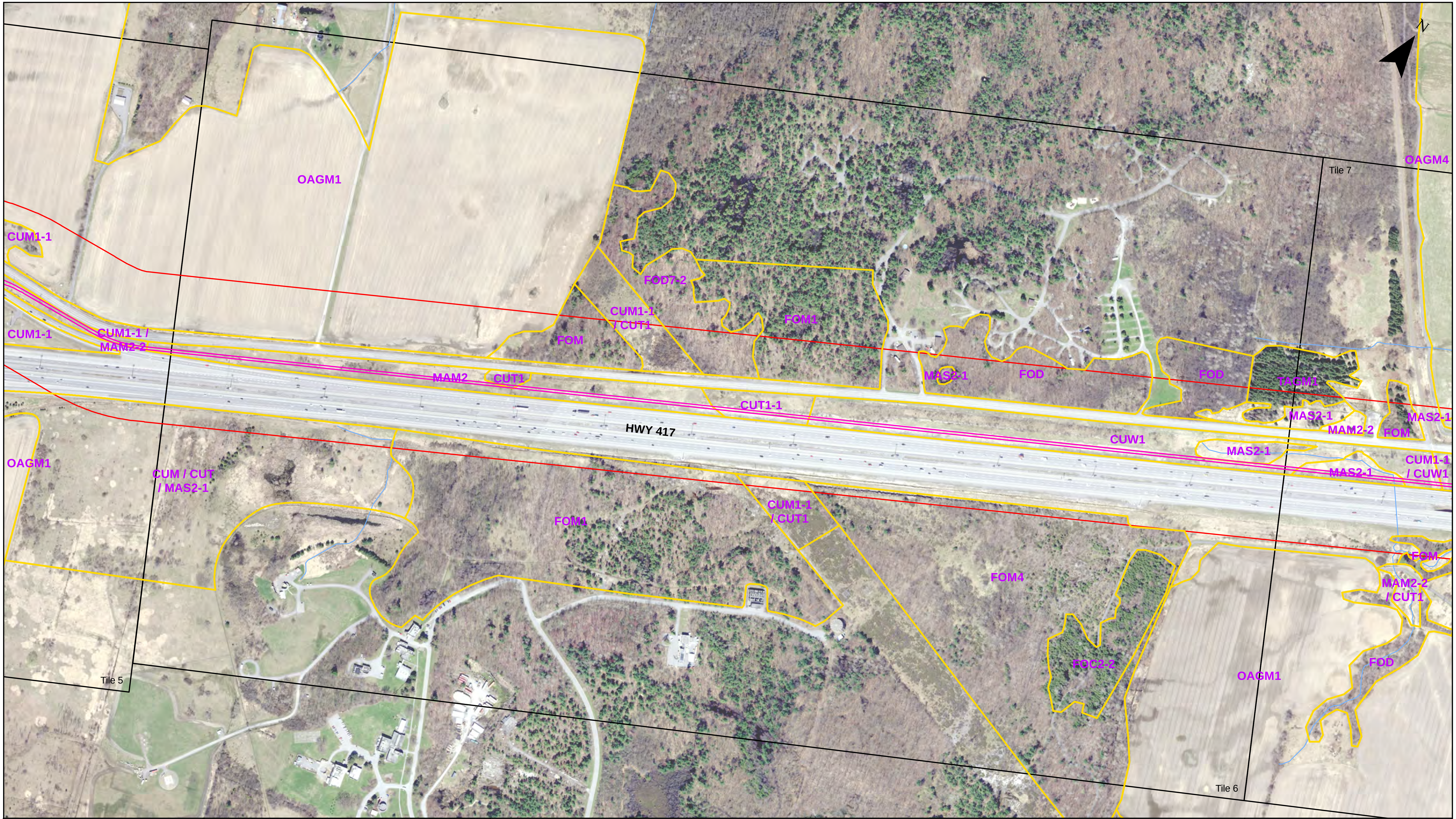
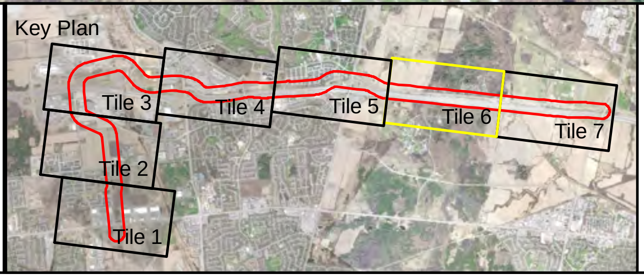
CVC_1: Business Sector

Ottawa

Kanata LRT (Moodie Drive to Hazeldean Road) Planning and Environmental Assessment Study

Figure 3-6: Ecological Land Classification





PARSONS

0 40 80 160 240

Meters

Legend

- ELC Polygon
- Study Area
- Tile Boundary
- Animal Den
- Butternut Tree
- Deer Trail
- Potential Snake Hibernacula
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OAGM4: Open Pasture
TAGM1: Coniferous Plantation
SWT2: Mineral Thicket Swamp Ecosite
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MAM2: Mineral Meadow Marsh Ecosite
MAM2-2: Reed-Canary Grass Mineral Meadow Marsh Type
MAS2-1: Cattail Mineral Shallow Marsh Type
MAS2-2: Bulrush Mineral Shallow Marsh Type
OA: Open Aquatic
SA: Shallow Water
CUM: Cultural Meadow
CUM1: Mineral Cultural Meadow Ecosite
CUM1-1: Dry-Moist Old Field Meadow Type
CUT1: Mineral Cultural Thicket Ecosite
CUT1-1: Sumac Cultural Thicket Type
CUW: Cultural Woodland
CUW1: Mineral Cultural Woodland Ecosite
CGL: Green Lands
CVC_1: Business Sector

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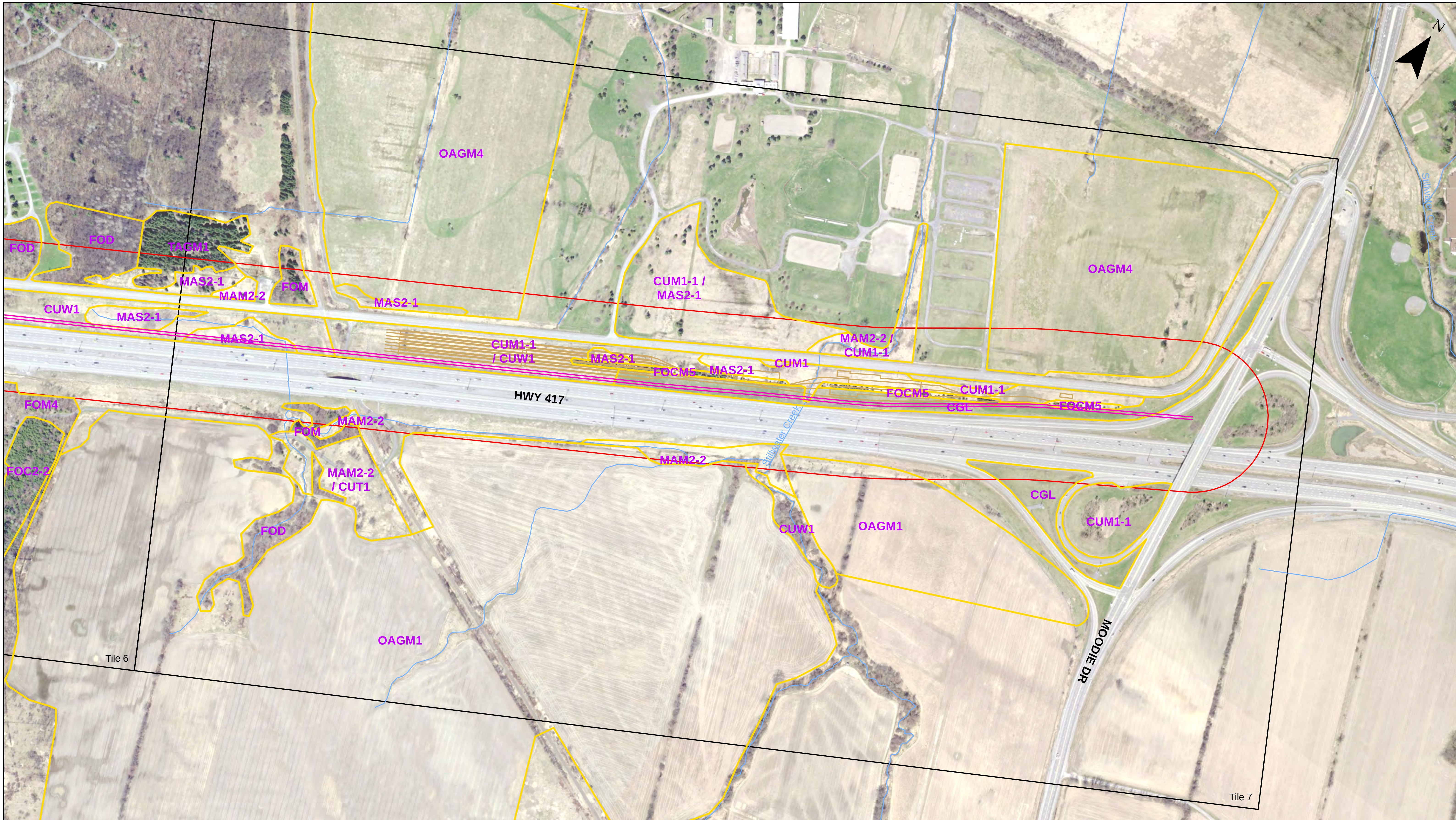
Kanata LRT (Moodie Drive to Hazeldean Road) Planning and Environmental Assessment Study

Figure 3-7: Ecological Land Classification



PARSONS

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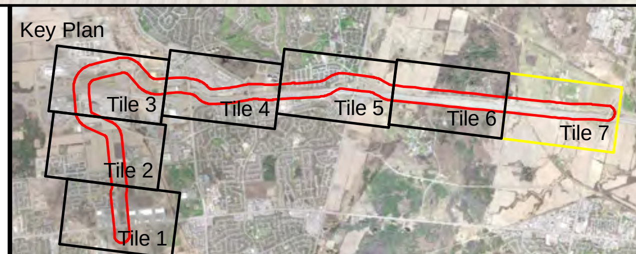
Meters

Key Plan



Legend

- ELC Polygon
- Study Area
- Tile Boundary
- Animal Den
- Butternut Tree
- Deer Trail
- Potential Snake Hibernacula
- Potential Turtle Wintering/Nesting
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FOD9-3: Fresh-Moist Bur Oak Deciduous Forest Type
FODM11: Naturalized Deciduous Hedge-row Ecosite
OAGM1: Annual Row Crops
OAGM4: Open Pasture
TAGM1: Coniferous Plantation
SWT2: Mineral Thicket Swamp Ecosite
MAM: Meadow Marsh
MAM2: Mineral Meadow Marsh Ecosite
MAM2-2: Reed-Canary Grass Mineral Meadow Marsh Type
MAS2-1: Cattail Mineral Shallow Marsh Type
MAS2-2: Bulrush Mineral Shallow Marsh Type
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Ottawa

Kanata LRT (Moodie Drive to Hazeldean Road) Planning and Environmental Assessment Study

Figure 3-8: Ecological Land Classification

APPENDIX B: Agency Correspondence

Ministry of Natural Resources

Ontario

Natural. Valued. Protected.

Email to MNR

Natural Areas and Features Information Request Form

Contact Information Clear Contact

Name: Brandon Jarivs

Address: 1223 Micheal Street Ottawa ON K2B 5S5

Phone Number: (613) 691-1551 ☐ **Owner** ☐ **Consultant**

E-mail Address: brandon.jarvis@parsons.com

****All red fields are manditory***

This includes X & Y Coordinates.

Please see page 2 for assistance.

Site Information **Project Name:** City of Ottawa Kanata LRT EA Study Clear Site

Township: West Carleton, Nepean, N **Lot:** ______ **Concession:** ______

X: 353309.7180 **Y:** 5020303.000 **Address:** Ottawa West, HWY 417 Corridor

*****If more than 1 site, please provide all individual coordinates in an attached spreadsheet***

Type of Proposal Clear Details

☐ **Severance / Zoning** ☐ **Drains / Roads / Culverts**

☐ **Hydroline clearing** ☐ **Small Scale Projects (less than 5 hectares)**

☐ **RE Projects** ☐ **Large Scale Projects (5 hectares or greater)**

☐ **Aggregate Project** ☐ **Other:** Light Rail Transit Environmental As

Attachments ******Please attach a Site Map showing the area of interest***

☐ **Picture** ☑ **Map(s)** ☐ **Engineered Drawings** ☐ **Other:** ______

Request

I would like to request the following information for the property identified above:

Natural Heritage Features such as ANSIs, wetland, woodlots, known and potential occurrences and habitat for Species at Risk / terrestrial / aquatic communities.

To better respond to your request please briefly outline the purpose for which this information is required (e.g. proposed development, lot severance, etc. or attach details):

The City of Ottawa has initiated a Planning and Environmental Assessment (EA) study to develop a Recommended Plan to extend Light Rail Transit (LRT) from Moodie Drive to Kanata. The Planning and EA Study will define a corridor for the future expansion of the City's LRT

Date of works proposed: ____ / ______ / ______

Personal information contained in this form is collected in order to fulfill your request, respond to your inquiries and for other administration purposes. With regard to the personal information it collects, the ministry is bound by privacy protection rules under the Freedom of Information and Protection of Privacy Act and takes all necessary steps to safeguard personal information collected.

Please Note: This request MUST be made by the property owner or by someone acting on their behalf. Depending on the nature of the request, it may take 6-8 weeks to respond to your inquiry. If the request does not include the manditory information, it may delay response time.

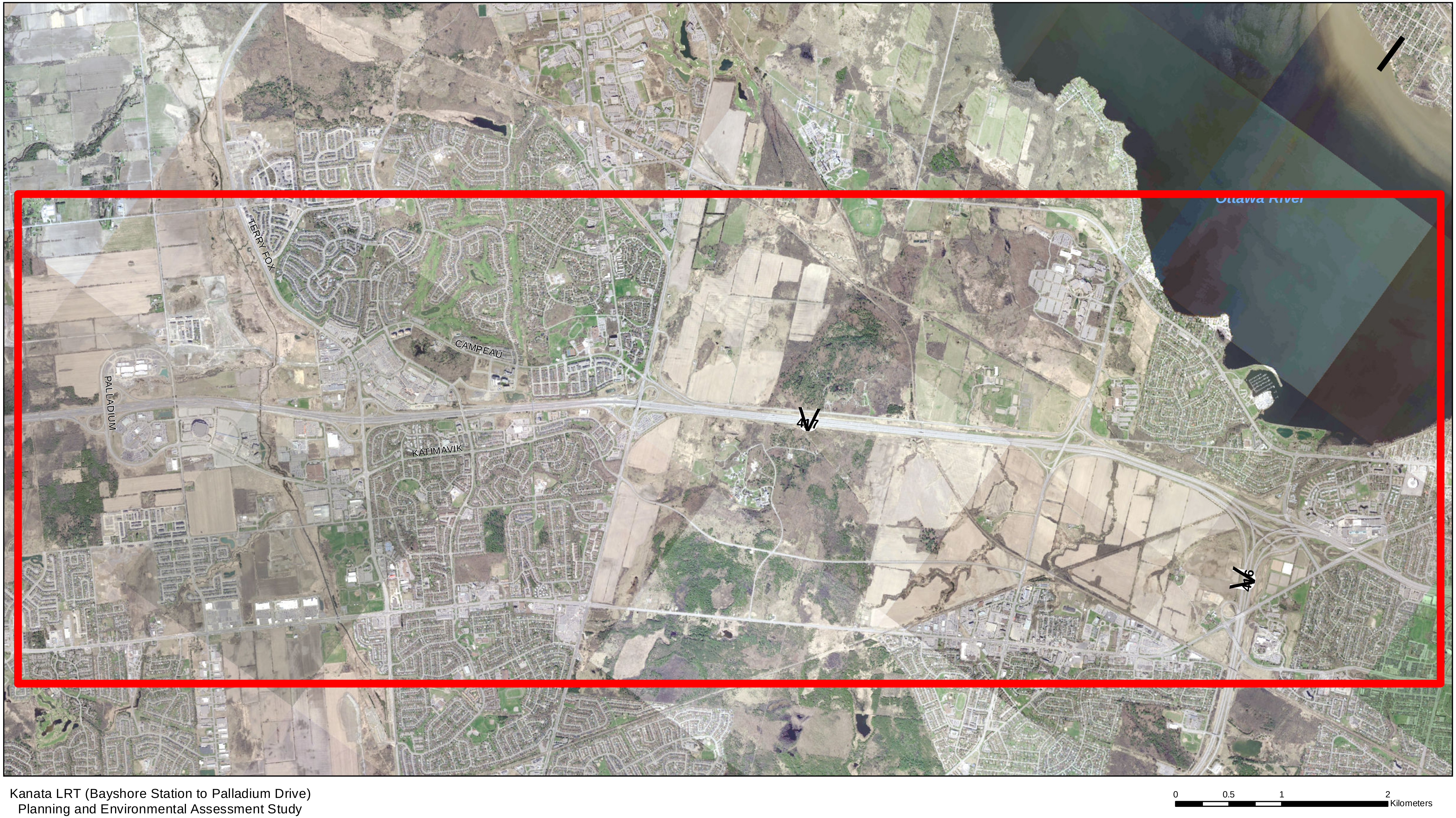
☑ ***I have read the above and agree to all Terms and Conditions***

Please forward the completed form to:

Kemptville.Inforequest@Ontario.ca OR **Fax: 613-258-3920**

Attention: Information Requests
10 Campus Drive, Postal Bag 2002
Kemptville, ON K0G 1J0

MNR File Number: ______



Kanata LRT (Bayshore Station to Palladium Drive)
Planning and Environmental Assessment Study

MNRF Information Request

Ministry of Natural Resources and Forestry

Kemptville District

10 Campus Drive
Postal Box 2002
Kemptville ON K0G 1J0
Tel.: 613 258-8204
Fax: 613 258-3920

Ministère des Richesses naturelles et des Forêts

District de Kemptville

10, promenade Campus
Case postale, 2002
Kemptville ON K0G 1J0
Tél.: 613 258-8204
Téléc.: 613 258-3920

Ontario

Wed. Aug 2, 2017

Brandon Jarvis
Parsons
1223 Michael Street, Suite 100
Ottawa, Ontario
K1J 7T2
(613) 738-4160 ext 5251
brandon.jarvis@parsons.com

Attention: Brandon Jarvis

Subject: Information Request - Developments
Project Name: City of Ottawa Kanata LRT EA Study
Site Address: Future Kanata LRT Route, Bayshore Station to Palladium Drive
Our File No. 2017_NEP-4147

Natural Heritage Values

The Ministry of Natural Resources and Forestry (MNRF) Kemptville District has carried out a preliminary review of the above mentioned area in order to identify any potential natural resource and natural heritage values.

The following Natural Heritage values were identified for the general subject area:

- ANSI, Earth Science, Campbells Quarry (Provincial)
- ANSI, Earth Science, Eagleson'S Corners (Provincial)
- ANSI, Earth Science, Katimavik (March Limestone) (Provincial)
- ANSI, Earth Science, Queensway Extension Sandstone (Provincial)
- ANSI, Earth Science, Queensway Roadcut (Provincial)
- ANSI, Life Science, Shirleys Bay (Provincial)
- Candidate ANSI, Life Science, Crystal Bay Forest (Regional)
- Candidate ANSI, Life Science, Ottawa Beach Wetland (Provincial)
- Candidate ANSI, Life Science, South March Highlands (Provincial)
- Candidate ANSI, Life Science, Stony Swamp (Provincial)
- Evaluated Wetland, Fernbank Wetland (Evaluated-Other)
- Evaluated Wetland, Goulbourn Wetland Complex (Evaluated-Provincial)
- Evaluated Wetland, Kizel Drain Wetland Complex (Evaluated-Provincial)
- Evaluated Wetland, Shirley's Bay (Evaluated-Provincial)
- Evaluated Wetland, South March Highlands Wetland Complex (Evaluated-Provincial)
- Evaluated Wetland, Stillwater Creek (Evaluated-Other)
- Evaluated Wetland, Stittsville Wetland Complex (Evaluated-Other)

- Evaluated Wetland, Stony Swamp Wetland Complex (Evaluated-Provincial)
- Fish Nursery, Banded Killifish Nursery Area (Non-Sensitive)
- Fish Nursery, Blacknose Shiner Nursery Area (Non-Sensitive)
- Fish Nursery, Bluntnose Minnow Nursery Area (Non-Sensitive)
- Fish Nursery, Brook Stickleback Nursery Area (Non-Sensitive)
- Fish Nursery, Carps and Minnows Nursery Area (Non-Sensitive)
- Fish Nursery, Central Mudminnow Nursery Area (Non-Sensitive)
- Fish Nursery, Creek Chub Nursery Area (Non-Sensitive)
- Fish Nursery, Eastern Blacknose Dace Nursery Area (Non-Sensitive)
- Fish Nursery, Emerald Shiner Nursery Area (Non-Sensitive)
- Fish Nursery, Northern Hog Sucker Nursery Area (Non-Sensitive)
- Fish Nursery, Pumpkinseed Nursery Area (Non-Sensitive)
- Fish Nursery, Rock Bass Nursery Area (Non-Sensitive)
- Fish Nursery, Sunfishes Nursery Area (Non-Sensitive)
- Fish Nursery, Unidentifiable Nursery Area (Non-Sensitive)
- Fish Nursery, White Sucker Nursery Area (Non-Sensitive)
- Fish Nursery, Yellow Perch Nursery Area (Non-Sensitive)
- Lake (Non-Sensitive)
- Lake, Lac Deschênes (Non-Sensitive)
- Municipal Drain, Carp River Municipal Drain (Non-Sensitive)
- Municipal Drain, Faulkner (Hewitt Br) Drain (Non-Sensitive)
- Municipal Drain, Faulkner (Seabrooke Br) Drain (Non-Sensitive)
- Municipal Drain, Faulkner Drain (Non-Sensitive)
- Municipal Drain, Flewellyn Branch 1 Drain (Non-Sensitive)
- Municipal Drain, Flewellyn Branch 2 Drain (Non-Sensitive)
- Municipal Drain, Flewellyn Branch 3 Drain (Non-Sensitive)
- Municipal Drain, Flewellyn Branch 4 Drain (Non-Sensitive)
- Municipal Drain, Flewellyn Branch 5 Drain (Non-Sensitive)
- Municipal Drain, Flewellyn Branch 6 Drain (Non-Sensitive)
- Municipal Drain, Flewellyn Branch 7 Drain (Non-Sensitive)
- Municipal Drain, Flewellyn Main Drain (Non-Sensitive)
- Municipal Drain, Hazeldean Municipal Drain (Non-Sensitive)
- Municipal Drain, Kenny Br (Monahan) Drain (Non-Sensitive)
- Municipal Drain, Kizzel Municipal Drain (Non-Sensitive)
- Municipal Drain, Monahan (Main) Drain (Non-Sensitive)
- Municipal Drain, Monahan Branch 1 Drain (Non-Sensitive)
- Municipal Drain, Monahan Branch 10 Drain (Non-Sensitive)
- Municipal Drain, Monahan Branch 2 Drain (Non-Sensitive)
- Municipal Drain, Monahan Branch 3 Drain (Non-Sensitive)
- Municipal Drain, Monahan Branch 4 Drain (Non-Sensitive)
- Municipal Drain, Monahan Branch 5 Drain (Non-Sensitive)
- Municipal Drain, Monahan Branch 6 Drain (Non-Sensitive)
- Municipal Drain, Monahan Branch 7 Drain (Non-Sensitive)

- Municipal Drain, Monahan Branch 8 Drain (Non-Sensitive)
- Municipal Drain, Monahan Branch 9 Drain (Non-Sensitive)
- Municipal Drain, Monahan Branch A Drain (Non-Sensitive)
- Municipal Drain, Monahan Branch B Drain (Non-Sensitive)
- Municipal Drain, O'Keefe Drain (Non-Sensitive)
- Municipal Drain, Smith (Main) Drain (Non-Sensitive)
- Municipal Drain, Smith Br 10 (Van Doormaal) Drain (Non-Sensitive)
- Municipal Drain, Smith Br 11 (Smith-Goulbourn) Drain (Non-Sensitive)
- Municipal Drain, Smith Br 12 (Smith-James) Drain (Non-Sensitive)
- Municipal Drain, Smith Br 2 (Argue) Drain (Non-Sensitive)
- Municipal Drain, Smith Br 3 (Argue-Aikins) Drain (Non-Sensitive)
- Municipal Drain, Smith Br 4 (Aikins-Seabrooke) Drain (Non-Sensitive)
- Municipal Drain, Smith Br 5 (Seabrooke-James) Drain (Non-Sensitive)
- Municipal Drain, Smith Br 6 (James Aikins) Drain (Non-Sensitive)
- Municipal Drain, Smith Br 7 (Aikins-James) Drain (Non-Sensitive)
- Municipal Drain, Smith Br 8 (C) Drain (Non-Sensitive)
- Municipal Drain, Smith Br 8 (Homer James) Drain (Non-Sensitive)
- Pit, 4117 (Non-Sensitive)
- Pit, 4166 (Non-Sensitive)
- Pit and Quarry, 4079 (Non-Sensitive)
- Pit and Quarry, 4106 (Non-Sensitive)
- Pit and Quarry, 4206 (Non-Sensitive)
- Pond (Non-Sensitive)
- Quarry, 4194 (Non-Sensitive)
- Quarry, 4216 (Non-Sensitive)
- Quarry, 5204 (Non-Sensitive)
- River, Jock River (Non-Sensitive)
- River, Shirleys Brook (Non-Sensitive)
- Spawning Area, Brown Bullhead Spawning Area (Non-Sensitive)
- Spawning Area, Common Carp Spawning Area (Non-Sensitive)
- Spawning Area, Northern Pike Spawning Area (Non-Sensitive)
- Spawning Area, Pumpkinseed Spawning Area (Non-Sensitive)
- Spawning Area, Silver Redhorse Spawning Area (Non-Sensitive)
- Spawning Area, Smallmouth Bass Spawning Area (Non-Sensitive)
- Spawning Area, Walleye Spawning Area (Non-Sensitive)
- Unevaluated Wetland (Not evaluated per OWES)
- Wildlife Staging Area, Waterfowl Staging Area (Non-Sensitive)
- Wintering Area, Deer Yard (Stratum 1) (Non-Sensitive)

Municipal Official Plans contain information related to natural heritage features. Please see the local municipal Official Plan for more information, such as specific policies and direction pertaining to activities which may impact natural heritage features. For planning advice or Official Plan interpretation, please contact the local municipality. Many municipalities require environmental impact studies and other supporting studies be carried out as part of the development application process to allow the municipality to make planning decisions which are consistent with the Provincial Policy Statement (PPS, 2014).

The MNRF strongly encourages all proponents to contact partner agencies and appropriate municipalities early on in the planning process. This provides the proponent with early knowledge regarding agency requirements, authorizations and approval timelines; Ministry of the Environment and Climate Change (MOECC) and the local Conservation Authority may require approvals and permitting where natural values and natural hazards (e.g., floodplains) exist.

As per the Natural Heritage Reference Manual (NHRM, 2010) the MNRF strongly recommends that an ecological site assessment be carried out to determine the presence of natural heritage features and species at risk and their habitat on site. The MNRF can provide survey methodology for particular species at risk and their habitats.

The NHRM also recommends that cumulative effects of development projects on the integrity of natural heritage features and areas be given due consideration. This includes the evaluation of the past, present and possible future impacts of development in the surrounding area that may occur as a result of demand created by the presently proposed project.

In Addition, the following Fish species were identified: American eel, banded killifish, black bullhead, black crappie, blackchin shiner, blacknose shiner, bluegill, bluntnose minnow, brassy minnow, bridle shiner, brook stickleback, brook trout, brown bullhead, brown trout, burbot, Carps and Minnows, central mudminnow, channel catfish, channel darter, cisco, common carp, common shiner, creek chub, eastern blacknose dace, eastern silvery minnow, emerald shiner, Etheostoma sp., fallfish, fathead minnow, finescale dace, freshwater drum, golden shiner, greater redhorse, hornyhead chub, Iowa darter, johnny darter, johnny darter/tesselated darter, lake sturgeon, largemouth bass, logperch, longnose dace, longnose gar, longnose sucker, mimic shiner, mooneye, mottled sculpin, Moxostoma sp., muskellunge, ninespine stickleback, North American Catfishes, northern brook lamprey, northern hog sucker, northern pike, northern redbelly dace, Notropis sp., pearl dace, Phoxinus sp., pumpkinseed, rainbow smelt, redside dace, Rhinichthys sp., river redhorse, rock bass, rosyface shiner, sand shiner, sauger, Sculpins, shorthead redhorse, silver lamprey, silver redhorse, slimy sculpin, smallmouth bass, spotfin shiner, spottail shiner, Sticklebacks, stonecat, Sunfishes, tadpole madtom, tessellated darter, trout-perch, walleye, white crappie, white sucker, yellow bullhead, yellow perch.

Wildland Fire

MNRF woodland data shows that the site contains woodlands. The lands should be assessed for the risk of wildland fire as per PPS 2014, Section 3.1.8 "*Development shall generally be directed to areas outside of lands that are unsafe for development due to the presence of hazardous forest types for wildland fire. Development may however be permitted in lands with hazardous forest types for wildland fire where the risk is mitigated in accordance with wildland fire assessment and mitigation standards".* Further discussion with the local municipality should be carried out to address how the risks associated with wildland fire will be covered for such a development proposal. Please see the Wildland Fire Risk Assessment and Mitigation Guidebook (2016) for more information.

Significant Woodlands
Section 2.1.5 b) of the PPS states: *Development and site alteration shall not be permitted in significant woodlands unless it has been demonstrated that there will be no negative impacts on the natural features or their ecological functions.* The 2014 PPS directs that significant woodlands must be identified following criteria established by the Ontario Ministry of Natural Resources and Forestry, i.e. the Natural Heritage Reference Manual (NHRM), 2010. Where the local or County Official Plan has not yet updated significant woodland mapping to reflect the 2014 PPS, all wooded areas should be reviewed on a site specific basis for significance. The MNRF Kemptville District modelled locations of significant woodlands in 2011 based on NHRM criteria. The presence of significant woodland on site or within 120 metres should trigger an assessment of the impacts to the feature and its function from the proposed development.

Significant Wildlife Habitat
Section 2.1.5 d) of the PPS states: *Development and site alteration shall not be permitted in significant wildlife habitat unless it has been demonstrated that there will be no negative impacts on the natural features or their ecological functions.* It is the responsibility of the approval authority to identify significant wildlife habitat or require its identification. The MNRF has several guiding documents which may be useful in identification of significant wildlife habitat and characterization of impacts and mitigation options:

- Significant Wildlife Habitat Technical Guide, 2000
- The Natural Heritage Reference Manual, 2010
- Significant Wildlife Habitat Mitigation Support Tool, 2014
- Significant Wildlife Habitat Criteria Schedule for Ecoregion 5E and 6E, 2015

The habitat of special concern species (as identified by the Species at Risk in Ontario list) and Natural Heritage Information Centre tracked species with a conservation status rank of S1, S2 and S3 may be significant wildlife habitat and should be assessed accordingly.

Water
If any in-water works are to occur, there are timing windows for which work in water should not take place (see below). Appropriate measures should be taken to minimize and mitigate impact on water quality and fish habitat, including:

- installation of sediment and erosion control measures;
- avoiding the removal, alteration, or covering of substrates used for fish spawning, feeding, over-wintering or nursery areas; and
- debris control measures to manage falling debris (e.g. spalling).

Timing windows (no in-water works) in MNRF Kemptville District*:

Warmwater and cool water	→ March 15 – June 30
St. Lawrence River & Ottawa River	→ March 15 – July 15
Coldwater	→ October 1 – May 31
Big Rideau Lake & Charleston Lake	→ October 1 – June 30

* *Please note: Additional timing restrictions may apply as they relate to endangered and threatened species for works in both water and wetland areas.*

Timing windows when in-water work is restricted – based on species presence:

Spring:

FISH SPECIES	TIMING WINDOW (No in-water works)
Walleye	March 15 to May 31
Northern Pike	March 15 to May 31
Lake Sturgeon	May 1 to June 30
Muskellunge	March 15 to May 31
Largemouth/Smallmouth Bass	May 1 to July 15
Rainbow Trout	March 15 to June 15
Other /Unknown Spring Spawning Species	March 15 to July 15

Fall:

FISH SPECIES	TIMING WINDOW (No in-water works)
Lake Trout	October 1 to May 31
Brook Trout	October 1 to May 31
Pacific Salmon	September 15 to May 31
Lake Whitefish	October 15 to May 31
Lake Herring	October 15 to May 31
Other /Unknown Fall Spawning Species	October 1 to May 31

Additional approvals and permits may be required under the Fisheries Act. Please contact Fisheries and Oceans Canada to determine requirements and next steps. There may also be approvals required by the local Conservation Authority or Transport Canada. As the MNRF is responsible for the management of provincial fish populations, we request ongoing involvement in such discussions in order to ensure population conservation.

Species at Risk

A review of the Natural Heritage Information Centre (NHIC) and internal records indicate that there is a potential for the following threatened (THR) and/or endangered (END) species on the site or in proximity to it:

- American Eel (END)
- Sensitive Species (END)
- Bank Swallow (THR)
- Barn Swallow (THR)
- Blanding's Turtle (THR)
- Bobolink (THR)
- Butternut (END)
- Chimney Swift (THR)
- Eastern Meadowlark (THR)
- Eastern Small-footed Myotis (END)
- Lake Sturgeon (THR)
- Least Bittern (THR)
- Little Brown Bat (END)
- Northern Long-eared Bat (END)
- Rusty-patched Bumble Bee (END)
- Tri-Colored Bat (END)

- Whip poor will (THR)

All endangered and threatened species receive individual protection under section 9 of the ESA and receive general habitat protection under Section 10 of the ESA, 2007. Thus any potential works should consider disturbance to the individuals as well as their habitat (e.g. nesting sites). General habitat protection applies to all threatened and endangered species. Note some species in Kemptville District receive regulated habitat protection. The habitat of these listed species is protected from damage and destruction and certain activities may require authorization(s) under the ESA. For more on how species at risk and their habitat is protected, please see: https://www.ontario.ca/page/how-species-risk-are-protected.

If the proposed activity is known to have an impact on any endangered or threatened species at risk (SAR), or their habitat, an authorization under the ESA may be required. It is recommended that MNRF Kemptville be contacted prior to any activities being carried out to discuss potential survey protocols to follow during the early planning stages of a project, as well as mitigation measures to avoid contravention of the ESA. Where there is potential for species at risk or their habitat on the property, an Information Gathering Form should be submitted to Kemptville MNRF at sar.kemptville@ontario.ca.

The Information Gathering Form may be found here:
http://www.forms.ssb.gov.on.ca/mbs/ssb/forms/ssbforms.nsf/FormDetail?OpenForm&ACT=RDR&TAB=PROFILE&ENV=WWE&NO=018-0180E

For more information on the ESA authorization process, please see:
https://www.ontario.ca/page/how-get-endangered-species-act-permit-or-authorization

One or more special concern species has been documented to occur either on the site or nearby. Species listed as special concern are not protected under the ESA, 2007. However, please note that some of these species may be protected under the Fish and Wildlife Conservation Act and/or Migratory Birds Convention Act. Again, the habitat of special concern species may be significant wildlife habitat and should be assessed accordingly. Species of special concern for consideration:

- Black Tern (SC)
- Canada Warbler (SC)
- Common Nighthawk (SC)
- Monarch (SC)
- Northern Map Turtle (SC)
- Peregrine Falcon (SC)
- Red-headed Woodpecker (SC)
- River Redhorse (SC)
- Short-eared Owl (SC)
- Snapping Turtle (SC)
- West Virginia White (SC)

If any of these or any other species at risk are discovered throughout the course of the work, and/or should any species at risk or their habitat be potentially impacted by on site activities, MNRF should be contacted and operations be modified to avoid any negative impacts to species at risk or their habitat until further direction is provided by MNRF.

Please note that information regarding species at risk is based largely on documented occurrences and does not necessarily include an interpretation of potential habitat within or in proximity to the site in question. Although this data represents the MNRF's best current available information, it is important to note that a lack of information for a site does not mean that additional features and values are not present. It is the responsibility of the proponent to ensure that species at risk are not killed, harmed, or harassed, and that their habitat is not damaged or destroyed through the activities carried out on the site.

The MNRF continues to strongly encourage ecological site assessments to determine the potential for SAR habitat and occurrences. When a SAR or potential habitat for a SAR does occur on a site, it is recommended that the proponent contact the MNRF for technical advice and to discuss what activities can occur without contravention of the Act. For specific questions regarding the Endangered Species Act (2007) or SAR, please contact MNRF Kemptville District at sar.kemptville@ontario.ca.

The approvals processes for a number of activities that have the potential to impact SAR or their habitat have recently changed. For information regarding regulatory exemptions and associated online registration of certain activities, please refer to the following website: https://www.ontario.ca/page/how-get-endangered-species-act-permit-or-authorization.

Please note: The advice in this letter may become invalid if:

- The Committee on the Status of Species at Risk in Ontario (COSSARO) re-assesses the status of the above-named species OR adds a species to the SARO List such that the section 9 and/or 10 protection provisions apply to those species; or
- Additional occurrences of species are discovered on or in proximity to the site.

This letter is valid until: Thu. Aug 2, 2018

The MNRF would like to request that we continue to be circulated on information with regards to this project. If you have any questions or require clarification please do not hesitate to contact me.

Sincerely,

Jane Devlin
Management Biologist
jane.devlin@ontario.ca

Encl.\
-ESA Infosheet
-NHIC/LIO Infosheet

Ministry of Natural Resources

Ontario

Natural. Valued. Protected.

Email to MNR

Natural Areas and Features Information Request Form

Contact Information

Clear Contact

Name: Brandon Jarivs

Address: 1223 Micheal Street Ottawa ON K2B 5S5

Phone Number: (613) 691-1551 ☐ **Owner** ☑ **Consultant**

E-mail Address: brandon.jarvis@parsons.com

All red fields are manditory

This includes X & Y Coordinates.

Please see page 2 for assistance.

Site Information **Project Name:** City of Ottawa Kanata LRT EA Study

Clear Site

Township: West Carleton, Nepean, N **Lot:** ______ **Concession:** ______

X: 353309.7180 **Y:** 5020303.000 **Address:** Ottawa West, HWY 417 Corridor

***If more than 1 site, please provide all individual coordinates in an attached spreadsheet*

Type of Proposal

Clear Details

- ☐ **Severance / Zoning**
- ☐ **Hydroline clearing**
- ☐ **RE Projects**
- ☐ **Aggregate Project**
- ☐ **Drains / Roads / Culverts**
- ☐ **Small Scale Projects (less than 5 hectares)**
- ☐ **Large Scale Projects (5 hectares or greater)**
- ☐ **Other:** Light Rail Transit Environmental As

Attachments ****Please attach a Site Map showing the area of interest***

☐ **Picture** ☑ **Map(s)** ☐ **Engineered Drawings** ☐ **Other:** ______

Request

I would like to request the following information for the property identified above:

Natural Heritage Features such as ANSIs, wetland, woodlots, known and potential occurrences and habitat for Species at Risk / terrestrial / aquatic communities.

To better respond to your request please briefly outline the purpose for which this information is required (e.g. proposed development, lot severance, etc. or attach details):

The City of Ottawa has initiated a Planning and Environmental Assessment (EA) study to develop a Recommended Plan to extend Light Rail Transit (LRT) from Moodie Drive to Kanata. The Planning and EA Study will define a corridor for the future expansion of the City's LRT

Date of works proposed: ____ / ______ / ______

Personal information contained in this form is collected in order to fulfill your request, respond to your inquiries and for other administration purposes. With regard to the personal information it collects, the ministry is bound by privacy protection rules under the Freedom of Information and Protection of Privacy Act and takes all necessary steps to safeguard personal information collected.

Please Note: ***This request MUST be made by the property owner or by someone acting on their behalf. Depending on the nature of the request, it may take 6-8 weeks to respond to your inquiry. If the request does not include the manditory information, it may delay response time.***

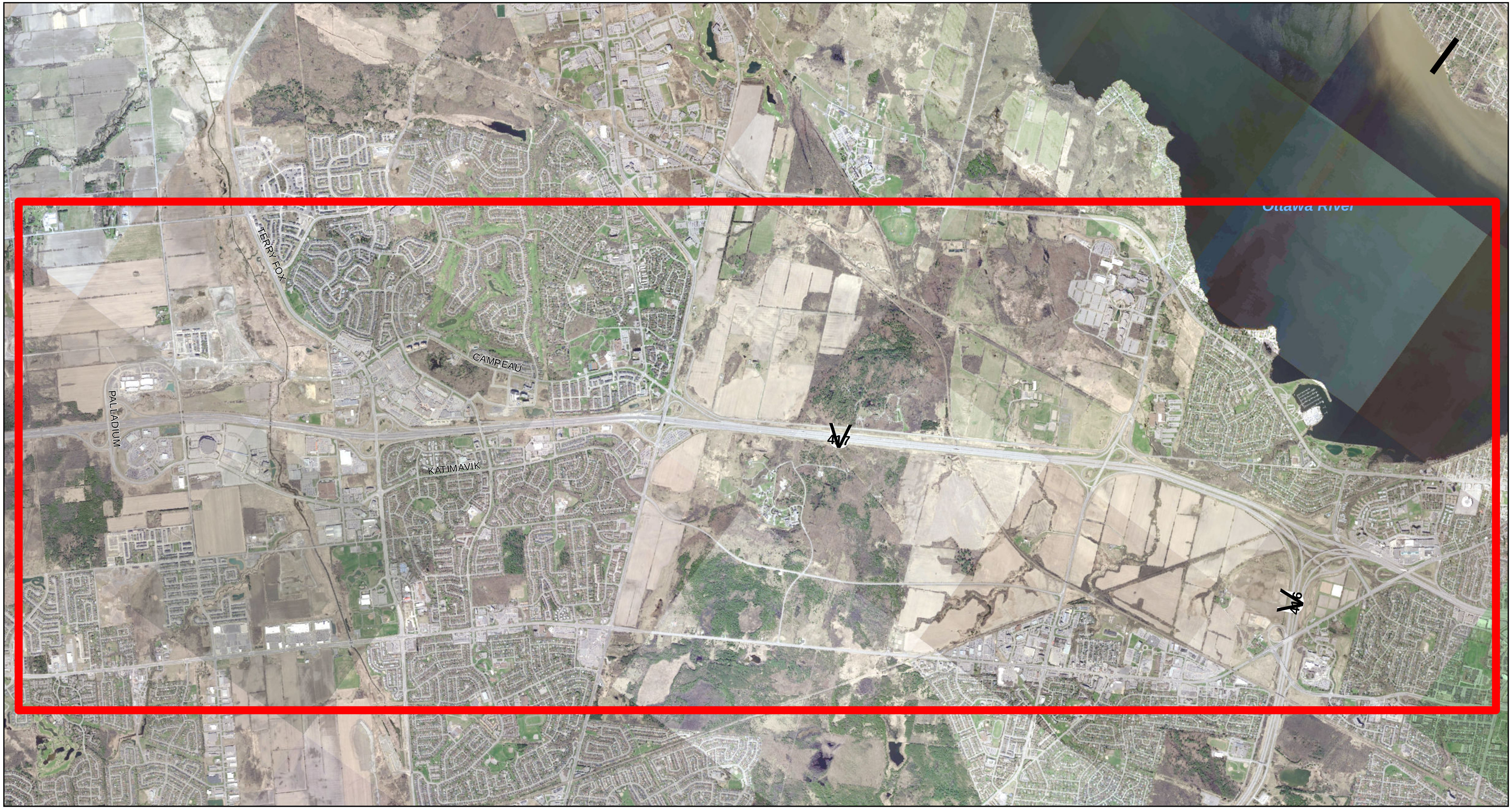
☑ ***I have read the above and agree to all Terms and Conditions***

Please forward the completed form to:

Kemptville.Inforequest@Ontario.ca OR **Fax: 613-258-3920**

Attention: Information Requests
10 Campus Drive, Postal Bag 2002
Kemptville, ON K0G 1J0

MNR File Number: ______



0 0.5 1 2 Kilometers

Kanata LRT (Bayshore Station to Palladium Drive)
Planning and Environmental Assessment Study

MNRF Information Request

APPENDIX C: Vascular Plants and Wildlife Species Lists

Table C1: Kanata LRT Extension - Vascular Plants Observed within the Study Area at the time Field Investigations

Common Name	Scientific Name	Order	Family	S_RANK	SARA (Schedule 1)	SARO	Exotic Status
American Larch	*Larix laricina*	Pinales	Pinaceae	S5			
Norway Spruce	*Picea abies*	Pinales	Pinaceae	SNA			SE3
White Spruce	*Picea glauca*	Pinales	Pinaceae	S5			
Blue Spruce	*Picea pungens*	Pinales	Pinaceae	SNA			SE1
Eastern White Pine	*Pinus strobus*	Pinales	Pinaceae	S5			
Common Red Raspberry	*Rubus idaeus ssp. idaeus*	Rosales	Rosaceae	SNA			SE1
Eastern White Cedar	*Thuja occidentalis*	Pinales	Cupressaceae	S5			
Narrow-leaved Cattail	*Typha angustifolia*	Typhales	Typhaceae	SNA			SE5
Broad-leaved Cattail	*Typha latifolia*	Typhales	Typhaceae	S5			
Field Horsetail	*Equisetum arvense*	Equisetales	Equisetaceae	S5			
Orchard Grass	*Dactylis glomerata*	Cyperales	Poaceae	SNA			SE5
Riverbank Grape	*Vitis riparia*	Rhamnales	Vitaceae	S5			
American Basswood	*Tilia americana*	Malvales	Tiliaceae	S5			
Garden Asparagus	*Asparagus officinalis*	Liliales	Liliaceae	SNA			SE5
White Poplar	*Populus alba*	Salicales	Salicaceae	SNA			SE5
Large-toothed Aspen	*Populus grandidentata*	Salicales	Salicaceae	S5			
Trembling Aspen	*Populus tremuloides*	Salicales	Salicaceae	S5			
Butternut	*Juglans cinerea*	Juglandales	Juglandaceae	S2?	END	END	
Paper Birch	*Betula papyrifera*	Fagales	Betulaceae	S5			
Eastern Hop-hornbeam	*Ostrya virginiana*	Fagales	Betulaceae	S5			
Bur Oak	*Quercus macrocarpa*	Fagales	Fagaceae	S5			
Northern Red Oak	*Quercus rubra*	Fagales	Fagaceae	S5			
American Elm	*Ulmus americana*	Urticales	Ulmaceae	S5			
Curly Dock	*Rumex crispus*	Polygonales	Polygonaceae	SNA			SE5
Garlic Mustard	*Alliaria petiolata*	Capparales	Brassicaceae	SNA			SE5
Hooked Agrimony	*Agrimonia gryposepala*	Rosales	Rosaceae	S5			
American Woodland Strawberry	*Fragaria vesca ssp. americana*	Rosales	Rosaceae	S5			
Red Clover	*Trifolium pratense*	Fabales	Fabaceae	SNA			SE5
Tufted Vetch	*Vicia cracca*	Fabales	Fabaceae	SNA			SE5
Staghorn Sumac	*Rhus typhina*	Sapindales	Anacardiaceae	S5			
Manitoba Maple	*Acer negundo*	Sapindales	Aceraceae	S5			
Norway Maple	*Acer platanoides*	Sapindales	Aceraceae	SNA			SE5
Silver Maple	*Acer saccharinum*	Sapindales	Aceraceae	S5			
Sugar Maple	*Acer saccharum*	Sapindales	Aceraceae	S5			
Common Buckthorn	*Rhamnus cathartica*	Rhamnales	Rhamnaceae	SNA			SE5
Purple Loosestrife	*Lythrum salicaria*	Myrtales	Lythraceae	SNA			SE5
Broad-leaved Enchanter's Nightshade	*Circaea canadensis*	Myrtales	Onagraceae	S5			
Wild Carrot	*Daucus carota*	Apiales	Apiaceae	SNA			SE5
Wild Parsnip	*Pastinaca sativa*	Apiales	Apiaceae	SNA			SE5
Gray Dogwood	*Cornus racemosa*	Cornales	Cornaceae	S5			
Red-osier Dogwood	*Cornus sericea*	Cornales	Cornaceae	S5			

Table C1: Kanata LRT Extension - Vascular Plants Observed within the Study Area at the time Field Investigations

Common Name	Scientific Name	Order	Family	S_RANK	SARA (Schedule 1)	SARO	Exotic Status
Black Ash	*Fraxinus nigra*	Scrophulariales	Oleaceae	S4			
Common Lilac	*Syringa vulgaris*	Scrophulariales	Oleaceae	SNA			SE5
Periwinkle	*Vinca minor*	Gentianales	Apocynaceae	SNA			SE5
Common Milkweed	*Asclepias syriaca*	Gentianales	Asclepiadaceae	S5			
European Swallow-wort	*Vincetoxicum rossicum*	Gentianales	Asclepiadaceae	SNA			SE5
Common Burdock	*Arctium minus*	Asterales	Asteraceae	SNA			SE5
Common Dandelion	*Taraxacum officinale*	Asterales	Asteraceae	SNA			SE5
Common Viper's Bugloss	*Echium vulgare*	Lamiales	Boraginaceae	SNA			SE5
Catnip	*Nepeta cataria*	Lamiales	Lamiaceae	SNA			SE5
Common Mullein	*Verbascum thapsus*	Scrophulariales	Scrophulariaceae	SNA			SE5
Canada Thistle	*Cirsium arvense*	Asterales	Asteraceae	SNA			SE5
Bull Thistle	*Cirsium vulgare*	Asterales	Asteraceae	SNA			SE5
Common Tansy	*Tanacetum vulgare*	Asterales	Asteraceae	SNA			SE5
European Reed	*Phragmites australis ssp. australis*	Cyperales	Poaceae	SNA			SE5
Eastern Tall Goldenrod	*Solidago altissima var. altissima*	Asterales	Asteraceae	S5			
Highbush Cranberry	*Viburnum opulus ssp. trilobum*	Dipsacales	Caprifoliaceae	S5			
Reed Canary Grass	*Phalaris arundinacea var. arundinacea*	Cyperales	Poaceae	S5			
Eastern Poison Ivy	*Toxicodendron radicans var. radicans*	Sapindales	Anacardiaceae	S5			
Pussytoe species	*Antennaria species*	Asterales	Asteraceae				
Hawthorn species	*Crataegus species*	Rosales	Rosaceae				
Ash species	*Fraxinus species*	Scrophulariales	Oleaceae				
Bedstraw species	*Galium species*	Rubiales	Rubiaceae				
Rush species	*Juncus species*	Juncales	Juncaceae				
Crabapple species	*Malus species*	Rosales	Rosaceae				
Poplar species	*Populus species*	Salicales	Salicaceae				
Cinquefoil species	*Potentilla species*	Rosales	Rosaceae				
Rose species	*Rosa species*	Rosales	Rosaceae				
Willow species	*Salix species*	Salicales	Salicaceae				
Bulrush species	*Scirpus species*	Cyperales	Cyperaceae				
Speedwell species	*Veronica species*	Scrophulariales	Scrophulariaceae				

Table C2: Natural heritage background review for the Kanata LRT study area

MNRF	NHIC	OBBA	ORAA	AMO	SCIENTIFIC NAME	COMMON NAME	S-RANK	SARA (Schedule 1)	SARO
Vascular Plants									
x	x				*Juglans cinerea*	Butternut	S2?	END	END
Insects									
x					*Bombus affinis*	Rusty-patched Bumble Bee	S1	END	END
x					*Danaus plexippus*	Monarch	S2N,S4B	END	SC
x					*Pieris virginiensis*	West Virginia White	S3		SC
Fish									
x	x				*Acipenser fulvescens pop. 3*	Lake Sturgeon (Great Lakes - Upper St. Lawrence River population)	S2	THR	THR
x	x				*Anguilla rostrata*	American Eel	S1?	THR	END
x					*Notropis bifrenatus*	Bridle Shiner	S2	SC	SC
x					*Moxostoma carinatum*	River Redhorse	S2	SC	SC
Amphibians									
			x		*Ambystoma laterale*	Blue-spotted Salamander	S4		
			x		*Ambystoma maculatum*	Spotted Salamander	S4		
			x		*Anaxyrus americanus*	American Toad	S5		
			x		*Eurycea bislineata*	Northern Two-lined Salamander	S4		
			x		*Hyla versicolor*	Gray Treefrog	S5		
			x		*Lithobates catesbeianus*	American Bullfrog	S4		
			x		*Lithobates clamitans*	Green Frog	S5		
			x		*Lithobates pipiens*	Northern Leopard Frog	S5	NAR	NAR
			x		*Lithobates sylvaticus*	Wood Frog	S5		
			x		*Necturus maculosus*	Mudpuppy	S4	NAR	NAR
			x		*Notophthalmus viridescens viridescens*	Red-spotted Newt	S5		
			x		*Plethodon cinereus*	Eastern Red-backed Salamander	S5		
			x		*Pseudacris crucifer*	Spring Peeper	S5		
			x		*Pseudacris maculata pop. 1*	Western Chorus Frog (Great Lakes / St. Lawrence - Canadian Shield population)	S3	THR	NAR
Reptiles									
x	x		x		*Chelydra serpentina*	Snapping Turtle	S3	SC	SC
			x		*Chrysemys picta marginata*	Midland Painted Turtle	S4		
			x		*Diadophis punctatus*	Ring-necked Snake	S4		
x	x		x		*Emydoidea blandingii*	Blanding's Turtle	S3	END	THR
x			x		*Graptemys geographica*	Northern Map Turtle	S3	SC	SC
	x		x		*Lampropeltis triangulum*	Eastern Milksnake	S4	SC	NAR
			x		*Nerodia sipedon sipedon*	Northern Watersnake	S5	NAR	NAR

Table C2: Natural heritage background review for the Kanata LRT study area

MNRF	NHIC	OBBA	ORAA	AMO	SCIENTIFIC NAME	COMMON NAME	S-RANK	SARA (Schedule 1)	SARO
			x		*Opheodrys vernalis*	Smooth Greensnake	S4		
			x		*Storeria occipitomaculata*	Red-bellied Snake	S5		
			x		*Thamnophis sirtalis sirtalis*	Eastern Gartersnake	S5		
Birds									
		x			*Gavia immer*	Common Loon	S5B,S5N	NAR	NAR
		x			*Podilymbus podiceps*	Pied-billed Grebe	S4B,S4N		
		x			*Botaurus lentiginosus*	American Bittern	S4B		
x		x			*Ixobrychus exilis*	Least Bittern	S4B	THR	THR
		x			*Ardea herodias*	Great Blue Heron	S4		
		x			*Butorides virescens*	Green Heron	S4B		
		x			*Cathartes aura*	Turkey Vulture	S5B		
		x			*Branta canadensis*	Canada Goose	S5		
		x			*Aix sponsa*	Wood Duck	S5		
		x			*Anas americana*	American Wigeon	S4		
		x			*Anas strepera*	Gadwall	S4		
		x			*Anas rubripes*	American Black Duck	S4		
		x			*Anas platyrhynchos*	Mallard	S5		
		x			*Anas discors*	Blue-winged Teal	S4		
		x			*Anas crecca*	Green-winged Teal	S4		
		x			*Aythya affinis*	Lesser Scaup	S4		
		x			*Lophodytes cucullatus*	Hooded Merganser	S5B,S5N		
		x			*Pandion haliaetus*	Osprey	S5B		
		x			*Haliaeetus leucocephalus*	Bald Eagle	S2N,S4B	NAR	SC
		x			*Circus cyaneus*	Northern Harrier	S4B	NAR	NAR
		x			*Accipiter striatus*	Sharp-shinned Hawk	S5		NAR
		x			*Accipiter cooperii*	Cooper's Hawk	S4	NAR	NAR
		x			*Accipiter gentilis*	Northern Goshawk	S4	NAR	NAR
		x			*Buteo jamaicensis*	Red-tailed Hawk	S5	NAR	NAR
		x			*Falco sparverius*	American Kestrel	S4		
		x			*Falco columbarius*	Merlin	S5B	NAR	NAR
x					*Falco peregrinus*	Peregrine Falcon	S3B	SC	SC
		x			*Bonasa umbellus*	Ruffed Grouse	S4		
		x			*Meleagris gallopavo*	Wild Turkey	S5		
		x			*Rallus limicola*	Virginia Rail	S5B		
		x			*Porzana carolina*	Sora	S4B		
		x			*Gallinula chloropus*	Common Gallinule	S4B		

Table C2: Natural heritage background review for the Kanata LRT study area

MNRF	NHIC	OBBA	ORAA	AMO	SCIENTIFIC NAME	COMMON NAME	S-RANK	SARA (Schedule 1)	SARO
		x			*Fulica americana*	American Coot	S4B	NAR	NAR
		x			*Charadrius vociferus*	Killdeer	S5B,S5N		
		x			*Actitis macularius*	Spotted Sandpiper	S5		
		x			*Bartramia longicauda*	Upland Sandpiper	S4B		
		x			*Gallinago delicata*	Wilson's Snipe	S5B		
		x			*Scolopax minor*	American Woodcock	S4B		
		x			*Sterna hirundo*	Common Tern	S4B	NAR	NAR
x					*Chlidonias niger*	Black Tern	S3B	NAR	SC
		x			*Columba livia*	Rock Pigeon	SNA		
		x			*Zenaida macroura*	Mourning Dove	S5		
		x			*Coccyzus erythropthalmus*	Black-billed Cuckoo	S5B		
		x			*Coccyzus americanus*	Yellow-billed Cuckoo	S4B		
		x			*Megascops asio*	Eastern Screech-Owl	S4	NAR	NAR
		x			*Bubo virginianus*	Great Horned Owl	S4		
		x			*Strix varia*	Barred Owl	S5		
x					*Asio flammeus*	Short-eared Owl	S2N,S4B	SC	SC
x		x			*Chordeiles minor*	Common Nighthawk	S4B	THR	SC
x		x			*Antrostomus vociferus*	Eastern Whip-poor-will	S4B	THR	THR
x		x			*Chaetura pelagica*	Chimney Swift	S4B,S4N	THR	THR
		x			*Archilochus colubris*	Ruby-throated Hummingbird	S5B		
		x			*Megaceryle alcyon*	Belted Kingfisher	S4B		
x					*Melanerpes erythrocephalus*	Red-headed Woodpecker	S4B	THR	SC
		x			*Sphyrapicus varius*	Yellow-bellied Sapsucker	S5B		
		x			*Picoides pubescens*	Downy Woodpecker	S5		
		x			*Picoides villosus*	Hairy Woodpecker	S5		
		x			*Colaptes auratus*	Northern Flicker	S4B		
		x			*Dryocopus pileatus*	Pileated Woodpecker	S5		
		x			*Contopus virens*	Eastern Wood-pewee	S4B	SC	SC
		x			*Empidonax alnorum*	Alder Flycatcher	S5B		
		x			*Empidonax traillii*	Willow Flycatcher	S5B		
		x			*Empidonax minimus*	Least Flycatcher	S4B		
		x			*Sayornis phoebe*	Eastern Phoebe	S5B		
		x			*Myiarchus crinitus*	Great Crested Flycatcher	S4B		
		x			*Tyrannus tyrannus*	Eastern Kingbird	S4B		
		x			*Vireo flavifrons*	Yellow-throated Vireo	S4B		
		x			*Vireo gilvus*	Warbling Vireo	S5B		
		x			*Vireo olivaceus*	Red-eyed Vireo	S5B		
		x			*Cyanocitta cristata*	Blue Jay	S5		

Table C2: Natural heritage background review for the Kanata LRT study area

MNRF	NHIC	OBBA	ORAA	AMO	SCIENTIFIC NAME	COMMON NAME	S-RANK	SARA (Schedule 1)	SARO
		x			*Corvus brachyrhynchos*	American Crow	S5B		
		x			*Corvus corax*	Common Raven	S5		
		x			*Eremophila alpestris*	Horned Lark	S5B		
		x			*Progne subis*	Purple Martin	S3S4B		
		x			*Tachycineta bicolor*	Tree Swallow	S4B		
		x			*Stelgidopteryx serripennis*	Northern Rough-winged Swallow	S4B		
x		x			*Riparia riparia*	Bank Swallow	S4B	THR	THR
		x			*Petrochelidon pyrrhonota*	Cliff Swallow	S4B		
x		x			*Hirundo rustica*	Barn Swallow	S4B	THR	THR
		x			*Poecile atricapillus*	Black-capped Chickadee	S5		
		x			*Sitta canadensis*	Red-breasted Nuthatch	S5		
		x			*Sitta carolinensis*	White-breasted Nuthatch	S5		
		x			*Certhia americana*	Brown Creeper	S5B		
		x			*Troglodytes aedon*	House Wren	S5B		
		x			*Troglodytes hiemalis*	Winter Wren	S5B		
		x			*Cistothorus platensis*	Sedge Wren	S4B	NAR	NAR
		x			*Cistothorus palustris*	Marsh Wren	S4B		
		x			*Regulus satrapa*	Golden-crowned Kinglet	S5B		
		x			*Sialia sialis*	Eastern Bluebird	S5B	NAR	NAR
		x			*Catharus fuscescens*	Veery	S4B		
		x			*Catharus guttatus*	Hermit Thrush	S5B		
		x			*Hylocichla mustelina*	Wood Thrush	S4B	THR	SC
		x			*Turdus migratorius*	American Robin	S5B		
		x			*Dumetella carolinensis*	Gray Catbird	S4B		
		x			*Mimus polyglottos*	Northern Mockingbird	S4		
		x			*Toxostoma rufum*	Brown Thrasher	S4B		
		x			*Bombycilla cedrorum*	Cedar Waxwing	S5B		
		x			*Sturnus vulgaris*	European Starling	SNA		
		x			*Vermivora cyanoptera*	Blue-winged Warbler	S4B		
		x			*Vermivora chrysoptera*	Golden-winged Warbler	S4B	THR	SC
		x			*Oreothlypis ruficapilla*	Nashville Warbler	S5B		
		x			*Setophaga petechia*	Yellow Warbler	S5B		
		x			*Setophaga pensylvanica*	Chestnut-sided Warbler	S5B		
		x			*Setophaga magnolia*	Magnolia Warbler	S5B		
		x			*Setophaga tigrina*	Cape May Warbler	S5B		
		x			*Setophaga caerulescens*	Black-throated Blue Warbler	S5B		
		x			*Setophaga coronata*	Yellow-rumped Warbler	S5B		
		x			*Setophaga virens*	Black-throated Green Warbler	S5B		

Table C2: Natural heritage background review for the Kanata LRT study area

MNRF	NHIC	OBBA	ORAA	AMO	SCIENTIFIC NAME	COMMON NAME	S-RANK	SARA (Schedule 1)	SARO
		x			*Setophaga fusca*	Blackburnian Warbler	S5B		
		x			*Setophaga pinus*	Pine Warbler	S5B		
		x			*Mniotilta varia*	Black-and-white Warbler	S5B		
		x			*Setophaga ruticilla*	American Redstart	S5B		
		x			*Seiurus aurocapilla*	Ovenbird	S4B		
		x			*Parkesia noveboracensis*	Northern Waterthrush	S5B		
		x			*Geothlypis philadelphia*	Mourning Warbler	S4B		
		x			*Geothlypis trichas*	Common Yellowthroat	S5B		
x					*Cardellina canadensis*	Canada Warbler	S4B	THR	SC
		x			*Piranga olivacea*	Scarlet Tanager	S4B		
		x			*Pipilo erythrophthalmus*	Eastern Towhee	S4B		
		x			*Spizella passerina*	Chipping Sparrow	S5B		
		x			*Spizella pusilla*	Field Sparrow	S4B		
		x			*Pooecetes gramineus*	Vesper Sparrow	S4B		
		x			*Passerculus sandwichensis*	Savannah Sparrow	S4B		
		x			*Ammodramus savannarum*	Grasshopper Sparrow	S4B	SC	SC
		x			*Melospiza melodia*	Song Sparrow	S5B		
		x			*Melospiza georgiana*	Swamp Sparrow	S5B		
		x			*Zonotrichia albicollis*	White-throated Sparrow	S5B		
		x			*Junco hyemalis*	Dark-eyed Junco	S5B		
		x			*Cardinalis cardinalis*	Northern Cardinal	S5		
		x			*Pheucticus ludovicianus*	Rose-breasted Grosbeak	S4B		
		x			*Passerina cyanea*	Indigo Bunting	S4B		
x	x	x			*Dolichonyx oryzivorus*	Bobolink	S4B	THR	THR
		x			*Agelaius phoeniceus*	Red-winged Blackbird	S4		
x	x	x			*Sturnella magna*	Eastern Meadowlark	S4B	THR	THR
		x			*Quiscalus quiscula*	Common Grackle	S5B		
		x			*Molothrus ater*	Brown-headed Cowbird	S4B		
		x			*Icterus galbula*	Baltimore Oriole	S4B		
		x			*Haemorhous purpureus*	Purple Finch	S4B		
		x			*Haemorhous mexicanus*	House Finch	SNA		
		x			*Loxia curvirostra*	Red Crossbill	S4B		
		x			*Loxia leucoptera*	White-winged Crossbill	S5B		
		x			*Coccothraustes vespertinus*	Evening Grosbeak	S4B	Special Concern	
Mammals									
				x	*Sorex cinereus*	Masked Shrew	S5		
				x	*Sorex fumeus*	Smoky Shrew	S5		

Table C2: Natural heritage background review for the Kanata LRT study area

MNRF	NHIC	OBBA	ORAA	AMO	SCIENTIFIC NAME	COMMON NAME	S-RANK	SARA (Schedule 1)	SARO
				x	*Sorex hoyi*	Pygmy Shrew	S4		
				x	*Blarina brevicauda*	Northern Short-tailed Shrew	S5		
				x	*Condylura cristata*	Star-nosed Mole	S5		
x				x	*Myotis lucifugus*	Little Brown Myotis	S4	END	END
x					*Myotis leibii*	Eastern Small-footed Myotis	S2S3	END	END
x				x	*Myotis septentrionalis*	Northern Myotis	S3	END	END
				x	*Lasionycteris noctivagans*	Silver-haired Bat	S4		
x					*Perimyotis subflavus*	Tricolored Bat	S3?	END	END
				x	*Eptesicus fuscus*	Big Brown Bat	S4		
				x	*Lasiurus borealis*	Eastern Red Bat	S4		
				x	*Lasiurus cinereus*	Hoary Bat	S4		
				x	*Sylvilagus floridanus*	Eastern Cottontail	S5		
				x	*Lepus americanus*	Snowshoe Hare	S5		
				x	*Tamias striatus*	Eastern Chipmunk	S5		
				x	*Marmota monax*	Woodchuck	S5		
				x	*Sciurus carolinensis*	Eastern Gray Squirrel	S5		
				x	*Tamiasciurus hudsonicus*	Red Squirrel	S5		
				x	*Glaucomys volans*	Southern Flying Squirrel	S4	NAR	NAR
				x	*Glaucomys sabrinus*	Northern Flying Squirrel	S5		
				x	*Castor canadensis*	Beaver	S5		
				x	*Peromyscus maniculatus*	Deer Mouse	S5		
				x	*Peromyscus leucopus*	White-footed Mouse	S5		
				x	*Myodes gapperi*	Southern Red-backed Vole	S5		
				x	*Microtus pennsylvanicus*	Meadow Vole	S5		
				x	*Ondatra zibethicus*	Muskrat	S5		
				x	*Rattus norvegicus*	Norway Rat	SNA		
				x	*Mus musculus*	House Mouse	SNA		
				x	*Zapus hudsonius*	Meadow Jumping Mouse	S5		
				x	*Napaeozapus insignis*	Woodland Jumping Mouse	S5		
				x	*Erethizon dorsatum*	Porcupine	S5		
				x	*Canis latrans*	Coyote	S5		
				x	*Vulpes vulpes*	Red Fox	S5		
				x	*Ursus americanus*	American Black Bear	S5	NAR	NAR
				x	*Procyon lotor*	Northern Raccoon	S5		
				x	*Mustela erminea*	Ermine	S5		
				x	*Mustela frenata*	Long-tailed Weasel	S4		
				x	*Neovison vison*	American Mink	S4		
				x	*Mephitis mephitis*	Striped Skunk	S5		

Table C2: Natural heritage background review for the Kanata LRT study area

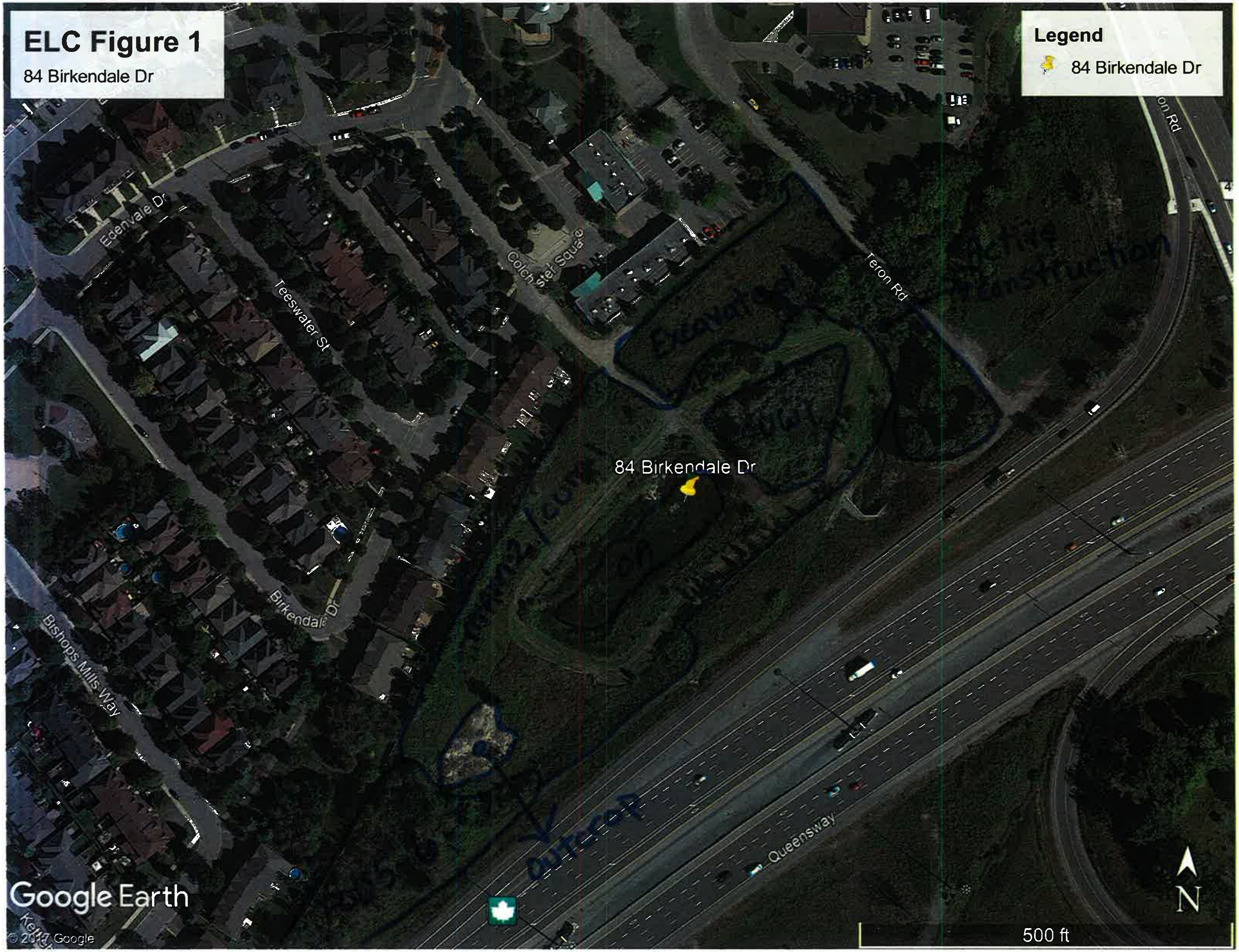
MNRF	NHIC	OBBA	ORAA	AMO	SCIENTIFIC NAME	COMMON NAME	S-RANK	SARA (Schedule 1)	SARO
				x	*Lontra canadensis*	North American River Otter	S5		
				x	*Odocoileus virginianus*	White-tailed Deer	S5		

Status and Acronymns Definition
MNRF: Ministry of Natural Resources and Forestry
NHIC: Natural Heritage Information Centre
OBBA: Ontario Breeding Bird Atlas
ORAA: Ontario Reptile and Amphibian Atlas
AMO: Atlas of the Mammals of Ontario
SARO: Species at Risk in Ontario
SARA: Species at Risk Act
END: Endangered
THR: Threatened
SC: Special Concern
NAR: Not at Risk
DD: Data Deficient
Provincial Status
S1: Critically Imperiled - Critically imperilled in the province (often 5 or fewer occurrences)
S2: Imperiled - Imperiled in the province, very few populations (often 20 or fewer)
S3: Vulnerable - Vulnerable in the province, relatively few populations (often 80 or fewer)
S4: Appaently Secure - Uncommon but not rare
S5: Secure - Common, widespread, and abundant in the province
SX: Presumed Extirpated
SH: Possibly Extirpated (Historical)
SNR: Unranked
SU: Unrankable - Curently unrankable due to a lack of information
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
S#B: Breeding status rank
S#N: Non-breeding status rank
?: Indicates uncertainty in the assigned rank
SE: Indicates that a species is exotic and not native in Ontario

Taxon	Common Name	Scientific Name	Background Source	Status under Ontario *Endangered Species Act, 2007*	Status under federal *Species at Risk Act* (SARA)	Habitat Requirements	Potential to Occur in the study area (Y/N)	Rationale for Potential to Occur in the Study Area
Plants	Butternut	*Juglans cinerea*	MNRF (2017); NHIC (2017); pers. comm MacPherson (2018)	Endangered	Endangered (Schedule 1)	In Ontario, the Butternut generally grows alone or in small groups in deciduous forests, in moist soil; intolerant of shade (MNR 2000).	Yes	Suitable habitat is present within the study area. MNRF response indicates potential. Field investigations and personal communication with Amy MacPherson (2018) confirmed the presence of Butternut within the study area.
Insects	Monarch	*Danaus plexippus*	MNRF (2017)	Special Concern	Special Concern (Schedule 1)	A variety of habitats where milkweed species are present including meadows, old fields, and roadsides (MNR 2000).	Yes	Suitable habitat present within the study area. MNRF response indicates potential.
	Rusty-patched Bumble Bee	*Bombus affinis*	MNRF (2017)	Endangered	Endangered (Schedule 1)	Inhabits open farmland, urban environments, savannahs, open woods, and sand dunes (SARO 2018).	No	MNRF response indicates potential however the extent of this species range is southern Ontario and no known occurences have been documented for the Ottawa area (SARO 2018). Personal communication with Amy MacPherson (2018) also indicated that the nearest known population is in southwestern Ontario; > 600 km from Ottawa, Ontario.
	West Virginia White	*Pieris virginiensis*	MNRF (2017)	Special Concern		Inhabits moist, deciduous woodlands, and requires a small spring ephemeral plant, toothwort, as it is the larvae's only food source (SARO 2018).	Yes	Suitable habitat of deciduous woodlands are present within the study area. But subsequent field studies to determine the presence of toothwort may be required. MNRF response indicates potential.
Fish	Bridle Shiner	*Notropis bifrenatus*	MNRF (2017)	Special Concern	Special Concern (Schedule 1)	Prefer clear unpoluuted streams, rivers, and lakes with dense vegetation. They prefer warm water habitats where substrate is sand, silt, or organics (SARO 2018).	Yes	Suitable habitst is present in the study area. This species has been identified to occur within Poole Creek (pers. comm. MacPherson 2018). The MNRF response has also indicated potential.
	River Redhorse	*Moxostoma carinatum*	MNRF (2017)	Special Concern	Special Concern (Schedule 1)	River redhorse prefer medium- to large-sized rivers. Preference for shallow areas with moderate to swift flow, riffle-run habitats and coarse substrates (e.g., gravel, cobble). Prefers fast-flowing, clear rivers over rocky substrate (MNR 2000).	Yes	Suitable habitat is present within the study area. Identified by DFO SAR mapping.
	Lake Sturgeon	*Acipenser fulvescens*	MNRF (2017); NHIC (2017)	Threatened		Inhabits larger rivers and lakes with a depth of >30 ft. deep (SARO 2018).	No	Suitable habitat of large rivers and lakes are absent within the study area. This species does not have potential to occur within the study area.
	American Eel	*Anguilla rostrata*	MNRF (2017); NHIC (2017); Pers. comm MacPherson (2018)	Endangered		Has a broad diversity of habitats; from salt to fresh water, from large lakes to small rivers (SARO 2018).	Yes	Suitable habitat of rivers and creeks are present within the study area. Also confirmed present in Poole Creek by MVCA (pers. comm. MacPherson 2018). This species has the potential to occur within the study area.
Amphibians	Western Chorus Frog	*Pseudacris triseriata*	ORAA (2017)	Not at Risk	Threatened (Schedule 1)	Roadside ditches or temporary ponds in fields; swamps or wet meadows; woodland or open country with cover and moisture; small ponds and temporary pools. Requires vernal (non-permanent) pools for breeding (MNR 2000).	Yes	Suitable habitat is present within the study area. This species has the potential to occur within the study area.
Reptiles	Blanding's Turtle	*Emydoidea blandingii*	MNRF (2017); NHIC (2017); ORAA (2017); pers. comm. MacPherson (2018)	Threatened	Threatened (Schedule 1)	Critical habitat features include wetlands, watercourses, and water bodies within 2 km of an occurrence record, plus upland terrestrial habitat up to 240 m from those features. Quiet lakes, streams and wetlands with abundant emergent vegetation; also frequently occurs in adjacent upland forests (MNR 2000).	Yes	Suitable habitat is present within the study area. MNRF response indicate potential. Personal communication with Amy MacPherson identified occurrence at Upper Poole Creek, Carp River, and in wetland north of Wesley Clover Park.
	Snapping Turtle	*Chelydra serpentina*	MNRF (2017); NHIC (2017); ORAA (2017)	Special Concern	Special Concern (Schedule 1)	The preferred habitat is slow-moving water with a soft mud bottom and dense aquatic vegetation. Nest in soft gravel, including gravel roadside shoulders (MNR 2000).	Yes	Suitable habitat is present within the study area. NHIC search result and MNRF response indicate potential.
	Northern Map Turtle	*Graptemys geographica*	MNRF (2017); ORAA (2017)	Special Concern	Special Concern (Schedule 1)	Inhabits rivers and lakeshores where is basks on emergent logs or rocks in spring or summer. In winter, hibernates on the bottom of deep, slow-moving sections of rivers (SARO 2017).	No	Suitable habitat in the form of large open rivers is absent from the study area as confirmed by Amy MacPherson (pers. comm. 2018).
	Eastern Milksnake	*Lampropeltis triangulum*	NHIC (2017); ORAA (2017)	Not at Risk	Special Concern (Schedule 1)	Use open habitats as rocky outcrops, fields, and forest edges (Ontario Nature 2016).	Yes	Suitable habitat is present within the study area. This species has the potential to occur.
	Least Bittern	*Ixobrychus exilis*	MNRF (2017); OBBA (2005)	Threatened	Threatened (Schedule 1)	Deep marshes, swamps, bogs; marshy borders of lakes, ponds, streams, ditches; dense emergent vegetation of cattail, bulrush, sedge; nests in cattails; intolerant of loss of habitat and human disturbance (MNR 2000).	No	MNRF response and OBBA record indicate potential. However, limited suitable habitat present within the study area and it is unlikely for this species to occur.
	Bald Eagle	*Haliaeetus leucocephalus*	OBBA (2005)	Special Concern	Not at Risk	Nests in forests near a major lake or river (SARO 2018).	No	Suitable habitat is absent within the study area and it is unlikely for this species to occur.
	Peregrine Falcon	*Falco peregrinus*	MNRF (2017)	Special Concern	Special Concern (Schedule 1)	Nest on tall, steep cliff ledges that are in proximity to large waterbodies. This species has adapted to urban environments and also nest on tall buildings within inner cities (SARO 2018).	No	Suitable habitat is absent within the study area and it is unlikely for this species to occur.
	Black Tern	*Chlidonias niger*	MNRF (2017)	Special Concern	Not at Risk	Mainly nest in the edges of shallow marshes along the Great Lakes (SARO 2018).	No	Suitable habitat is absent within the study area and it is unlikely for this species to occur.
	Short-eared Owl	*Asio flammeus*	MNRF (2017)	Special Concern	Special Concern (Schedule 1)	Grasslands, open areas or meadows that are grassy or bushy; marshes, bogs or tundra; both diurnal and nocturnal habits; ground nester; requires 75-100 ha of contiguous open habitat (MNR 2000).	No	There is limited contiguous suitable habitat present within the study area. Therefore, it is unlikely for this species to occur.
	Common Nighthawk	*Chordeiles minor*	MNRF (2017); OBBA (2007)	Special Concern	Threatened (Schedule 1)	Open ground; clearings in dense forests; ploughed fields; gravel beaches or barren areas with rocky soils; open woodlands; flat gravel roofs (MNR 2000).	Yes	Suitable habitat in the form of open ground, clearings, and ploughed fields is present within the study area. There is potential for this species to occur within the study area.

Taxon	Common Name	Scientific Name	Background Source	Status under Ontario *Endangered Species Act, 2007*	Status under federal *Species at Risk Act* (SARA)	Habitat Requirements	Potential to Occur in the study area (Y/N)	Rationale for Potential to Occur in the Study Area
Birds	Eastern Whip-poor-will	*Antrostomus vociferus*	MNRF (2017); OBBA (2007)	Threatened	Threatened (Schedule 1)	Dry, open, deciduous woodlands of small to medium trees; oak or beech with lots of clearings and shaded leaf litter; wooded edges, forest clearings with little herbaceous growth; associated with >100 ha forests; may require 500 to 1000 ha to maintain population (MNR 2000).	No	Limited suitable habitat present within the study area and unlikely for this species to occur.
	Chimney Swift	*Chaetura pelagica*	MNRF (2017), OBBA (2007)	Threatened	Threatened (Schedule 1)	Commonly found in urban areas near buildings; less commonly, nests in large hollow trees (>60 cm dbh), crevices of rock cliffs, historic chimneys; highly gregarious; feeds over open water (MNR 2000).	No	Limited suitable habitat within the study area and unlikely for this species to occur.
	Red-headed Woodpecker	*Melanerpes erythrocephalus*	MNRF (2017)	Special Concern	Threatened (Schedule 1)	Inhabits open woodlands and edges; found in parks, golf courses, and cemetaries (SARO 2018).	Yes	Suitable habitat is present within the study area and there is potential for this species to occur.
	Eastern Wood-pewee	*Contopus virens*	OBBA (2007)	Special Concern	Special Concern (Schedule 1)	Open, deciduous, mixed or coniferous forest; predominated by oak with little understory; forest clearings, edges; farm woodlots, parks (MNR 2000).	Yes	Suitable habitat is present within the study area and there is potential for this species to occur.
	Bank Swallow	*Riparia riparia*	MNRF (2017); OBBA (2007)	Threatened	Threatened (Schedule 1)	Colonial nesters that build nests near water in steep sand, dirt, or gravel banks, in burrows dug near the top of the bank, including road embankments and other man-made settings (MNR 2000).	Yes	Suitable habitat is present within the study area; MNRF response and OBBA record also indicate high potential.
	Barn Swallow	*Hirundo rustica*	MNRF (2017); OBBA (2007)	Threatened	Threatened (Schedule 1)	Farmlands or rural areas; cliffs, caves, rock niches; buildings or other man-made structures for nesting; typically feeds in open country near body of water (MNR 2000).	Yes	Suitable habitat is present within the study area. MNRF response and OBBA record indicate potential.
	Wood Thrush	*Hylocichla mustelina*	OBBA (2007)	Special Concern	Threatened (Schedule 1)	Carolinian and Great Lakes-St. Lawrence forest zones; undisturbed moist mature deciduous or mixed forest with deciduous sapling growth; near pond or swamp; hardwood forest edges; must have some trees higher than 12m (MNR 2000).	Yes	Suitable habitat is present within the study area. MNRF response and OBBA record indicate potential.
	Golden-winged Warbler	*Vermivora chrysoptera*	OBBA (2007)	Special Concern	Threatened (Schedule 1)	Nests in areas with young shrubs surrounded by mature forests. They also prefer recently disturbed areas; field edges, hydro corridors, etc (SARO 2018).	Yes	Suitable habitat in the form of field edges and hydro corridors is present within the study area. There is potential for this species to occur.
	Canada Warbler	*Cardellina canadensis*	MNRF (2017)	Special Concern	Threatened (Schedule 1)	Breeds in a range of wet forest types consisting of deciduous and coniferous canopy cover. It requires dense shrub and understorey layer to conceal their nests (SARO 2018).	No	Suitable habitat is absent from the study area as wet forests/swamps with a dense understorey do not occur.
	Grasshopper Sparrow	*Ammodramus savannarum*	OBBA (2007)	Special Concern	Special Concern (Schedule 1)	Breeds within open grassland habitats as well as hayfields, pastures, alvars, and prairies preferring areas that are sparsely vegetated (SARO 2018).	Yes	Suitable hayfield habitat may be present within the study area depending on future crop production and rotation. There is minimal potential for this species to occur.
	Bobolink	*Dolichonyx oryzivorus*	MNRF (2017); NHIC (2017); OBBA (2007)	Threatened	Threatened (Schedule 1)	Large, open expansive grasslands (>10 ha) with dense ground cover. Bobolinks often build their small nests on the ground in dense grasses (MNR 2000).	Yes	Suitable habitat is present within the study area. NHIC search result, MNRF response and OBBA record indicate potential.
	Eastern Meadowlark	*Sturnella magna*	MNRF (2017); NHIC (2017); OBBA (2007)	Threatened	Threatened (Schedule 1)	Open, grassy meadows, farmland, pastures, hayfields or grasslands with elevated singing perches; cultivated land and weedy areas with trees; old orchards with adjacent, open grassy areas >5 ha in size (MNR 2000).	Yes	Suitable habitat is present within the study area. NHIC search result, MNRF response and OBBA record indicate potential.
Mammals	Little Brown Myotis	*Myotis lucifugus*	MNRF (2017); AMO (1994)	Endangered	Endangered (Schedule 1)	Roosts in hollow trees in forested communities or buildings, feeds primarily in wetlands, forest edges (MNR 2000).	Yes	Suitable habitat is present within the study area. MNRF response indicates potential.
	Eastern Small-footed Myotis	*Myotis leibii*	MNRF (2017)	Endangered		Roost in a variety of habitats; rock outcrops, buildings, under bridges, or hollow trees. This species of bat change roosting locations daily (SARO 2018).	Yes	Suitable habitat is present within the study area. MNRF response indicates potential.
	Tricolored Bat	*Perimyotis subflavus*	MNRF (2017)	Endangered	Endangered (Schedule 1)	Inhabits forested areas where it forms day roosts and maternity colonies in mature forests. Occasionally it occupies barns or other structures. It is very rare with scattered distribution (SARO 2018).	Yes	Suitable habitat is present within the study area. MNRF response indicates potential.
	Northern Myotis	*Myotis septentrionalis*	MNRF (2017); AMO (1994)	Endangered	Endangered (Schedule 1)	Roosts in houses or manmade structures but prefers hollow trees or under loose bark; hunts within forests, below canopy (MNR 2000).	Yes	Suitable habitat is present within the study area. MNRF response indicates potential.

APPENDIX D: Field Data and Forms



ELC Figure 1
84 Birkendale Dr
Legend
84 Birkendale Dr
Edenvale Dr
Teeswater St
Colchester Square
Teron Rd
Birkendale Dr
Bishops Mills Way
Queensway
84 Birkendale Dr
Excavated
Active construction
outcrop
Google Earth
© 2017 Google
500 ft
N

KANATA LRT — 476274 3°C, 30% cloud, 2 wind, no precip.

ELC
COMMUNITY DESCRIPTION & CLASSIFICATION

SITE: 84 Birkendale		POLYGON: 1	
SURVEYOR(S): A. Orr	DATE: Nov 24, 2017	TIME: start 9am	finish
UTMZ:	UTME:	UTMN:	

POLYGON DESCRIPTION

SYSTEM	SUBSTRATE	TOPOGRAPHIC FEATURE	HISTORY	PLANT FORM	COMMUNITY
G TERRESTRIAL G WETLAND G AQUATIC	G ORGANIC G MINERAL SOIL G PARENT MIN. G ACIDIC BEDRK. G BASIC BEDRK. G CARB. BEDRK.	G LACUSTRINE G RIVERINE G BOTTOMLAND G TERRACE G VALLEY SLOPE G TABLELAND G ROLL. UPLAND G CLIFF G TALUS G CREVICE / CAVE G ALVAR G ROCKLAND G BEACH / BAR G SAND DUNE G BLUFF	G NATURAL G CULTURAL	G PLANKTON G SUBMERGED G FLOATING-LVD. G GRAMINOID G FORB G LICHEN G BRYOPHYTE G DECIDUOUS G CONIFEROUS G MIXED	G LAKE G POND G RIVER G STREAM G MARSH G SWAMP G FEN G BOG G BARREN G MEADOW G PRAIRIE G THICKET G SAVANNAH G WOODLAND G FOREST G PLANTATION
SITE			**COVER**		
G OPEN WATER G SHALLOW WATER G SURFICIAL DEP. G BEDROCK			G OPEN G SHRUB G TREED		

STAND DESCRIPTION:

	LAYER	HT	CVR	SPECIES IN ORDER OF DECREASING DOMINANCE (up to 4 sp) (>> MUCH GREATER THAN; > GREATER THAN; = ABOUT EQUAL TO)
1	CANOPY	2	2	SALIX-SP > PINSTRO > Poplar > ULMAMER.
2	SUB-CANOPY	3	2	RHACATH > CORRACE = RHAHIRT
3	UNDERSTOREY	4	3	PHAARUN = PHRAUST = TYPANGU
4	GRD. LAYER	5	3	TANSY > LYTSALI = DAUCARO.

HT CODES: 1 = >25 m 2 = 10<HT≤25 m 3 = 2<HT≤10 m 4 = 1<HT≤2 m 5 = 0.5<HT≤1 m 6 = 0.2<HT≤0.5 m 7 = HT<0.2 m

CVR CODES 0= NONE 1= 0% < CVR ≤ 10% 2= 10 < CVR ≤ 25% 3= 25 < CVR ≤ 60% 4= CVR > 60%

STAND COMPOSITION:	BA:

SIZE CLASS ANALYSIS:		< 10		10 - 24		25 - 50		> 50
STANDING SNAGS:		< 10		10 - 24		25 - 50		> 50
DEADFALL / LOGS:		< 10		10 - 24		25 - 50		> 50

ABUNDANCE CODES: N = NONE R = RARE O = OCCASIONAL A = ABUNDANT

COMM. AGE :		PIONEER		YOUNG		MID-AGE		MATURE		OLD GROWTH

SOIL ANALYSIS:

TEXTURE:	DEPTH TO MOTTLES / GLEY	g =	G=
MOISTURE:	DEPTH OF ORGANICS:		(cm)
HOMOGENEOUS / VARIABLE	DEPTH TO BEDROCK:		(cm)

COMMUNITY CLASSIFICATION:

		ELC CODE
COMMUNITY CLASS:		
COMMUNITY SERIES:		
ECOSITE:		
VEGETATION TYPE:	Mineral Meadow Marsh.	MAM 2
INCLUSION	Mineral Cultural Woodland	CUW1
COMPLEX	Mineral Cultural Meadow	CUM1

Notes: Incidentals: 20-30 MALL in OA, CAGO (flyover), CORA.

ELC
STAND CHARACTERISTICS

SITE:
POLYGON:
DATE:
SURVEYOR(S):

TREE TALLY BY SPECIES:

PRISM FACTOR

SPECIES	TALLY 1	TALLY 2	TALLY 3	TALLY 4	TALLY 5	TOTAL	REL. AVG
TOTAL							100
BASAL AREA (BA)							
DEAD							

STAND COMPOSITION:

~~COMMUNITY PROFILE DIAGRAM~~ NOTES:

Active construction to east of property; installation of culverts.

- Rare cavity tree present
- OA and surrounding creeks may offer potential wintering/nesting turtle habitat. Gravel path adjacent to OA.
- Highly disturbed area and mosaic landscape due to development of stormwater pond.
- Large outcrop to the west of property, alvar species potential - may need a 3-season veg. survey to determine rare species.

Notes:

OA feature = Stone substrate & clear

Potential Snake hibernacula: #1 UTM: 0430338/5018898 (342)
#2: UTM: 0430229/5018795 (343)

Photos: 555 – 572

pg. 1

ELC SOILS ONTARIO

SITE:
POLYGON:
DATE:
SURVEYOR(S):

	P/A	PP	Dr	Position	Slope: Aspect	Slope: %	Slope: Type	Class	Z	UTM: EASTING	UTM: NORTHING
1											
2											
3											
4											
5											

SOIL	1	2	3	4	5
TEXTURE x HORIZON					
A TEXTURE					
COURSE FRAGMENTS					
B TEXTURE					
COURSE FRAGMENTS					
C TEXTURE					
COURSE FRAGMENTS					
EFFECTIVE TEXTURE					
SURFACE STONINESS					
SURFACE ROCKINESS					
DEPTH TO / OF					
MOTTLES					
GLEY					
BEDROCK					
WATER TABLE					
CARBONATES					
DEPTH OF ORGANICS					
PORE SIZE DISC #1					
PORE SIZE DISC #2					
MOISTURE REGIME					
SOIL SURVEY MAP					
LEGEND CLASS					

ELC PLANT SPECIES LIST

SITE:
POLYGON:
DATE:
SURVEYOR(S):

LAYERS: 1 = CANOPY 2 = SUB-CANOPY 3 = UNDERSTOREY 4 = GROUND (GRD.) LAYER
ABUNDANCE CODES: R = RARE O = OCCASIONAL A = ABUNDANT D = DOMINANT

SPECIES CODE	LAYER 1	LAYER 2	LAYER 3	LAYER 4	COL.
lansV				A	
PHAARUN				A	
DAUCARO					
Galium-sp					
TAROFFI					
PHRAUST				A	
TYPLATI					
SOLALTI					
RUBIDAE					
ANT-SP					
Mullien					
VITRIPA					
CORSTOL					
RUBIDAE					
VIBTRIL					
TYPANGU				A	
ROSA_SP					
ASCSVRI					
CIRRACE					
LYTSALI				A	
ARCMINU					
RUMCRIS					
PINSTRO	O				
Salix-sp	D				
Silver poplar					
Potentilla-sp					
PICGLAU					
Ash-sp					
ULMAMER					
Norway maple					
RHACATH					

SPECIES CODE	LAYER 1	LAYER 2	LAYER 3	LAYER 4	COL.
LARLARI					
FRANIGR					
RHUHIRT					
POPGRAN					

KANATA LRT – 476274

ELC COMMUNITY DESCRIPTION & CLASSIFICATION	SITE: 84 Birkendale		POLYGON: 2
	SURVEYOR(S): A. ORR	DATE: Nov 24, 2017	TIME: start 9 a.m. finish
	UTMZ:	UTME:	UTMN:

POLYGON DESCRIPTION

SYSTEM	SUBSTRATE	TOPOGRAPHIC FEATURE	HISTORY	PLANT FORM	COMMUNITY
G TERRESTRIAL G WETLAND G AQUATIC	G ORGANIC G MINERAL SOIL G PARENT MIN. G ACIDIC BEDRK. G BASIC BEDRK. G CARB. BEDRK.	G LACUSTRINE G RIVERINE G BOTTOMLAND G TERRACE G VALLEY SLOPE G TABLELAND G ROLL. UPLAND G CLIFF G TALUS G CREVICE / CAVE G ALVAR G ROCKLAND G BEACH / BAR G SAND DUNE G BLUFF	G NATURAL G CULTURAL	G PLANKTON G SUBMERGED G FLOATING-LVD. G GRAMINOID G FORB G LICHEN G BRYOPHYTE G DECIDUOUS G CONIFEROUS G MIXED	G LAKE G POND G RIVER G STREAM G MARSH G SWAMP G FEN G BOG G BARREN G MEADOW G PRAIRIE G THICKET G SAVANNAH G WOODLAND G FOREST G PLANTATION
SITE			**COVER**		
G OPEN WATER G SHALLOW WATER G SURFICIAL DEP. G BEDROCK			G OPEN G SHRUB G TREED		

STAND DESCRIPTION:

	LAYER	HT	CVR	SPECIES IN ORDER OF DECREASING DOMINANCE (up to 4 sp) (>> MUCH GREATER THAN; > GREATER THAN; ≈ ABOUT EQUAL TO)
1	CANOPY			TILAMER > ACESASA >> PINSTRO
2	SUB-CANOPY			" " "
3	UNDERSTOREY			RUBIDAE
4	GRD. LAYER			AGRGRYP

HT CODES: 1 = >25 m 2 = 10<HT≤25 m 3 = 2<HT≤10 m 4 = 1<HT≤2 m 5 = 0.5<HT≤1 m 6 = 0.2<HT≤0.5 m 7 = HT<0.2 m

CVR CODES 0= NONE 1= 0% < CVR ≤ 10% 2= 10 < CVR ≤ 25% 3= 25 < CVR ≤ 60% 4= CVR > 60%

STAND COMPOSITION:	BA:

SIZE CLASS ANALYSIS:		< 10		10 - 24		25 - 50		> 50
STANDING SNAGS:		< 10		10 - 24		25 - 50		> 50
DEADFALL / LOGS:		< 10		10 - 24		25 - 50		> 50

ABUNDANCE CODES: N = NONE R = RARE O = OCCASIONAL A = ABUNDANT

COMM. AGE :		PIONEER		YOUNG		MID-AGE		MATURE		OLD GROWTH

SOIL ANALYSIS:

TEXTURE:	DEPTH TO MOTTLES / GLEY	g =	G=
MOISTURE:	DEPTH OF ORGANICS:		(cm)
HOMOGENEOUS / VARIABLE	DEPTH TO BEDROCK:		(cm)

COMMUNITY CLASSIFICATION:

		ELC CODE
COMMUNITY CLASS:		
COMMUNITY SERIES:		
ECOSITE:		
VEGETATION TYPE:	Dry-fresh Sugar Maple - Basswood Deciduous	FOD5-6
INCLUSION	Forest Type)	
COMPLEX		

Notes:

ELC STAND CHARACTERISTICS	SITE:
	POLYGON:
	DATE:
	SURVEYOR(S):

TREE TALLY BY SPECIES:

PRISM FACTOR

SPECIES	~~TALLY 1~~	TALLY 2	TALLY 3	TALLY 4	TALLY 5	TOTAL	REL. AVG
TILAMER	D						
PINSTRO							
RHACATH							
RUBIDAE		D					
Malus_sp							
PRA_SP							
SOLALTI							
ACESASH	O						
AGRGRYP							
TOTAL							100
BASAL AREA (BA)							
DEAD							

STAND COMPOSITION:

COMMUNITY PROFILE DIAGRAM

Photos: 565- 566

Notes:

Pg. 3

ELC SOILS ONTARIO

SITE:

POLYGON:

DATE:

SURVEYOR(S):

	P/A	PP	Dr	Slope Position	Slope Aspect	Slope %	Slope Type	Slope Class	Z	UTM EASTING	UTM NORTHING
1											
2											
3											
4											
5											

SOIL	1	2	3	4	5
TEXTURE x HORIZON					
A TEXTURE					
COURSE FRAGMENTS					
B TEXTURE					
COURSE FRAGMENTS					
C TEXTURE					
COURSE FRAGMENTS					
EFFECTIVE TEXTURE					
SURFACE STONINESS					
SURFACE ROCKINESS					
DEPTH TO / OF					
MOTTLES					
GLEY					
BEDROCK					
WATER TABLE					
CARBONATES					
DEPTH OF ORGANICS					
PORE SIZE DISC #1					
PORE SIZE DISC #2					
MOISTURE REGIME					
SOIL SURVEY MAP					
LEGEND CLASS					

ELC PLANT SPECIES LIST

SITE:

POLYGON:

DATE:

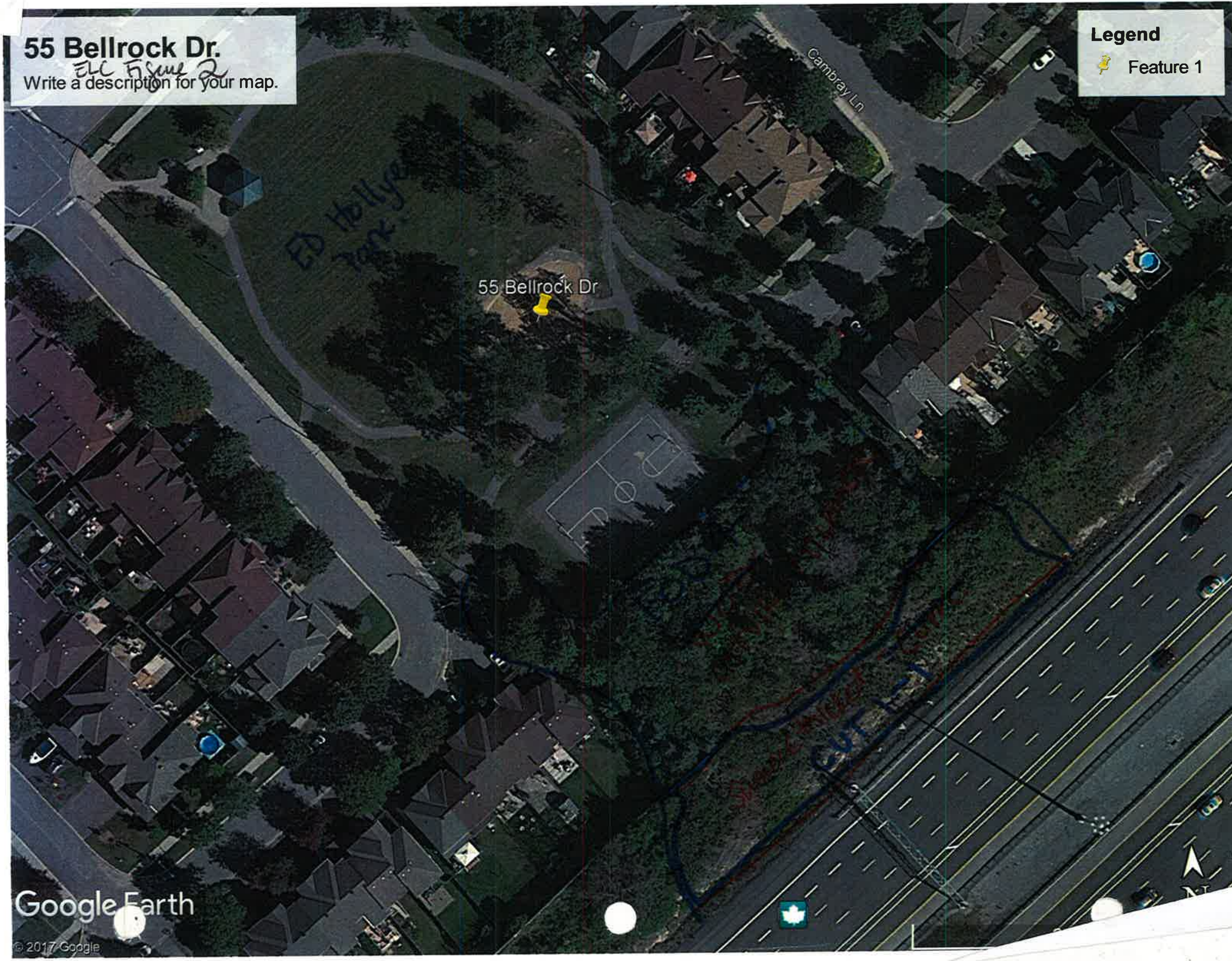
SURVEYOR(S):

LAYERS: 1 = CANOPY 2 = SUB-CANOPY 3 = UNDERSTOREY 4 = GROUND (GRD.) LAYER

ABUNDANCE CODES: R = RARE O = OCCASIONAL A = ABUNDANT D = DOMINANT

SPECIES CODE	LAYER 1	LAYER 2	LAYER 3	LAYER 4	COL.

SPECIES CODE	LAYER 1	LAYER 2	LAYER 3	LAYER 4	COL.


55 Bellrock Dr.
ELC Figure 2
Write a description for your map.
Legend
Feature 1
Cambray Ln
ED Hollyer Park
55 Bellrock Dr
CUT 1-1
Google Earth
© 2017 Google

KANATA - 476274

ELC COMMUNITY DESCRIPTION & CLASSIFICATION	SITE: 55 Bellrock Dr.		POLYGON: ~~2~~ 3
	SURVEYOR(S): A. ORR	DATE: Nov 24 2011	TIME: start / finish
	UTMZ:	UTME:	UTMN:

POLYGON DESCRIPTION

SYSTEM	SUBSTRATE	TOPOGRAPHIC FEATURE	HISTORY	PLANT FORM	COMMUNITY
G TERRESTRIAL G WETLAND G AQUATIC	G ORGANIC G MINERAL SOIL G PARENT MIN. G ACIDIC BEDRK. G BASIC BEDRK. G CARB. BEDRK.	G LACUSTRINE G RIVERINE G BOTTOMLAND G TERRACE G VALLEY SLOPE G TABLELAND G ROLL. UPLAND G CLIFF G TALUS G CREVICE / CAVE G ALVAR G ROCKLAND G BEACH / BAR G SAND DUNE G BLUFF	G NATURAL G CULTURAL	G PLANKTON G SUBMERGED G FLOATING-LVD. G GRAMINOID G FORB G LICHEN G BRYOPHYTE G DECIDUOUS G CONIFEROUS G MIXED	G LAKE G POND G RIVER G STREAM G MARSH G SWAMP G FEN G BOG G BARREN G MEADOW G PRAIRIE G THICKET G SAVANNAH G WOODLAND G FOREST G PLANTATION
SITE			**COVER**		
G OPEN WATER G SHALLOW WATER G SURFICIAL DEP. G BEDROCK			G OPEN G SHRUB G TREED		

STAND DESCRIPTION:

	LAYER	HT	CVR	SPECIES IN ORDER OF DECREASING DOMINANCE (up to 4 sp) (>> MUCH GREATER THAN; > GREATER THAN; = ABOUT EQUAL TO)
1	CANOPY			N/A.
2	SUB-CANOPY			ASTVIRG > TILAMER > ULMAMER
3	UNDERSTOREY			RHACATH > RHOHIRT
4	GRD. LAYER			N/D

HT CODES: 1 = >25 m 2 = 10<HT≤25 m 3 = 2<HT≤10 m 4 = 1<HT≤2 m 5 = 0.5<HT≤1 m 6 = 0.2<HT≤0.5 m 7 = HT<0.2 m

CVR CODES 0= NONE 1= 0% < CVR ≤ 10% 2= 10 < CVR ≤ 25% 3= 25 < CVR ≤ 60% 4= CVR > 60%

STAND COMPOSITION:	BA:

SIZE CLASS ANALYSIS:		< 10		10 - 24		25 - 50		> 50
STANDING SNAGS:		< 10		10 - 24		25 - 50		> 50
DEADFALL / LOGS:		< 10		10 - 24		25 - 50		> 50

ABUNDANCE CODES: N = NONE R = RARE O = OCCASIONAL A = ABUNDANT

COMM. AGE :		PIONEER	✓	YOUNG		MID-AGE		MATURE		OLD GROWTH

SOIL ANALYSIS:

TEXTURE:	DEPTH TO MOTTLES / GLEY	g =	G=
MOISTURE:	DEPTH OF ORGANICS:		(cm)
HOMOGENEOUS / VARIABLE	DEPTH TO BEDROCK:		(cm)

COMMUNITY CLASSIFICATION:

		ELC CODE
COMMUNITY CLASS:		
COMMUNITY SERIES:		
ECOSITE:		
VEGETATION TYPE:	Dry-Fresh Deciduous Forest	FOD4
INCLUSION	Sumac Cultural Thicket	CUT1-1
COMPLEX		

Notes:

ELC STAND CHARACTERISTICS	SITE:
	POLYGON:
	DATE:
	SURVEYOR(S):

TREE TALLY BY SPECIES:

PRISM FACTOR

SPECIES	TALLY 1	TALLY 2	TALLY 3	TALLY 4	TALLY 5	TOTAL	REL. AVG
TOTAL							100
BASAL AREA (BA)							
DEAD							

STAND COMPOSITION:

~~COMMUNITY PROFILE DIAGRAM~~ NOTES:

Exposed bedrock in wooded community. Large cavity tree present.
- Ironwood abundant with regenerating Basswood.
- Young age stand.
- Sumac thicket adjacent to 417

Photos # 573 - 583

Notes:

Potential snake hibernacula: UTM: 0429969/5018566 (344)
Animal burrow: UTM: 0429966/5018560 (345)

_C SOILS ONTARIO

SITE:
POLYGON:
DATE:
SURVEYOR(S):

	P/A	PP	Dr	Position	Aspect	Slope %	Slope Type	Slope Class	UTM Z	UTM EASTING	UTM NORTHING
1											
2											
3											
4											
5											

SOIL	1	2	3	4	5
TEXTURE x HORIZON					
A TEXTURE					
COURSE FRAGMENTS					
B TEXTURE					
COURSE FRAGMENTS					
C TEXTURE					
COURSE FRAGMENTS					
EFFECTIVE TEXTURE					
SURFACE STONINESS					
SURFACE ROCKINESS					
DEPTH TO / OF					
MOTTLES					
GLEY					
BEDROCK					
WATER TABLE					
CARBONATES					
DEPTH OF ORGANICS					
PORE SIZE DISC #1					
PORE SIZE DISC #2					
MOISTURE REGIME					
SOIL SURVEY MAP					
LEGEND CLASS					

ELC PLANT SPECIES LIST

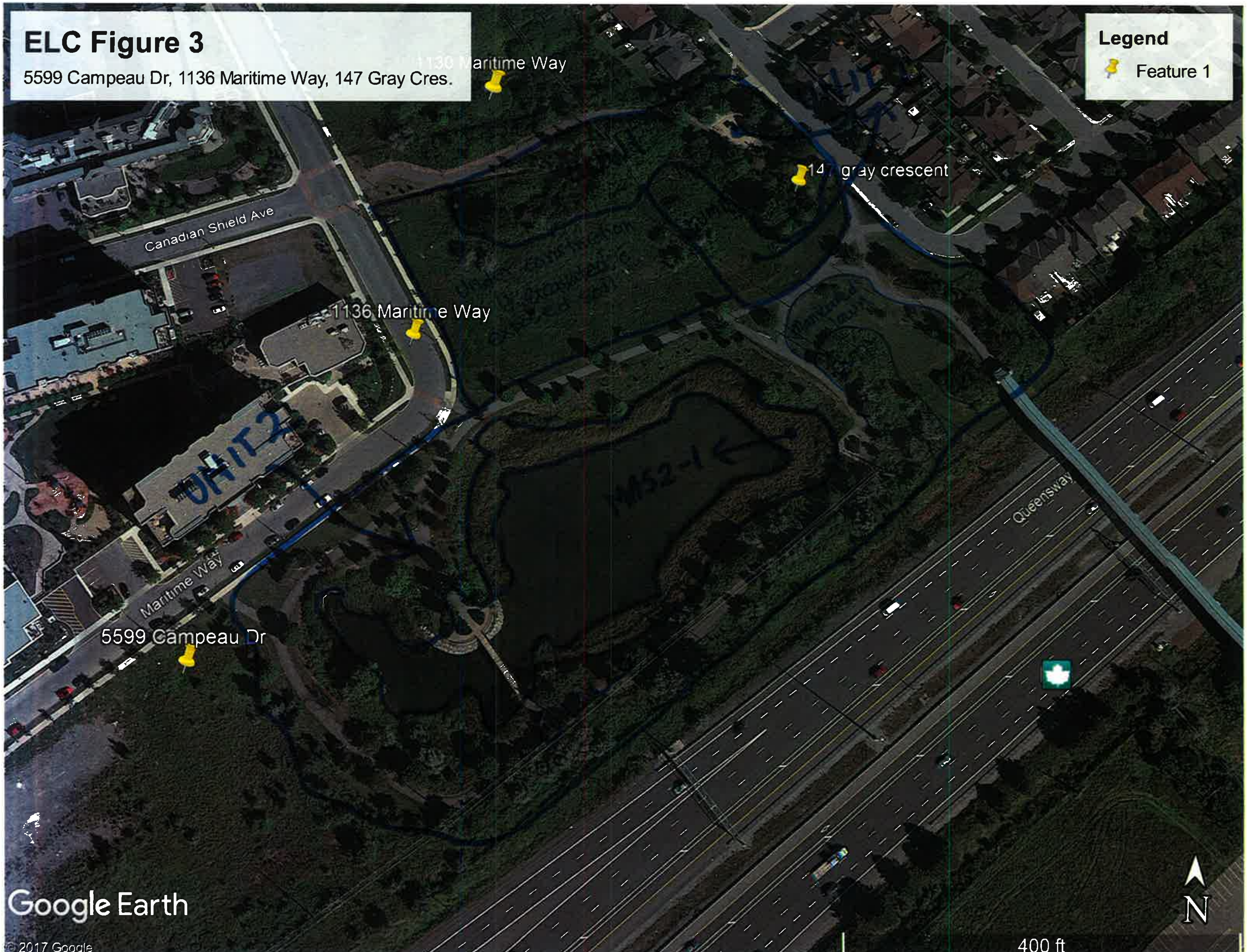
SITE:
POLYGON:
DATE:
SURVEYOR(S):

LAYERS: 1 = CANOPY 2 = SUB-CANOPY 3 = UNDERSTOREY 4 = GROUND (GRD.) LAYER
ABUNDANCE CODES: R = RARE O = OCCASIONAL A = ABUNDANT D = DOMINANT

species in park

SPECIES CODE	LAYER 1	LAYER 2	LAYER 3	LAYER 4	COL.
QUERUBR-P					
Blue spruce-	P				
Lilac - P					
QUEMACR					
ACESASA					
ULMAMER					
ACENEGU					
ULMAMER					
ACESASA					
FRA-SP					
RHACATH			D		
OSTVIRG	O	O			
ANT-SP					
RHUHIRT					
TILAMER		O			
TAROFFI					
Speedwell					
DAUGLOM					
Lilac					
QUEMACR					
ALLPETI					

SPECIES CODE	LAYER 1	LAYER 2	LAYER 3	LAYER 4	COL.



ELC Figure 3
5599 Campeau Dr, 1136 Maritime Way, 147 Gray Cres.
Legend
Feature 1
1130 Maritime Way
147 gray crescent
Canadian Shield Ave
1136 Maritime Way
UNIT 2
MS2-1
Maritime Way
5599 Campeau Dr
Queensway
Google Earth
© 2017 Google
400 ft
N

KANATA LRT - 476274 > 5599 Campeau

ELC COMMUNITY DESCRIPTION & CLASSIFICATION	SITE: 147 Grey, 1130/1136 Maritime		POLYGON: Unit 1
	SURVEYOR(S): A ORR	DATE: NOV 24 2017	TIME: start / finish
	UTMZ:	UTME:	UTMN:

POLYGON DESCRIPTION

SYSTEM	SUBSTRATE	TOPOGRAPHIC FEATURE	HISTORY	PLANT FORM	COMMUNITY
G TERRESTRIAL G WETLAND G AQUATIC	G ORGANIC G MINERAL SOIL G PARENT MIN. G ACIDIC BEDRK. G BASIC BEDRK. G CARB. BEDRK.	G LACUSTRINE G RIVERINE G BOTTOMLAND G TERRACE G VALLEY SLOPE G TABLELAND G ROLL. UPLAND G CLIFF G TALUS G CREVICE / CAVE G ALVAR G ROCKLAND G BEACH / BAR G SAND DUNE G BLUFF	G NATURAL G CULTURAL	G PLANKTON G SUBMERGED G FLOATING-LVD. G GRAMINOID G FORB G LICHEN G BRYOPHYTE G DECIDUOUS G CONIFEROUS G MIXED	G LAKE G POND G RIVER G STREAM G MARSH G SWAMP G FEN G BOG G BARREN G MEADOW G PRAIRIE G THICKET G SAVANNAH G WOODLAND G FOREST G PLANTATION
SITE			**COVER**		
G OPEN WATER G SHALLOW WATER G SURFICIAL DEP. G BEDROCK			G OPEN G SHRUB G TREED		

STAND DESCRIPTION:

	LAYER	HT	CVR	SPECIES IN ORDER OF DECREASING DOMINANCE (up to 4 sp) (>> MUCH GREATER THAN; > GREATER THAN; = ABOUT EQUAL TO)
1	CANOPY			QUEMACR >> TILAMER = ULMAMER
2	SUB-CANOPY			QUEMACR > RHACATH = RHUHIRT
3	UNDERSTOREY			" " "
4	GRD. LAYER			GRASS-SPP > DAUCARO = SOL-SPP

HT CODES: 1 = >25 m 2 = 10<HT≤25 m 3 = 2<HT≤10 m 4 = 1<HT≤2 m 5 = 0.5<HT≤1 m 6 = 0.2<HT≤0.5 m 7 = HT<0.2 m

CVR CODES 0 = NONE 1 = 0% < CVR ≤ 10% 2 = 10 < CVR ≤ 25% 3 = 25 < CVR ≤ 60% 4 = CVR > 60%

STAND COMPOSITION:	BA:

SIZE CLASS ANALYSIS:		< 10		10 - 24		25 - 50		> 50
STANDING SNAGS:		< 10		10 - 24		25 - 50		> 50
DEADFALL / LOGS:		< 10		10 - 24		25 - 50		> 50

ABUNDANCE CODES: N = NONE R = RARE O = OCCASIONAL A = ABUNDANT

COMM. AGE :		PIONEER	YOUNG	MID-AGE	MATURE	OLD GROWTH

SOIL ANALYSIS:

TEXTURE:	DEPTH TO MOTTLES / GLEY	g =	G=
MOISTURE:	DEPTH OF ORGANICS:		(cm)
HOMOGENEOUS / VARIABLE	DEPTH TO BEDROCK:		(cm)

COMMUNITY CLASSIFICATION:

		ELC CODE
COMMUNITY CLASS:		
COMMUNITY SERIES:		
ECOSITE:		
VEGETATION TYPE:	Mineral Cultural Woodland	CUW1
INCLUSION	Mineral Cultural Meadow	CUM1
COMPLEX		

Notes:

ELC STAND CHARACTERISTICS	SITE:
	POLYGON:
	DATE:
	SURVEYOR(S):

TREE TALLY BY SPECIES:

PRISM FACTOR

SPECIES	TALLY 1	TALLY 2	TALLY 3	TALLY 4	TALLY 5	TOTAL	REL. AVG
TOTAL							100
BASAL AREA (BA)							
DEAD							

STAND COMPOSITION:

~~COMMUNITY PROFILE DIAGRAM~~ NOTES:

- Includes Robert Gray Park
- Areas with exposed bedrock
- Large oaks with regenerating oaks in subcanopy and understorey. Oak, buckthorn & sumac in understorey
- Woodland with a complex of cultural thicket & meadow.
- Photos # 584 - 604
- OH feature appears shallow with sandy substrate; clear.

Notes:

ELC SOILS ONTARIO

SITE:
POLYGON:
DATE:
SURVEYOR(S):

	P/A	PP	Dr	Slope Position	Slope Aspect	Slope %	Slope Type	Slope Class	Z	UTM EASTING	UTM NORTHING
1											
2											
3											
4											
5											

SOIL	1	2	3	4	5
TEXTURE x HORIZON					
A TEXTURE					
COURSE FRAGMENTS					
B TEXTURE					
COURSE FRAGMENTS					
C TEXTURE					
COURSE FRAGMENTS					
EFFECTIVE TEXTURE					
SURFACE STONINESS					
SURFACE ROCKINESS					
DEPTH TO / OF					
MOTTLES					
GLEY					
BEDROCK					
WATER TABLE					
CARBONATES					
DEPTH OF ORGANICS					
PORE SIZE DISC #1					
PORE SIZE DISC #2					
MOISTURE REGIME					
SOIL SURVEY MAP					
LEGEND CLASS					

ELC PLANT SPECIES LIST

SITE:
POLYGON:
DATE:
SURVEYOR(S):

LAYERS: 1 = CANOPY 2 = SUB-CANOPY 3 = UNDERSTOREY 4 = GROUND (GRD.) LAYER
ABUNDANCE CODES: R = RARE O = OCCASIONAL A = ABUNDANT D = DOMINANT

SPECIES CODE	LAYER 1	LAYER 2	LAYER 3	LAYER 4	COL.
QUEMACR	A				
TILAMER					
dog-strangling vine					
PINSTRO - planted					
PICABIE					
FRA-SP					
ACESASA					
RUBIDAE					
CIRLUTE					
RHUHIRT					
Mullein					
RUMCRIS					
DAUCARO					
SAL-SP					
SOL-SPP					
ARCMINU					
ULMAMER					
Podocr-SP					
PHAARUN					
FRAVIVI					
VICCRAC					
CIRARVE					
poison ivy					
grass-spp					
AGRGRVP					
RHACATH					
ASCSYRI					
CRAT_SP					
wild parsnip - mod. abund.					
ACESACC					

SPECIES CODE	LAYER 1	LAYER 2	LAYER 3	LAYER 4	COL.

KANATA - 476274 35599 Campeau

ELC COMMUNITY DESCRIPTION & CLASSIFICATION	SITE: 147 Grey, 1130/1136 Maritime		POLYGON: Unit 2
	SURVEYOR(S): A. ORR	DATE: Nov 24, 2017	TIME: start / finish
	UTMZ:	UTME:	UTMN:

POLYGON DESCRIPTION

SYSTEM	SUBSTRATE	TOPOGRAPHIC FEATURE	HISTORY	PLANT FORM	COMMUNITY
G TERRESTRIAL G WETLAND G AQUATIC	G ORGANIC G MINERAL SOIL G PARENT MIN. G ACIDIC BEDRK. G BASIC BEDRK. G CARB. BEDRK.	G LACUSTRINE G RIVERINE G BOTTOMLAND G TERRACE G VALLEY SLOPE G TABLELAND G ROLL. UPLAND G CLIFF G TALUS G CREVICE / CAVE G ALVAR G ROCKLAND G BEACH / BAR G SAND DUNE G BLUFF	G NATURAL G CULTURAL	G PLANKTON G SUBMERGED G FLOATING-LVD. G GRAMINOID G FORB G LICHEN G BRYOPHYTE G DECIDUOUS G CONIFEROUS G MIXED	G LAKE G POND G RIVER G STREAM G MARSH G SWAMP G FEN G BOG G BARREN G MEADOW G PRAIRIE G THICKET G SAVANNAH G WOODLAND G FOREST G PLANTATION
SITE			**COVER**		
G OPEN WATER G SHALLOW WATER G SURFICIAL DEP. G BEDROCK			G OPEN G SHRUB G TREED		

STAND DESCRIPTION:

	LAYER	HT	CVR	SPECIES IN ORDER OF DECREASING DOMINANCE (up to 4 sp) (>> MUCH GREATER THAN; > GREATER THAN; = ABOUT EQUAL TO)
1	CANOPY			ULMAMER = ACESASA = Spruce-SO > PINSTRO
2	SUB-CANOPY			" " "
3	UNDERSTOREY			CORSTOL > unknown Shrub > RHUHIRT = RUBIDAE
4	GRD. LAYER			PHAARUN = SOL-SPP > DAUCARO > VICCRAC.

HT CODES: 1 = >25 m 2 = 10<HT≤25 m 3 = 2<HT≤10 m 4 = 1<HT≤2 m 5 = 0.5<HT≤1 m 6 = 0.2<HT≤0.5 m 7 = HT<0.2 m

CVR CODES 0= NONE 1= 0% < CVR ≤ 10% 2= 10 < CVR ≤ 25% 3= 25 < CVR ≤ 60% 4= CVR > 60%

STAND COMPOSITION:	BA:

SIZE CLASS ANALYSIS:		< 10		10 - 24		25 - 50		> 50
STANDING SNAGS:		< 10		10 - 24		25 - 50		> 50
DEADFALL / LOGS:		< 10		10 - 24		25 - 50		> 50

ABUNDANCE CODES: N = NONE R = RARE O = OCCASIONAL A = ABUNDANT

COMM. AGE:		PIONEER		YOUNG		MID-AGE		MATURE		OLD GROWTH

SOIL ANALYSIS:

TEXTURE:	DEPTH TO MOTTLES / GLEY	g =	G=
MOISTURE:	DEPTH OF ORGANICS:		(cm)
HOMOGENEOUS / VARIABLE	DEPTH TO BEDROCK:		(cm)

COMMUNITY CLASSIFICATION:

		ELC CODE
COMMUNITY CLASS:		
COMMUNITY SERIES:		
ECOSITE:		
VEGETATION TYPE:	Mineral Cultural Woodland.	CUW1
INCLUSION 1	Cattail Mineral Shallow Marsh	MAS2-1
~~COMPLEX~~	> Mineral Cultural Thicket	CUT1

Notes: Inclusion 2

ELC STAND CHARACTERISTICS	SITE:
	POLYGON:
	DATE:
	SURVEYOR(S):

TREE TALLY BY SPECIES:

PRISM FACTOR

SPECIES	TALLY 1	TALLY 2	TALLY 3	TALLY 4	TALLY 5	TOTAL	REL. AVG
TOTAL							100
BASAL AREA (BA)							
DEAD							

STAND COMPOSITION:

~~COMMUNITY PROFILE DIAGRAM~~ NOTES:

- Unit 2 includes parkland, trails, plantings, CUW1, MAS and CUT units. Matrix of landscape due to Stormwater pond and urban intensification.

Notes: Photos # 584 - 604

CAGO

Pg. 8

ELC SOILS ONTARIO

SITE:
POLYGON:
DATE:
SURVEYOR(S):

	Slope								UTM	
	P/A	PP	Dr	Position	Aspect	%	Type	Class	Z	EASTING	NORTHING
1											
2											
3											
4											
5											

SOIL	1	2	3	4	5
TEXTURE x HORIZON					
A TEXTURE					
COURSE FRAGMENTS					
B TEXTURE					
COURSE FRAGMENTS					
C TEXTURE					
COURSE FRAGMENTS					
EFFECTIVE TEXTURE					
SURFACE STONINESS					
SURFACE ROCKINESS					
DEPTH TO / OF					
MOTTLES					
GLEY					
BEDROCK					
WATER TABLE					
CARBONATES					
DEPTH OF ORGANICS					
PORE SIZE DISC #1					
PORE SIZE DISC #2					
MOISTURE REGIME					
SOIL SURVEY MAP					
LEGEND CLASS					

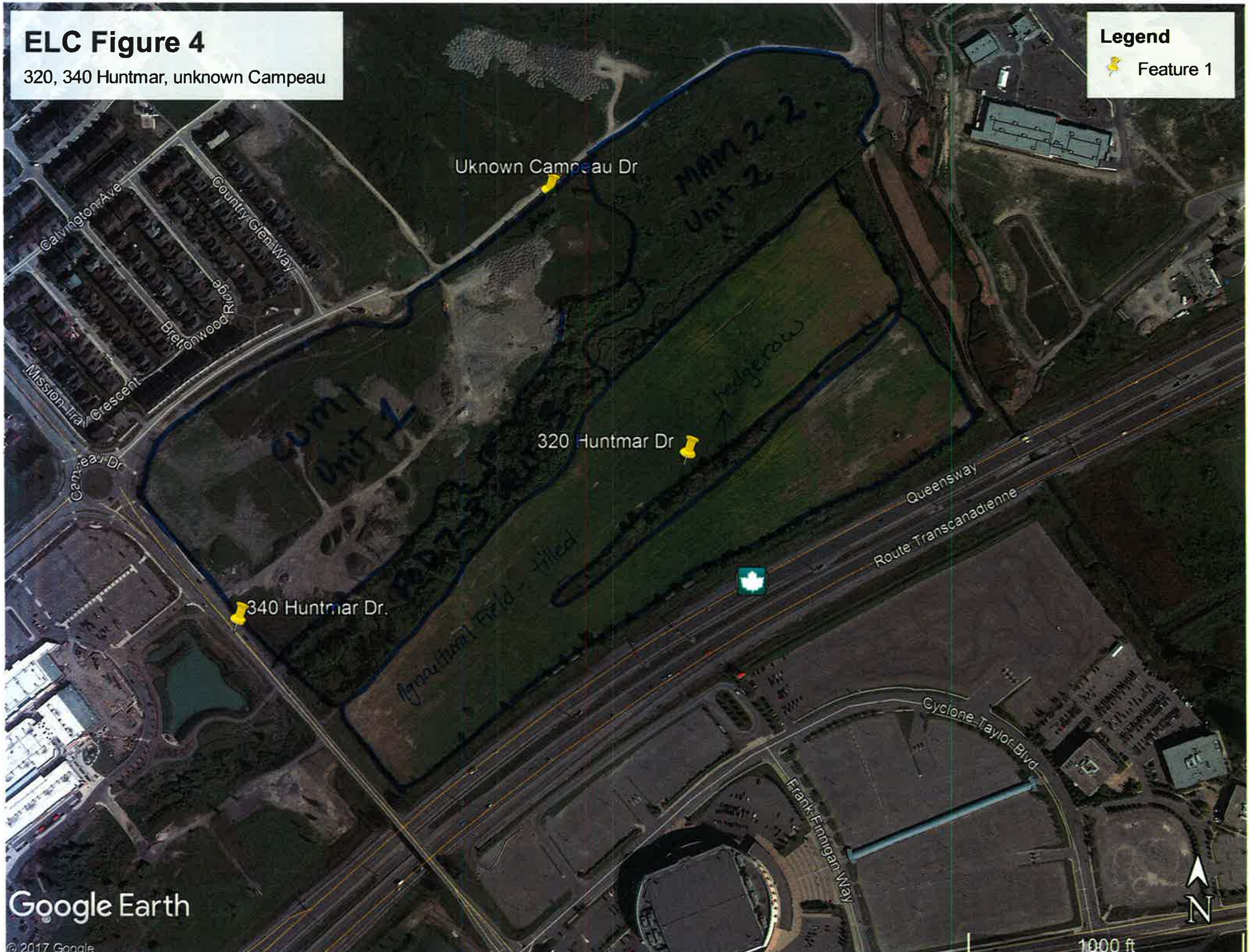
ELC PLANT SPECIES LIST

SITE:
POLYGON:
DATE:
SURVEYOR(S):

LAYERS: 1 = CANOPY 2 = SUB-CANOPY 3 = UNDERSTOREY 4 = GROUND (GRD.) LAYER
ABUNDANCE CODES: R = RARE O = OCCASIONAL A = ABUNDANT D = DOMINANT

SPECIES CODE	LAYER 1	LAYER 2	LAYER 3	LAYER 4	COL.
CORSTOL		A	A		
ASCSYRI					
ULMAMER					
RHUHIRT					
unknown shrub - ninebark?					
DAUGLOM					
PHAARUN					
SOL_SP					
Salix-sp					
ACESASA					
VICCRAC					
Mullein					
CIRARVE					
DAUCARO					
unknown_sp					
Malus-sp					
PINSTRO					
LILAC					
VITRIPA					
TYPANGU					
CIRVULG					
CIRLUTE					
Spruce-sp					
RUBIDAE					
LYTSALI					
ARCMINU					
ALLPETI					
ROSA-sp					

SPECIES CODE	LAYER 1	LAYER 2	LAYER 3	LAYER 4	COL.


ELC Figure 4
320, 340 Huntmar, unknown Campeau
Legend
Feature 1
Uknown Campeau Dr
320 Huntmar Dr
340 Huntmar Dr.
CUM1
Unit 1
MAM 2-2
Unit 2
hedgerow
Agricultural Field - tilled
Calvington Ave
Country Glen Way
Bretonwood Ridge
Mission Trail Crescent
Campeau Dr
Queensway
Route Transcanadienne
Cyclone Taylor Blvd
Frank Finnigan Way
Google Earth
© 2017 Google
1000 ft
N

KANATA - 476274

Campeau.

ELC COMMUNITY DESCRIPTION & CLASSIFICATION	SITE: 320, 340 Huntmar, unknown		POLYGON: Unit 1
	SURVEYOR(S): A. ORR	DATE: Nov. 24 2017	TIME: start / finish
	UTMZ:	UTME:	UTMN:

POLYGON DESCRIPTION

SYSTEM	SUBSTRATE	TOPOGRAPHIC FEATURE	HISTORY	PLANT FORM	COMMUNITY
G TERRESTRIAL G WETLAND G AQUATIC	G ORGANIC G MINERAL SOIL G PARENT MIN. G ACIDIC BEDRK. G BASIC BEDRK. G CARB. BEDRK.	G LACUSTRINE G RIVERINE G BOTTOMLAND G TERRACE G VALLEY SLOPE G TABLELAND G ROLL. UPLAND G CLIFF G TALUS G CREVICE / CAVE G ALVAR G ROCKLAND G BEACH / BAR G SAND DUNE G BLUFF	G NATURAL G CULTURAL	G PLANKTON G SUBMERGED G FLOATING-LVD. G GRAMINOID G FORB G LICHEN G BRYOPHYTE G DECIDUOUS G CONIFEROUS G MIXED	G LAKE G POND G RIVER G STREAM G MARSH G SWAMP G FEN G BOG G BARREN G MEADOW G PRAIRIE G THICKET G SAVANNAH G WOODLAND G FOREST G PLANTATION
SITE			**COVER**		
G OPEN WATER G SHALLOW WATER G SURFICIAL DEP. G BEDROCK			G OPEN G SHRUB G TREED		

STAND DESCRIPTION:

LAYER	HT	CVR	SPECIES IN ORDER OF DECREASING DOMINANCE (up to 4 sp) (>> MUCH GREATER THAN; > GREATER THAN; = ABOUT EQUAL TO)
1 CANOPY			
2 SUB-CANOPY			
3 UNDERSTOREY			
4 GRD. LAYER			PHAARUN = PHRAUST > DAUCARO > CIRARVE

HT CODES: 1 = >25 m 2 = 10<HT≤25 m 3 = 2<HT≤10 m 4 = 1<HT≤2 m 5 = 0.5<HT≤1 m 6 = 0.2<HT≤0.5 m 7 = HT<0.2 m

CVR CODES 0= NONE 1= 0% < CVR ≤ 10% 2= 10 < CVR ≤ 25% 3= 25 < CVR ≤ 60% 4= CVR > 60%

STAND COMPOSITION:	BA:

SIZE CLASS ANALYSIS:		< 10		10 - 24		25 - 50		> 50
STANDING SNAGS:		< 10		10 - 24		25 - 50		> 50
DEADFALL / LOGS:		< 10		10 - 24		25 - 50		> 50

ABUNDANCE CODES: N = NONE R = RARE O = OCCASIONAL A = ABUNDANT

COMM. AGE :		PIONEER		YOUNG		MID-AGE		MATURE		OLD GROWTH

SOIL ANALYSIS:

TEXTURE:	DEPTH TO MOTTLES / GLEY	g =	G=
MOISTURE:	DEPTH OF ORGANICS:		(cm)
HOMOGENEOUS / VARIABLE	DEPTH TO BEDROCK:		(cm)

COMMUNITY CLASSIFICATION:

		ELC CODE
COMMUNITY CLASS:		
COMMUNITY SERIES:		
ECOSITE:		
VEGETATION TYPE:	Mineral Cultural Meadow	CUM1
INCLUSION		
COMPLEX		

Notes:

ELC STAND CHARACTERISTICS	SITE:
	POLYGON:
	DATE:
	SURVEYOR(S):

TREE TALLY BY SPECIES:

PRISM FACTOR

SPECIES	TALLY 1	TALLY 2	TALLY 3	TALLY 4	TALLY 5	TOTAL	REL. AVG
PHAARUN							
PHRAUST							
DAUCARO							
CIRARVE							
TOTAL							100
BASAL AREA (BA)							
DEAD							

STAND COMPOSITION:

~~COMMUNITY PROFILE DIAGRAM~~ Notes:

Highly disturbed area due to recent development. Large soil piles present. Overgrown with meadow species.

Photos # 605 - 633

Notes:

Pg. 10

_C

SOILS ONTARIO

SITE:

POLYGON:

DATE:

SURVEYOR(S):

	Slope								UTM	
	P/A	PP	Dr	Position	Aspect	%	Type	Class	Z	EASTING	NORTHING
1											
2											
3											
4											
5											

SOIL	1	2	3	4	5
TEXTURE x HORIZON					
A TEXTURE					
COURSE FRAGMENTS					
B TEXTURE					
COURSE FRAGMENTS					
C TEXTURE					
COURSE FRAGMENTS					
EFFECTIVE TEXTURE					
SURFACE STONINESS					
SURFACE ROCKINESS					
DEPTH TO / OF					
MOTTLES					
GLEY					
BEDROCK					
WATER TABLE					
CARBONATES					
DEPTH OF ORGANICS					
PORE SIZE DISC #1					
PORE SIZE DISC #2					
MOISTURE REGIME					
SOIL SURVEY MAP					
LEGEND CLASS					

ELC

PLANT SPECIES LIST

SITE:

POLYGON:

DATE:

SURVEYOR(S):

LAYERS: 1 = CANOPY 2 = SUB-CANOPY 3 = UNDERSTOREY 4 = GROUND (GRD.) LAYER

ABUNDANCE CODES: R = RARE O = OCCASIONAL A = ABUNDANT D = DOMINANT

SPECIES CODE	LAYER 1	LAYER 2	LAYER 3	LAYER 4	COL.

SPECIES CODE	LAYER 1	LAYER 2	LAYER 3	LAYER 4	COL.

KANATA - 476274 Campeau Unit

ELC COMMUNITY DESCRIPTION & CLASSIFICATION	SITE: 320, 340 Hurtmar, unknown		POLYGON: 2	
	SURVEYOR(S): A.ORR	DATE: Nov 24, 2017	TIME: start finish	
	UTMZ:	UTME:	UTMN:	

POLYGON DESCRIPTION

SYSTEM	SUBSTRATE	TOPOGRAPHIC FEATURE	HISTORY	PLANT FORM	COMMUNITY
✓ TERRESTRIAL G WETLAND G AQUATIC	G ORGANIC ✓ MINERAL SOIL G PARENT MIN. G ACIDIC BEDRK. G BASIC BEDRK. G CARB. BEDRK.	G LACUSTRINE G RIVERINE G BOTTOMLAND G TERRACE G VALLEY SLOPE G TABLELAND G ROLL. UPLAND G CLIFF G TALUS G CREVICE / CAVE G ALVAR G ROCKLAND G BEACH / BAR G SAND DUNE G BLUFF	✓ NATURAL G CULTURAL	G PLANKTON G SUBMERGED G FLOATING-LVD. G GRAMINOID G FORB G LICHEN G BRYOPHYTE G DECIDUOUS G CONIFEROUS G MIXED	G LAKE G POND G RIVER G STREAM G MARSH G SWAMP G FEN G BOG G BARREN ✓ MEADOW G PRAIRIE G THICKET G SAVANNAH G WOODLAND G FOREST G PLANTATION
SITE			**COVER**		
G OPEN WATER G SHALLOW WATER G SURFICIAL DEP. G BEDROCK			✓ OPEN G SHRUB G TREED		

STAND DESCRIPTION:

	LAYER	HT	CVR	SPECIES IN ORDER OF DECREASING DOMINANCE (up to 4 sp) (>> MUCH GREATER THAN; > GREATER THAN; = ABOUT EQUAL TO)
1	CANOPY			N/A
2	SUB-CANOPY			N/A
3	UNDERSTOREY			PHAARUN >> PHRAUST
4	GRD. LAYER			DAUCARO > LYTSALI > ASCSYRI

HT CODES: 1 = >25 m 2 = 10<HT≤25 m 3 = 2<HT≤10 m 4 = 1<HT≤2 m 5 = 0.5<HT≤1 m 6 = 0.2<HT≤0.5 m 7 = HT<0.2 m

CVR CODES 0= NONE 1= 0% < CVR ≤ 10% 2= 10 < CVR ≤ 25% 3= 25 < CVR ≤ 60% 4= CVR > 60%

STAND COMPOSITION:	BA:

SIZE CLASS ANALYSIS:		< 10		10 - 24		25 - 50		> 50
STANDING SNAGS:		< 10		10 - 24		25 - 50		> 50
DEADFALL / LOGS:		< 10		10 - 24		25 - 50		> 50

ABUNDANCE CODES: N = NONE R = RARE O = OCCASIONAL A = ABUNDANT

COMM. AGE :		PIONEER		YOUNG		MID-AGE		MATURE		OLD GROWTH

SOIL ANALYSIS:

TEXTURE:	DEPTH TO MOTTLES / GLEY	g =	G=
MOISTURE:	DEPTH OF ORGANICS:		(cm)
HOMOGENEOUS / VARIABLE	DEPTH TO BEDROCK:		(cm)

COMMUNITY CLASSIFICATION:

		ELC CODE
COMMUNITY CLASS:		
COMMUNITY SERIES:		
ECOSITE:		
VEGETATION TYPE:	Reed-canary grass mineral meadow marsh	MAM2-2
INCLUSION		
COMPLEX		

Notes:

ELC STAND CHARACTERISTICS	SITE:
	POLYGON:
	DATE:
	SURVEYOR(S):

~~TREE TALLY BY SPECIES:~~

PRISM FACTOR —

SPECIES	TALLY 1	TALLY 2	TALLY 3	TALLY 4	TALLY 5	TOTAL	REL. AVG
PHARUN							
PHRAUST							
DAUCARO							
LYTSALI							
wild parsnip							
ASCSYRI							
TOTAL							100
BASAL AREA (BA)							
DEAD							

STAND COMPOSITION:

COMMUNITY PROFILE DIAGRAM

Photos #605-633

Notes:

ELC SOILS ONTARIO

SITE:
POLYGON:
DATE:
SURVEYOR(S):

	Slope								UTM	
	P/A	PP	Dr	Position	Aspect	%	Type	Class	Z	EASTING	NORTHING
1											
2											
3											
4											
5											

SOIL	1	2	3	4	5
TEXTURE x HORIZON					
A TEXTURE					
COURSE FRAGMENTS					
B TEXTURE					
COURSE FRAGMENTS					
C TEXTURE					
COURSE FRAGMENTS					
EFFECTIVE TEXTURE					
SURFACE STONINESS					
SURFACE ROCKINESS					
DEPTH TO / OF					
MOTTLES					
GLEY					
BEDROCK					
WATER TABLE					
CARBONATES					
DEPTH OF ORGANICS					
PORE SIZE DISC #1					
PORE SIZE DISC #2					
MOISTURE REGIME					
SOIL SURVEY MAP					
LEGEND CLASS					

ELC PLANT SPECIES LIST

SITE:
POLYGON:
DATE:
SURVEYOR(S):

LAYERS: 1 = CANOPY 2 = SUB-CANOPY 3 = UNDERSTOREY 4 = GROUND (GRD.) LAYER
ABUNDANCE CODES: R = RARE O = OCCASIONAL A = ABUNDANT D = DOMINANT

SPECIES CODE	LAYER 1	LAYER 2	LAYER 3	LAYER 4	COL.	SPECIES CODE	LAYER 1	LAYER 2	LAYER 3	LAYER 4	COL.

KANATA 476274

ELC COMMUNITY DESCRIPTION & CLASSIFICATION	SITE: 320, 340 Huntmar, unknown camp.		POLYGON: Unit 3	
	SURVEYOR(S): A. ORR	DATE: Nov 24, 2017	TIME: start	
			finish	
	UTMZ:	UTME:	UTMN:	

POLYGON DESCRIPTION

SYSTEM	SUBSTRATE	TOPOGRAPHIC FEATURE	HISTORY	PLANT FORM	COMMUNITY
☑ TERRESTRIAL G WETLAND G AQUATIC	G ORGANIC ☑ MINERAL SOIL G PARENT MIN. G ACIDIC BEDRK. G BASIC BEDRK. G CARB. BEDRK.	G LACUSTRINE G RIVERINE G BOTTOMLAND G TERRACE G VALLEY SLOPE G TABLELAND G ROLL. UPLAND G CLIFF G TALUS G CREVICE / CAVE G ALVAR G ROCKLAND G BEACH / BAR G SAND DUNE G BLUFF	☑ NATURAL G CULTURAL	G PLANKTON G SUBMERGED G FLOATING-LVD. G GRAMINOID G FORB G LICHEN G BRYOPHYTE ☑ DECIDUOUS G CONIFEROUS G MIXED	G LAKE G POND G RIVER G STREAM G MARSH G SWAMP G FEN G BOG G BARREN G MEADOW G PRAIRIE G THICKET G SAVANNAH G WOODLAND ☑ FOREST G PLANTATION
SITE			**COVER**		
G OPEN WATER G SHALLOW WATER ☑ SURFICIAL DEP. G BEDROCK			G OPEN G SHRUB ☑ TREED		

STAND DESCRIPTION:

	LAYER	HT	CVR	SPECIES IN ORDER OF DECREASING DOMINANCE (up to 4 sp) (>> MUCH GREATER THAN; > GREATER THAN; = ABOUT EQUAL TO)
1	CANOPY			SAL_SP > ULMAMER = ACENEGU = FRA-SP
2	SUB-CANOPY			" " "
3	UNDERSTOREY			RHACATH > CORSTOL > PHRAUST
4	GRD. LAYER			PHAARUN > DAUCARO > SOL_SPP

HT CODES: 1 = >25 m 2 = 10<HT≤25 m 3 = 2<HT≤10 m 4 = 1<HT≤2 m 5 = 0.5<HT≤1 m 6 = 0.2<HT≤0.5 m 7 = HT<0.2 m

CVR CODES 0 = NONE 1 = 0% < CVR ≤ 10% 2 = 10 < CVR ≤ 25% 3 = 25 < CVR ≤ 60% 4 = CVR > 60%

STAND COMPOSITION:	BA:

SIZE CLASS ANALYSIS:		< 10		10 - 24		25 - 50		> 50
STANDING SNAGS:		< 10		10 - 24		25 - 50		> 50
DEADFALL / LOGS:		< 10		10 - 24		25 - 50		> 50

ABUNDANCE CODES: N = NONE R = RARE O = OCCASIONAL A = ABUNDANT

COMM. AGE :		PIONEER		YOUNG	✓	MID-AGE		MATURE		OLD GROWTH

SOIL ANALYSIS:

TEXTURE:	DEPTH TO MOTTLES / GLEY	g =	G=
MOISTURE:	DEPTH OF ORGANICS:		(cm)
HOMOGENEOUS / VARIABLE	DEPTH TO BEDROCK:		(cm)

COMMUNITY CLASSIFICATION:

		ELC CODE
COMMUNITY CLASS:		
COMMUNITY SERIES:		
ECOSITE:		
VEGETATION TYPE:	F-M Willow Lowland deciduous Forest.	FOD7-3
INCLUSION		
COMPLEX	Reed-canary grass mineral	MAM2-2

Notes: meadow marsh (along creek)

Photos # 605 - 633   DEJU

ELC STAND CHARACTERISTICS	SITE:
	POLYGON:
	DATE:
	SURVEYOR(S):

TREE TALLY BY SPECIES:

PRISM FACTOR

SPECIES	TALLY 1	TALLY 2	TALLY 3	TALLY 4	TALLY 5	TOTAL	REL. AVG
TOTAL							100
BASAL AREA (BA)							
DEAD							

STAND COMPOSITION:

COMMUNITY PROFILE DIAGRAM Notes:

- Creek runs throughout community. Holds potential for turtle wintering/nesting. Creek has soft / sandy substrate and exposed banks. Moderate flow - 0.2-0.5 m deep.
- Community is co-dominant with Willow and Ash, transitioning to Manitoba maple further northeast.
- Deer trail throughout
- 4 Butternuts occured:

JUGCINE #1 : UTM: 0426914/5016662. (347) Healthy tree, no evidence of dieback or cankers. Nuts found on ground.

Notes:

JUGCINE #2 : UTM: 0426922/5016653 (348). Has 3 clusters of trees, divides below dbh. Cankers starting to form at base of tree and a few branches experiencing dieback.

JUGCINE #3 : Multi-stemmed. 2 trees, split below dbh UTM. 0426908/5016644 (349). Canker present at base, no die back.

pg. 12 →

SOILS ONTARIO

SITE:
POLYGON:
DATE:
SURVEYOR(S):

	P/A	PP	Dr	Position	Aspect	Slope %	Slope Type	Slope Class	UTM Z	UTM EASTING	UTM NORTHING
1											
2											
3											
4											
5											

SOIL	1	2	3	4	5
TEXTURE x HORIZON					
A TEXTURE					
COURSE FRAGMENTS					
B TEXTURE					
COURSE FRAGMENTS					
C TEXTURE					
COURSE FRAGMENTS					
EFFECTIVE TEXTURE					
SURFACE STONINESS					
SURFACE ROCKINESS					
DEPTH TO / OF MOTTLES					
GLEY					
BEDROCK					
WATER TABLE					
CARBONATES					
DEPTH OF ORGANICS					
PORE SIZE DISC #1					
PORE SIZE DISC #2					
MOISTURE REGIME					
SOIL SURVEY MAP					
LEGEND CLASS					

→ Animal den adjacent to JUGCINE #3.

JUGCINE #4: UTM: 0426908 / 5016644 (349). Multi-stemmed 3 trunks split at base ~~&~~ Cankers present and bark peeling. Some die back.

ELC PLANT SPECIES LIST

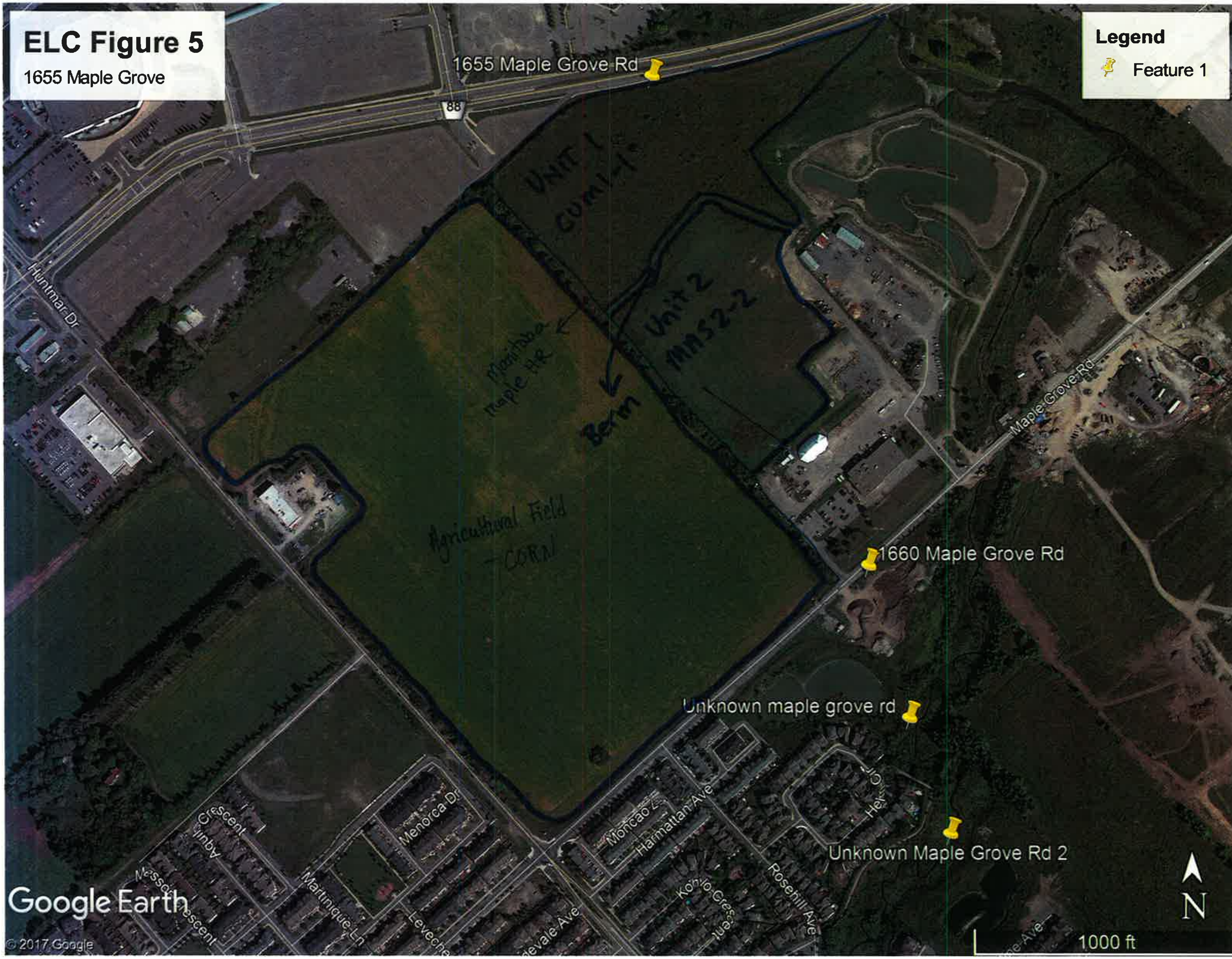
SITE:
POLYGON:
DATE:
SURVEYOR(S):

LAYERS: 1 = CANOPY 2 = SUB-CANOPY 3 = UNDERSTOREY 4 = GROUND (GRD.) LAYER
ABUNDANCE CODES: R = RARE O = OCCASIONAL A = ABUNDANT D = DOMINANT

SPECIES CODE	LAYER 1	LAYER 2	LAYER 3	LAYER 4	COL.
BETPAPY					
POPTREM					
TYPANGU					
Mullein - VERTHAP					
SAL-SP	D				
ULMAMER	A				
RUMCRIS				O	
PHAARUN			A		
DAUCARO				A	
SOLALTI				A	
LYTSALI					
CIRARVE					
RHACATH			A		
ACENEGU	A				
CORSTOL			A		
Clover					
PARAUST			A		
ARCMINU					
FRAVIVI					
VITRIPA					
ALLPETI					
RUBIDAE					
JUGCINE					
Mint					
TILAMER					
poison ivy					
ACENEGU					
FRA-SP					

SPECIES CODE	LAYER 1	LAYER 2	LAYER 3	LAYER 4	COL.

- Lots of bedrock crevices throughout. Potential snake hibernacula (0426916/5016682) (346)
- All butternuts located along creek.
- Cavity trees present in lg. willows.


ELC Figure 5
1655 Maple Grove
Legend
Feature 1
1655 Maple Grove Rd
88
Huntmar Dr
Unit 1
CUM1-1
Unit 2
MAS2-2
Manitoba maple HR
Berm
Agricultural Field
- CORN
1660 Maple Grove Rd
Maple Grove Rd
Unknown maple grove rd
Unknown Maple Grove Rd 2
Menorca Dr
Harmattan Ave
Rosehill Ave
Martinique Ln
Google Earth
© 2017 Google
1000 ft
N

KANATA 476274

ELC COMMUNITY DESCRIPTION & CLASSIFICATION

SITE: 1655 Maple Grove Rd.		POLYGON: Unit 1		
SURVEYOR(S): A. ORR	DATE: Nov 28, 2017	TIME: start		
		finish		
UTMZ:	UTME:	UTMN:		

POLYGON DESCRIPTION

SYSTEM	SUBSTRATE	TOPOGRAPHIC FEATURE	HISTORY	PLANT FORM	COMMUNITY
G TERRESTRIAL G WETLAND G AQUATIC	G ORGANIC G MINERAL SOIL G PARENT MIN. G ACIDIC BEDRK. G BASIC BEDRK. G CARB. BEDRK.	G LACUSTRINE G RIVERINE G BOTTOMLAND G TERRACE G VALLEY SLOPE G TABLELAND G ROLL. UPLAND G CLIFF G TALUS G CREVICE / CAVE G ALVAR G ROCKLAND G BEACH / BAR G SAND DUNE G BLUFF	G NATURAL G CULTURAL	G PLANKTON G SUBMERGED G FLOATING-LVD. G GRAMINOID G FORB G LICHEN G BRYOPHYTE G DECIDUOUS G CONIFEROUS G MIXED	G LAKE G POND G RIVER G STREAM G MARSH G SWAMP G FEN G BOG G BARREN G MEADOW G PRAIRIE G THICKET G SAVANNAH G WOODLAND G FOREST G PLANTATION
SITE			COVER		
G OPEN WATER G SHALLOW WATER G SURFICIAL DEP. G BEDROCK			G OPEN G SHRUB G TREED		

STAND DESCRIPTION:

	LAYER	HT	CVR	SPECIES IN ORDER OF DECREASING DOMINANCE (up to 4 sp) (>> MUCH GREATER THAN; > GREATER THAN; = ABOUT EQUAL TO)
1	CANOPY			N/A
2	SUB-CANOPY	2	1	ACENEGU
3	UNDERSTOREY	4	3	PHAARUN > SOL-SPP > DAUCARO
4	GRD. LAYER	6	4	GRASS-Spp >> CIRARVE >> ASCSYRI

HT CODES: 1 = >25 m 2 = 10<HT≤25 m 3 = 2<HT≤10 m 4 = 1<HT≤2 m 5 = 0.5<HT≤1 m 6 = 0.2<HT≤0.5 m 7 = HT<0.2 m

CVR CODES 0 = NONE 1 = 0% < CVR ≤ 10% 2 = 10 < CVR ≤ 25% 3 = 25 < CVR ≤ 60% 4 = CVR > 60%

STAND COMPOSITION:	BA:

SIZE CLASS ANALYSIS:		< 10		10 - 24		25 - 50		> 50
STANDING SNAGS:		< 10		10 - 24		25 - 50		> 50
DEADFALL / LOGS:		< 10		10 - 24		25 - 50		> 50

ABUNDANCE CODES: N = NONE R = RARE O = OCCASIONAL A = ABUNDANT

COMM. AGE :		PIONEER		YOUNG		MID-AGE		MATURE		OLD GROWTH

SOIL ANALYSIS:

TEXTURE:	DEPTH TO MOTTLES / GLEY	g =	G=
MOISTURE:	DEPTH OF ORGANICS:		(cm)
HOMOGENEOUS / VARIABLE	DEPTH TO BEDROCK:		(cm)

COMMUNITY CLASSIFICATION:

		ELC CODE
COMMUNITY CLASS:		
COMMUNITY SERIES:		
ECOSITE:		
VEGETATION TYPE:	Dry-moist Old Field Meadow	CUM1-1
INCLUSION		
COMPLEX		

Notes:

ELC STAND CHARACTERISTICS

SITE:	
POLYGON:	
DATE:	
SURVEYOR(S):	

TREE TALLY BY SPECIES:

PRISM FACTOR

SPECIES	TALLY 1	TALLY 2	TALLY 3	TALLY 4	TALLY 5	TOTAL	REL. AVG
PHAARUN							
DAUCARO							
VERTHAP							
CIRARVE							
SOL-SPP							
ASCSYRI							
ACENEGU							
TOTAL							100
BASAL AREA (BA)							
DEAD							

STAND COMPOSITION:

COMMUNITY PROFILE DIAGRAM

Incidentals: CORA, CAGO, MALL (flyovers)

Photos # 638-644.

Notes:

ELC — SOILS ONTARIO

SITE:
POLYGON:
DATE:
SURVEYOR(S):

	Slope								UTM		
	P/A	PP	Dr	Position	Aspect	%	Type	Class	Z	EASTING	NORTHING
1											
2											
3											
4											
5											

SOIL	1	2	3	4	5
TEXTURE x HORIZON					
A TEXTURE					
COURSE FRAGMENTS					
B TEXTURE					
COURSE FRAGMENTS					
C TEXTURE					
COURSE FRAGMENTS					
EFFECTIVE TEXTURE					
SURFACE STONINESS					
SURFACE ROCKINESS					
DEPTH TO / OF					
MOTTLES					
GLEY					
BEDROCK					
WATER TABLE					
CARBONATES					
DEPTH OF ORGANICS					
PORE SIZE DISC #1					
PORE SIZE DISC #2					
MOISTURE REGIME					
SOIL SURVEY MAP					
LEGEND CLASS					

ELC PLANT SPECIES LIST

SITE:
POLYGON:
DATE:
SURVEYOR(S):

LAYERS: 1 = CANOPY 2 = SUB-CANOPY 3 = UNDERSTOREY 4 = GROUND (GRD.) LAYER
ABUNDANCE CODES: R = RARE O = OCCASIONAL A = ABUNDANT D = DOMINANT

SPECIES CODE	LAYER				COL.	SPECIES CODE	LAYER				COL.
	1	2	3	4			1	2	3	4	

KANATA 476274

ELC COMMUNITY DESCRIPTION & CLASSIFICATION	SITE: 1155 Maple Grove Rd.		POLYGON: 2-Unit
	SURVEYOR(S): H. ORR	DATE: Nov 24, 2017	TIME: start / finish
	UTMZ:	UTME:	UTMN:

POLYGON DESCRIPTION

SYSTEM	SUBSTRATE	TOPOGRAPHIC FEATURE	HISTORY	PLANT FORM	COMMUNITY
G TERRESTRIAL G WETLAND G AQUATIC	G ORGANIC G MINERAL SOIL G PARENT MIN. G ACIDIC BEDRK. G BASIC BEDRK. G CARB. BEDRK.	G LACUSTRINE G RIVERINE G BOTTOMLAND G TERRACE G VALLEY SLOPE G TABLELAND G ROLL. UPLAND G CLIFF G TALUS G CREVICE / CAVE G ALVAR G ROCKLAND G BEACH / BAR G SAND DUNE G BLUFF	G NATURAL G CULTURAL	G PLANKTON G SUBMERGED G FLOATING-LVD. G GRAMINOID G FORB G LICHEN G BRYOPHYTE G DECIDUOUS G CONIFEROUS G MIXED	G LAKE G POND G RIVER G STREAM G MARSH G SWAMP G FEN G BOG G BARREN G MEADOW G PRAIRIE G THICKET G SAVANNAH G WOODLAND G FOREST G PLANTATION
SITE			**COVER**		
G OPEN WATER G SHALLOW WATER G SURFICIAL DEP. G BEDROCK			G OPEN G SHRUB G TREED		

STAND DESCRIPTION:

	LAYER	HT	CVR	SPECIES IN ORDER OF DECREASING DOMINANCE (up to 4 sp) (>> MUCH GREATER THAN; > GREATER THAN; = ABOUT EQUAL TO)
1	CANOPY			N/A
2	SUB-CANOPY			N/A
3	UNDERSTOREY			N/A
4	GRD. LAYER		4	Grass-SP > Juncus-SP > Scirpus-SP

HT CODES: 1 = >25 m 2 = 10<HT≤25 m 3 = 2<HT≤10 m 4 = 1<HT≤2 m 5 = 0.5<HT≤1 m 6 = 0.2<HT≤0.5 m 7 = HT<0.2 m

CVR CODES 0= NONE 1= 0% < CVR ≤ 10% 2= 10 < CVR ≤ 25% 3= 25 < CVR ≤ 60% 4= CVR > 60%

STAND COMPOSITION:	BA:

SIZE CLASS ANALYSIS:		< 10		~~10 - 24~~		25 - 50		> 50
STANDING SNAGS:		< 10		10 - 24		25 - 50		> 50
DEADFALL / LOGS:		< 10		10 - 24		25 - 50		> 50

ABUNDANCE CODES: N = NONE R = RARE O = OCCASIONAL A = ABUNDANT

COMM. AGE :		PIONEER	YOUNG		MID-AGE		MATURE		OLD GROWTH

SOIL ANALYSIS:

TEXTURE:	DEPTH TO MOTTLES / GLEY	g =	G=
MOISTURE:	DEPTH OF ORGANICS:		(cm)
HOMOGENEOUS / VARIABLE	DEPTH TO BEDROCK:		(cm)

COMMUNITY CLASSIFICATION:

		ELC CODE
COMMUNITY CLASS:		
COMMUNITY SERIES:		
ECOSITE:		
VEGETATION TYPE:	Bulrush Mineral Shallow marsh.	MAS2-2
INCLUSION		
COMPLEX		

Notes:

ELC STAND CHARACTERISTICS	SITE:
	POLYGON:
	DATE:
	SURVEYOR(S):

TREE TALLY BY SPECIES:

PRISM FACTOR

SPECIES	TALLY 1	TALLY 2	TALLY 3	TALLY 4	TALLY 5	TOTAL	REL AVG
Juncus_SP							
Scirpus_SP							
Grass_SP							
TOTAL							100
BASAL AREA (BA)							
DEAD							

STAND COMPOSITION:

COMMUNITY PROFILE DIAGRAM

Photos # 638 - 644

Notes:

ELC
SOILS ONTARIO

SITE:
POLYGON:
DATE:
SURVEYOR(S):

	P/A	PP	Dr	Slope Position	Slope Aspect	Slope %	Slope Type	Slope Class	UTM Z	UTM EASTING	UTM NORTHING
1											
2											
3											
4											
5											

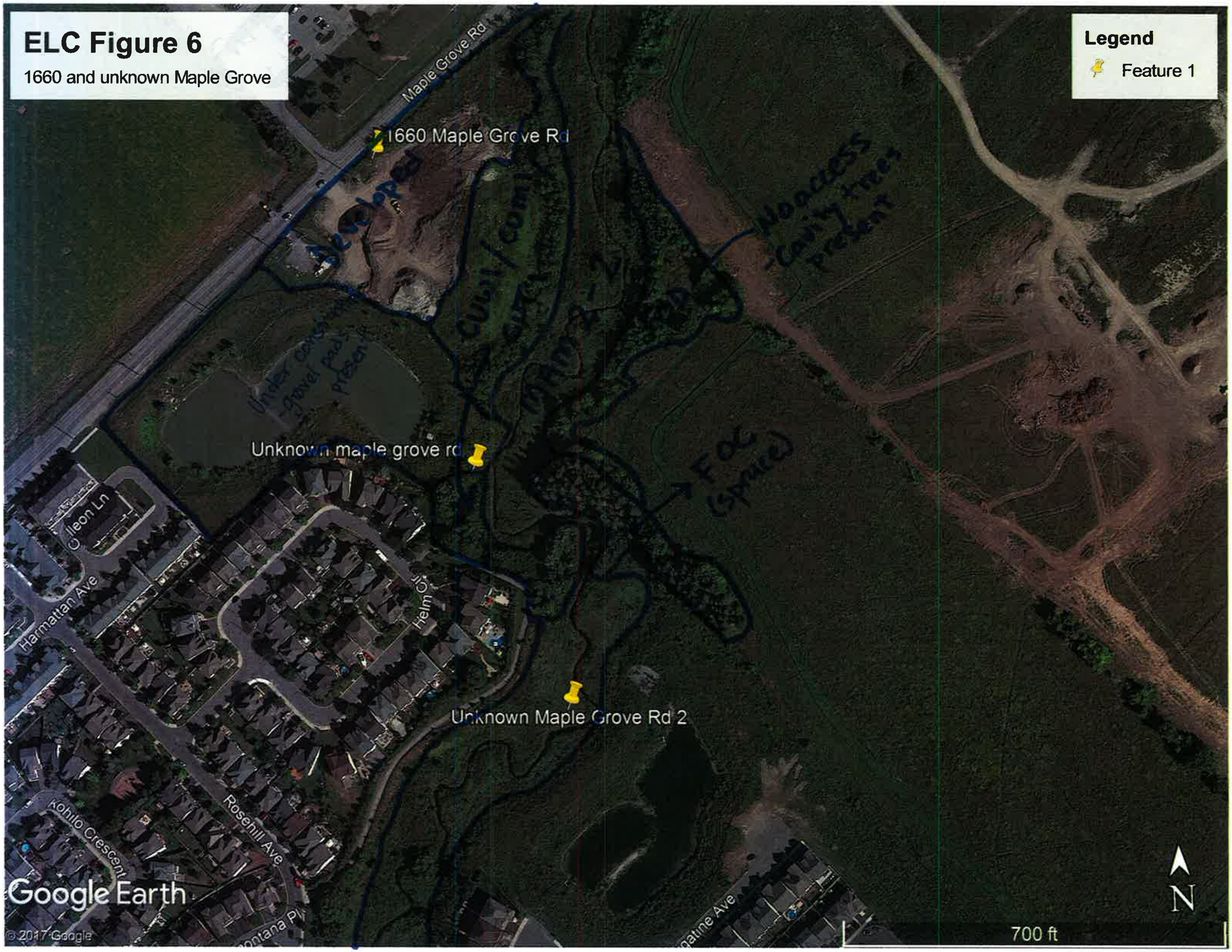
SOIL	1	2	3	4	5
TEXTURE x HORIZON					
A TEXTURE					
COURSE FRAGMENTS					
B TEXTURE					
COURSE FRAGMENTS					
C TEXTURE					
COURSE FRAGMENTS					
EFFECTIVE TEXTURE					
SURFACE STONINESS					
SURFACE ROCKINESS					
DEPTH TO / OF					
MOTTLES					
GLEY					
BEDROCK					
WATER TABLE					
CARBONATES					
DEPTH OF ORGANICS					
PORE SIZE DISC #1					
PORE SIZE DISC #2					
MOISTURE REGIME					
SOIL SURVEY MAP					
LEGEND CLASS					

ELC
PLANT SPECIES LIST

SITE:
POLYGON:
DATE:
SURVEYOR(S):

LAYERS: 1 = CANOPY 2 = SUB-CANOPY 3 = UNDERSTOREY 4 = GROUND (GRD.) LAYER
ABUNDANCE CODES: R = RARE O = OCCASIONAL A = ABUNDANT D = DOMINANT

SPECIES CODE	LAYER 1	LAYER 2	LAYER 3	LAYER 4	COL.	SPECIES CODE	LAYER 1	LAYER 2	LAYER 3	LAYER 4	COL.



ELC Figure 6
1660 and unknown Maple Grove
Legend
Feature 1
Maple Grove Rd
1660 Maple Grove Rd
Developed
CUM1/CUW1
Under construction - gravel pads present
MAM2-2
No access - cavity trees present
Unknown maple grove rd
FOC (spruce)
Cleon Ln
Harmattan Ave
Helm Cir
Unknown Maple Grove Rd 2
Kohilo Crescent
Rosehill Ave
Google Earth
© 2017 Google
700 ft
N

KANATA 476274 -6 to -3°C, 10% cloud, 1 wind, snow

ELC COMMUNITY DESCRIPTION & CLASSIFICATION	SITE: Unknown Maple Grove		POLYGON: Unit 1
	SURVEYOR(S): A. ORR.	DATE: Nov 28, 2017	TIME: start / finish
	UTMZ:	UTME:	UTMN:

POLYGON DESCRIPTION

SYSTEM	SUBSTRATE	TOPOGRAPHIC FEATURE	HISTORY	PLANT FORM	COMMUNITY
G TERRESTRIAL ✓ G WETLAND G AQUATIC	G ORGANIC G MINERAL SOIL ✓ G PARENT MIN. G ACIDIC BEDRK. G BASIC BEDRK. G CARB. BEDRK.	G LACUSTRINE G RIVERINE G BOTTOMLAND G TERRACE G VALLEY SLOPE G TABLELAND G ROLL. UPLAND G CLIFF G TALUS G CREVICE / CAVE G ALVAR G ROCKLAND G BEACH / BAR G SAND DUNE G BLUFF	G NATURAL ✓ G CULTURAL	G PLANKTON G SUBMERGED G FLOATING-LVD. G GRAMINOID G FORB G LICHEN G BRYOPHYTE G DECIDUOUS G CONIFEROUS G MIXED	G LAKE G POND G RIVER G STREAM G MARSH G SWAMP G FEN G BOG G BARREN G MEADOW G PRAIRIE G THICKET G SAVANNAH G WOODLAND G FOREST G PLANTATION
SITE			**COVER**		
G OPEN WATER G SHALLOW WATER G SURFICIAL DEP. G BEDROCK			G OPEN ✓ G SHRUB G TREED		

STAND DESCRIPTION:

	LAYER	HT	CVR	SPECIES IN ORDER OF DECREASING DOMINANCE (up to 4 sp) (>> MUCH GREATER THAN; > GREATER THAN; = ABOUT EQUAL TO)
1	CANOPY			N/A.
2	SUB-CANOPY			N/A
3	UNDERSTOREY	4	4	PHAARUN > TYPLATI > CORSTOL = SAL-SP.
4	GRD. LAYER	4	4	SOL-SPP > ASCSYRI

HT CODES: 1 = >25 m 2 = 10<HT≤25 m 3 = 2<HT≤10 m 4 = 1<HT≤2 m 5 = 0.5<HT≤1 m 6 = 0.2<HT≤0.5 m 7 = HT<0.2 m

CVR CODES 0= NONE 1= 0% < CVR ≤ 10% 2= 10 < CVR ≤ 25% 3= 25 < CVR ≤ 60% 4= CVR > 60%

STAND COMPOSITION:	BA:

SIZE CLASS ANALYSIS:		< 10		10 - 24		25 - 50		> 50
STANDING SNAGS:		< 10		10 - 24		25 - 50		> 50
DEADFALL / LOGS:		< 10		10 - 24		25 - 50		> 50

ABUNDANCE CODES: N = NONE R = RARE O = OCCASIONAL A = ABUNDANT

COMM. AGE :		PIONEER		YOUNG		MID-AGE		MATURE		OLD GROWTH

SOIL ANALYSIS:

TEXTURE:	DEPTH TO MOTTLES / GLEY	g =	G=
MOISTURE:	DEPTH OF ORGANICS:		(cm)
HOMOGENEOUS / VARIABLE	DEPTH TO BEDROCK:		(cm)

COMMUNITY CLASSIFICATION:

		ELC CODE
COMMUNITY CLASS:		
COMMUNITY SERIES:		
ECOSITE:		
VEGETATION TYPE:	Reed-canary grass mineral meadow marsh	MAM2-2
INCLUSION		
COMPLEX		

Notes:

ELC STAND CHARACTERISTICS	SITE:
	POLYGON:
	DATE:
	SURVEYOR(S):

TREE TALLY BY SPECIES:

PRISM FACTOR

SPECIES	TALLY 1	TALLY 2	TALLY 3	TALLY 4	TALLY 5	TOTAL	REL. AVG
PHAARUN							
CORSTOL							
SAL SP							
TYPLATI							
ASCSYRI							
SOL-SPP							
TOTAL							100
BASAL AREA (BA)							
DEAD							

STAND COMPOSITION:

COMMUNITY PROFILE DIAGRAM

Water present in creek, creek holds water year round.
Areas of shoreline have steep/eroding banks
Incidentals: CORA, WBNU, LBHE, BCCH, ROPI
Creek appears suitable for turtle wintering/nesting
- Rabbit tracks.
Photos# 645-656

Notes:

_C
SOILS ONTARIO

SITE:
POLYGON:
DATE:
SURVEYOR(S):

	P/A	PP	Dr	Slope Position	Slope Aspect	Slope %	Slope Type	Slope Class	UTM Z	UTM EASTING	UTM NORTHING
1											
2											
3											
4											
5											

SOIL	1	2	3	4	5
TEXTURE x HORIZON					
A TEXTURE					
COURSE FRAGMENTS					
B TEXTURE					
COURSE FRAGMENTS					
C TEXTURE					
COURSE FRAGMENTS					
EFFECTIVE TEXTURE					
SURFACE STONINESS					
SURFACE ROCKINESS					
DEPTH TO / OF					
MOTTLES					
GLEY					
BEDROCK					
WATER TABLE					
CARBONATES					
DEPTH OF ORGANICS					
PORE SIZE DISC #1					
PORE SIZE DISC #2					
MOISTURE REGIME					
SOIL SURVEY MAP					
LEGEND CLASS					

ELC
PLANT SPECIES LIST

SITE:
POLYGON:
DATE:
SURVEYOR(S):

LAYERS: 1 = CANOPY 2 = SUB-CANOPY 3 = UNDERSTOREY 4 = GROUND (GRD.) LAYER
ABUNDANCE CODES: R = RARE O = OCCASIONAL A = ABUNDANT D = DOMINANT

SPECIES CODE	LAYER 1	LAYER 2	LAYER 3	LAYER 4	COL.

SPECIES CODE	LAYER 1	LAYER 2	LAYER 3	LAYER 4	COL.

KANATA 476274

ELC COMMUNITY DESCRIPTION & CLASSIFICATION	SITE: Unknown Maple Grove		POLYGON: 2-Unit	
	SURVEYOR(S): A. ORR	DATE: Nov 28, 2017	TIME: start / finish	
	UTMZ:	UTME:	UTMN:	

POLYGON DESCRIPTION

SYSTEM	SUBSTRATE	TOPOGRAPHIC FEATURE	HISTORY	PLANT FORM	COMMUNITY
G TERRESTRIAL G WETLAND G AQUATIC	G ORGANIC G MINERAL SOIL G PARENT MIN. G ACIDIC BEDRK. G BASIC BEDRK. G CARB. BEDRK.	G LACUSTRINE G RIVERINE G BOTTOMLAND G TERRACE G VALLEY SLOPE G TABLELAND G ROLL. UPLAND G CLIFF G TALUS G CREVICE / CAVE G ALVAR G ROCKLAND G BEACH / BAR G SAND DUNE G BLUFF	G NATURAL G CULTURAL	G PLANKTON G SUBMERGED G FLOATING-LVD. G GRAMINOID G FORB G LICHEN G BRYOPHYTE G DECIDUOUS G CONIFEROUS G MIXED	G LAKE G POND G RIVER G STREAM G MARSH G SWAMP G FEN G BOG G BARREN G MEADOW G PRAIRIE G THICKET G SAVANNAH G WOODLAND G FOREST G PLANTATION
SITE			**COVER**		
G OPEN WATER G SHALLOW WATER G SURFICIAL DEP. G BEDROCK			G OPEN G SHRUB G TREED		

STAND DESCRIPTION:

	LAYER	HT	CVR	SPECIES IN ORDER OF DECREASING DOMINANCE (up to 4 sp) (>> MUCH GREATER THAN; > GREATER THAN; ≈ ABOUT EQUAL TO)
1	CANOPY	2	3	ACENEGU > ACESASH > THUOCCI > PINSTRO
2	SUB-CANOPY	3	3	RHACATH > RHUHIRT > ULMAMER
3	UNDERSTOREY	4	4	RHACATH > RHUHIRT > CORSTOL > RUBIDAE
4	GRD. LAYER	6	4	VITRIPA = DAUCARO > PHAARUN > SOL-SPP

HT CODES: 1 = >25 m 2 = 10<HT≤25 m 3 = 2<HT≤10 m 4 = 1<HT≤2 m 5 = 0.5<HT≤1 m 6 = 0.2<HT≤0.5 m 7 = HT<0.2 m

CVR CODES 0= NONE 1= 0% < CVR ≤ 10% 2= 10 < CVR ≤ 25% 3= 25 < CVR ≤ 60% 4= CVR > 60%

STAND COMPOSITION:	BA:

SIZE CLASS ANALYSIS:		< 10		10 - 24		25 - 50		> 50
STANDING SNAGS:		< 10		10 - 24		25 - 50		> 50
DEADFALL / LOGS:		< 10		10 - 24		25 - 50		> 50

ABUNDANCE CODES: N = NONE R = RARE O = OCCASIONAL A = ABUNDANT

COMM. AGE :		PIONEER		YOUNG		MID-AGE		MATURE		OLD GROWTH

SOIL ANALYSIS:

TEXTURE:	DEPTH TO MOTTLES / GLEY	g =	G=
MOISTURE:	DEPTH OF ORGANICS:		(cm)
HOMOGENEOUS / VARIABLE	DEPTH TO BEDROCK:		(cm)

COMMUNITY CLASSIFICATION:

		ELC CODE
COMMUNITY CLASS:		
COMMUNITY SERIES:		
ECOSITE:		
VEGETATION TYPE:	Mineral Cultural Woodland.	CUW1
INCLUSION	Mineral Cultural Meadow	CUM1
COMPLEX	Mineral Cultural thicket	CUT1

Notes:

ELC STAND CHARACTERISTICS	SITE:
	POLYGON:
	DATE:
	SURVEYOR(S):

TREE TALLY BY SPECIES:

PRISM FACTOR

SPECIES	TALLY 1	TALLY 2	TALLY 3	TALLY 4	TALLY 5	TOTAL	REL. AVG
TOTAL							100
BASAL AREA (BA)							
DEAD							

STAND COMPOSITION:

COMMUNITY PROFILE DIAGRAM

Mosaic landscape, transitioning from woodland to thicket to meadow.

Photo # 645 - 656

1 large cavity tree present.

- Mounds of fill present with meadow species on top.

Notes:

SOILS ONTARIO

SITE:
POLYGON:
DATE:
SURVEYOR(S):

	P/A	PP	Dr	Position	Slope: Aspect	Slope: %	Slope: Type	Slope: Class	Z	UTM: EASTING	UTM: NORTHING
1											
2											
3											
4											
5											

SOIL	1	2	3	4	5
TEXTURE x HORIZON					
A TEXTURE					
COURSE FRAGMENTS					
B TEXTURE					
COURSE FRAGMENTS					
C TEXTURE					
COURSE FRAGMENTS					
EFFECTIVE TEXTURE					
SURFACE STONINESS					
SURFACE ROCKINESS					
DEPTH TO / OF					
MOTTLES					
GLEY					
BEDROCK					
WATER TABLE					
CARBONATES					
DEPTH OF ORGANICS					
PORE SIZE DISC #1					
PORE SIZE DISC #2					
MOISTURE REGIME					
SOIL SURVEY MAP					
LEGEND CLASS					

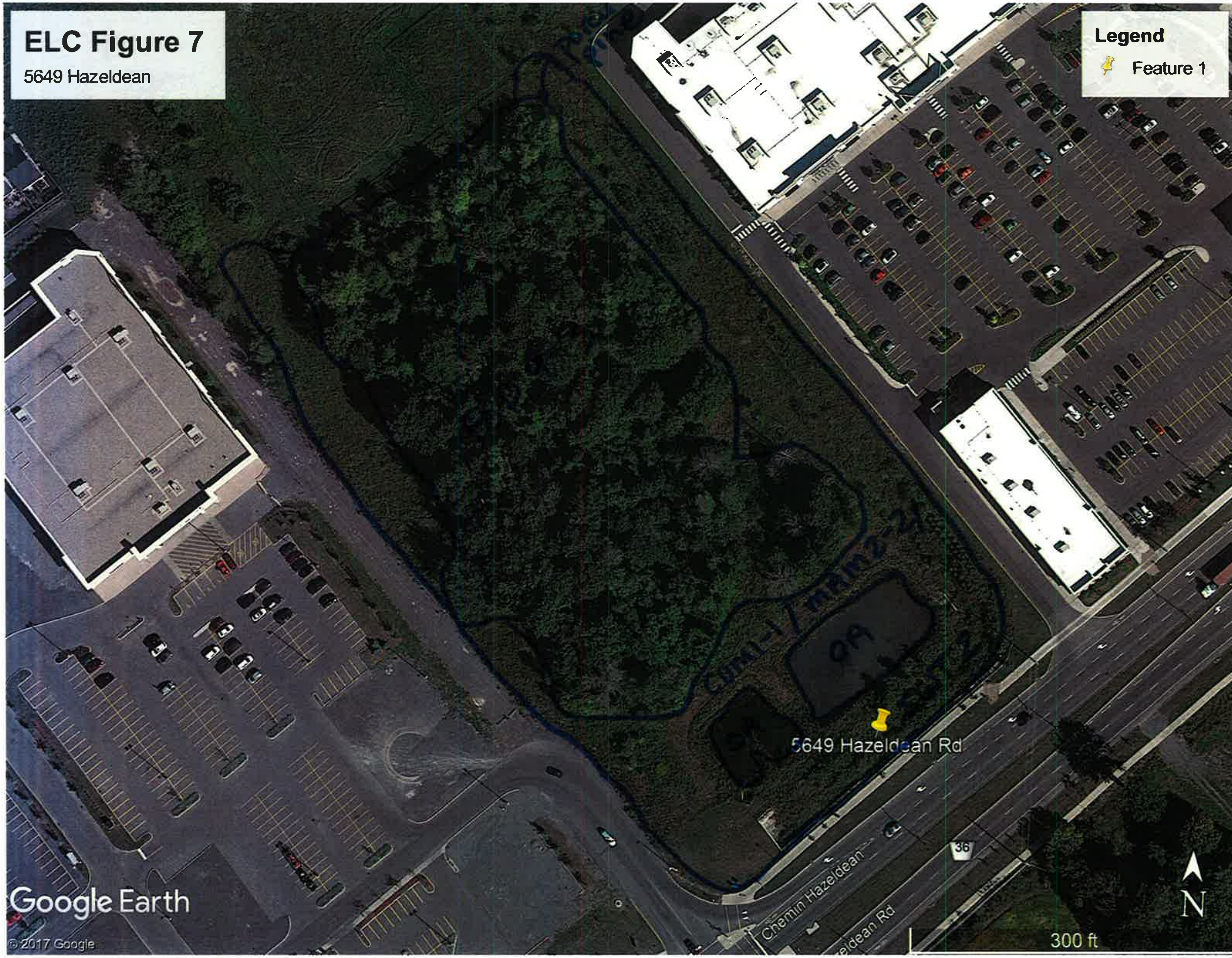
ELC PLANT SPECIES LIST

SITE:
POLYGON:
DATE:
SURVEYOR(S):

LAYERS: 1 = CANOPY 2 = SUB-CANOPY 3 = UNDERSTOREY 4 = GROUND (GRD.) LAYER
ABUNDANCE CODES: R = RARE O = OCCASIONAL A = ABUNDANT D = DOMINANT

SPECIES CODE	LAYER 1	LAYER 2	LAYER 3	LAYER 4	COL.
RHACATH		A	A		
VITRIPA					
RUBIDAE					
ACENEGU					
PINSTRO - planted					
CORSTOL					
THUOCCI					
AESCSVRI					
RHUHIRT					
ACESASA					
ARCMINU					
AST. SP					
ACENEGU	A				
RHUHIRT		A	A		
PHAARUN					
ULMAMER					
DAUCARD					
AST-SPP					
SOL-SPP					
Asparagus					

SPECIES CODE	LAYER 1	LAYER 2	LAYER 3	LAYER 4	COL.



ELC Figure 7
5649 Hazeldean
Legend
Feature 1
CUM1-1
MAM2-2
5649 Hazeldean Rd
Chemin Hazeldean
36
300 ft
N
Google Earth
© 2017 Google

KANATA - 476274

ELC COMMUNITY DESCRIPTION & CLASSIFICATION

SITE: 5649 Hazeldean		POLYGON: UNIT 1	
SURVEYOR(S): A. ORR	DATE: Nov 28, 2017	TIME: start / finish	
UTMZ:	UTME:	UTMN:	

POLYGON DESCRIPTION

SYSTEM	SUBSTRATE	TOPOGRAPHIC FEATURE	HISTORY	PLANT FORM	COMMUNITY
✓ TERRESTRIAL G WETLAND G AQUATIC	G ORGANIC ✓ MINERAL SOIL G PARENT MIN. G ACIDIC BEDRK. G BASIC BEDRK. G CARB. BEDRK.	G LACUSTRINE G RIVERINE G BOTTOMLAND G TERRACE G VALLEY SLOPE G TABLELAND G ROLL. UPLAND G CLIFF G TALUS G CREVICE / CAVE G ALVAR G ROCKLAND G BEACH / BAR G SAND DUNE G BLUFF	✓ NATURAL G CULTURAL	G PLANKTON G SUBMERGED G FLOATING-LVD. G GRAMINOID G FORB G LICHEN G BRYOPHYTE G DECIDUOUS G CONIFEROUS G MIXED	G LAKE G POND G RIVER G STREAM G MARSH G SWAMP G FEN G BOG G BARREN G MEADOW G PRAIRIE G THICKET G SAVANNAH G WOODLAND G FOREST G PLANTATION
SITE			**COVER**		
G OPEN WATER G SHALLOW WATER G SURFICIAL DEP. G BEDROCK			G OPEN G SHRUB ✓ TREED		

STAND DESCRIPTION:

	LAYER	HT	CVR	SPECIES IN ORDER OF DECREASING DOMINANCE (up to 4 sp) (>> MUCH GREATER THAN; > GREATER THAN; = ABOUT EQUAL TO)
1	CANOPY	2	4	QUEMACR = TILAMER = ACESASA > POPALBA
2	SUB-CANOPY	3	3	RHACATH > ULMAMER = FRA-SP
3	UNDERSTOREY	4	3	RHACATH > VITRIPA
4	GRD. LAYER	6	?	periwinkle

HT CODES: 1 = >25 m 2 = 10<HT≤25 m 3 = 2<HT≤10 m 4 = 1<HT≤2 m 5 = 0.5<HT≤1 m 6 = 0.2<HT≤0.5 m 7 = HT<0.2 m

CVR CODES 0= NONE 1= 0% < CVR ≤ 10% 2= 10 < CVR ≤ 25% 3= 25 < CVR ≤ 60% 4= CVR > 60%

STAND COMPOSITION:	BA:

SIZE CLASS ANALYSIS:		< 10		10 - 24		25 - 50		> 50
STANDING SNAGS:	R	< 10	O	10 - 24	N	25 - 50	N	> 50
DEADFALL / LOGS:	A	< 10	A	10 - 24	N	25 - 50	N	> 50

ABUNDANCE CODES: N = NONE R = RARE O = OCCASIONAL A = ABUNDANT

COMM. AGE :		PIONEER		YOUNG		MID-AGE		MATURE		OLD GROWTH

SOIL ANALYSIS:

TEXTURE:	DEPTH TO MOTTLES / GLEY	g =	G=
MOISTURE:	DEPTH OF ORGANICS:		(cm)
HOMOGENEOUS / VARIABLE	DEPTH TO BEDROCK:		(cm)

COMMUNITY CLASSIFICATION:

		ELC CODE
COMMUNITY CLASS:		
COMMUNITY SERIES:		
ECOSITE:		
VEGETATION TYPE:	FM Bur Oak Deciduous Forest	FOD4-3
INCLUSION		
COMPLEX		

Notes:

ELC STAND CHARACTERISTICS

SITE:	
POLYGON:	
DATE:	
SURVEYOR(S):	

TREE TALLY BY SPECIES:

PRISM FACTOR

SPECIES	TALLY 1	TALLY 2	TALLY 3	TALLY 4	TALLY 5	TOTAL	REL. AVG
TOTAL							100
BASAL AREA (BA)							
DEAD							

STAND COMPOSITION:

COMMUNITY PROFILE DIAGRAM NOTES:

Lrg. mature trees present, some with cavities

- Many downed trees present. - Abundant DWD
- Rabbit, raccoon tracks, deer tracks, coyote tracks.
- Porcupine observed on ground.

Photo # 657-663

Notes:

C

SOILS ONTARIO

SITE:
POLYGON:
DATE:
SURVEYOR(S):

	P/A	PP	Dr	Position	Aspect	Slope %	Slope Type	Slope Class	UTM Z	UTM EASTING	UTM NORTHING
1											
2											
3											
4											
5											

SOIL	1	2	3	4	5
TEXTURE x HORIZON					
A TEXTURE					
COURSE FRAGMENTS					
B TEXTURE					
COURSE FRAGMENTS					
C TEXTURE					
COURSE FRAGMENTS					
EFFECTIVE TEXTURE					
SURFACE STONINESS					
SURFACE ROCKINESS					
DEPTH TO / OF					
MOTTLES					
GLEY					
BEDROCK					
WATER TABLE					
CARBONATES					
DEPTH OF ORGANICS					
PORE SIZE DISC #1					
PORE SIZE DISC #2					
MOISTURE REGIME					
SOIL SURVEY MAP					
LEGEND CLASS					

ELC
PLANT SPECIES LIST

SITE:
POLYGON:
DATE:
SURVEYOR(S):

LAYERS: 1 = CANOPY 2 = SUB-CANOPY 3 = UNDERSTOREY 4 = GROUND (GRD.) LAYER
ABUNDANCE CODES: R = RARE O = OCCASIONAL A = ABUNDANT D = DOMINANT

SPECIES CODE	LAYER 1	LAYER 2	LAYER 3	LAYER 4	COL.
POPALBA	O				
QUERUBR					
PINSTRO	R				
Cornus_sp					
QUEMACR	A				
ULMAMER		O			
TILAMER	A				
VITRIPA			A		
ACESASA	A				
FRA-SP					
RHACATH		A	A		
periwinkle				A	
EQUARVE					
POPTREM	R				
ACENEGU					
SALIX_SP					
BETPAPY	R				

SPECIES CODE	LAYER 1	LAYER 2	LAYER 3	LAYER 4	COL.

KANATA - 476274

ELC COMMUNITY DESCRIPTION & CLASSIFICATION	SITE: 5649 Hazeldean		POLYGON: 2-Unit
	SURVEYOR(S): H. ORR	DATE: Nov 28, 2017	TIME: start / finish
	UTMZ:	UTME:	UTMN:

POLYGON DESCRIPTION

SYSTEM	SUBSTRATE	TOPOGRAPHIC FEATURE	HISTORY	PLANT FORM	COMMUNITY
G TERRESTRIAL (checked)	G ORGANIC	G LACUSTRINE	G NATURAL (checked)	G PLANKTON	G LAKE
G WETLAND	G MINERAL SOIL (checked)	G RIVERINE	G CULTURAL	G SUBMERGED	G POND
G AQUATIC	G PARENT MIN.	G BOTTOMLAND		G FLOATING-LVD.	G RIVER
	G ACIDIC BEDRK.	G TERRACE		G GRAMINOID	G STREAM
	G BASIC BEDRK.	G VALLEY SLOPE		G FORB	G MARSH
	G CARB. BEDRK.	G TABLELAND		G LICHEN	G SWAMP
		G ROLL. UPLAND		G BRYOPHYTE	G FEN
		G CLIFF		G DECIDUOUS	G BOG
		G TALUS		G CONIFEROUS	G BARREN
		G CREVICE / CAVE		G MIXED	G MEADOW
		G ALVAR			G PRAIRIE
		G ROCKLAND			G THICKET
		G BEACH / BAR			G SAVANNAH
		G SAND DUNE			G WOODLAND
		G BLUFF			G FOREST
					G PLANTATION

SITE	COVER
G OPEN WATER	G OPEN (checked)
G SHALLOW WATER	G SHRUB
G SURFICIAL DEP.	G TREED
G BEDROCK	

STAND DESCRIPTION:

	LAYER	HT	CVR	SPECIES IN ORDER OF DECREASING DOMINANCE (up to 4 sp) (>> MUCH GREATER THAN; > GREATER THAN; = ABOUT EQUAL TO)
1	CANOPY			
2	SUB-CANOPY	4	2	CORSTOL > CORRACE > SALIX_SP
3	UNDERSTOREY	5	4	PHAARUN > TYPLAT I
4	GRD. LAYER	6	4	AST. SP = SOL-SPP > DAUCARO

HT CODES: 1 = >25 m 2 = 10<HT≤25 m 3 = 2<HT≤10 m 4 = 1<HT≤2 m 5 = 0.5<HT≤1 m 6 = 0.2<HT≤0.5 m 7 = HT<0.2 m

CVR CODES 0= NONE 1= 0% < CVR ≤ 10% 2= 10 < CVR ≤ 25% 3= 25 < CVR ≤ 60% 4= CVR > 60%

STAND COMPOSITION:	BA:

SIZE CLASS ANALYSIS:		< 10		10 - 24		25 - 50		> 50
STANDING SNAGS:		< 10		10 - 24		25 - 50		> 50
DEADFALL / LOGS:		< 10		10 - 24		25 - 50		> 50

ABUNDANCE CODES: N = NONE R = RARE O = OCCASIONAL A = ABUNDANT

COMM. AGE :		PIONEER		YOUNG		MID-AGE		MATURE		OLD GROWTH

SOIL ANALYSIS:

TEXTURE:	DEPTH TO MOTTLES / GLEY	g =	G=
MOISTURE:	DEPTH OF ORGANICS:		(cm)
HOMOGENEOUS / VARIABLE	DEPTH TO BEDROCK:		(cm)

COMMUNITY CLASSIFICATION:

		ELC CODE
COMMUNITY CLASS:		
COMMUNITY SERIES:		
ECOSITE:		
VEGETATION TYPE:	Dry-Moist Old Field Meadow	CUM1-1
INCLUSION	Reed-canary meadow marsh	MAM2-2
~~COMPLEX~~	Mineral Thicket Swamp	SWT2

Notes: Incl. 2

ELC STAND CHARACTERISTICS	SITE:
	POLYGON:
	DATE:
	SURVEYOR(S):

TREE TALLY BY SPECIES:

PRISM FACTOR

SPECIES	TALLY 1	TALLY 2	TALLY 3	TALLY 4	TALLY 5	TOTAL	REL. AVG
TOTAL							100
BASAL AREA (BA)							
DEAD							

STAND COMPOSITION:

COMMUNITY PROFILE DIAGRAM

Mix of meadow & marsh

Photo# 657-663

Notes:

ELC SOILS ONTARIO

SITE:
POLYGON:
DATE:
SURVEYOR(S):

	P/A	PP	Dr	Position	Aspect	Slope %	Slope Type	Slope Class	Z	UTM EASTING	UTM NORTHING
1											
2											
3											
4											
5											

SOIL	1	2	3	4	5
TEXTURE x HORIZON					
A TEXTURE					
COURSE FRAGMENTS					
B TEXTURE					
COURSE FRAGMENTS					
C TEXTURE					
COURSE FRAGMENTS					
EFFECTIVE TEXTURE					
SURFACE STONINESS					
SURFACE ROCKINESS					
DEPTH TO / OF					
MOTTLES					
GLEY					
BEDROCK					
WATER TABLE					
CARBONATES					
DEPTH OF ORGANICS					
PORE SIZE DISC #1					
PORE SIZE DISC #2					
MOISTURE REGIME					
SOIL SURVEY MAP					
LEGEND CLASS					

ELC PLANT SPECIES LIST

SITE:
POLYGON:
DATE:
SURVEYOR(S):

LAYERS: 1 = CANOPY 2 = SUB-CANOPY 3 = UNDERSTOREY 4 = GROUND (GRD.) LAYER
ABUNDANCE CODES: R = RARE O = OCCASIONAL A = ABUNDANT D = DOMINANT

SPECIES CODE	LAYER 1	LAYER 2	LAYER 3	LAYER 4	COL.
AST-SPP				A	
SOL-SPP				A	
PHAARUN			A		
ARCMINU				O	
CORSTOL		O			
CORRACE		D			
wild parsnip				O	
DAUCARO				A	
CIRARVE				O	
VERTHAP				R	
Viper bulgloss				R	
ASCSYRI				O	
RUMCRIS				O	
TYPLATI			O		
Salix sp.			O		

SPECIES CODE	LAYER 1	LAYER 2	LAYER 3	LAYER 4	COL.

APPENDIX E: Photographic Record

Photo 1: Stormwater management pond #1 west of March Road, looking south (Figure 3-6).

Photo 2: Cultural woodland (CUW1) vegetation community west of March Road, looking northeast (Figure 3-6).

Photo 3: Partial excavated land within cultural woodland community, west of March Road, looking north (Figure 3-6).

Photo 4: Partial excavated land within cultural meadow (CUM1) community, west of March Road, looking northeast (Figure 3-6).

Photo 5: Potential snake hibernacula within cobble stones and cracks within culvert foundation, west of March Road (Figure 3-6).

Photo 6: Stormwater management pond #1, west of March Road, looking northwest (Figure 3-6).

Photo 7: Rock outcrop within meadow marsh (MAM2) community, west of March Road, looking south (Figure 3-6).

Photo 8: Potential animal burrow and/or snake hibernacula within rock outcrop, west of March Road (Figure 3-6).

Photo 9: Overview of meadow marsh and stormwater management pond #1, west of March Road, looking east (Figure 3-6).

Photo 10: Substrate of stormwater management pond #1, west of March Road, looking south (Figure 3-6).

Photo 11: Excavated area and active construction work within cultural meadow (CUM1) community, west of March Road, looking northeast (Figure 3-6).

Photo 12: Rock outcrop within deciduous forest (FOD4) community, southeast of Ed Hollyer Park (Figure 3-6).

Photo 13: Potential snake hibernacula within deciduous forest (FOD4) community, southeast of Ed Hollyer Park, looking south (Figure 3-6).

Photo 14: Potential animal burrow within deciduous forest (FOD4) community, southeast of Ed Hollyer Park (Figure 3-6).

Photo 15: Sumac cultural thicket (CUT1-1) community, southeast of Ed Hollyer Park, looking east toward Highway 417 (Figure 3-6).

Photo 16: Edge of Ed Hollyer Park and deciduous forest (FOD4) community, looking southeast (Figure 3-6).

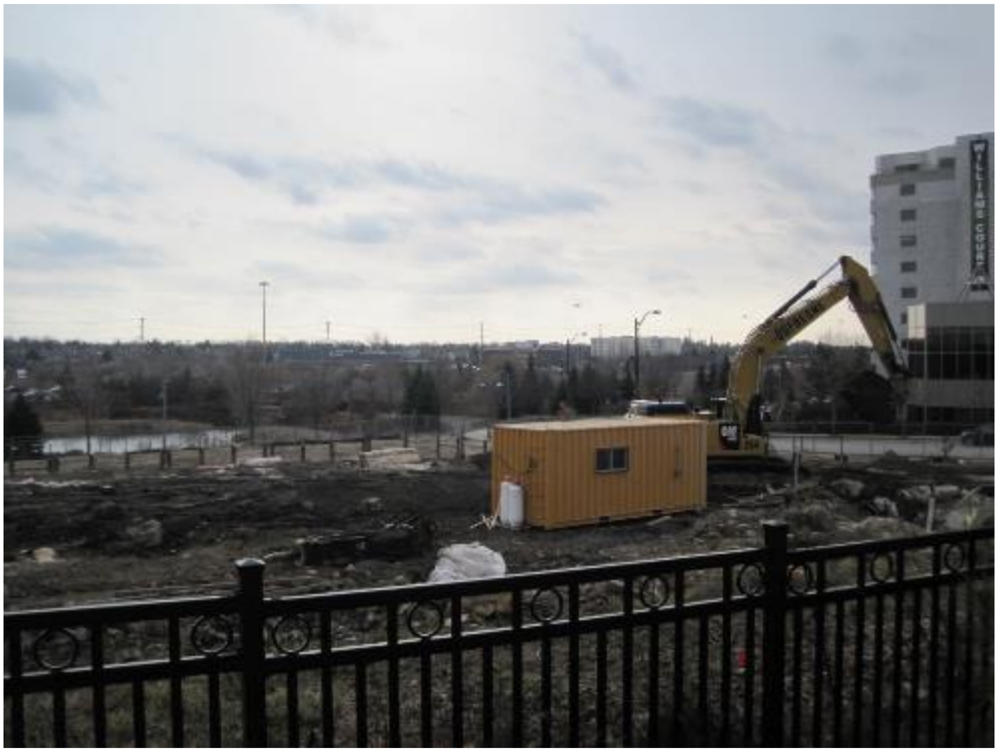


Photo 17: View of excavated land and active construction adjacent to Maritime Way, looking south (Figure 3-6).

Photo 18: Cultural meadow (CUM1) community adjacent to Robert Gray Park, looking southeast (Figure 3-6).

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Photo 20: Cultural woodland (CUW1) community adjacent to Robert Gray Park, looking northwest (Figure 3-6).

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Photo 22: Stormwater management pond #2 and cattail shallow marsh (MAS2-1), west of Robert Gray Park, looking east (Figure 3-6).

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Photo 24: Meadow occurrences along the edge of lowland deciduous forest (FOD7-3) community, east of Huntmar Drive, looking southeast (Figure 3-4).

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Photo 26: Rock outcrops throughout meadow and lowland deciduous forest (FOD7-3), potential snake hibernacula, east of Huntmar Drive (Figure 3-4).

Photo 27: Trunk of butternut tree #1 within lowland deciduous forest (FOD7-3), east of Huntmar Drive (Figure 3-4).

Photo 28: Crown of butternut tree #1 within lowland deciduous forest (FOD7-3), east of Huntmar Drive (Figure 3-4).

Photo 29: Meadow marsh complexed throughout the lowland deciduous forest (FOD7-3) community, east of Huntmar Dive, looking south (Figure 3-4).

Photo 30: Butternut tree #2 within lowland deciduous forest (FOD7-3), east of Huntmar Drive (Figure 3-4).

Photo 31: Canker within the trunk of butternut tree #3 within the lowland deciduous forest (FOD7-3) community, east of Huntmar Drive (Figure 3-4).

Photo 32: Canker and peeling bark of butternut tree #3 and 4 within the lowland deciduous forest (FOD7-3) community, east of Huntmar Drive (Figure 3-4).

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Photo 42: Reed-canary grass mineral meadow marsh (MAM2-2) community surrounding Poole Creek, southeast of Maple Grove Road, looking north (Figure 3-2).

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Photo 44: Poole Creek, southeast of Maple Grove, looking south (Figure 3-2).

Photo 45: Gravel pads and construction area, southeast of Maple Grove, looking northwest (Figure 3-3).

Photo 46: Mosaic landscape of cultural woodland, thicket, and meadow communities adjacent to Poole Creek, looking southeast (Figure 3-3).

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Photo 48: Fresh-moist bur oak deciduous forest (FOD9-3) community, northwest of Hazeldean Road, looking northwest (Figure 3-2).

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II. Preliminary Existing Conditions Assessment Air Quality, Noise, and Ground Vibrations

Preliminary Existing Conditions Assessment
Air Quality, Noise, and Ground Vibrations
Kanata LRT

Ottawa, Ontario

REPORT: GWE17-043 - QEC

DRAFT

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Michael Lafortune, Environmental Scientist
Joshua Foster, P.Eng., Principal

August 21, 2018

EXECUTIVE SUMMARY

Gradient Wind Engineering Inc. (GWE) was retained by Parsons to provide engineering support in the areas of air quality, noise, and ground vibrations, for the environmental assessment (EA) and planning phase of the City of Ottawa's Kanata LRT project. The project is a proposed extension of the Confederation Line rail system from Moodie Drive to Kanata. Figure 1 illustrates an overview of the project.

As a preliminary step in the environmental assessment process for the Kanata LRT project, the existing environmental conditions relating to air quality, noise and ground vibrations have been qualitatively summarized and compared to standard criteria as a precursor to more detailed subsequent studies. With respect to environmental impacts within the study area, Figure 2 to 22 illustrate the zones where the existing air quality, noise and ground vibration conditions (respectively) may be categorized as either low, moderate, or elevated. In summary, the conditions may be generally described as follows:

(i) **Air Quality (Figure 2 to 8)**: The concentrations of pollutants produced by vehicle emissions are moderate throughout the study area, with higher consecrations expected around Highway 417.

(ii) **Noise (Figure 9 to 15)**: Environmental noise levels are generally moderate to elevated depending on proximity to roadways. Beyond 100 meters from arterial roadways and 500 m from a freeway, noise levels fall below the ENCG objective level of 55 dBA.

(iii) **Ground Vibrations (Figure 16 to 22)**: The estimated ground vibration levels are low, and fall below the human perception level of 0.1 mm/s (72 dBV) throughout the study area. Ground-borne noise levels produced by ground vibrations have similar impacts.

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1. INTRODUCTION

Gradient Wind Engineering Inc. (GWE) was retained by Parsons to provide engineering support in the areas of air quality, noise and ground vibrations for the Environmental Assessment (EA) and planning phase of the City of Ottawa's Kanata LRT project. The Kanata LRT project is being undertaken as a provincial Environmental Assessment. This qualitative report describes the existing conditions relating to air quality, noise and ground vibrations. Our work is based on alignment alternatives provided by Parsons, satellite imagery, GWE's experience with similar projects, and a review of the West Transitway Connection and East-West Corridor LRT projects' qualitative existing conditions assessments.

2. TERMS OF REFERENCE

The focus of this qualitative existing conditions environmental analysis is the proposed Kanata LRT project. The project is a proposed extension of the Confederation Line rail system from Moodie Drive to Kanata. Consideration is also being given to new stations along the LRT line, as well as to a light maintenance and storage facility. The purpose of the provincial EA is to develop a functional plan for extended light rail services to Kanata. The planning and EA studies will perform a needs assessment for the corridor, evaluate various alternative designs, and recommend a preferred design for the corridor. This information will later be used to evaluate the impacts of various future alternative solutions and designs. GWE will conduct a more detailed assessment of existing and future conditions following the release of a short list of selected options.

The overall study area extends from Terry Fox Drive to the north, Moodie Drive to the east, Huntmar Drive to the west and Abbott Street to the south. Thirteen possible corridors were under consideration within this broad area.

The major sources of air quality and noise emissions in the area are Highway 417, March Road, Eagleson Road, Terry Fox Drive, and Hazeldeen Road. Highway 417 is also a source of minor ground vibrations and ground-borne noise, mainly due to heavy vehicles passing over uneven surfaces. The impact of such sources has been described in previous EA work, such as for the East West Corridor Light Rail Transit (LRT) project.

3. OBJECTIVES

The underlying goal of this report is to provide context and background information for the Kanata LRT study area; qualitatively estimating the existing environmental conditions relating to ambient air quality, noise, and ground vibrations. This information will later be used to evaluate the impacts of various future alternative solutions and designs. Upon the selection of a short list of options, GWE will conduct more detailed assessments of existing and future conditions for comparison against a preferred alternative.

4. QUALITATIVE EXISTING CONDITIONS

This qualitative existing conditions assessment of air quality, noise, and ground vibrations was based on a review of transportation related activities within the study area, generalized noise calculations using STAMSON 5.04, generalized air quality calculations using AERMOD and research into local geology. The calculations are based on traffic count data received by Parsons, originating from the City of Ottawa, as well as the City of Ottawa document, Environmental Noise Control Guidelines[1] (ENCG). Sensitive land uses within the corridor are sporadic and include residential properties, specifically at the outdoor living area. These properties are identified with the colour blue in all figures.

4.1 Air Quality Assessment

Roadway vehicle traffic is the primary source of air-borne pollutants in the study area. In addition to roadway sources, stationary pollution sources exist within the same area, which include emergency diesel generators, steam and hot water boilers, paint spray booths and numerous other processes and equipment at commercial and industrial facilities along the corridor. Emissions from roadway vehicles and stationary sources include Carbon Monoxide (CO), Hydrocarbons (HC), Oxides of Nitrogen (NOx) and Particulate Matter (PM), among other volatile organic compounds (VOC), which contribute to ambient air quality levels.

This assessment of ambient air quality requires estimating the concentrations of the noted pollutants, measured in either parts per million (ppm) or micrograms per cubic meter ($\mu g/m^3$). The estimated pollutant concentrations are thus compared to clean air standards that have been set by the Ontario Ministry of the Environment and Climate Change's (MOECC) Standards Development Branch, including:

[1] City of Ottawa Environmental Noise Control Guidelines, January 2016

- The Ambient Air Quality Criteria (AAQC)[2] are the Ministry's targets for clean air from all sources of pollutants, including transit, transportation, and industrial facilities.
- Ontario Regulation 419: Air Pollution – Local Air Quality Standards (O. Reg. 419/05)[3], are the legal limits for single or multiple sources falling within a single property, such as an industrial facility.
- Canadian Ambient Air Quality Standards (CAAQS).

The AAQC standards for representative pollutants are listed in Table 1 with the averaging period for each pollutant indicated in parenthesis.

TABLE 1: AMBIENT AIR QUALITY CRITERIA STANDARDS

Pollutant	AAQC (µg/m^3)	2020 CAAQS (µg/m^3)	Limiting Effect
CO	36,200 (1 Hour)	N/A	Health
	15,700 (8 Hour)	N/A	
NO_x	400 (1 Hour)*	112 (1 Hour)	Health
	200 (24 Hour)*	N/A	
	N/A	32 (Annual)	
PM_{10} < 10µm	50 (24 Hour)	N/A	Health
$PM_{2.5}$ < 2.5µm	30 (24 Hour)	27 (24 Hour)	Health
	N/A	8.8 (Annual)	
Benzene	2.3 (24 Hour)	N/A	Health
	0.45 (Annual)	N/A	
1,3-Butadiene,	10 (24 Hour)	N/A	Health
	2 (Annual)	N/A	
Formaldehyde	65 (24 Hour)	N/A	Health
Benzo(a)pyrene	0.00005 (24 Hour)	N/A	Health
	0.00001 (Annual)	N/A	
Acetaldehyde,	500 (½ Hour)	N/A	Health
	500 (24 Hour)	N/A	
Acrolein	4.5 (1 Hour)	N/A	Health
	0.4 (24 Hour)	N/A	

Note: *Limit for NOx is a mixture of both NO and NO_2. In ambient air, NO converts to NO_2, which has more severe health effects than NO. Therefore, AAQC is based on health effects of NO_2

[2] Standards Development Branch, Ontario Ministry of the Environment, *Ontario's Ambient Air Quality Criteria (AAQC)*, April 2012.

[3] Standards Development Branch, Ontario Ministry of the Environment, Summary of Standards and Guidelines to Support Ontario Regulation 419: Air Pollution – Local Air Quality, April 2012

For reference, the current ambient concentration levels for the noted pollutants are available from the MOECC permanent monitoring station at 960 Carling Avenue in Ottawa, Ontario (NAPS Station 60104). These values represent conservative estimates of the 90th percentile ambient levels existing in the study area. The 90th percentile for each major vehicle emission is included in Table 2. This data indicates that, for 90% of the time, the actual background concentrations will fall below the levels stated in Table 2.

TABLE 2: AMBIENT AIR QUALITY BACKGROUND LEVELS[4,5]

Pollutant	90% Background Concentrations (µg/m3)		
	1 Hour	24 Hour	Annual
Carbon Monoxide (CO)	345*	138	28
Hydrocarbons (HC)	N/A	N/A	N/A
Oxides of Nitrogen (NO_x)	40	16	3.2
Particulate Matter (PM2.5, < 2.5 m)	13	5.2	1.0
Benzene	0.71	0.28	0.056
1,3-Butadiene,	0.057	0.023	0.005
Formaldehyde	N/A	N/A	N/A
Acetaldehyde,	0.94**	0.38	0.076
Acrolein	N/A	N/A	N/A

Note: * Measured at the Ottawa Downtown Monitoring station
**No Report for 2014 data taken from 2013 data set

Based on the AAQC, recorded ambient levels and land usage within the study area, the following categories are applicable to describe air quality conditions in the Kanata LRT study area:

ELEVATED Selected pollutants are expected to approach AAQC standards on a regular basis, or occasionally exceed them

MODERATE Selected pollutants are expected to approach AAQC standards occasionally

LOW Selected pollutants are expected to rarely approach AAQC standards

Figure 2 to 8 illustrate the zones within the Kanata LRT study area for which the foregoing descriptions are applied. The concentrations of pollutants produced by vehicle emissions are low to moderate throughout the study area. With respect to commercial, industrial, and institutional facilities, these facilities are

[4] MOECC, Air Quality in Ontario 2013 Report,
[5] http://maps-cartes.ec.gc.ca/rnspa-naps/data.aspx?lang=en, 2010 data set

assumed to have undergone screening under the MOECC's Environmental Compliance Approvals (formally Certificate of Approval) process and O.Reg. 419/05, and are not considered to have significant impacts.

4.2 Noise Assessment

Vehicular traffic is the primary source of environmental noise within the study area. Similar to considerations of air quality, stationary noise sources exist within the study area and include emergency generators, HVAC equipment and numerous other processes at commercial and industrial facilities.

The quantification of roadway noise is based on the decibel unit, dBA, which is a logarithmic ratio referenced to a standard noise level ($2x10^{-5}$ Pascals). The 'A' suffix refers to a weighting scale, which represents how noise is perceived by humans. With this scale, a doubling of sound power at the source results in a 3 dBA increase in measured noise at the receiver, and is just perceptible to most people. An increase of 10 dBA is usually perceived to be twice as loud. The results of roadway noise calculations are expressed in terms of the equivalent sound level, L_{eq}, for daytime and nighttime periods. The L_{eq} provides a weighted measure of the time varying noise levels produced by vehicle traffic. It is defined as the continuous sound level that has the same energy as a time varying noise level over a selectable period of time. For roadways in the City of Ottawa, the L_{eq} is calculated based on a 16-hour daytime / 8-hour nighttime split.

The MOECC provides guidelines for control of noise produced by human activities[6]. These guidelines have been adopted by various municipalities and are incorporated into local noise by-laws. The City of Ottawa Environmental Noise Control Guidelines (ENCG)[7] is a comprehensive technical document for the purpose of assessing and controlling noise impacts within its urban boundary. According to the ENCG, daytime L_{eq} of 55 dBA or lower are acceptable for outdoor living areas (OLA's), with mitigating measures being required as the noise levels exceed 60 dBA. Noise sensitive areas defined by the ENCG and MOECC guidelines include residential and institution land uses such as schools and hospitals.

[5] Ontario Ministry of the Environment and Climate Change – Environmental Noise Guidelines, Publication NPC-300, Queens Printer for Ontario, Toronto, 2013
[6] City of Ottawa Environmental Noise Control Guidelines, January 2016

Based on the ENCG, the following categories are applicable to describe the existing noise conditions for the Kanata LRT study area:

ELEVATED	Daytime L_{eq} noise levels at receivers are expected to exceed 60 dBA
MODERATE	Daytime L_{eq} noise levels at receivers are expected to fall in the range of 55 to 60 dBA
LOW	Daytime L_{eq} noise levels are expected to fall below 55 dBA

Figure 9 to 15 illustrate the zones within the Kanata LRT study area for which the foregoing descriptions are appropriate for roadway traffic noise impacts. In general terms, noise levels throughout the study area will fall into one of the three categories. The levels are dictated by proximity to high-volume roadways. Noise levels will exceed 55 dBA where receptors are located in close proximity to arterial roadways, and will fall below 55 dBA in more isolated areas.

With respect to stationary noise sources, the noted industrial and commercial facility types are considered to have undergone screening under MOECC's Environmental Compliance Approval process and NPC-300, therefore their impacts on overall noise levels within the study area are assumed to be negligible.

4.3 Ground Vibrations and Ground Borne Noise Assessment

Heavy vehicles (trucks and buses) passing over uneven roadway surfaces can produce perceptible levels of ground vibrations, and incidentally ground-borne noise. Human response to ground vibrations is measured by the root mean square (RMS) of the movement of a particle on a surface. Typical units of ground vibration measures are millimeters per second (mm/s), or inch per second (in/s). Since vibrations can vary over a wide range it is also convenient to represent them in decibel units, of dBV, referenced to one micro inch per second. The threshold level of human perception to vibrations is about 0.14 mm/s RMS or about 75 dBV. Although somewhat variable, the threshold of annoyance for continuous vibrations (0.5 mm/s RMS or 85 dBV) is approximately 3.5 times higher than the perception threshold, whereas the threshold for cosmetic damage (10 mm/s RMS or 112 dBV) is at least twenty times higher than the annoyance threshold level. Human sensitivity to ground-borne noise is similar to air-borne noise.

Vibration criteria for a variety of building functions have been established by the International Standards Organization[8], the United States Federal Transportation Authority, the MOECC and the Toronto Transit

[8] ISO 2631-2 Evaluation of Human Exposure to Whole-Body Vibrations – Part 2: Continuous and Shock-Induced Vibrations In Buildings (1 to 80 Hertz), 1989-02-15

Commission[9], among others. According to these standards, the appropriate criteria for residential buildings are 0.1 mm/s RMS (72 dBV) for vibrations and 35 dBA for ground borne noise.

Based on the ground vibration criteria for human perception, the following categories are applicable to describe the existing ground vibrations within the Kanata LRT study area:

ELEVATED	Vibrations at receptors exceed 1 mm/s (92 dBV) rms particle velocity and are likely to cause adverse reactions with building occupants
MODERATE	Vibrations at receptors fall between 0.1 mm/s (72 dBV) to 1 mm/s (92 dBV) rms particle velocity and will be noticeable but will not cause adverse reactions in the building occupants
LOW	Vibrations at receptors fall below 0.1 mm/s (72 dBV) and will not be noticeable to building occupants

Figure 16 to 22 illustrate the zones within the Kanata LRT study area for which the foregoing descriptions are appropriate. In general terms, vibration levels throughout the area are expected to fall below the human perception level of 0.1 mm/s (72 dBV).

5. SUMMARY AND CONCLUSIONS

As a preliminary step in the environmental assessment process for the Kanata LRT project, the existing environmental conditions relating to air quality, noise and ground vibrations have been qualitatively summarized and compared to standard criteria as a precursor to more detailed subsequent studies. With respect to environmental impacts within the study area, Figure 2 to 22 illustrate the zones where the existing air quality, noise and ground vibration conditions (respectively) may be categorized as either low, moderate, or elevated. In summary, the conditions may be generally described as follows:

(i) **Air Quality (Figure 2 to 8)**: The concentrations of pollutants produced by vehicle emissions are moderate throughout the study area, with higher consecrations expected around Highway 417.

(ii) **Noise (Figure 9 to 15)**: Environmental noise levels are generally moderate to elevated depending on proximity to roadways. Beyond 100 meters from arterial roadways, noise levels fall below the ENCG objective level of 55 dBA.

[9] MOEE/TTC Protocol for Noise and Vibration Assessment for the Proposed Yonge-Spadina Subway Loop, June 16, 1993

(iii) **Ground Vibrations (Figure 16 to 22)**: The estimated ground vibration levels are low, and fall below the human perception level of 0.1 mm/s (72 dBV) throughout the study area. Ground-borne noise levels produced by ground vibrations have similar impacts.

This concludes our preliminary qualitative assessment of existing environmental conditions in the areas of noise, air quality, and ground vibrations, for the proposed Kanata LRT project. Please contact the undersigned for questions or clarifications

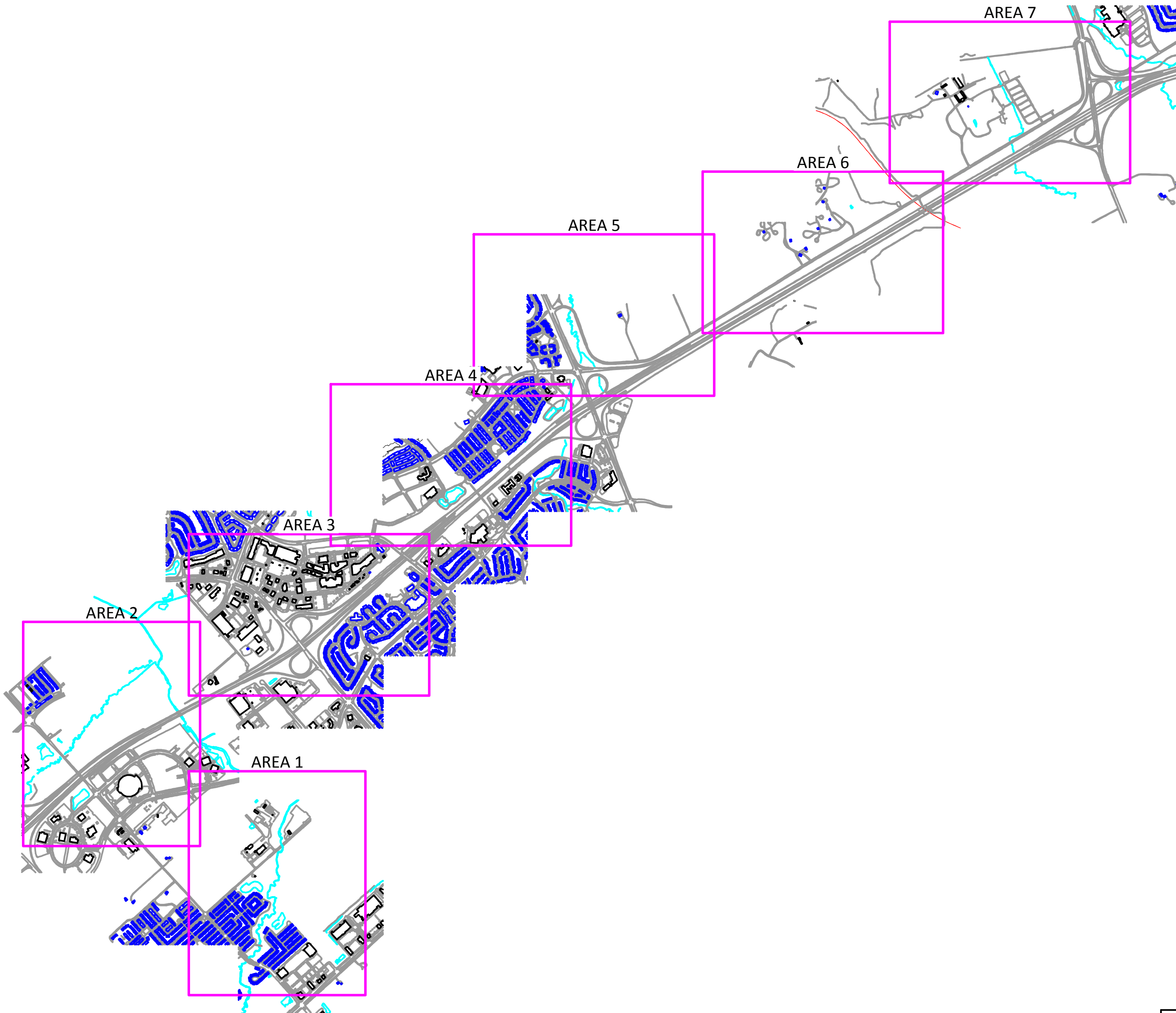
Yours truly,

Gradient Wind Engineering Inc.

DRAFT

Michael Lafortune
Environmental Scientist
GWE17-043 – QEC

Joshua Foster, P.Eng.
Principal



N

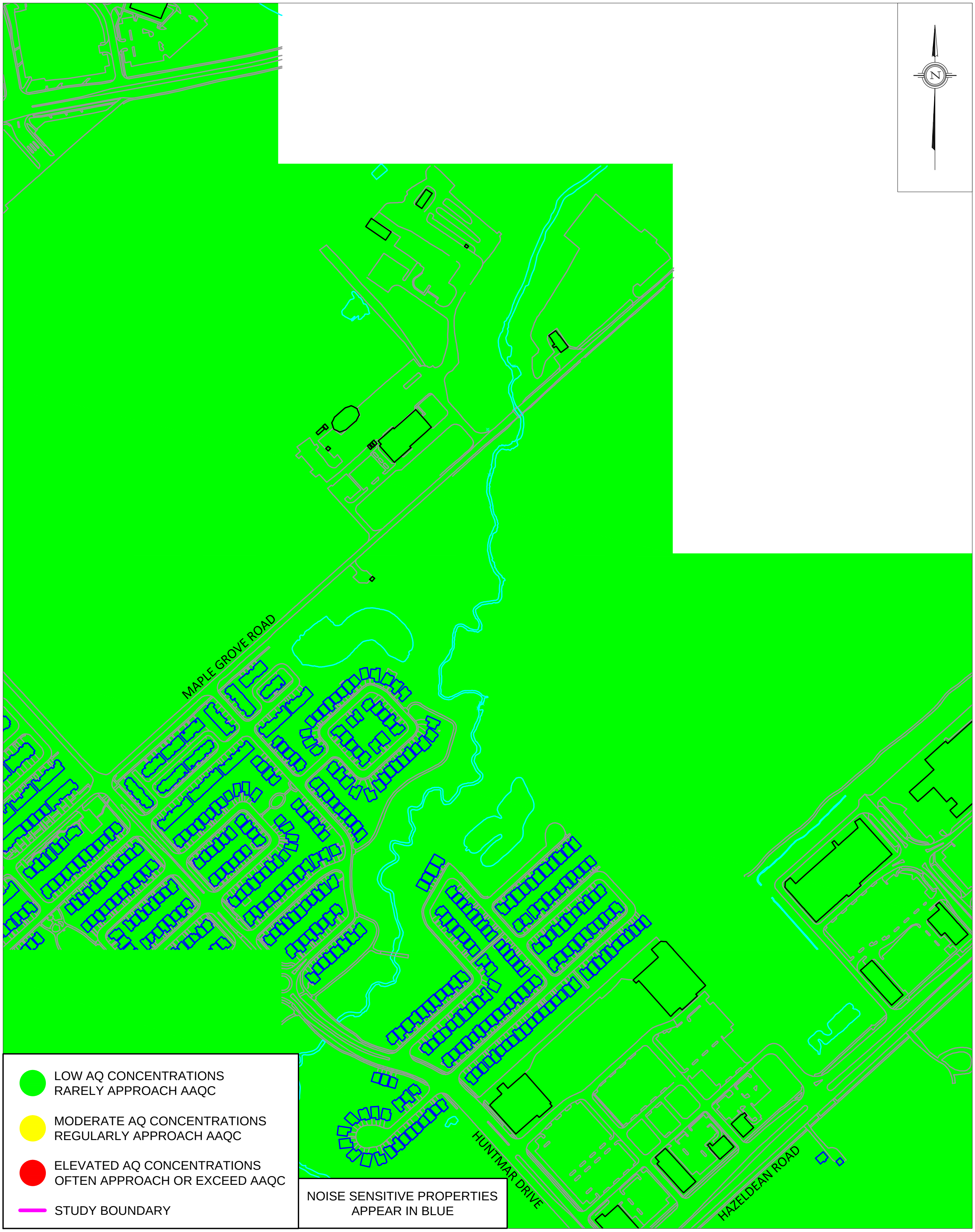
NOISE SENSITIVE PROPERTIES APPEAR IN BLUE

127 Walgreen Road
Ottawa, Ontario
(613) 836 0934
GRADIENT WIND ENGINEERING INC

PROJECT	KANATA LRT PRELIMINARY EXISTING CONDITIONS ASSESSMENT		
SCALE	1:45000 (APPROX.)	DRAWING NO.	GWE17-043-1
DATE	MARCH 15, 2018	DRAWN BY	M.L.

DESCRIPTION

FIGURE 1:
STUDY AREA AND SURROUNDING CONTEXT



127 Walgreen Road
Ottawa, Ontario
(613) 836 0934

GRADIENT WIND ENGINEERING INC

PROJECT	KANATA LRT PRELIMINARY EXISTING CONDITIONS ASSESSMENT		
SCALE	1:6500 (APPROX.)	DRAWING NO.	GWE17-043-2
DATE	MARCH 15, 2018	DRAWN BY	M.L.

DESCRIPTION

FIGURE 2:
AIR QUALITY CONTOURS - AREA 1

GRADIENT WIND ENGINEERING INC
127 Walgreen Road
Ottawa, Ontario
(613) 836 0934

PROJECT	KANATA LRT PRELIMINARY EXISTING CONDITIONS ASSESSMENT		
SCALE	1:6500 (APPROX.)	DRAWING NO.	GWE17-043-3
DATE	MARCH 15, 2018	DRAWN BY	M.L.

DESCRIPTION

FIGURE 3:
AIR QUALITY CONTOURS - AREA 2

GRADIENT WIND ENGINEERING INC
127 Walgreen Road
Ottawa, Ontario
(613) 836 0934

PROJECT	KANATA LRT PRELIMINARY EXISTING CONDITIONS ASSESSMENT		
SCALE	1:6500 (APPROX.)	DRAWING NO.	GWE17-043-6
DATE	MARCH 15, 2018	DRAWN BY	M.L.

DESCRIPTION

FIGURE 4:
AIR QUALITY CONTOURS - AREA 3

LOW AQ CONCENTRATIONS RARELY APPROACH AAQC

MODERATE AQ CONCENTRATIONS REGULARLY APPROACH AAQC

ELEVATED AQ CONCENTRATIONS OFTEN APPROACH OR EXCEED AAQC

STUDY BOUNDARY

NOISE SENSITIVE PROPERTIES APPEAR IN BLUE

127 Walgreen Road
Ottawa, Ontario
(613) 836 0934
GRADIENT WIND ENGINEERING INC

PROJECT	KANATA LRT PRELIMINARY EXISTING CONDITIONS ASSESSMENT		
SCALE	1:6500 (APPROX.)	DRAWING NO.	GWE17-043-5
DATE	MARCH 15, 2018	DRAWN BY	M.L.

DESCRIPTION

FIGURE 5:
AIR QUALITY CONTOURS - AREA 4

LOW AQ CONCENTRATIONS RARELY APPROACH AAQC

MODERATE AQ CONCENTRATIONS REGULARLY APPROACH AAQC

ELEVATED AQ CONCENTRATIONS OFTEN APPROACH OR EXCEED AAQC

STUDY BOUNDARY

NOISE SENSITIVE PROPERTIES APPEAR IN BLUE

127 Walgreen Road
Ottawa, Ontario
(613) 836 0934
GRADIENT WIND ENGINEERING INC

PROJECT	KANATA LRT PRELIMINARY EXISTING CONDITIONS ASSESSMENT		
SCALE	1:6500 (APPROX.)	DRAWING NO.	GWE17-043-6
DATE	MARCH 15, 2018	DRAWN BY	M.L.

DESCRIPTION

FIGURE 6:
AIR QUALITY CONTOURS - AREA 5

127 Walgreen Road
Ottawa, Ontario
(613) 836 0934

GRADIENT WIND
ENGINEERING INC

PROJECT	KANATA LRT PRELIMINARY EXISTING CONDITIONS ASSESSMENT		
SCALE	1:6500 (APPROX.)	DRAWING NO.	GWE17-043-7
DATE	MARCH 15, 2018	DRAWN BY	M.L.

DESCRIPTION

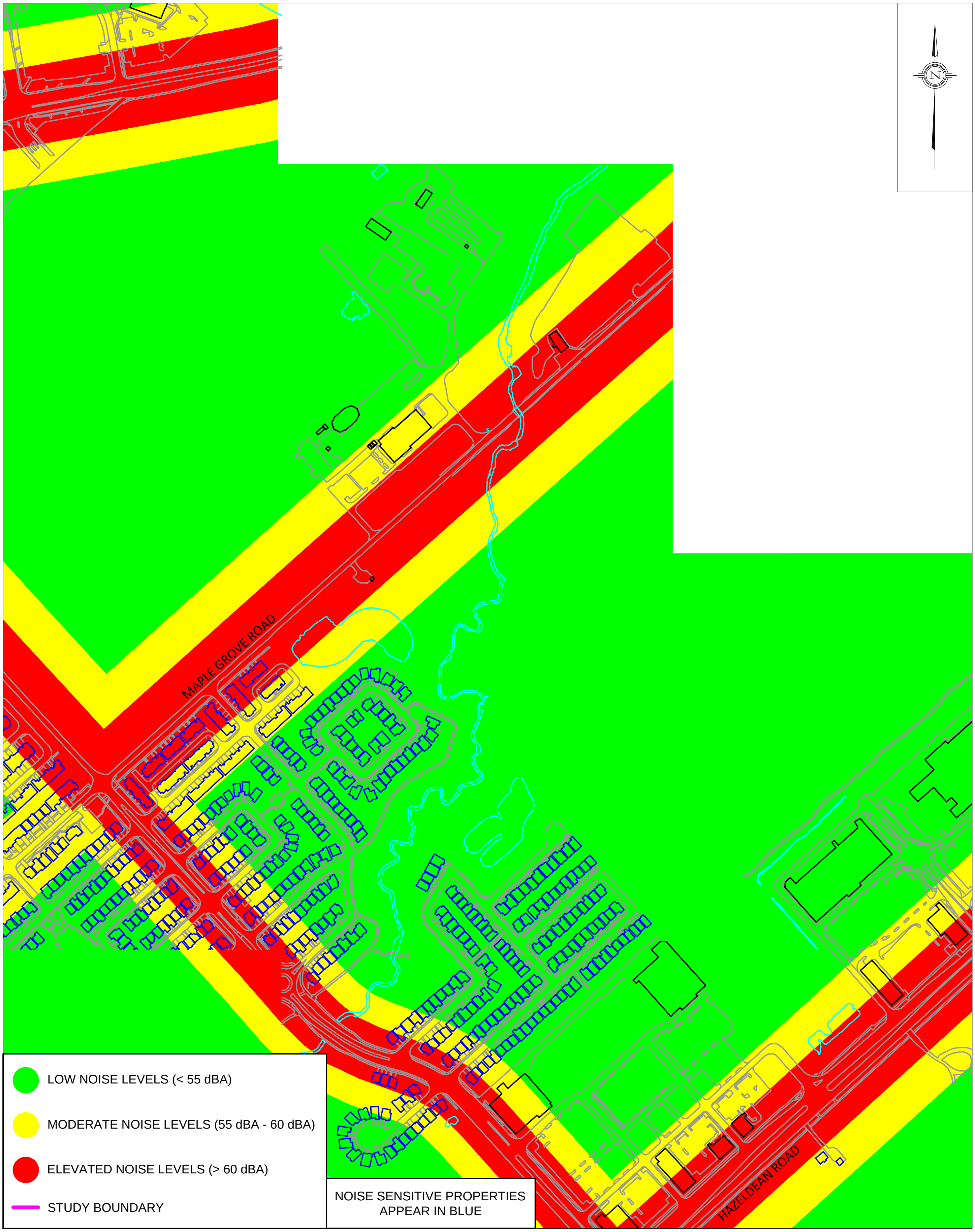
FIGURE 7:
AIR QUALITY CONTOURS - AREA 6

GRADIENT WIND ENGINEERING INC
127 Walgreen Road
Ottawa, Ontario
(613) 836 0934

PROJECT	KANATA LRT PRELIMINARY EXISTING CONDITIONS ASSESSMENT		
SCALE	1:6500 (APPROX.)	DRAWING NO.	GWE17-043-8
DATE	MARCH 15, 2018	DRAWN BY	M.L.

DESCRIPTION

FIGURE 8:
AIR QUALITY CONTOURS - AREA 7



LOW NOISE LEVELS (< 55 dBA)

MODERATE NOISE LEVELS (55 dBA - 60 dBA)

ELEVATED NOISE LEVELS (> 60 dBA)

STUDY BOUNDARY

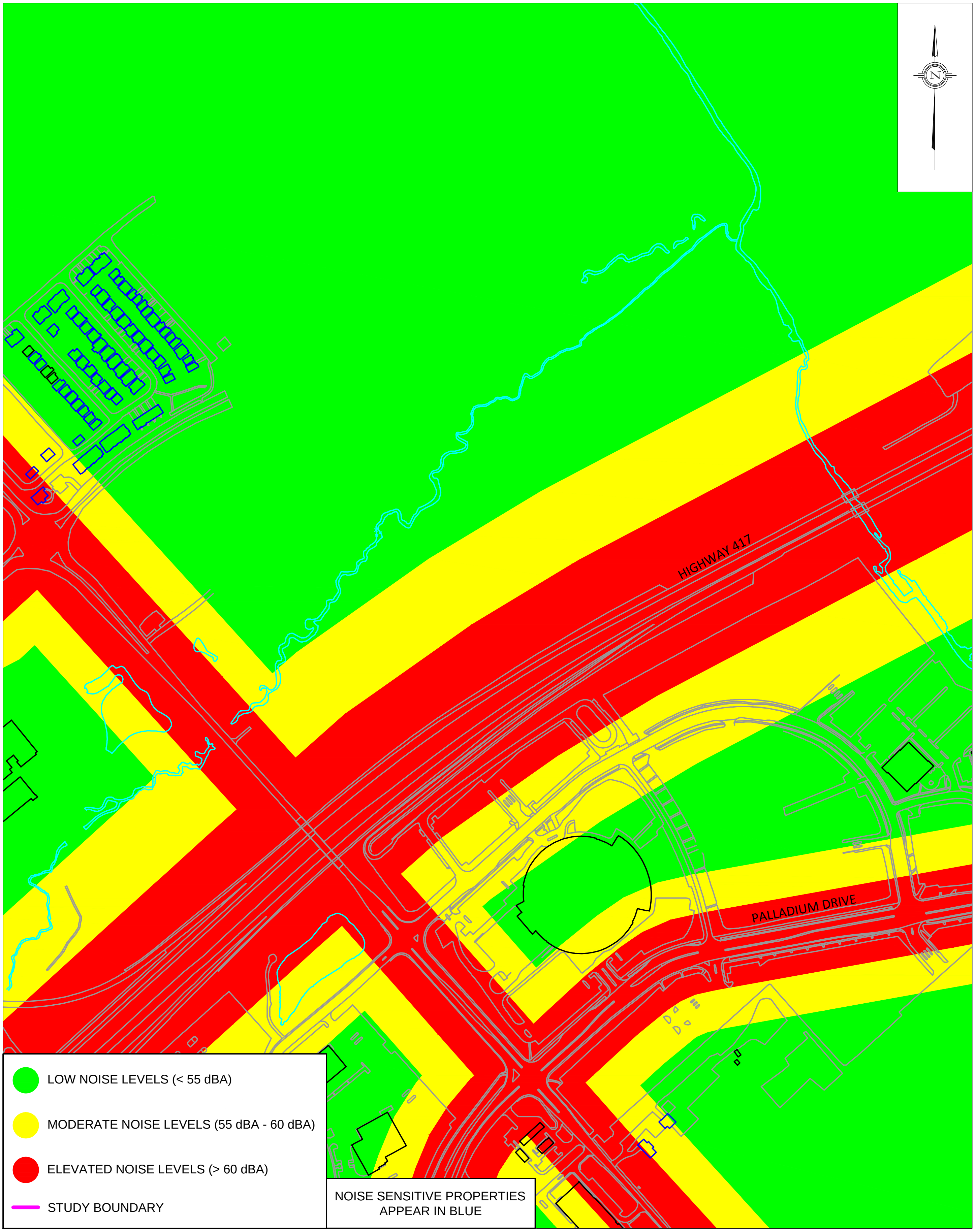
NOISE SENSITIVE PROPERTIES APPEAR IN BLUE

GRADIENT WIND ENGINEERING INC
127 Walgreen Road
Ottawa, Ontario
(613) 836 0934

PROJECT	KANATA LRT PRELIMINARY EXISTING CONDITIONS ASSESSMENT		
SCALE	1:6500 (APPROX.)	DRAWING NO.	GWE17-043-9
DATE	MARCH 15, 2018	DRAWN BY	M.L.

DESCRIPTION

FIGURE 9:
NOISE CONTOURS - AREA 1

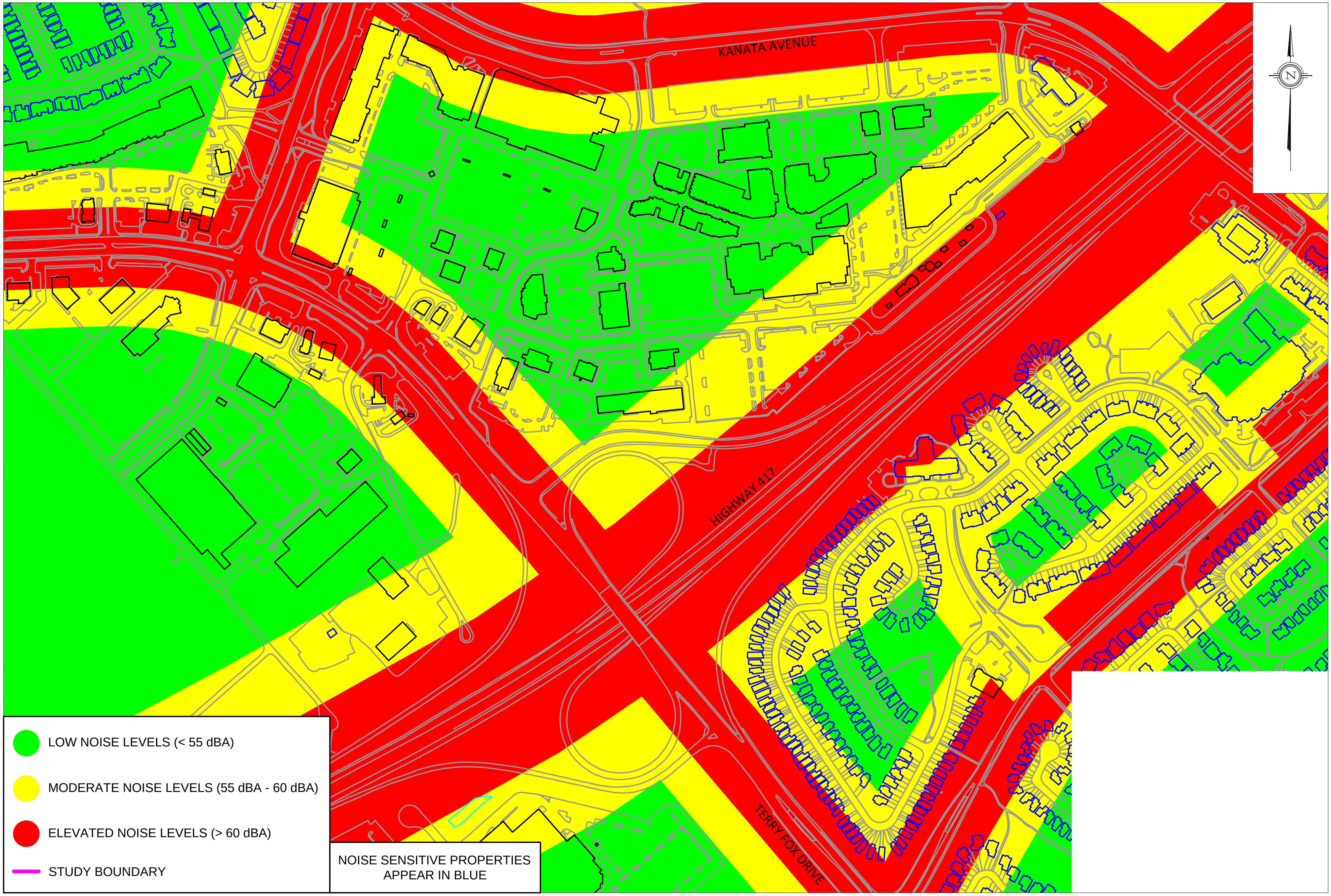


GRADIENT WIND ENGINEERING INC
127 Walgreen Road
Ottawa, Ontario
(613) 836 0934

PROJECT	KANATA LRT PRELIMINARY EXISTING CONDITIONS ASSESSMENT		
SCALE	1:6500 (APPROX.)	DRAWING NO.	GWE17-043-10
DATE	MARCH 15, 2018	DRAWN BY	M.L.

DESCRIPTION

FIGURE 10:
NOISE CONTOURS - AREA 2



127 Walgreen Road
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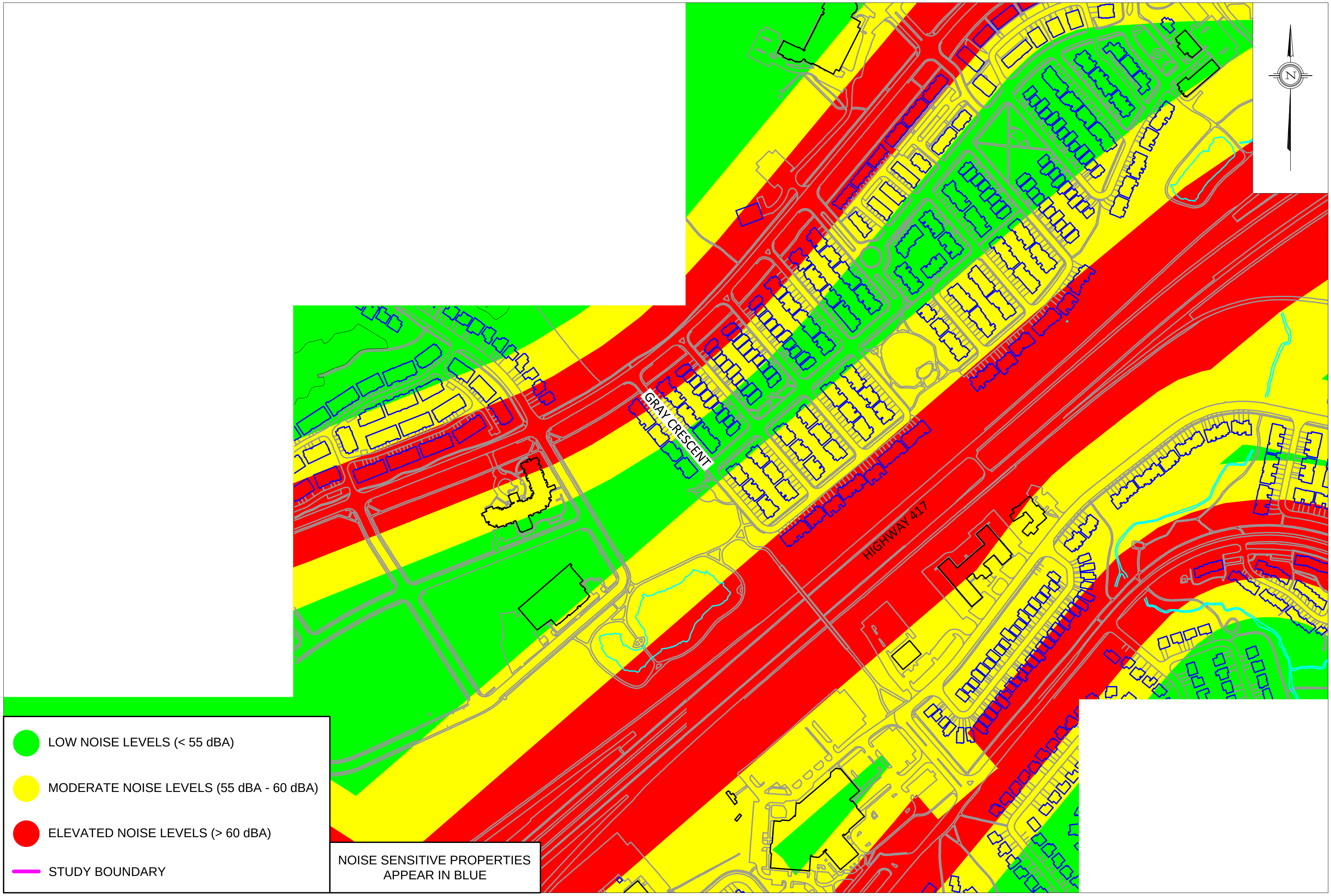
GRADIENTWIND ENGINEERING INC

PROJECT	KANATA LRT PRELIMINARY EXISTING CONDITIONS ASSESSMENT		
SCALE	1:6500 (APPROX.)	DRAWING NO.	GWE17-043-11
DATE	MARCH 15, 2018	DRAWN BY	M.L.

DESCRIPTION

FIGURE 11:
NOISE CONTOURS - AREA 3



LOW NOISE LEVELS (< 55 dBA)

MODERATE NOISE LEVELS (55 dBA - 60 dBA)

ELEVATED NOISE LEVELS (> 60 dBA)

STUDY BOUNDARY

NOISE SENSITIVE PROPERTIES APPEAR IN BLUE

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PROJECT	KANATA LRT PRELIMINARY EXISTING CONDITIONS ASSESSMENT
SCALE	1:6500 (APPROX.)
DRAWING NO.	GWE17-043-12
DATE	MARCH 15, 2018
DRAWN BY	M.L.
DESCRIPTION	FIGURE 12: NOISE CONTOURS - AREA 4

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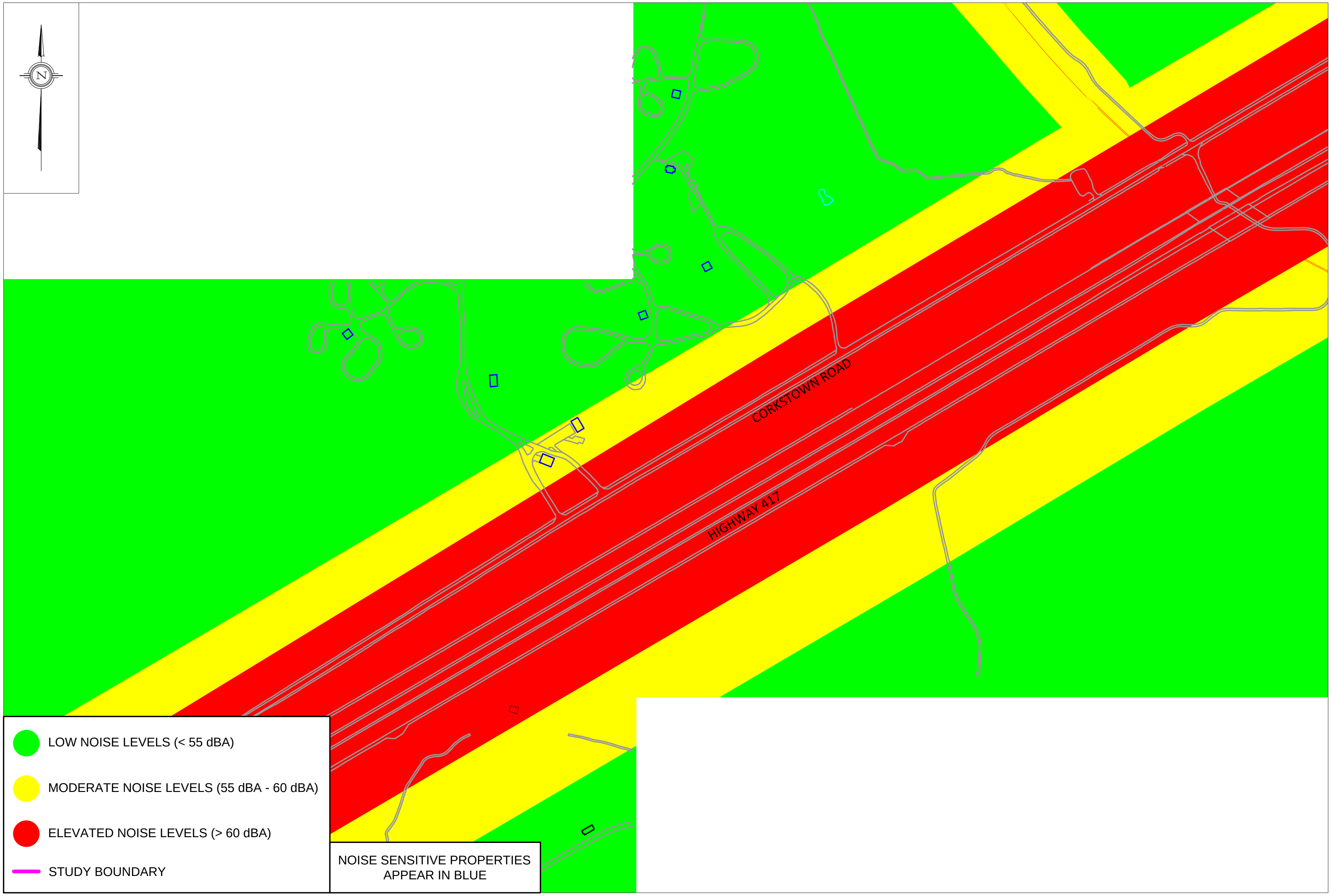
GRADIENT WIND ENGINEERING INC

PROJECT	KANATA LRT PRELIMINARY EXISTING CONDITIONS ASSESSMENT		
SCALE	1:6500 (APPROX.)	DRAWING NO.	GWE17-043-13
DATE	MARCH 15, 2018	DRAWN BY	M.L.

DESCRIPTION

FIGURE 13:
NOISE CONTOURS - AREA 5



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GRADIENT WIND ENGINEERING INC

PROJECT: KANATA LRT
PRELIMINARY EXISTING CONDITIONS ASSESSMENT

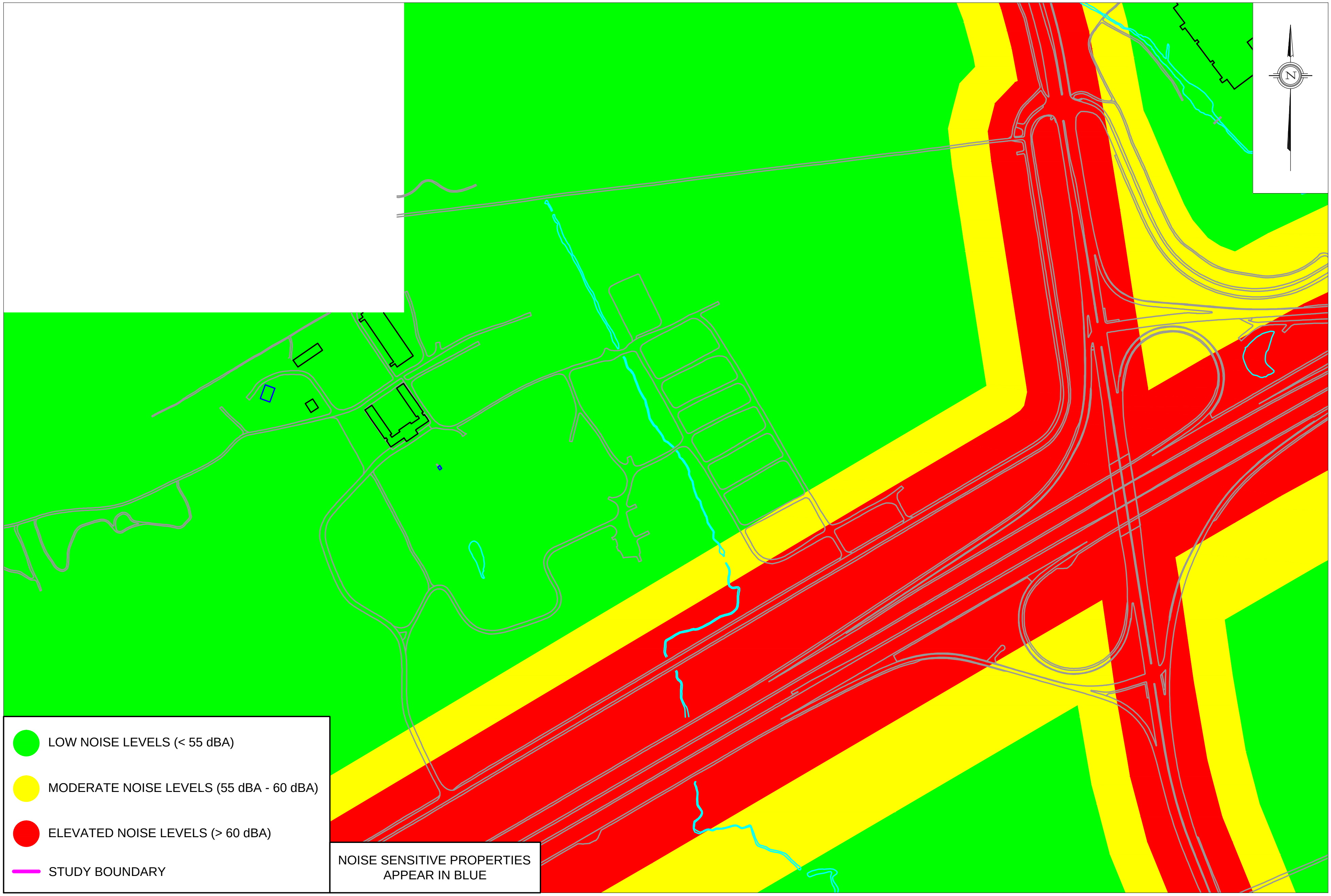
SCALE: 1:6500 (APPROX.)

DRAWING NO.: GWE17-043-14

DATE: MARCH 15, 2018

DRAWN BY: M.L.

DESCRIPTION: FIGURE 14:
NOISE CONTOURS - AREA 6



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(613) 836 0934

PROJECT	KANATA LRT PRELIMINARY EXISTING CONDITIONS ASSESSMENT	DESCRIPTION	FIGURE 15: NOISE CONTOURS - AREA 7
SCALE	1:6500 (APPROX.)	DRAWING NO.	GWE17-043-15
DATE	MARCH 15, 2018	DRAWN BY	M.L.

127 Walgreen Road
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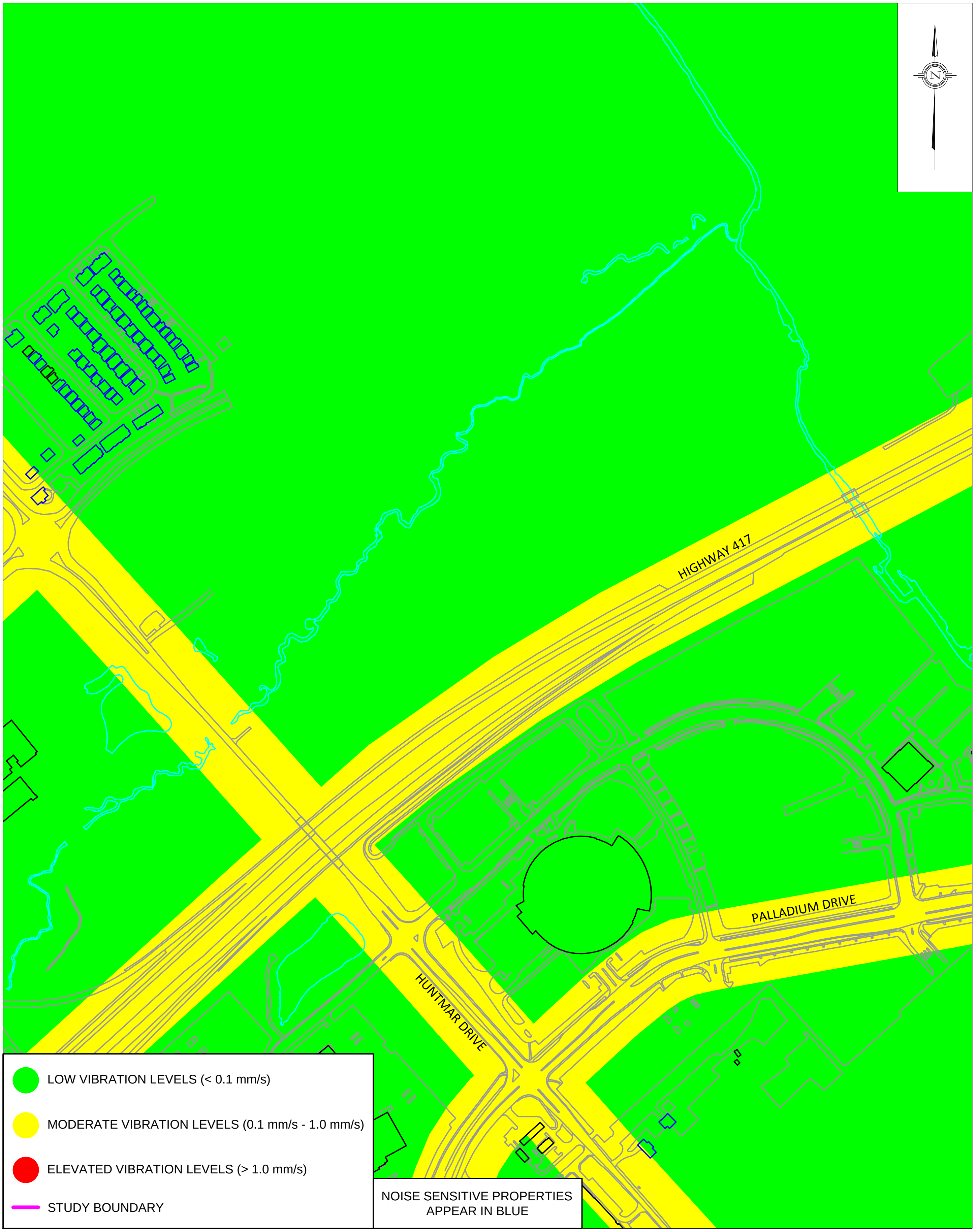
GRADIENT WIND ENGINEERING INC

PROJECT	KANATA LRT PRELIMINARY EXISTING CONDITIONS ASSESSMENT		
SCALE	1:6500 (APPROX.)	DRAWING NO.	GWE17-043-16
DATE	MARCH 15, 2018	DRAWN BY	M.L.

DESCRIPTION

FIGURE 16:
VIBRATION CONTOURS - AREA 1



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(613) 836 0934
GRADIENT WIND ENGINEERING INC

PROJECT: KANATA LRT PRELIMINARY EXISTING CONDITIONS ASSESSMENT		DESCRIPTION: FIGURE 17: VIBRATION CONTOURS - AREA 2
SCALE: 1:6500 (APPROX.)	DRAWING NO.: GWE17-043-17	
DATE: MARCH 15, 2018	DRAWN BY: M.L.	

127 Walgreen Road
Ottawa, Ontario
(613) 836 0934
GRADIENTWIND ENGINEERING INC

PROJECT	KANATA LRT PRELIMINARY EXISTING CONDITIONS ASSESSMENT
SCALE	1:6500 (APPROX.)
DRAWING NO.	GWE17-043-18
DATE	MARCH 15, 2018
DRAWN BY	M.L.
DESCRIPTION	FIGURE 18: VIBRATION CONTOURS - AREA 3

LOW VIBRATION LEVELS (< 0.1 mm/s)

MODERATE VIBRATION LEVELS (0.1 mm/s - 1.0 mm/s)

ELEVATED VIBRATION LEVELS (> 1.0 mm/s)

STUDY BOUNDARY

NOISE SENSITIVE PROPERTIES APPEAR IN BLUE

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(613) 836 0934

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PROJECT	KANATA LRT PRELIMINARY EXISTING CONDITIONS ASSESSMENT		
SCALE	1:6500 (APPROX.)	DRAWING NO.	GWE17-043-19
DATE	MARCH 15, 2018	DRAWN BY	M.L.

DESCRIPTION

FIGURE 19:
VIBRATION CONTOURS - AREA 4

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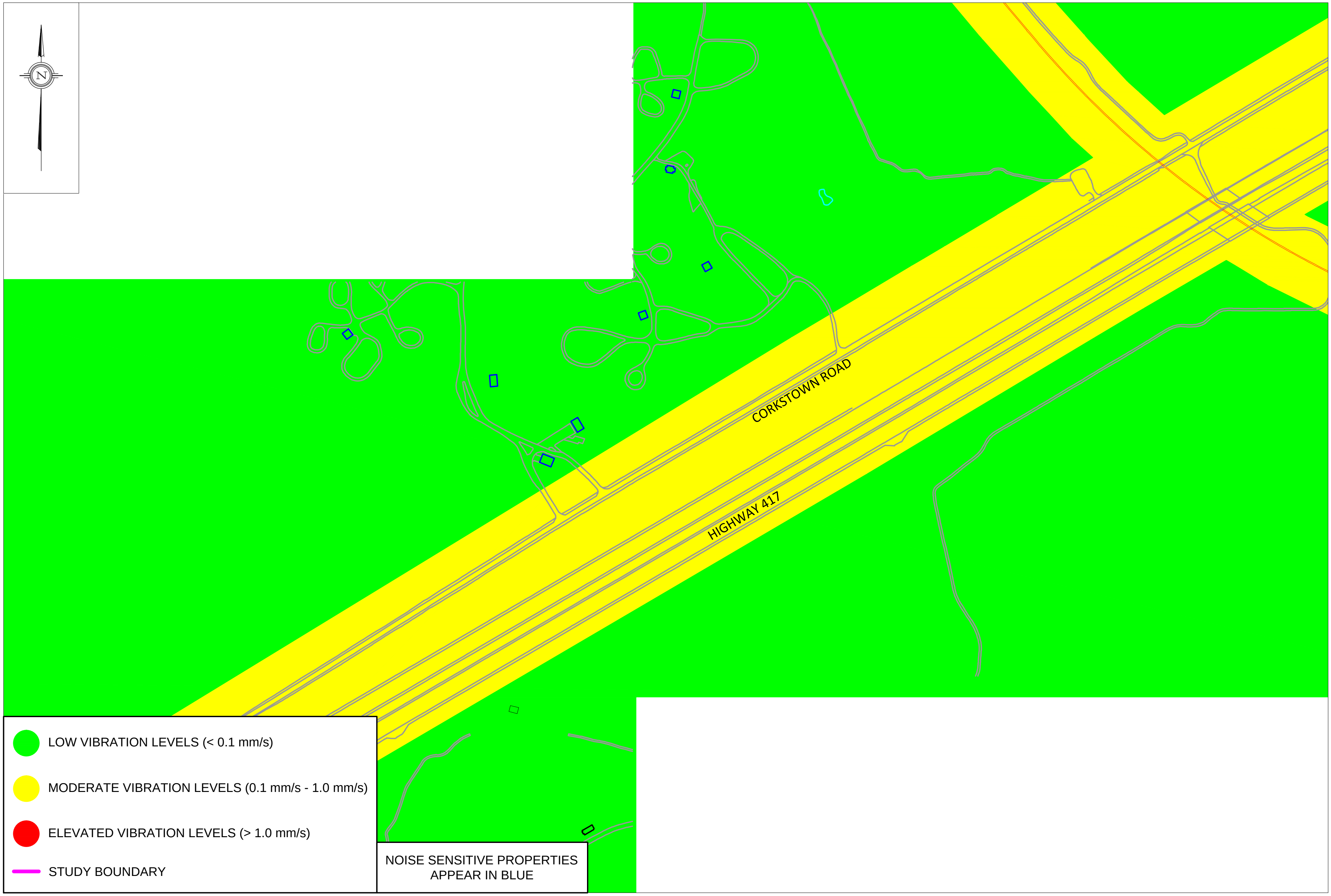
(613) 836 0934

PROJECT	KANATA LRT PRELIMINARY EXISTING CONDITIONS ASSESSMENT		
SCALE	1:6500 (APPROX.)	DRAWING NO.	GWE17-043-20
DATE	MARCH 15, 2018	DRAWN BY	M.L.

DESCRIPTION

FIGURE 20:
VIBRATION CONTOURS - AREA 5



LOW VIBRATION LEVELS (< 0.1 mm/s)

MODERATE VIBRATION LEVELS (0.1 mm/s - 1.0 mm/s)

ELEVATED VIBRATION LEVELS (> 1.0 mm/s)

STUDY BOUNDARY

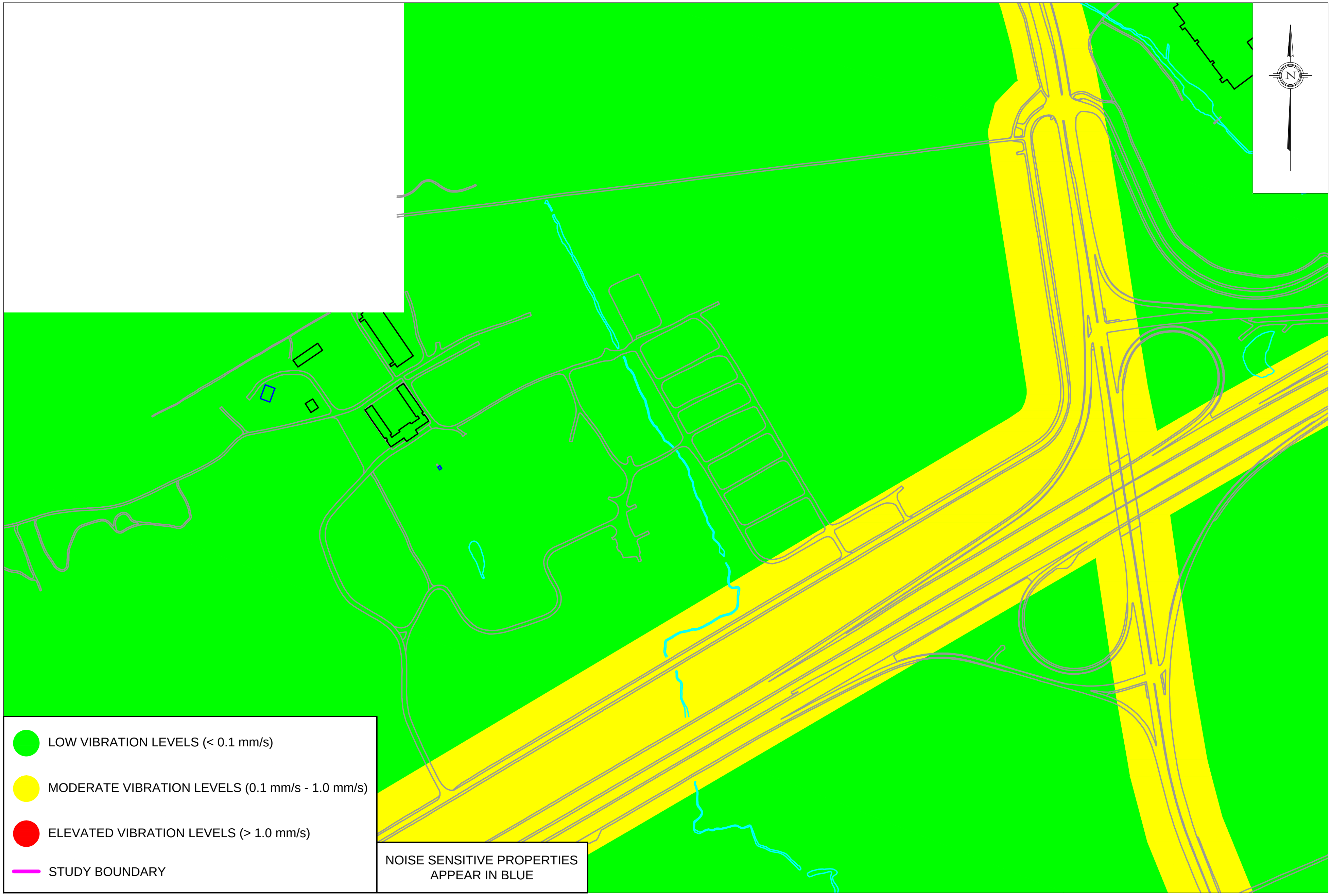
NOISE SENSITIVE PROPERTIES APPEAR IN BLUE

GRADIENT WIND ENGINEERING INC
127 Walgreen Road
Ottawa, Ontario
(613) 836 0934

PROJECT	KANATA LRT PRELIMINARY EXISTING CONDITIONS ASSESSMENT		
SCALE	1:6500 (APPROX.)	DRAWING NO.	GWE17-043-21
DATE	MARCH 15, 2018	DRAWN BY	M.L.

DESCRIPTION

FIGURE 21:
VIBRATION CONTOURS - AREA 6



GRADIENT WIND ENGINEERING INC
127 Walgreen Road
Ottawa, Ontario
(613) 836 0934

PROJECT	KANATA LRT PRELIMINARY EXISTING CONDITIONS ASSESSMENT		
SCALE	1:6500 (APPROX.)	DRAWING NO.	GWE17-043-22
DATE	MARCH 15, 2018	DRAWN BY	M.L.

DESCRIPTION

FIGURE 22:
VIBRATION CONTOURS - AREA 7

III. Stage 1 Archaeological Assessment, Kanata LRT

REPORT

Stage 1 Archaeological Assessment

Kanata LRT, Various Concessions and Lots, Townships of Nepean, March, Huntley and Goulbourn, Carleton County, City of Ottawa

Licensee: Aaron Mior (P1077)

PIF Number: P1077-0042-2017

Submitted to:

Paul Croft, MCIP, RPP, Project Planner
Parsons Corporation
100-1223 Michael Street
Ottawa, Ontario
K1J 7T2

Submitted by:

Golder Associates Ltd.
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1668654

November 21, 2018

Distribution List

1 e-copy - Parsons Corporation

1 e-copy - Ministry of Tourism, Culture and Sport

1 e-copy - Golder Associates Ltd.

Executive Summary

The Executive Summary highlights key points from the report only, for complete information and findings as well as limitations, the reader should examine the complete report.

Golder Associates Ltd. (Golder) was retained by Parsons Corporation to complete a Stage 1 archaeological assessment as part of the Planning and *Environmental Assessment* Study for the Kanata LRT from Moodie Drive to Palladium Drive. The study area was later expanded to include an alignment extending south to Hazeldean Road. The project corridor, approximately 12 kilometres in length, runs approximately northeast-southwest along the north side of Highway 417 between Moodie Drive and Huntmar Drive then turns 90 degrees southeast and extends to Hazeldean Road.

A buffer measuring 100 metres on either side of the proposed alignment is included in the study area to provide flexibility in determining the final alignment and corresponding construction disturbance areas (e.g. staging areas, temporary access roads, etc.). The study area encompasses property within Concessions 1 and 2, Nepean Township, Concessions 1, 2 and 3 in March Township, Concession 1 in Huntley Township and Concessions 11 and 12, Goulbourn Township (Maps 1 and 2, pp.37 and 38).

The primary objectives of this Stage 1 archaeological assessment were to identify known archaeological resources within and in the vicinity of the study corridor, to provide information on previous archaeological investigations conducted in the area, to assess the archaeological potential of the study area and to provide recommendations as to whether any additional archaeological investigations are required.

In consultation with the Ontario Ministry of Tourism, Culture and Sport's (MTCS) archaeological database and additional archaeological data available for this report, twenty-four archaeological sites have been identified within a two-kilometre radius of the study area corridor.

Previous archaeological investigations have confirmed the existence of Indigenous sites occupied during the Archaic Period (9,500 – 2,500 BP) within the study area vicinity and based on specific landscape features there is potential to document additional Indigenous sites within the project boundary.

Historically significant 19th century Euro-Canadian occupation and land use has also been identified within the study area, with the presence of known settlement areas and historic transportation routes documented on 19th century cartographic sources reflecting these past demographic patterns.

Based on the attributes defining the presence of archaeological potential detailed in the MTCS *Standards and Guidelines for Consultant Archaeologists* (2011), the entire study area has been determined to possess the potential to recover and document archaeological resources (Map 12F, p.53). However, properties which have been previously assessed for archaeological resources and sufficiently mitigated and cleared by the MTCS are no longer considered to possess archaeological potential (Map 12G, p.54).

This Stage 1 archaeological assessment has provided the basis for the following recommendations:

1) All portions of the study area that have been identified as possessing archaeological potential that have not been mitigated by previous archaeological investigations will require additional archaeological assessment prior to any project related activities that will impact the existing landscape (Maps 13A to 13F, pp.55 to 60);

2) Where additional archaeological assessment has been recommended, and no previous assessment has been completed, the additional assessment should consist of a Stage 2 field investigation compliant with the MTCS *Standards and Guidelines for Consultant Archaeologists* (2011). The Stage 2 archaeological assessment should consist of pedestrian surface survey at five metre intervals where the land is ploughable and hand excavated shovel test pits at five metre intervals where lands are not viably ploughable. Regardless of the existing landscape, where the Stage 2 corridor is less than 10 metres in width these areas can be investigated by hand excavated shovel test pits at the consultant's discretion;

3) All land recommended for Stage 2 assessment which has been sufficiently disturbed to have removed the potential for archaeological resources will require visual inspection and photographic documentation during the Stage 2 assessment to be completed when climatic conditions are sufficient to meet the MTCS *Standards and Guidelines for Consultant Archaeologists* (2011);

4) Known archaeological sites determined to possess Cultural Heritage Value or Interest (CHVI) identified in the present study area that have not been completely mitigated, or deemed to merit further investigation, should be avoided. Should these sites not be avoidable, additional archaeological investigations will be required prior to any project impacts to these areas. This includes, but is not limited to, registered sites BhFx-2, BhFx-47 and BhFx-49;

5) CHVI was identified for registered site BhFx-2 and additional assessment was recommended in the original project report (Swayze 2000). A Stage 2 assessment should be completed in this location in an attempt to define the spatial extent of the site and determine the significance of the lithic scatter prior to any additional disturbances to the area;

6) A Stage 3 archaeological investigation should be completed at the Bradley Farm site (BhFx-47) and James Farm site (BhFx-49) prior to any potential project impacts to the existing landscape at these site locations. The Stage 3 assessment should consist of one metre square units hand excavated on a five-metre grid, with a minimum of 20% infill units. The Stage 3 excavation should be completed by a Professionally licensed archaeologist in the Province of Ontario and conform to the MTCS *Standards and Guidelines for Consultant Archaeologists* (2011);

7) All land identified on Maps 13A to 13F (pp.55 to 60) not identified for additional assessment are considered to have been sufficiently mitigated during previously completed archaeological assessments and no additional archaeological assessments are recommended for these areas; and,

8) Should future construction, and/or other development related activities, that will disturb soils and/or affect the archaeological integrity of the landscape, extend beyond the boundary of the proposed alignment or surrounding study area buffer defined in this report, additional archaeological investigations may be required based on the archaeological potential identified within the general vicinity.

This report is submitted to the Ministry of Tourism, Culture and Sport (MTCS) as a condition of licensing in accordance with Part VI of the *Ontario Heritage Act*, R.S.O. 1990, c. 0.18. The report is reviewed to ensure that the licensed consultant archaeologist has met the terms and conditions of their archaeological license, and that the archaeological field work and report recommendations ensure the conservation, protection and preservation of the cultural heritage of Ontario.

The MTCS is requested to review and provide a letter indicating their satisfaction with the results and recommendations presented herein, with regard to the 2011 *Standards and Guidelines for Consultant Archaeologists* (2011) and the terms and conditions for archaeological licenses, and to enter this report into the Ontario Register of Archaeological Reports.

Project Personnel

Client Contact:	Paul Croft, MCIP, RPP, Parsons Corporation
Project Director:	Troy Skinner, P. Eng.
Project Manager:	Erin O’Neill, P. Eng
Licensed Archaeologist:	Aaron Mior, M.MA. (P1077)
Report Preparation:	Aaron Mior, M.MA.
Senior Technical Review:	Hugh Daechsel, M.A.
Spatial IM:	Jamie McKenzie, B.A., Dipl. T. (GIS)
Administrative Support:	Courtney Adey

Report Abbreviations

MTCS	Ministry of Tourism, Culture and Sport
BP	Before Present
m	Metres
CHVI	Cultural Heritage Value or Interest
PIF	Project Information Form (MTCS Project File Number)

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TABLES

MAPS

APPENDICES

1.0 PROJECT CONTEXT

1.1 Development Context

Golder Associates Ltd. (Golder) was retained by Parsons Corporation to complete a Stage 1 archaeological assessment as part of the Planning and *Environmental Assessment* Study for the Kanata LRT from Moodie Drive to Palladium Drive. The study area was later expanded to include an alignment extending south to Hazeldean Road. The project corridor, approximately 12 kilometres in length, runs approximately northeast-southwest along the north side of Highway 417 between Moodie Drive and Huntmar Drive then turns 90 degrees southeast and extends to Hazeldean Road.

The preferred alignment was previously selected as a result of a number of previous environmental assessments, including the West Transitway Extension Project, Kanata North Project, and the original East-West LRT Environmental Assessment (EA) study in 2004. Some of these projects were carried forward to preliminary/detailed design. While some minor adjustments may be made to the alignment, it is understood that the corridor is generally fixed.

A buffer measuring 100 metres on either side of the proposed alignment is included in the study area to provide flexibility in determining the final alignment and corresponding construction disturbance areas (e.g. staging areas, temporary access roads, etc.). The study area encompasses property within Concessions 1 and 2, Nepean Township, Concessions 1, 2 and 3 in March Township, Concession 1 in Huntley Township and Concessions 11 and 12, Goulbourn Township (Maps 1 and 2, pp.37 and 38).

1.2 Objectives

This Stage 1 archaeological assessment was completed to identify known archaeological resources on, or in the vicinity of, the study area, as well as to assess the archaeological potential of the study area. The objectives of a Stage 1 archaeological assessment are based on principals outlined in the *Ontario Heritage Act* (consolidated 2007) and the Ministry of Tourism, Culture and Sport's (MTCS) *Standards and Guidelines for Consultant Archaeologists* (2011). More specifically, this Stage 1 archaeological assessment was completed with the following objectives:

- To provide information about the study area's geography, environment, cultural history, previous archaeological fieldwork and current land condition;
- To evaluate in detail the property's archaeological potential, which will support recommendations for Stage 2 survey for all or parts of the property (if required); and,
- To recommend appropriate strategies for Stage 2 field survey (if required).

2.0 HISTORICAL CONTEXT

2.1 Regional Aboriginal History

The Ottawa Valley was covered by the Laurentide ice sheet until approximately 11,000 years before present (BP). Following the period of deglaciation, the Ottawa Valley was inundated by the Champlain Sea which is interpreted to have extended from Rideau Lakes in the south, along the Ottawa Valley and St. Lawrence areas and terminating around Petawawa in the west. The exact western boundary is unknown as current elevation levels reflect the isostatic adjustment of the land following the melting of the glaciers and cannot be used to determine the exact location of the Champlain Sea at the time of its existence. The eastern portion of the sea extended into the Atlantic Ocean.

The earliest possible settlement in the Ottawa area would have occurred following the recession of the Champlain Sea when the vegetation and wildlife had the opportunity to develop within the area and enable the sustainability of humans (Watson 1999a). The ridges and old shorelines of the Champlain Sea and early Ottawa River channels reflect areas most likely to contain evidence of Paleo-Indian Period occupation in the region. Archaeological and geological investigations in the Ottawa Valley have suggested these early sites may be identified within the 550 foot (167.6 metres) or higher contour topography, although additional research may be required to confidently assess this correlation (Kennedy 1976).

During the Early and Middle Paleo-Indian Periods (12,000–10,500 BP) Ottawa would have remained inundated by the Champlain Sea, but as the Champlain Sea receded during the Late Paleo-Indian Period (10,500–9,500 BP) it is possible that people migrated along the changing waterfront eventually moving into the Ottawa Valley (Watson 1999a).

Identifying the location and dates of the ancient Champlain Sea shorelines and the possible Paleo-Indian archaeological sites that may have been associated with this evolving landscape has proved challenging. These boundaries are not marked by a continuous identifiable shoreline, especially along the western periphery where rocky conditions were not favorable to the formation of beach ridges (Chapman and Putman 1973). Attempts to use mollusk shells as a source for radiocarbon dates have provided unreliable results as shells absorb carbon at different rates according to their depth below the surface and geological context (Robinson 2012). Additionally, earlier interpretations implying discrete stages of regression (Chapman 1937) have not been supported by the geological record. Unlike the catastrophic flood events during the Younger Dryas climatic event that led to the rapid formation of the Champlain Sea, its regression was a slow process occurring as sea waters drained during isostatic rebound (Robinson 2012). The interpreted presence of shorelines is further complicated by the fact that isostatic rebound may have raised the Ottawa region above its modern elevation before it receded to its current level (Fulton and Richard 1987). As a consequence, only the margins of the Champlain Sea at its maximum extent, a time when the Ottawa region would have been fully submerged, have been reliably mapped due to the rapid inundation creating pronounced shoreline features (Loring 1980). Although recent studies using various dating techniques that do not rely upon deposits of mollusk shells have provided some favourable results (Tremblay 2008), considerable work remains in developing the chronology of the Champlain Sea's regression.

The identification of Paleo-Indian sites in the Middle Ottawa Valley region has also be hindered by the erosion of accessible locations during the environmental changes associated with the transition from the Late Paleo-Indian Period to the succeeding Archaic Period (9,500-2,500 BP). The potential use of watercraft by Paleo-Indian peoples (Engelbrecht and Seyfert 1995; Jodry 2005) and evidence for the abundance of marine resources (Loring 1980; Robinson 2012) raises the possibility of occupation sites situated on accessible landforms. For example, the Ottawa River delta that prograded eastward as the Champlain Sea regressed (Fulton *et al* 1987) would have been impacted by periods of overflow from glacial Lake Agassiz. The inundation of flood waters from the glacial lake may have eroded or buried archaeological remains within these potential occupation landscapes.

Paleo-Indians were characterized as highly mobile hunters and gatherers who primarily relied on a subsistence strategy based on caribou, small game, fish and wild plants typically found in the sub-arctic environment of the time. The majority of the Paleo-Indian Period materials recovered in southeastern Ontario represent isolated findspots supporting the interpretation of a nomadic lifestyle rather than extended occupation sites (Storck 1984). Although evidence exists documenting Paleo-Indian occupation in Ontario as early as 11,000 years BP, minimal evidence exists for occupation within the Ottawa Valley during this period.

Evidence suggesting limited occupation and land use during the Paleo-Indian Period in the Ottawa Valley includes two bi-facially fluted projectile points found near the Rideau Lakes which would have been located near the shoreline of the Champlain Sea during this period (Watson 1999b), a Late Paleo-Indian Period Dovetail point recovered in Ottawa South sometime around 1918 (Pilon and Fox 2015) and additional interpretations of Paleo-Indian Period material identified during archaeological investigations near Greenbank Road (Swayze 2003) Albion Road and Rideau Road (Swayze 2004). The closest site with an interpreted Late Paleo-Indian component is situated just over two kilometres southwest of the project corridor where a number of lithic artifacts have been recovered at the Holy Spirit site (BhFx-33), which is suggested to represent a campsite (MTCS 2017).

The environment of Ontario approached modern conditions during the succeeding Archaic Period (9,500-2,500 BP). Stone tool technologies evolved during this time as a broader range of tool types were created, although the skill and workmanship is considered to have declined from earlier Paleo-Indian standards. Ground stone tools appeared, such as adzes and gouges, tool types indicating increased wood working and greater adaptation to evolving environmental conditions.

During the Early Archaic Period (9,500 BP – 8,000 BP), the jack and red pine forests that characterized the Late Paleo-Indian Period environment were replaced by landscapes dominated by white pine with some associated deciduous trees (Ellis, Kenyon and Spence 1990). One of the more notable changes during the Early Archaic Period was the appearance of side and corner-notched projectile points. Other significant innovations included the introduction of ground stone tools such as celts and axes, which suggest the beginning of a simple woodworking industry. The presence of these often large and not easily portable tools also implies there may have been some reduction in the degree of seasonal movement, although it is suspected that population densities were quite low with band territories continuing to travel across large areas.

During the Middle Archaic Period (8,000 BP – 4,500 BP) the trend towards more diverse toolkits continued, as the presence of netsinkers and fish weirs suggests that fishing was becoming an important component of the subsistence strategy. It was also during this period that stone tools especially designed for the preparation of wild plant foods were crafted and also when ‘bannerstones” were first manufactured, which are carefully crafted ground stone devices that served as a counterbalance for *atlatls* or spear-throwers.

Another characteristic of the Middle Archaic Period is an increased reliance on local, often poor quality, chert resources for manufacturing projectile points. While groups occupied larger territories during the Paleo-Indian and Early Archaic Periods and were able to visit primary outcrops of high quality chert at least once during their seasonal round, during the Middle Archaic Period groups traveled within comparatively smaller territories which did not always possess a source of high quality raw materials. In these instances, lower quality materials which had been previously deposited by the glaciers in the local till and river gravels were utilized.

This reduction in territory size was likely the result of gradual region-wide population growth which led to infilling of the landscape. This process resulted in a reorganization of Indigenous subsistence strategies, as more people had to be supported from the resources extracted from a smaller area.

It was also during the latter part of the Middle Archaic Period that long distance trade routes began to develop, spanning the northeastern part of the continent. In particular, native copper tools manufactured from a source located northwest of Lake Superior were being widely traded (Ellis, Kenyon and Spence 1990). During the Middle and Late segments of the Archaic Period, copper was being mined from surface outcrops around Lake Superior and traded into southern Ontario, with the Ottawa River acting as a significant transportation route facilitating this trade network (Chapdelaine *et al* 2001). These trade connections also brought marine shell artifacts from as far away as the Mid-Atlantic coast, which are frequently encountered as items associated with burial deposits (Ellis, Kenyon and Spence 1990; Ellis, Timmins and Martelle 2009).

Sites with Archaic components which demonstrate this expanding trade network include Morrison's Island and Allumette Island in the Outaouais region of the Ottawa River (Chapdelaine *et al* 2001; Clermont 1999), sites identified at Lake Leamy near the junction of the Gatineau and Ottawa Rivers, and also in the Rideau Lakes area (Watson 1982). Additional significant occupation sites with Archaic Period components along Ottawa Valley waterways which were likely influenced by these trade routes include Jessup Falls near the mouth of the South Nation River and at Spencerville near the source of the South Nation River (Daechsel 1980).

Trade connections across vast territories continued into the Late Archaic Period (4,500 BP – 2,500 BP), when the trend towards decreased territory size and a broadening subsistence strategy continued. Late Archaic sites have been discovered in greater numbers compared to Early and Middle Archaic sites, suggesting the local population was rapidly expanding. It is during the Late Archaic Period that the first defined cemeteries are identified, as prior to this period individuals were regularly interred close to the location where they died. During the Late Archaic Period, when an individual died while their group was away from the territorial cemetery, the remains would be kept until the group returned to the home cemetery where they could be interred. Consequently, it is not unusual to find disarticulated skeletons, or even skeletons lacking minor elements such as fingers, toes or ribs, in Late Archaic Period burial pits.

The appearance of burial pits during the Late Archaic Period has been interpreted as a response to increased population densities and competition between local groups for access to natural resources. It has been theorized that cemeteries and burial grounds may have provided strong symbolic claims over a local territory and the surrounding resources. These burial grounds are often located within areas of elevated topography containing well-drained sandy and gravel soils adjacent to major watercourses.

There are fifteen known archaeological sites with an Archaic Period component within three kilometres of the study area. One of the closest, and most significant, is the Akandoo site (BhFx-62) identified along the Carp River floodplain and situated less than 100 metres north of the project corridor. Among the artifacts recovered from this site were modified and utilized lithic debitage, biface thinning flakes, faunal fragments, lithic shatter, utilized cores and biface fragments manufactured primarily from local chert material (NAA 2017).

The Archaic Period was followed by the Woodland Period, beginning around 2,500 years ago in Ontario and lasting until 450 years ago. The Early Woodland Period is distinguished from the Late Archaic Period primarily by the addition of ceramic technology. The first pots were very crudely constructed, thick walled, friable vessels, and essentially imitated containers originally constructed out of steatite during the Archaic Period. These vessels were not easily portable, and their fragile nature suggests they may have required regular replacement. It has been suggested these ceramic containers were used in the processing of nut oils by boiling crushed nut fragments in water and skimming off the oil (Spence, Pihl and Murphy 1990). One example of this type of ceramic pot was located along the Ottawa River at registered site CaGi-1 in Hull, Québec (Watson 1999b). Over time, pottery became more refined and began to incorporate elaborate decorative patterns and styles distinct for specific regional populations as well as specific date ranges (Laliberté 1999).

There have also been numerous Early Woodland sites identified where no ceramics were observed, suggesting these poorly constructed, undecorated vessels had yet to assume a central position within the daily lives of Early Woodland peoples.

The trade networks which were established in the Middle and Late Archaic Periods also continued to flourish, although there does not appear to have been as much exchange of marine shell during the Early Woodland Period. Through the last 200 years of the Early Woodland Period, projectile points manufactured from high quality raw materials from the American Midwest begin to appear in southern Ontario (Spence, Pihl and Murphy 1990).

Towards the end of the Middle Woodland Period (approximately 1,500 years ago) agriculture was introduced and developed into a significant role in subsistence strategies. It began with the cultivation of corn, beans and tobacco, which eventually led to the development of semi-permanent and permanent villages. Many of these villages were surrounded by palisades, suggesting increased hostilities between neighbouring groups, which was more common in regions with arable land such as southern Ontario. The impact of these changes did not appear to significantly influence people occupying areas north of the St. Lawrence Valley who continued to utilize the region as a hunting area and trade route with many groups retaining a semi-nomadic lifestyle. Middle Woodland Period sites have been identified in the South Nation Drainage Basin (Daechsel 1980), near Casselman (Clark 1905), within the City of Ottawa west of Bank Street (Golder 2014) and along the Ottawa River at Constance Bay (Watson 1972), as well as Marshall’s and Sawdust Bays (Daechsel 1981).

During the Late Woodland Period, the South Nation River basin appears to have been a zone of interaction between Iroquoian speaking populations who relied primarily on domesticated crops to the south and Algonquian speaking groups who continued a primarily hunter-gatherers lifestyle to the north. The Huron peoples along the north shore of Lake Ontario had moved to the Lake Simcoe – Georgian Bay region, leaving the area of eastern Ontario, except for some small Algonquin groups, unoccupied by the time early French explorers arrived in the area around the beginning of the seventeenth century. Six St. Lawrence Iroquoian villages dating to *ca*. 1400 AD have been found in the Spencerville area documenting the significant occupation in this area.

Evidence of occupation and land utilization within the vicinity of the study area during the Woodland Period is evident at the BhFx-66 site which is located 2.5 kilometres north of the study area and the Jinkinson/Keyes site situated 9.1 kilometres west of the project corridor. One of the most significant sites in the region with a Woodland Period component is the BiFw-101 site located along the Rideau River 12 kilometres east of the study area where archaeological excavation provided evidence of prolonged habitation extending from the Late Archaic to Late Woodland Periods, documenting a sustained, although likely only seasonal, occupation over a period of almost 3,000 years (MTCS 2017).

The Algonquin historical hunting territory may have extended as far east as the St. Maurice River in Quebec and into the lowlands south of the St. Lawrence River after the disappearance of the St. Lawrence Iroquois in the late 16th century (Trigger and Day 1994). Following European contact, Algonquin occupation along the river networks used by the French for transportation provided an opportunity to monopolize the early fur trade and the two entities developed close relations following Champlain’s expedition in 1603. Competition for commodities such as furs and hides increased existing tensions between the Algonquin and their neighbours including the Haudenosaunee Nations such as the Mohawk residing to the south in the modern New York State area. The 17th

century saw a prolonged period of conflict known as the Beaver Wars between the Algonquin and the Haudenosaunee resulting in the significant disruption to traditional lifestyles, with Mohawk raids against Algonquin Villages in the upper Ottawa and St. Lawrence Valleys resulting in the abandonment or destruction of many Algonquin villages in these areas (Trigger and Day 1994).

The French brokered a peace treaty in 1701 at Montreal where the Algonquin, Haudenosaunee and French representatives agreed to peacefully share the lands around the Great Lakes (INAC 2011). In exchange for peace, the Algonquin gave the Haudenosaunee secure access to furs which the Haudenosaunee used to develop their alliance with the British. Following the Seven Years' War (1754-1764), the defeat of the French and their Algonquin allies by the British and the Haudenosaunee resulted in the further loss of Algonquin hunting territories in southern Quebec and Eastern Ontario as the British exerted control over former French colonies. The extension of Quebec's boundaries in 1774 through the Quebec Act and the use of the Ottawa River as the boundary of Upper and Lower Canada following the 1791 Constitution Act separated the Algonquin peoples between two government administrations (AOP 2012).

Britain's colonial policy differed from the French with the British Crown increasingly more interested in securing land surrenders from the Indigenous populations for settlement by European immigrants. The Royal Proclamation of 1763 issued by King George III enabled the Crown to monopolize the purchase of Indigenous lands west of Quebec. Although the proclamation recognized Indigenous land rights, it also provided a way through which these rights could be taken away (Surtees 1994). Land cession agreements increased following the War of 1812 as a new wave of settlers arrived in Upper Canada primarily from Britain. The Crown also implemented the annuity system in the purchase of lands from Indigenous peoples where the interest payments of settlers on the land would cover the cost of the annuity rather than pay a one-time lump sum. By the 1850s, Indigenous groups had become disenfranchised with these agreements and began to demand the retention of reserved land and preservation of hunting and fishing rights (Surtees 1994).

At a council held on 31 May 1819, Crown agent John Ferguson met with approximately 250 Mississauga community members of the Bay of Quinte and Kingston areas who claimed ownership of land within the Ottawa area. The Algonquin population who lived in the Ottawa Valley, a portion of which was negotiated and transferred to the Crown, were not invited and as a result never legally succeeded their lands. The Rideau Purchase Tract, as it was known, included one million hectares of land, which the Mississauga agreed to sell for an annuity of £642 10s (Surtees 1994).

The absence of a treaty demonstrating the Algonquin sale of their lands to the Crown enabled them to achieve a historic land claim victory in October 2016. The Algonquin and the Government of Canada signed an agreement in principal to transfer 117,500 acres of Crown lands in eastern Ontario to the Algonquin (INAC 2011; Tasker 2016) and includes a $300 million monetary settlement from the Ontario and Federal governments.

2.2 Initial Euro-Canadian Occupation and Settlement in the Ottawa Valley

The St. Lawrence Iroquois disappeared from the Ottawa Valley in the sixteenth century not long after initial contact with Jacques Cartier in 1535. Étienne Brûlé is reported to have been the first European to pass through what is now the Ottawa area when he portaged at the Rideau Falls in 1610, followed by Nicholas de Vignau in 1611 and Samuel de Champlain in 1613. The Ottawa River served as a major route for explorers, traders and missionaries throughout the seventeenth and eighteenth centuries, with a series of trading posts and forts being constructed by the French along the river in the early eighteenth century. Champlain's navigation of the Rideau and Ottawa River systems became a principal route for succeeding explorers, missionaries and traders travelling from the St. Lawrence River to the interior. This route remained an important link in the French fur trade throughout the seventeenth and eighteenth centuries.

A seigneury was established at L'Orignal in 1674, east of the study area, and granted to Nathaniel Hazard Treadwell, with a French trading post also established near the mouth of the Le Lievre River, close to the present community of Buckingham, Quebèc, during the eighteenth century. Although there was an increased European presence within the region, very few settlers arrived or established residences within the area during this period

The majority of European contact with Indigenous populations was sporadic and primarily facilitated through trade and religious missionary excursions. The recovery of European trade goods (e.g. iron axes, copper kettle fragments and glass beads) from Indigenous sites throughout the Ottawa River drainage basin provides evidence of the extent of contact between the Indigenous population and the European explorers traversing this transportation corridor during this period. The English also continued to utilize the Ottawa River as an important transportation corridor following French administrative withdrawal from New France following the Treaty of Paris in 1763.

Settlement in the Ottawa area was not actively encouraged by the colonial government until the late eighteenth century. Within two years following the 1791 division of the Province of Quebec into Upper and Lower Canada, John Stegmann, the Deputy Surveyor for the Province of Upper Canada, surveyed four townships (Nepean, North Gower, Osgoode and Gloucester) straddling the Rideau River near its junction with the Ottawa River. This survey was undertaken under the initiative instituted by John Graves Simcoe, Lieutenant Governor of the Province of Upper Canada, associated with his proclamation aimed at attracting new settlers to the region.

Commonly acknowledged as the first permanent European resident in the area, Philemon Wright settled in Hull Township with five families and thirty-three men in 1800 (Bond 1984). This community grew over the next few years along the north shore of the Ottawa River and by 1805 Wright had established a significant lumbering industry in the area.

Settlement along the south shore was very slow through the early nineteenth century. In 1809, Jehiel Collins erected a store at what was to become known as Bellows and later Richmond Landing and in 1810 Ira Honeywell constructed a cabin west of the Chaudière Rapids (Bond 1984). Another early settler was Braddish Billings, who constructed a small cabin in Gloucester Township in 1812. Billings went into the lumbering business with Philemon Wright and developed his homestead into a large family estate along the banks of the Rideau River. The lumber industry created the impetus for early settlement in the area, providing employment for early settlers and contributed to the general economic stability through the mid-19th century.

2.3 Study Area General History

The study area extends through the Townships of Nepean, March, Huntley and Goulbourn. Table 1 provides the Concession and Lots of each township within the project corridor (Map 2, p.38).

Table 1: Geographic Delineation of Study Area Corridor.

Township	Concession(s)	Lot(s)
Nepean	1 (Ottawa River)	1-11
	2 (Ottawa River)	1-11
March	1	1-3
	2	2-3
	3	2
Huntley	1	2-3
Goulbourn	11	28
	12	28

2.3.1 Nepean Township General History

Two years after the 1791 division of the Province of Quebec into Upper and Lower Canada, the initial survey of Township "D" was undertaken by John Stegman, Deputy Surveyor for the Province of Upper Canada. This survey was completed under the initiative instituted by John Graves Simcoe, Lieutenant Governor of the Province of Upper Canada, associated with his proclamation aimed at attracting new settlers to the region. Under a statute passed by the second Parliament of Upper Canada in 1798, Township "D" was officially re-named the Township of Nepean (Walker and Walker 1975).

A significant number of township lots were granted to military veterans, United Empire Loyalists and their children prior to 1800 in an effort to distribute the land to British loyalist families. Although provided with granted property within an emerging community, few United Empire Loyalists chose to travel to Nepean and preferred to settle along the St. Lawrence River (Belden 1879).

John Stegman's survey of Nepean Township was initiated in anticipation of 143 settlers arriving in the area lead by George Hamilton, an Irish veteran of the Revolutionary War (Elliott 1991). Unfortunately, this first wave of settlers never materialized and the government revoked Hamilton's grant soon after.

Those few who did eventually arrive to Nepean found the land to be without any roads and essentially remote from any primary settlement that they quickly left the area. By the early 1800s, the original Loyalist settler's children were coming of age and began to claim their inherited property grants. Between 1800 and 1812, Loyalist heirs received 200 grants in Nepean and another portion of the township was set aside for crown and clergy reserves (Elliott 1991). The land grants did not immediately encourage settlement as many of the grant holders continued to reside along the St. Lawrence and Lake Ontario waterfronts holding their lands in Nepean as investment properties. As such, these properties were the object of speculation and many of the grants were consolidated into the hands a few families. Among the largest landowners in Nepean during this period were the Fraser family who held forty lots along the Rideau River in Nepean, including much of what was later to become Ottawa, by acquiring land through their Loyalist rights and then increasing their holdings with speculative purchases (Elliott 1991).

Another early settler to Nepean Township was Ira Honeywell who received the title for Lot 26, Concession 1 (Ottawa River), from his father. Leaving his wife and young family in Prescott, Honeywell arrived at his plot along the Ottawa River in November 1810 and proceeded to clear four acres of timber and construct a log cabin on the river front, which represented the first log home constructed in Nepean Township. In February 1811, Ira's family traveled from Prescott to join him in Nepean with a second log cabin being built that year about half a mile inland from the river to provide privacy from those accessing the area along the Ottawa River (Walker and Walker 1975; Belden 1879).

Despite the numerous land grants to prospective settlers, Nepean Township remained largely an undeveloped wilderness until the end of the War of 1812. Following the war, a depression in Great Britain coupled with the lack of enthusiasm displayed during the war by the loyalists to take up arms to defend British North America from their neighbours to the south lead the Colonial Office to disband some units of the army in the colony. The Richmond military settlement in Goulbourn Township was founded under this directive, with a road being cut through Nepean Township from the Ottawa River in the area now called Lebreton Flats to the new village site of Richmond on the Jock River soon afterwards (Elliott 1991). This transportation route, known today as Richmond Road, is the oldest thoroughfare in Ottawa (Woods Jr 1980) and became Bytown's first road into the hinterland (Taylor 1986). It was along Richmond Road that ten of Nepean's forty early resident families operated taverns which catered to lumbermen and those traveling from rural farmsteads to sell their goods at the markets in Bytown (Elliott 1991).

In 1833, Goulbourn Road, known today as Robertson Road, was constructed with a legislative grant though Bell's Corners and that same year a forced Road (Jockvale Road/Bren Maur Road) was built from Richmond Road through to Chapman's Mill and onto the Rideau River. A somewhat dispersed community developed around Chapman's Mill, spreading along the forced Road, which eventually became known as Jockvale (Elliott 1991).

The construction of the Rideau Canal (1826 - 1832) accelerated settlement in Nepean Township and brought a large population of labourers to the area which necessitated infrastructure improvements as new roads were cut to facilitate construction activities. Bytown continued to develop at the junction of the Rideau Canal and the Ottawa River, with the influx of labourers increasing the population of the township from 580 in 1827 to 2,758 just one year later. Many of the new arrivals to Nepean Township were transient and left the area following the completion of the canal, although some stayed and established homesteads in the region. By 1832, the population of Nepean was sustained at 940, with many of these residents settling within the burgeoning Bytown settlement (Elliott 1991).

The earliest known township meeting in Nepean was held in January 1836 in J. R. Stanley's tavern, with a second commissioned a month later at Silas Burpee's tavern "by reason of Stanley's tavern having burned down" (Walker and Walker 1975). The tradition of convening township meetings in local taverns continued through the 1840s with Hugh Bell's establishment the primary host (Walker and Walker 1975) until 1845 when they were moved to Woods tavern on Richmond Road (Belden 1879).

Between 1851 and 1878, the population of Nepean Township expanded from 3,800 to 6,510 (Belden 1879), with a number of small communities developing including Jockvale, Britannia Heights, Westboro, Hintonburg, Rochesterville and Bell's Corners (Walker and Walker 1975). Settlement within the study area in 1863 concentrated around Corkstown Road which was an established transportation route leading into Bytown. Walling's 1863 plan of Nepean Township shows a number of residences on both sides of this thoroughfare, with concentrations around Lots 2-3 and Lots 6-8 (Map 3, p.39).

The majority of Carleton County, including Nepean Township, was devastated during the August 1870 fire. Along Richmond Road alone, there were over 2,000 people left homeless, with many surviving the flames by seeking shelter in wells and root houses. As an aftermath of the Carleton County fire, plans were developed for the first waterworks system in the Capital. In 1875, the first tap water was delivered to Ottawa residents, as it had formerly been provided by door to door service by horse drawn puncheons taken directly from the Ottawa River (Walker and Walker 1975).

Although the 1870 fire devastated many of the township's residential and commercial structures, settlement within the study area continued to focus around Corkstown Road. By 1879, the area had experienced a significant increase in settlement, with a number of lots having been subdivided to accommodate the increase demand for ownership in the area (Map 4, p.40).

Although the 1906 topographic plan for Carleton County does not accurately reflect the settlement within the study area, it does provide an overview of the generally flat landscape and the delineation of primary and secondary waterways extending through the study area, with Watt's Creek in the western extent of the township being the most prominent within the project area (Map 5, p.41). The 1906 plan also details the transportation corridors within the project vicinity, with Moodie Drive extending southward from Corkstown Road in the eastern limit of the study area, and a number of road allowances deviating north and south from Corkstown Road, although it is doubtful these were all accessible during this period.

A 1945 aerial image depicts the project landscape within a primarily rural, undeveloped, context, extending through a number of farmsteads and wooded areas (Map 6, p.42). Although there appears to be some development within the project area in Nepean Township by 1976, notably the construction of Highway 417, the landscape remained primarily rural through this period (Map 7, p.43) which is generally consistent with the modern landscape within this section of the project corridor (Map 2, p.38).

Beginning in 1889, and continuing through the mid-twentieth century, The City of Ottawa conveniently annexed portions of Nepean Township slicing 9,997.2 acres from the township territory by January 1, 1950, which left Nepean almost exclusively a rural municipality with a population of 2,500 residents. By 1967, Nepean Township had developed into the second fastest growing township with a population increase from 2,500 to 50,000 people (Walker and Walker 1975). In 2001, the city of Nepean was officially amalgamated into the City of Ottawa (Gordon 2015).

2.3.2 March Township General History

March Township was officially surveyed in 1820, though Euro-Canadian immigrant settlers began to arrive the previous year. At this time March Township was part of the District of Johnstown, becoming part of the District of Bathurst in 1822, and eventually integrating into Carleton County in the 1840s.

March Township was primarily settled by retired officers of the Napoleonic wars in 1819 who were offered free land grants as a reward for their loyal service, with the amount of land given to each serviceman proportional to their military rank. Under this system, colonels became entitled to a substantial plot of land, being as much as 1,600 acres, whereas privates may only be provided with a half lot, encompassing 100 acres (Burns *et al* 1972). Settlers were also given a starter tool kit consisting of various necessary implements and supplies needed to settle and work the land including axes, shovels and nails, as well as a blanket, kettle and panes of glass. Additionally, each soldier was offered a year's rations (Belden 1879) intended to provide them with the required necessitates until they could become self-sufficient. Several distinguished English officers chose to settle in March and selected plots adjacent to the river. Among them were Captains Landell, John B. Monk, Benjamin Street, Weatherby, Cox, Stephens, General Arthur Lloyd and Lieutenant Thomas Reid (Belden 1879; Walker and Walker 1975; Burns *et al* 1972).

Another prominent settler along the Ottawa River was Hamnett Kirkes Pinhey, a former merchant from Plymouth, England. As a civilian, Pinhey won distinction during the Napoleonic wars by getting messages through the French blockade, an honour that later earned him 1,000 acres in March Township (Burns *et al* 1972). In 1820, he settled on Lot 23 of Concessions 6 and 7 with his wife, Mary Ann.

Pinhey had considerable wealth and leveraged it to build an estate that suited his needs as well as those of the community. He financed construction of the first church, St. Mary's, built on his land between 1824 and 1826, as well as a saw mill and grist mill (Walker and Walker 1975; Belden 1879). Pinhey's estate, known as Horaceville after his son, became the focus of the community, and Pinhey himself took on the natural role as a community leader, later serving as Reeve between 1850 and 1855 (Bond 1984; Walker and Walker 1975).

While English officers settled on the picturesque lands of the river bank, the first four concessions at the west end of the township were settled by Irish farmers, tradesmen and lower ranking veterans. As it turned out, some of these settlers ended up with the best arable land in the township, whereas the soil closer to the river was deceptively shallow (Burns *et al* 1972). Belden (1879) observed that March was the poorest township in Carleton County in terms of soil.

More settlers arrived in the early 1820s, capitalizing on the prospect of free land grants. The first census of March Township, taken in 1823, recorded 49 families with a population of over 200 inhabitants (Walker and Walker 1975). Even after the land grants were discontinued in 1824, settlers continued to arrive. By the mid-19th century, the population blossomed to 1,125 inhabitants and included a number of commercial and industrial enterprises comprising blacksmiths, cobblers, carpenters, tailors, innkeepers and merchants (Bond 1968; Burns *et al* 1972).

Walling's 1863 plan of March Township shows the project corridor extending through a primarily rural landscape, although evidence of settlement occupation within the study area is visible in Concessions 1 and 3 (Map 3, p.39). Of particular note are the structures identified within close proximity to the proposed alignment specifically on Concession 1, Lot 3, on both sides of the Carp River and within Concession 1, Lot 2, where it traverses through the property of T. James. The James Farm site (BhFx-49) has been registered with the MTCS in this location and reflects the historical occupation of the James family during this period.

The summer of 1870 was a particularly dry one and a fire which started in neighbouring Huntley Township swept through much of March Township. Crops, homes and livestock were burned, and although most settlers were able to take refuge at the river or in wells, a few human casualties occurred. This was one of many country fires to engulf Carleton County that summer. The fire brought changes to the agricultural landscape such as clearing the land of trees and losing soil from erosion, significantly impacting the drainage system by turning swamps into fallow fields as they had dried out (Burns *et al* 1972).

March Township recovered from the 1870 and by the end of the decade the study area region witnessed increased settlement, with a number of properties having been subdivided and settled within the previous fifteen years (Map 4, p.40). In addition to the structure on Thos. James' property present on the 1863 Walling plan, the structure on the McCurdy property (Concession 1, Lot 3) is also situated within the proposed alignment by 1879.

Unfortunately, the 1906 topographic plan for Carleton County does not provide an accurate reflection of the settlement within the study area during this period, although it does identify occupation along the North-South oriented Hazeldean Road (not to be confused with the modern Hazeldean Road in Goulbourn Township) which extends through the project corridor (Map 5, p.41).

A 1945 aerial image documenting the study area within March Township clearly shows a relatively rural, undeveloped, landscape primarily comprised of farmsteads and small sections of wood lot (Map 6, p.42). Of particular interest are the structures documented within the proposed project alignment which correlate to those documented on the 1879 Belden plan on the McCurdy and James properties, indicating the prolonged occupation of these locations. Although portions of the surrounding landscape had been developed by 1976, the majority of the study area continued to represent a rural landscape (Map 7, p.43).

In 1978, March Township was integrated into the City of Kanata and in 2001 was amalgamated into the new City of Ottawa (Gordon 2015). Since the integration into the City of Kanata, and later the City of Ottawa, the study area landscape in March Township has undergone significant development, primarily for residential and commercial infrastructure (Map 2, p.38).

2.3.3 Huntley Township History

Huntley Township, named in honour of Lord Huntley, only brother of the Duchess of Richmond (Walker and Walker 1975), was surveyed in anticipation of settlement in 1818 with the first settlers arriving shortly afterwards (HTHS n.d).

The first Catholic emigrants to permanently settle in Huntley Township arrived between 1820 and 1822 from Richmond and included forty families who primarily settled along the Third Line where the first village of Huntley, later known as Huntley Centre, developed (HTHS n.d; Walker and Walker 1975). Among the early families arriving in the township were John Kavanagh and William Mooney, who arrived together in 1819 or 1820 (Belden 1879).

The influx of Irish immigrants to Huntley Township in 1823 and 1824, who primarily settled around the Old Almonte Road and Corkery Road (9th Line of Huntley), where the enclaves of Manion Corners, Powell and Clandeboyne became established, significantly increased the rural population within the township (HTHS n.d; Walker and Walker 1975).

Each early settler was granted a location ticket for 70 acres with the option of an additional 30 acres when specific “settlement duties” were completed. These settlement duties included “that the locatees clear thoroughly and fence five acres for every one hundred acres granted; build a house 16 by 20 feet in the clear; clear one half of the road and chop down, without clearing, one chain in depth across the lot next to the road” (Walker and Walker 1975).

On 23 April 1824, while the 4th Carleton Militia was celebrating the birthday of His Majesty King George the Fourth at Alexander Morris’s tavern in Morphy’s Falls (modern Carleton Place), a group of Irish settlers advanced on the tavern and confronted the celebrating British loyalists. A skirmish ensued between the groups causing a number of injuries, although fortunately no fatalities. Following an investigation, which ultimately placed responsibility on the “ineptness of some of the magistrates in not taking proper preventive action”, the disturbances were terminated and the rival groups resided together in relative peace (Walker and Walker 1975).

In its early years the township was linked with March Township in municipal affairs, but with the adoption of the Municipal Act in 1849, each township became an entity with separate representation in County Council. In 1850, the assessment rolls indicate Huntley Township produced 15,000 bushels of wheat, 19,000 bushels of oats, 27,500 bushels of potatoes, 5,000 lbs of wool, and 13,000 lbs of butter, with a population of 2,080. By the census returns of 1861, the township contained 2,651 inhabitants (Walker and Walker 1975).

The 1863 plan of Huntley Township shows the settlement and occupation within the properties surrounding the project corridor, with the residence of W. Roe (Concession 1, Lot 2) situated within proximity to the proposed alignment (Map 3, p.39).

In August 1870, a great fire spread quickly and engulfed Carleton County. In Huntley Township, the fire began in the bush near the Seventh Line and travelled eastward rapidly causing destruction along the Third Line, becoming augmented by auxiliary fires ignited throughout the Township. In Huntley Centre, the Presbyterian Church and the home of the pastor, Rev. James Sinclair, suffered damage as well as other recognizable landmarks including the Methodist Church, the residence and valuable library of Rev. Mr. Godfrey the Anglican Clergyman of Hazeldean and Huntley, Mulligan’s Schoolhouse, the Orange Hall and the general store, which were all burned with only few of the surrounding homes escaping damage (Walker and Walker 1975).

The settlement of Carp, situated at the junction of the roads from Ottawa, Arnprior and Stittsville, grew as the primary town in Huntley Township following the 1870 fire, which had devastated the settlement of Huntley Centre (HTHS n.d).

Belden's 1879 map of Huntley Township documents the increased settlement within the vicinity of the project corridor, although only the structure depicted on Wm Roe's property (Concession 1, Lot 2) is situated within the study area buffer (Map 4, p.40). The appearance of a structure within the vicinity of the Roe property in the 1945 aerial imagery provides additional documentation of the historic occupation in this area (Map 6, p.42).

Huntley Township was amalgamated into West Carleton Township in 1974 (HTHS n.d) and the landscape within the study area in Huntley Township continued to be primarily rural through the 1970s (Map 7, p.43). In 2001, Huntley Township was integrated into the City of Ottawa and an auto mall development is currently situated within the general project study area today (Map 2, p.38).

2.3.4 Goulbourn Township History

Goulbourn Township was part of a large tract of First Nations land purchased by the British Government in 1816, as part of a defense/settlement scheme north of the Rideau River. The township was roughly surveyed over the following years, together with Bathurst, Drummond and Beckwith Townships in neighbouring Lanark County. To help counter a steady influx of American settlers into Upper Canada, whose loyalty the British Government could not always rely on in times of uncertainty, immigrants from the British Isles were given government assistance to emigrate and build homesteads upon the newly surveyed two hundred acre lots. Much of rural Goulbourn Township was settled by immigrants from Ireland between 1821 and 1824 (Walker and Walker 1975).

The first permanent community within Goulbourn was established around the third concession near the southeast comer of the township. In 1818, 400 members of the British 99th Regiment and their families constructed a road from Bytown (Ottawa) and settled in and around the carefully planned village of Richmond (Bond 1984). Many of the settlers were disbanded military, although a number were tradespeople who accompanied the expedition or arrived shortly afterwards to provide essential services for the community. By 1821, a grist mill, sawmill and school house had been erected, and over the next few years both an Episcopal and Catholic church were built. The village continued to develop with as many as twenty stores and a dozen breweries and distilleries providing economic stability for the community. Initially the most important settlement in the county, with the construction of the Rideau Canal (1826 - 1832) many settlers relocated to Bytown and Richmond Village experienced a gradual but steady decline. In spite of becoming an independent municipal corporation in 1850, by 1879 Richmond had only four general stores, two harness shops, four blacksmith shops, two wagon shops, three shoe stores, one tailor, one combined grist and saw mill, one water mill, two hotels, four churches, a school and a town hall (Belden 1879).

The village of Ashton began its existence as 'Mount Pleasant' in the early 1820s, representing the second largest nineteenth century village in the township. The first sawmill was built there by John Sumner in the mid-1820s, together with a potash works and a general store. By the mid-nineteenth century, the village had grown considerably to include three general stores, two taverns, a tannery, three blacksmith shops, three wagonmaker's shops, two tailors, a small foundry, a harness shop, three carpenters, a post office, a school and two churches (Walker and Walker 1975; Belden 1879).

The community of Stittsville emerged on Lot 23, Concession 11, in the early 1820s. The original community was located at the junction of Carp Road and the 12th Line (Hazeldean Road), about three kilometers west of the study area. Jackson Stitt, for whom the village was named, acquired property in the area in the 1830s and became the first post-master in 1854. By 1864, Stittsville had a population of about 100 residents and was developing into a thriving community with the establishment of a number of businesses and social institutions. With the exception of one stone building, the village was swept away by the "great fire" of 1870. At the same time, the Canada Central Railway was constructed to the south of the original village site. When reconstruction was completed much of the business community had migrated to the new transportation route in Lot 23, Concession 10. This area came to be known as New Stittsville and the original village became Old Stittsville. By 1879, the new community had two general stores, a hotel and a number of tradesmen's shops (Bottriell 1998; Walker and Walker 1975; Belden 1879).

Munster was another early hamlet in the township and by 1879 a general store, two blacksmith shops, a school, a temperance hall, an Orange Hall and a Methodist church had been established. Rathwell's Corners was home to the township Council, though according to Belden it lay "in the midst of a most uninviting tract of country, and dilapidation and deterioration seem to threaten its existence, though it was in the early days of the Township quite a little Village, with a couple of stream mills in the immediate vicinity, and any quantity of tradespeople" (Belden 1879).

In contrast, the village of Hazeldean, situated in the northeast corner of the township along the eastern periphery of the study area corridor, was settled between 1818 and 1819 and was, in Belden' s opinion, "situated very pleasantly in the midst of a most delightful agricultural country" (Belden 1879). By 1879, the settlement of Hazeldean contained a general store, a few tradesmen's shops, a school, two churches, a temperance hall and an Orange hall. Another established village in the township was Dwyer's Hill, which was situated toward the southwest corner of the township and had a post office and a small store (Belden 1879; Walker and Walker 1975).

As indicated above, most of the township was devastated by a vast fire in 1870, which also affected other portions of Carleton County. Nine years later, when surveying the county Belden found most of Goulbourn to still be unpalatable:

> The “great fire” of 1870, and subsequent ones in many places, have swept most of what valuable timber was then left upon it, except where it was in isolated patches; and altogether the dreariness and feeling of desolation experienced by traveling through many parts of it exceed those imparted by contact with the wildest imaginable waste of forest, simply, for long distances nought intervening to break the line of the horizon but the few charred stubs still standing among impenetrable “windfalls” of their mates (Belden 1879).

Transportation through the region was provided by a series of roads, many of which reflected early pathways and trails utilized by the settlers in the early nineteenth century. Initially many of the routes were only traveled on foot, although gradually they were improved to become passable for horse-drawn traffic. Richmond was already linked in 1818 to the settlement at Bytown and in 1820 a trail was forced westward to Perth (Bottriell 1998). Large areas of swamp and bog in the township made laying a complete grid-system of roads impossible. In many cases, trails were forced through at odd angles wherever the ground allowed convenient passage. The Canada Central Railway (later part of the Canadian Pacific Railway) was constructed across the township along the line between the Tenth and Eleventh Concessions with stations being established at Stittsville and Ashton.

The project corridor landscape remained primarily rural through the early 19th century, with two structures represented within the study area on the property owned by R. Grant (Concession 12, Lot 28), by 1863 (Map 3, p.39). By 1879, two additional structures are depicted within the study area in Concession 11, south of Hazeldean Road (Map 4, p.40).

Hazeldean Road is part of the 12th line and was established when the township was surveyed between 1818 and 1828. The corridor's importance increased when it linked the outer communities with Bells Comers and connected to Richmond Road in 1833, which provided more direct access to Bytown. The construction of the railway in 1870 somewhat diminished the commercial transportation along the route, although it continued to be vital for the area's rural population, especially those living in the vicinity of the study area. Hazeldean Road, and the occupation around the vicinity of the study area in Concessions 11 and 12, is visible within a 1945 aerial image which documents the surrounding rural landscape (Map 6, p.42). Additional structures were built around the southern limits of the project corridor by 1976, with the community of Bell Corners experiencing significant growth by this period (Map 7, p.43). More recently, development along both the eastern and western limits of the study area is present within the modern landscape, with Hazeldean Road continuing to provide a reliable transportation route for the area residents and subsequent commercial development initiatives (Map 2, p.38).

3.0 ARCHAEOLOGICAL CONTEXT

3.1 Study Area Environment and Landscape

The environmental landscape within the region began to emerge following the retreat of the glacial ice during the Holocene Period. Immediately adjacent to the retreating ice sheets, melt water lakes formed within the low-lying Ottawa Valley which had depressed from the weight of the ice cap. Around 11,000 BP, the ice had sufficiently melted to allow sea water from the Atlantic Ocean access to the glacially lowered lands of eastern Ontario via the St. Lawrence (Cronin *et al* 2008). The marine inundation formed the Champlain Sea, which is represented within the sedimentary record by a change from laminated glaciolacustrine clays to marine deposited clays.

Isostatic adjustment gradually raised the topography within the Ottawa Valley, resulting in the reduction of the Champlain Sea eastwards. Large amounts of meltwater from the retreating ice sheets to the northwest flowed down through the Ottawa Valley, resulting in the freshwater fusion with the saline Champlain Sea producing a brackish environment, eventually producing the smaller freshwater Lake Lampsilis around 9,800 BP. Following the draining of Lake Lampsilis, the Ottawa River remained as a drainage channel to the Atlantic Ocean for larger glacial lakes and water bodies to the west, with occasional large release episodes. Based on the historic topographic contours within the study area region (Map 5, p.41), this area would have been inundated by Lake Champlain during the Early Paleo-Indian Period as it is situated below the 550 foot (167.6 metre) contour elevation (Kennedy 1976). Based on this interpretation, the study area vicinity would have drained and become habitable during the Late Paleo-Indian/Early Archaic Period.

The surficial geology and physiography within the study area represents the glacial and post-glacial depositional processes which have influenced the study area environment. The majority of the corridor consists of offshore marine sediments of clay, silty clay and silt deposited by the receding glacial lake, interrupted by bedrock escarpments. A deposit of nearshore sediments composed of fine to medium grained sand is situated north of Highway 417 and west of Terry Fox Drive (Map 8, p.44).

The Ottawa Valley Clay Plains encompass the majority of the study area, with a segment of the Limestone Plains extending into the eastern section of the project corridor (Map 9, p.45). Within the Ottawa Valley below Chalk River, the clay beds are irregularly stratified and not varved. Shells of prehistoric marine creatures typical of salt water environments have been identified within the region confirming this low-lying area was submerged under the Champlain Sea during and immediately after the recession of the glacier (Chapman 1975).

The primary soil composition within the eastern section of the corridor consists of poorly drained Brandon classified soils which are predominately identified on the level to nearly level marine clay plains. Nepean classified soils are also documented in the eastern and central sections of the study area and primarily consist of relatively well drained soils between 10 and 50 centimetres in thickness overlaying sandstone and quartzite bedrock. Soils classified with the Anstruther complex are documented in the central portion of the corridor on consist of well drained undifferentiated stony drift material ranging between 10 and 50 centimetres thickness overlying Precambrian igneous and metamorphic bedrock. Bainsville soils are documented within the central section of the study area and consist of imperfectly drained soils within the gently sloping topography. They are typically dark brown in colour with granular inclusions ranging in thickness between 15 and 25 centimeters. The predominant soil matrix within the southern portion of the study area consists of North Gower olive gray to grayish brown clay loam and silty clay textured composition. These soils developed on level to very gently sloping marine clay plains which were deposited in deep water during the Champlain Sea inundation. The upper 1 to 2 metres have frequently been modified reflecting the reworking and redeposition of sediments in increasingly shallower water conditions as the Champlain Sea receded (Schut and Wilson 1987).

The study area lies within the Upper St. Lawrence sub-region of the Great Lakes/St. Lawrence Forest Region. The trees characteristic of this sub-region includes sugar maple, beech, red maple, yellow birch, basswood, white ash, largetooth aspen, red oak and burr oak. Coniferous species include eastern hemlock, eastern white pine, white spruce and balsam fir. Poorly drained areas typically contain swamp adapted hardwoods, black spruce or white cedar (Rowe 1977). Extensive settlement and agricultural development within the study area since the nineteenth century have left little, if any, of the original forest cover intact.

The Ottawa River is situated north of the project corridor and provides the primary drainage capacity for the area, with a number of natural drainage channels and tributaries within the surrounding area including Still Water Creek, Watts Creek, Poole Creek and Feedmill Creek which are prominent features within the general study area landscape.

The most significant water course within the project vicinity is the Carp River which may have provided an important navigable access corridor between the Ottawa River and the environmentally diverse uplands of the Carp Ridge (ASI and GII 1999). The documentation of Archaic Period components at the Akandoo (BhFx-62) and Corelview (BhFx-27) sites along the eastern bank of the Carp River less than 150 metres north of the study area may provide additional evidence documenting the importance of this waterway as both a navigable access route and preferred settlement landscape.

3.2 Previous Archaeological Assessments Within Fifty metres of Study Area

A search of the Ministry of Tourism, Culture and Sport's Past Portal database for previous archaeological assessments within the vicinity of the study area was completed on 3 January 2018 (MTCS 2018a).

Appendix A provides information regarding the previous archaeological assessments known to have been completed within fifty metres of the current study area and Map 11 (p.47) delineates the spatial relationship between the previously completed assessments and the current study area.

Some of these previous assessments were completed prior to the publication of the 2011 MTCS *Standards and Guidelines for Consultant Archaeologists* and may require additional assessment to meet current compliance regulations.

3.3 Known and Registered Archaeological Sites within Vicinity of Study Area

The primary source of information regarding known archaeological sites within the province is the Ontario Ministry of Tourism, Culture and Sport's archaeological site database (ASDB), which designates archaeological sites registered according to the Borden system. Under the Borden system, Canada is 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 within Borden Blocks BhFx and BiFx.

A search of the MTCS Past Portal ASDB for all sites within two kilometres of the study area was completed on 22 December 2017 (MTCS 2017). The MTCS also provided a list of all registered sites within the vicinity of the project corridor which was received on 3 January 2018 and provided additional documentation of registered archaeological sites within the vicinity of the study area (MTCS 2018b).

Table 2 provides information retrieved from the MTCS Past Portal ASDB and project specific reports for each registered archaeological site within two kilometres of the study area corridor.

Table 2: Registered Sites Within Two Kilometres of Study Area.

Borden Number	Site Name	PIF(s) Associated with Site	Spatial Relationship to Study Area	Temporal Context	Inferred Site Type	Development Review Status
BhFx-1	Nathaniel Scharf	n/a	705 m north	Post-Contact	Farmstead?	n/a
BhFx-2	n/a	2000-019-005	Within Study Area	Pre-Contact	Findspot	Further CHVI
BhFx-12	Findspot 9	P039	1,840 m west	Early Archaic	Camp/campsite	Further CHVI
BhFx-26	Allen	P003-031, P003-037 & P003-041	165 m north	Post-Contact	Farmstead	No Further CHVI
BhFx-27	Corelview	P003-031, P003-037 & P003-041	120 m north	Middle Archaic	Camp/campsite	No Further CHVI
BhFx-28	n/a	P039-077	1,420 m north	Pre-Contact	n/a	n/a
BhFx-29	n/a	P039	1,215 m north	Early Archaic	Quarry, camp/campsite	n/a
BhFx-30	Richardson Farm	n/a	1,230 m north	Post-Contact	Farmstead, outbuilding	n/a
BhFx-31	n/a	P039	1,335 m north	Early Archaic	Quarry, Camp/campsite	n/a
BhFx-35	Robertson	P051-141-2005	570 m north	Pre-Contact (1500-5500 BP) and Post-Contact (1850-1980)	Findspot (Indigenous) and Agricultural (Euro-Canadian)	No Further CHVI
BhFx-36	Hartin 1	P051-141-2007	960 m west	Pre-Contact (7,000-500 BP)	Findspot	No Further CHVI
BhFx-37	Hartin 2	P051-142-2007	880 m west	Pre-Contact (7,000-500 BP) and Post-Contact (1800-1950)	Processing/quarry (Indigenous) and Scatter (Euro-Canadian)	No Further CHVI
BhFx-38	Armstrong House	P025-153-2007	1,860 m north	Post Contact (1870s)	Farmstead	No Further CHVI
BhFx-39	Gourley House	P025-153-2007	1,630 m north	Post-Contact (1870s)	Farmstead	No Further CHVI

Borden Number	Site Name	PIF(s) Associated with Site	Spatial Relationship to Study Area	Temporal Context	Inferred Site Type	Development Review Status
BhFx-40	Taggart 1	P003-232-2009	70 m west	Post-Contact (1840s-2000)	Agricultural	Further CHVI
BhFx-47	Bradley Farm	P031-035-2011	Within Study Area	Post-Contact (19th and 20th century)	Farmstead, cabin	Further CHVI
BhFx-49	James Farm	P031-035-2011	Within Study Area	Post-Contact	n/a	Further CHVI
BhFx-50	173 Huntmar	P003-369-2013	525 m west	Post-Contact (1860)	Euro-Canadian	Further CHVI
BhFx-62	Akandoo	P025-0482-2014, P025-0494-2015, P025-0498-2015	75 m north	Archaic Period	Unknown	Further CHVI
BhFx-65	Bradley-Criag	P378-006-2013	740 m south	Post-Contact (mid to late 19th century)	Agricultural, homestead	No further CHVI
BhFx-67	H. Bradley	P378-0019-2016	Within Study Area	Post-Contact (1860s)	Agricultural, farmstead	No Further CHVI
BhFx-68	W. Bradley	P378-0019-2016	380 m south	Post-Contact (1830)	Agricultural, farmstead	Further CHVI
BiFx-18	North Kanata H1	P390-0073-2013	1,750 m north	Post-Contact (1870s-20th century)	Homestead, industrial	Further CHVI
BiFx-21	W. Craig	P386-0015-2014	65 m north	Post-Contact (1800-1950)	Farmstead, house	Further CHVI

Additional clarification regarding two of the registered archaeological sites is provided below as additional information has been documented for these sites which may not be reflected in the corresponding MTCS Past Portal Site Form.

In March 2000, a Stage 2 field investigation was completed within Nepean Township, Concession 1 (Ottawa Front), Lot 1, identifying “a unifacially untouched ‘notched-flake’ scraping tool, made on a piece of slate” and “a flake of quartzite, also of cultural origin”. While the report indicated that “their cultural assignation could be considered equivocal”, the licensee was “confident of their cultural origin and has registered the area as BhFx-2”. Based on the interpreted significance of the materials, the licensee recommended additional Stage 2/3 assessment prior to further soil disturbance impacts within the area (Swayze 2000).

The current Past Portal Site Form for BhFx-2 is assigned as “Cancelled” based on an email correspondence from the original licensee to the MTCS indicating the Borden Number is “not referenced in any report” (MTCS pers comm. 12 Jan 2018). As BhFx-2 is documented in the 2000 report (Swayze 2000), the cancellation of the BhFx-2 Site Form may represent a mis-understanding and should continue to be recognized as a registered archaeological site.

During the Stage 1 assessment for the proposed East-West corridor Light Rail Project completed in 2005, this site is identified as “UR-4” (Unregistered) and documented as “Undiagnostic Native lithics have been recorded from the Corkstown Road/March Road area (Ken Swayze, personal communication, 2005)” and determined “further investigation required” (Heritage Quest 2005). This location correlates to the spatial context provided for BhFx-2 in the original report (Swayze 2000) indicating the documentation of material in this area, although there appears to be confusion regarding the Borden Number originally assigned to this site.

Based on the available data, the location of BhFx-2 should be recognized as a registered archaeological site. In reference to the material documented in the original report (Swayze 2000), additional Stage 2 field assessment should be completed in this location in an attempt to re-locate and define the spatial extent of the site and determine the significance of the lithic scatter prior to any additional disturbances to the area.

The Bradley Farm site (BhFx-47) was documented during a Stage 2 field assessment completed in 2011-2012 and identified as possessing sufficient CHVI to recommend a Stage 3 investigation (Past Recovery 2013). This property was subsequently investigated during a Stage 1 and 2 assessment in 2016-2017 (Patterson 2017), although the presence of registered site BhFx-47 is not identified in the corresponding report and it is likely the licensee was not made aware of the site due to transitional issues with the MTCS database.

During the Stage 2 field assessment completed in 2016-2017, the original BhFx-47 site was not re-identified, although a second loci likely associated with this site was documented 80 metres south and registered as the H. Bradley site (BhFx-67). Based on the recovered cultural heritage resources documented during the 2016-2017 survey, registered site BhFx-67 was not recommended for additional archaeological assessment (Patterson 2017). Therefore, although the area has been recommended to be cleared of archaeological concern following the 2016-2017 Stage 2 assessment, the original recommendation for a Stage 3 assessment at BhFx-47 has not been sufficiently mitigated to meet the MTCS *Standards and Guidelines for Consultant Archaeologists* (2011) and therefore additional work may be required for undisturbed portions of this site prior to any subsurface impacts to the existing site landscape.

3.4 Study Area Archaeological Potential

Several factors are employed when determining archaeological potential within a particular area. In addition to the proximity to known archaeological sites, factors for determining archaeological potential for Indigenous and Euro-Canadian historical resources include watershed area (primary and secondary watercourses), distance from water, drainage patterns, identification of historic water sources (e.g. beach ridges, river beds, relic creeks, ancient shorelines, etc.), elevated topography, identification of significant physiological and geological features (e.g. knolls, drumlins, eskers, plateaus, etc.), soil geomorphology, distinctive land formations (e.g. mounds, caverns, waterfalls, peninsulas, etc.), known burials sites and cemeteries, biological features (distribution of food and animal resources before colonization), features identifying early Euro-Canadian settlements (e.g. monuments, structures, etc.), historic transportation routes (e.g. historic roads, trails, portages, rail corridors, etc.) and properties designated and/or listed under the *Ontario Heritage Act.* Local knowledge from Indigenous communities and heritage organizations, as well as consultation of available historical and archaeological literature and cartographic resources, aids in the identification of features triggering archaeological potential.

These criteria are based on the Ontario Ministry of Tourism, Culture and Sport's *Standards and Guidelines for Consultant Archaeologists* (2011) and were used to identify archaeological potential for the study area under investigation.

Map 12A (p.48) represents the area determined to possess archaeological potential based on all identified natural water sources located within 300 metres to the study area. This includes Still Water Creek, Watts Creek, Carp River, Poole Creek and Feedmill Creek, as well as the numerous tributaries prominent within the project landscape. This layer also reflects the 300-metre buffer around wetlands which represent areas of natural water resources as well as potential subsistence extraction areas.

Map 12B (p.49) details the potential for archaeological resources based on the correlation between the study area and the 300 metre radius around known areas of historic occupation, with Map 12C (p.50) representing the potential denoted within areas situated 100 metres from known historic transportation routes.

Map 12D (p.51) identifies the areas determined to possess archaeological potential based on the 300-metre buffer delineated around known archaeological sites identified during previous assessments in the area. Although some specific sites have been sufficiently mitigated of archaeological resources, the MTCS *Standards and Guidelines for Consultant Archaeologists* (2011) requires all property within 300 metres of registered sites to be identified as possessing archaeological potential until the surrounding landscape has been subjected to archaeological field investigations.

Map 12E (p.52) represents the archaeological potential layer defined within the City of Ottawa Archaeological Master Plan (ASI and GII 1999). This document was prepared prior to the publication of the 2011 *Standards and Guidelines for Consultant Archaeologists* and may not conform to existing compliance regulations, although it is useful in determining areas of archaeological potential.

Additional attributes triggering archaeological potential within the project landscape may not be relevant to the current Stage 1 assessment. There are currently no known listed or designated heritage properties within the project corridor (Golder 2018) and there are no known heritage monuments or markers within, or adjacent to, the study area boundaries.

Only one historic cemetery is known to have been located within proximity to the project corridor. The Wiggins Burial Ground was identified through archival research and subsequently mitigated during archaeological investigations in 2004 and 2005. The mechanical and hand excavation of the area revealed a single burial shaft with two internments contained within an "exterior coffin". The remains of a perimeter fence were discovered, which has been interpreted to have been constructed during the mid to late 19th century based on the presence of cut (square) nails. The post holes and wood remains of the fence were delineated surrounding the burial shaft. All recovered human remains and burial components were re-located to the St. John's Anglican Cemetery located on Sandhill Road, Ottawa, Ontario (Adams Heritage 2005).

No additional burials were identified in the area during subsequent archaeological investigations, and the delineation of the enclosure fence suggests there is minimal potential for additional burials within or outside the previously assessed area. As the interpreted limits of the cemetery are located more than fifty metres north of the current study area, the cemetery does not present an archaeological concern for the present study.

Based on the attributes defined in the MTCS *Standards and Guidelines for Consultant Archaeologists* (2011) for determining archaeological potential within a project landscape, the entire study area is determined to possess the potential for archaeological resources (Map 12F, p.53).

Properties which have been previously assessed for archaeological resources and sufficiently mitigated and cleared by the MTCS are no longer considered to possess archaeological potential. Map 12G (p.54) delineates the previously assessed areas documented in reports which have been accepted as MTCS compliant and entered into the Public Register of Archaeological Reports.

4.0 ANALYSIS AND CONCLUSIONS

On behalf of Parsons Corporation, Golder Associates completed a Stage 1 archaeological assessment as part of the Planning and *Environmental Assessment* Study for the Kanata LRT from Moodie Drive to Palladium Drive. The project corridor, approximately 12 kilometres in length, runs approximately northeast-southwest along the north side of Highway 417 between Moodie Drive and Huntmar Drive then turns 90 degrees southeast and extends to Hazeldean Road (Map 1, p.37).

A buffer measuring 100 metres on either side of the proposed alignment is included in the study area to provide flexibility in determining the final alignment and corresponding construction disturbance areas (e.g. staging areas, temporary access roads, etc.). The study area encompasses property within Concessions 1 and 2, Nepean Township, Concessions 1, 2 and 3 in March Township, Concession 1 in Huntley Township and Concessions 11 and 12, Goulbourn Township (Map 2, p.38).

Previous archaeological investigations have confirmed the existence of Indigenous sites occupied during the Archaic Period (9,500 – 2,500 BP) within the study area vicinity and based on specific landscape features there is potential to document additional Indigenous sites within the project boundary.

Historically significant 19th century Euro-Canadian occupation and land use has also been identified within the study area, with the presence of known settlement areas and historic transportation routes documented on 19th century cartographic sources reflecting these past demographic patterns.

Based on the attributes defining the presence of archaeological potential detailed in the MTCS *Standards and Guidelines for Consultant Archaeologists* (2011), the entire study area has been determined to possess the potential to recover and document archaeological resources (Map 12F, p.53). Properties which have been previously assessed for archaeological resources and sufficiently mitigated and cleared by the MTCS are no longer considered to possess archaeological potential (Map 12G, p.54).

In specific circumstances, areas identified as possessing archaeological potential which have been previously subjected to intensive subsurface disturbance activities may be exempt from requiring archaeological field investigations, despite the proximity to features triggering archaeological potential. These areas will require visual inspection and photographic documentation during subsequent Stage 2 field assessments to confirm these landscapes have been sufficiently disturbed to mitigate archaeological potential. As this Stage 1 report was completed during winter conditions, and the MTCS Technical Bulletin for Winter Archaeology clearly states that “Stage 1 property inspection… cannot be carried out under winter conditions” (MTCS 2013), these areas should be documented as disturbed when climatic conditions are sufficient to meet the MTCS *Standards and Guidelines for Consultant Archaeologists* (2011).

Map 13A (p.55) identifies two areas within the southern extent of the study area which have not been sufficiently mitigated to MTCS compliance requirements. The small area south of Hazeldean Road is situated within the study area, but beyond the current proposed alignment. Should this area be impacted during the Kanata LRT project, additional assessment will be required to mitigate the existing archaeological resources. The second area is located north of Maple Grove Road and abuts the eastern limit of the proposed alignment. This area is currently being utilized by the City of Ottawa Maple Grove facilities depot and includes asphalt parking areas east of the proposed alignment. No additional archaeological assessment will be required if construction disturbance activities are limited to the proposed alignment, although should property within the City of Ottawa Maple Grove facilities depot be impacted additional archaeological assessment will be required. This may include visual inspection and photographic documentation of previously disturbed areas when climatic conditions are sufficient to meet the MTCS *Standards and Guidelines for Consultant Archaeologists* (2011).

Map 13A (p.55) delineates areas which have been recommended for additional archaeological assessment within the western portion of the study area corridor. The majority of property south of Highway 417 within the proposed alignment is situated west of the previously proposed alignment which was archaeologically investigated in 2011-2012 (Past Recovery 2013). A significant portion of the currently proposed alignment, as well as the study area buffer to the east, appears to have been previously disturbed during construction activities related to the Canadian Tire Centre and surrounding parking facilities. Any areas which have been sufficiently disturbed to mitigate archaeological potential should be assessed by visual inspection and photographic documentation when climatic conditions are sufficient to meet the MTCS *Standards and Guidelines for Consultant Archaeologists* (2011).

The property within the proposed alignment at 210 Huntmar Drive was recommended for additional archaeological field investigations following the completion of the Stage 2 assessment in 2012 (Past Recovery 2013). If this area cannot be avoided, it will require archaeological mitigation compliant with the MTCS *Standards and Guidelines for Consultant Archaeologists* (2011) prior to any disturbances to the landscape.

The proposed alignment north of Highway 417 also deviates from the corridor subjected to archaeological testing in 2011-2012 (Past Recovery 2013) and extends through an agricultural field. This area is recommended to be investigated during a Stage 2 archaeological field investigation prior to any construction or other activities which may impact the existing landscape.

The remainder of the proposed alignment west of the Carp River is situated within land which has been previously assessed and mitigated for archaeological resources. The area within the proposed alignment east of the Carp River depicted on Map 13B (p.56) has been mitigated of archaeological concern, although should the previously untested property located south of the proposed corridor, situated south of Roger Neilson Way, be situated within future construction areas, a Stage 2 archaeological assessment will be required prior to any disturbance to the existing landscape.

Property within the proposed alignment between Didsbury Road and the western road allowance for Terry Fox Road has been previously mitigated during the Stage 2 assessment completed in 2011-2012 (Past Recovery 2013), although should the construction disturbance area expand beyond the existing proposed alignment, a Stage 2 archaeological investigation will be required prior to any landscape disturbances (Map 13C, p.57).

No previous archaeological assessments are known to have mitigated archaeological potential between the western road allowance of Terry Fox Road and Kanata Avenue. Therefore, a Stage 2 archaeological assessment will be required prior to any construction or landscape disturbance activities within this portion of the project corridor delineated on Map 13C (p.57). All undisturbed lands within this area will require archaeological field testing, while all portions of the existing landscape which have been sufficiently disturbed to have removed the potential for archaeological resources will require visual inspection and photographic documentation when climatic conditions are sufficient to meet the MTCS *Standards and Guidelines for Consultant Archaeologists* (2011).

Map 13D (p.58) delineates the area within the proposed alignment from Kanata Avenue to just west of the pedestrian overpass crossing Highway 417 as having been previously mitigated of archaeological potential during the Stage 1 (Heritage Quest 1999) and subsequent Stage 2 (Heritage Quest 2001) archaeological assessments completed for the Highway 417/Castlefrank Overpass and Interchange Environmental Assessment study. All areas recommended for additional archaeological assessment depicted on Map 13D (p.58) which will be impacted during the proposed Kanata LRT project will require the completion of a Stage 2 archaeological field investigation prior to the commencement of construction or landscape disturbance activities. This will include archaeological field testing of all previously undisturbed lands, while all portions of the existing landscape which have been sufficiently disturbed to have removed the potential for archaeological resources will require visual inspection and photographic documentation when climatic conditions are sufficient to meet the MTCS *Standards and Guidelines for Consultant Archaeologists* (2011).

Although previous archaeological assessments have been completed within the project segment delineated on Map 13E (p.59), these assessments did not sufficiently mitigate the potential for archaeological resources within the specific study area. This includes the assessment completed in 2000 within an area located north of Corkstown Road and east of March Road, where lithic materials were documented, and the area was recommended for additional Stage 2/3 assessment prior to further soil disturbance impacts (Swayze 2000). Therefore, all undisturbed lands within the landscape depicted on Map 13E (p.) will require archaeological field testing prior to any project impacts to the environment, while all portions of the existing landscape which have been sufficiently disturbed to have removed the potential for archaeological resources will require visual inspection and photographic documentation when climatic conditions are sufficient to meet the MTCS *Standards and Guidelines for Consultant Archaeologists* (2011).

Map 13 F (p.60) details the area recommended for additional archaeological assessment within the eastern portion of the project study area. A small segment at the eastern limit of the proposed corridor has been previously mitigated during the Stage 2 assessment for the West Transitway Extension project (Golder 2010), and an additional area within the study area, north of the eastern limit of the proposed corridor, has been cleared following the completion of the Stage 2 field investigation within the Wesley Clover Equestrian Park (Golder 2016). All remaining areas recommended for additional archaeological assessment depicted on Map 13F (p.60) which will be impacted during the proposed Kanata LRT project will require the completion of a Stage 2 archaeological field investigation prior to the commencement of construction or landscape disturbance activities. This will include archaeological field testing of all previously undisturbed lands, while all portions of the existing landscape which have been sufficiently disturbed to have removed the potential for archaeological resources will require visual inspection and photographic documentation when climatic conditions are sufficient to meet the MTCS *Standards and Guidelines for Consultant Archaeologists* (2011).

5.0 RECOMMENDATIONS

This Stage 1 archaeological assessment has provided the basis for the following recommendations:

1) All portions of the study area that have been identified as possessing archaeological potential that have not been mitigated by previous archaeological investigations will require additional archaeological assessment prior to any project related activities that will impact the existing landscape (Maps 13A to 13F, pp.55 to 60);

2) Where additional archaeological assessment has been recommended, and no previous assessment has been completed, the additional assessment should consist of a Stage 2 field investigation compliant with the MTCS *Standards and Guidelines for Consultant Archaeologists* (2011). The Stage 2 archaeological assessment should consist of pedestrian surface survey at five metre intervals where the land is ploughable and hand excavated shovel test pits at five metre intervals where lands are not viably ploughable. Regardless of the existing landscape, where the Stage 2 corridor is less than 10 metres in width these areas can be investigated by hand excavated shovel test pits at the consultant's discretion;

3) All land recommended for Stage 2 assessment which has been sufficiently disturbed to have removed the potential for archaeological resources will require visual inspection and photographic documentation during the Stage 2 assessment to be completed when climatic conditions are sufficient to meet the MTCS *Standards and Guidelines for Consultant Archaeologists* (2011);

4) Known archaeological sites determined to possess Cultural Heritage Value or Interest (CHVI) identified in the present study area that have not been completely mitigated, or deemed to merit further investigation, should be avoided. Should these sites not be avoidable, additional archaeological investigations will be required prior to any project impacts to these areas. This includes, but is not limited to, registered sites BhFx-2, BhFx-47 and BhFx-49;

5) CHVI was identified for registered site BhFx-2 and additional assessment was recommended in the original project report (Swayze 2000). A Stage 2 assessment should be completed in this location in an attempt to define the spatial extent of the site and determine the significance of the lithic scatter prior to any additional disturbances to the area;

6) A Stage 3 archaeological investigation should be completed at the Bradley Farm site (BhFx-47) and James Farm site (BhFx-49) prior to any potential project impacts to the existing landscape at these site locations. The Stage 3 assessment should consist of one metre square units hand excavated on a five-metre grid, with a minimum of 20% infill units. The Stage 3 excavation should be completed by a Professionally licensed archaeologist in the Province of Ontario and conform to the MTCS *Standards and Guidelines for Consultant Archaeologists* (2011);

7) All land identified on Maps 13A to 13F (pp.55 to 60) not identified for additional assessment are considered to have been sufficiently mitigated during previously completed archaeological assessments and no additional archaeological assessments are recommended for these areas; and,

8) Should future construction, and/or other development related activities, that will disturb soils and/or affect the archaeological integrity of the landscape, extend beyond the boundary of the proposed alignment or surrounding study area buffer defined in this report, additional archaeological investigations may be required based on the archaeological potential identified within the general vicinity.

This report is submitted to the Ministry of Tourism, Culture and Sport (MTCS) as a condition of licensing in accordance with Part VI of the *Ontario Heritage Act*, R.S.O. 1990, c. 0.18. The report is reviewed to ensure that the licensed consultant archaeologist has met the terms and conditions of their archaeological license, and that the archaeological field work and report recommendations ensure the conservation, protection and preservation of the cultural heritage of Ontario.

The MTCS is requested to review and provide a letter indicating their satisfaction with the results and recommendations presented herein, with regard to the 2011 *Standards and Guidelines for Consultant Archaeologists* (2011) and the terms and conditions for archaeological licenses, and to enter this report into the Ontario Register of Archaeological Reports.

6.0 ADVICE ON COMPLIANCE WITH LEGISLATION

This report is submitted to the Minister of Tourism and Culture as a condition of licensing in accordance with Part VI of the Ontario Heritage Act, R.S.O. 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 fieldwork and report recommendations ensure the conservation, protection and preservation 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 Tourism and Culture, 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 us or activity from the site, until such time as a licensed archaeologist has completed archaeological fieldwork 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 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 Section 48(1) of the Ontario Heritage Act. Archaeological sites recommended for further archaeological fieldwork or protection remains subject to Section 48 (1) of the Ontario Heritage Act and may not be altered, or have artifacts removed from them, except by a person holding an archaeological licence.

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 Ontario Ministry of Consumer Services is also immediately notified.

Archaeological sites recommended for further archaeological fieldwork or protection remain subject to Section 48 (1) of the Ontario Heritage Act and may not be altered, or have artifacts removed from them, expect by a person holding an archaeological license.

7.0 IMPORTANT INFORMATION AND LIMITATIONS OF THIS REPORT

Golder Associates Ltd. (Golder) has prepared this report in a manner consistent with that level of care and skill ordinarily exercised by members of the archaeological profession currently practicing under similar conditions in the jurisdiction in which the services are provided, subject to the time limits and physical constraints applicable to this report. No other warranty, expressed or implied, is made.

This report has been prepared for the specific site, design objective, developments and purpose described to Golder by Parsons Corporation (the Client). The factual data, interpretations and recommendations pertain to a specific project as described in this report and are not applicable to any other project or site location.

The information, recommendations and opinions expressed in this report are for the sole benefit of the Client. No other party may use or rely on this report or any portion thereof without Golder's express written consent. If the report was prepared to be included for a specific permit application process, then upon the reasonable request of the client, Golder may authorize in writing the use of this report by the regulatory agency as an Approved User for the specific and identified purpose of the applicable permit review process. Any other use of this report by others is prohibited and is without responsibility to Golder. The report, all plans, data, drawings and other documents as well as all electronic media prepared by Golder are considered its professional work product and shall remain the copyright property of Golder, who authorizes only the Client and Approved Users to make copies of the report, but only in such quantities as are reasonably necessary for the use of the report by those parties. The Client and Approved Users may not give, lend, sell, or otherwise make available the report or any portion thereof to any other party without the express written permission of Golder. The Client acknowledges the electronic media is susceptible to unauthorized modification, deterioration and incompatibility and therefore the Client cannot rely upon the electronic media versions of Golder's report or other work products.

Unless otherwise stated, the suggestions, recommendations and opinions given in this report are intended only for the guidance of the Client in the design of the specific project.

Special risks occur whenever archaeological investigations are applied to identify subsurface conditions and even a comprehensive investigation, sampling and testing program may fail to detect all or certain archaeological resources. The sampling strategies incorporated in this study comply with those identified in the Ministry of Tourism and Culture and Sport's Standards and Guidelines for Consultant Archaeologists (2011).

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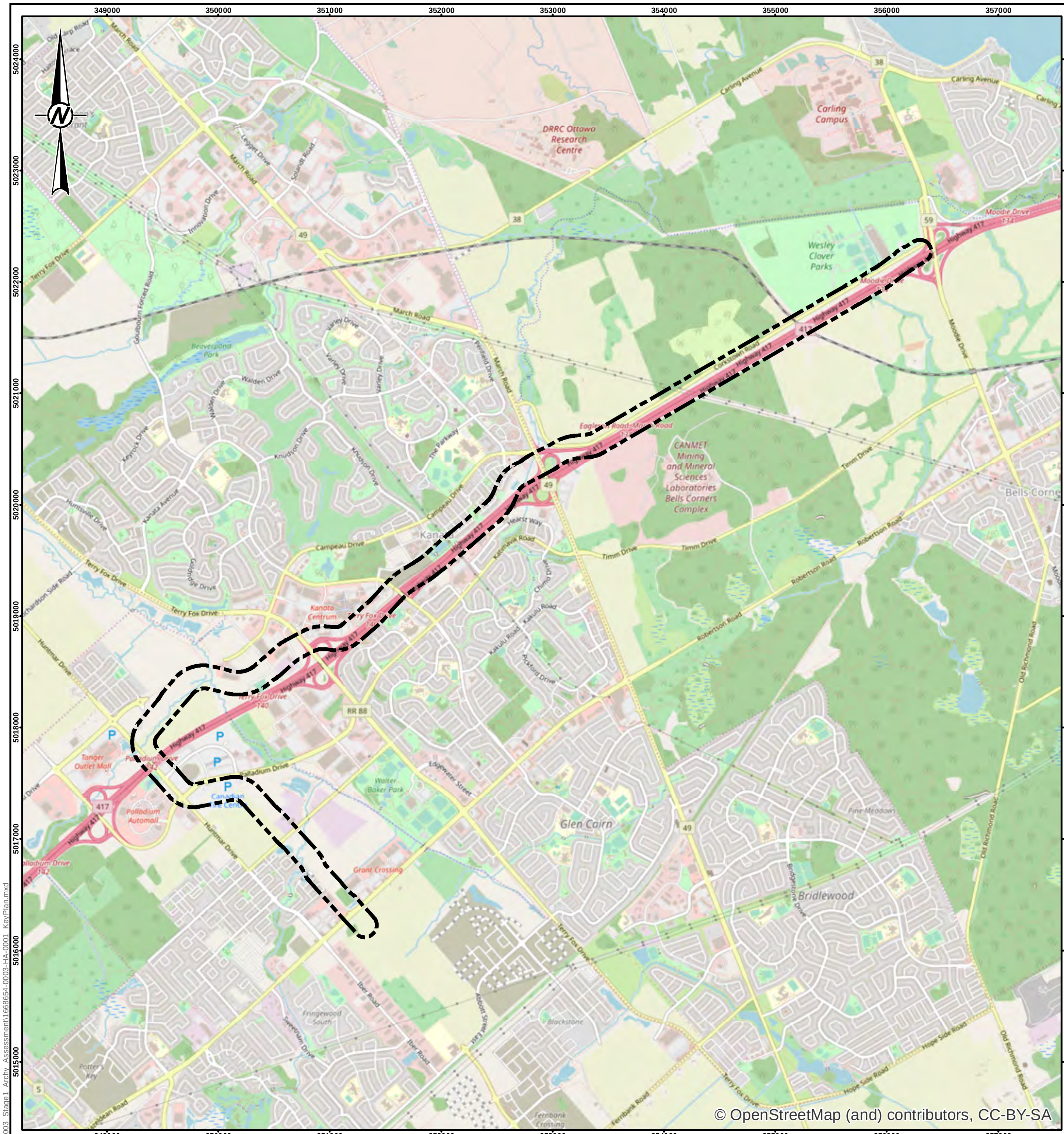
9.0 MAPS



LEGEND

STAGE 1 STUDY AREA

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NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)

1. PROJECTION: TRANSVERSE MERCATOR DATUM: NAD 83
COORDINATE SYSTEM: MTM ZONE 9 VERTICAL DATUM: CGVD28

CLIENT
PARSONS CORP

PROJECT
STAGE 1 ARCHAEOLOGICAL ASSESSMENT, KANATA LIGHT RAIL TRANSIT PLANNING AND EA STUDY, OTTAWA, ONTARIO

TITLE
KEY PLAN

CONSULTANT

GOLDER

YYYY-MM-DD	2018-01-05
DESIGNED	AM
PREPARED	JEM
REVIEWED	AM
APPROVED	HJD

PROJECT NO.	CONTROL	REV.	MAP
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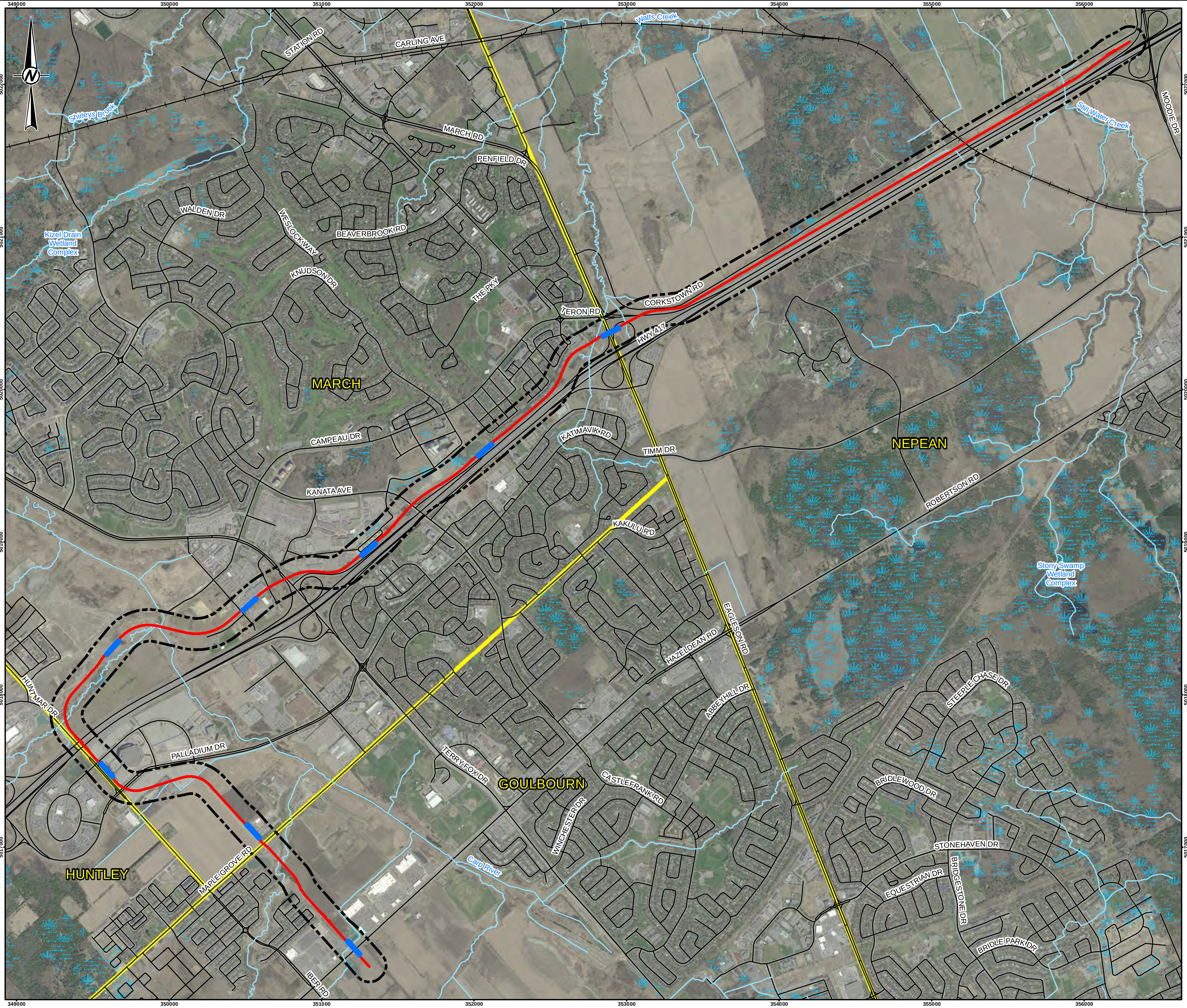

LEGEND

WATERCOURSE
ROADWAY
RAILWAY
WETLAND
PROPOSED ALIGNMENT
PROPOSED PLATFORM
STAGE 1 STUDY AREA
GEOGRAPHIC TOWNSHIP BOUNDARY

NOTE(S)

1. FOR INFORMATIONAL PURPOSES ONLY. NO EVALUATION OR ASSESSMENT PROVIDED.

REFERENCE(S)

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CLIENT
PARSONS CORP

PROJECT
STAGE 1 ARCHAEOLOGICAL ASSESSMENT, KANATA LIGHT RAIL TRANSIT PLANNING AND EA STUDY, OTTAWA, ONTARIO

TITLE
SITE PLAN

CONSULTANT

GOLDER

YYYY-MM-DD	2018-01-05
DESIGNED	AM
PREPARED	JEM
REVIEWED	AM
APPROVED	HJD

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LEGEND

PROPOSED ALIGNMENT

PROPOSED PLATFORM

STAGE 1 STUDY AREA

NOTE(S)

1. FOR INFORMATIONAL PURPOSES ONLY. NO EVALUATION OR ASSESSMENT PROVIDED.

REFERENCE(S)

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CLIENT

PARSONS CORP

PROJECT

STAGE 1 ARCHAEOLOGICAL ASSESSMENT, KANATA LIGHT RAIL TRANSIT PLANNING AND EA STUDY, OTTAWA, ONTARIO

TITLE

1863 WALLING MAP OF CARLETON COUNTY

CONSULTANT

GOLDER

YYYY-MM-DD	2018-01-05
DESIGNED	AM
PREPARED	JEM
REVIEWED	AM
APPROVED	HJD

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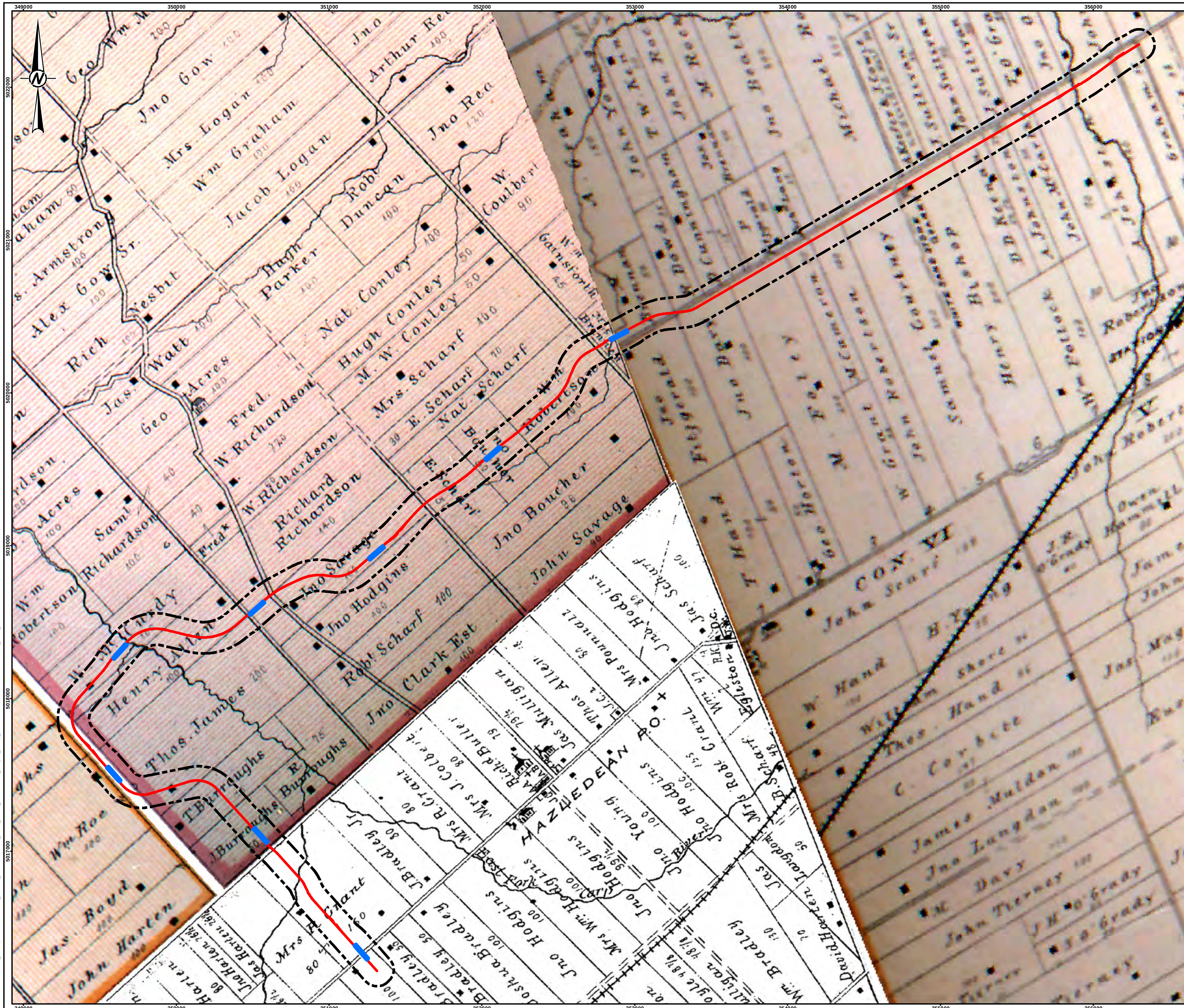

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PROPOSED ALIGNMENT

PROPOSED PLATFORM

STAGE 1 STUDY AREA

NOTE(S)

1. FOR INFORMATIONAL PURPOSES ONLY. NO EVALUATION OR ASSESSMENT PROVIDED.

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CLIENT

PARSONS CORP

PROJECT

STAGE 1 ARCHAEOLOGICAL ASSESSMENT, KANATA LIGHT RAIL TRANSIT PLANNING AND EA STUDY, OTTAWA, ONTARIO

TITLE

1879 BELDEN MAP OF CARLETON COUNTY

CONSULTANT

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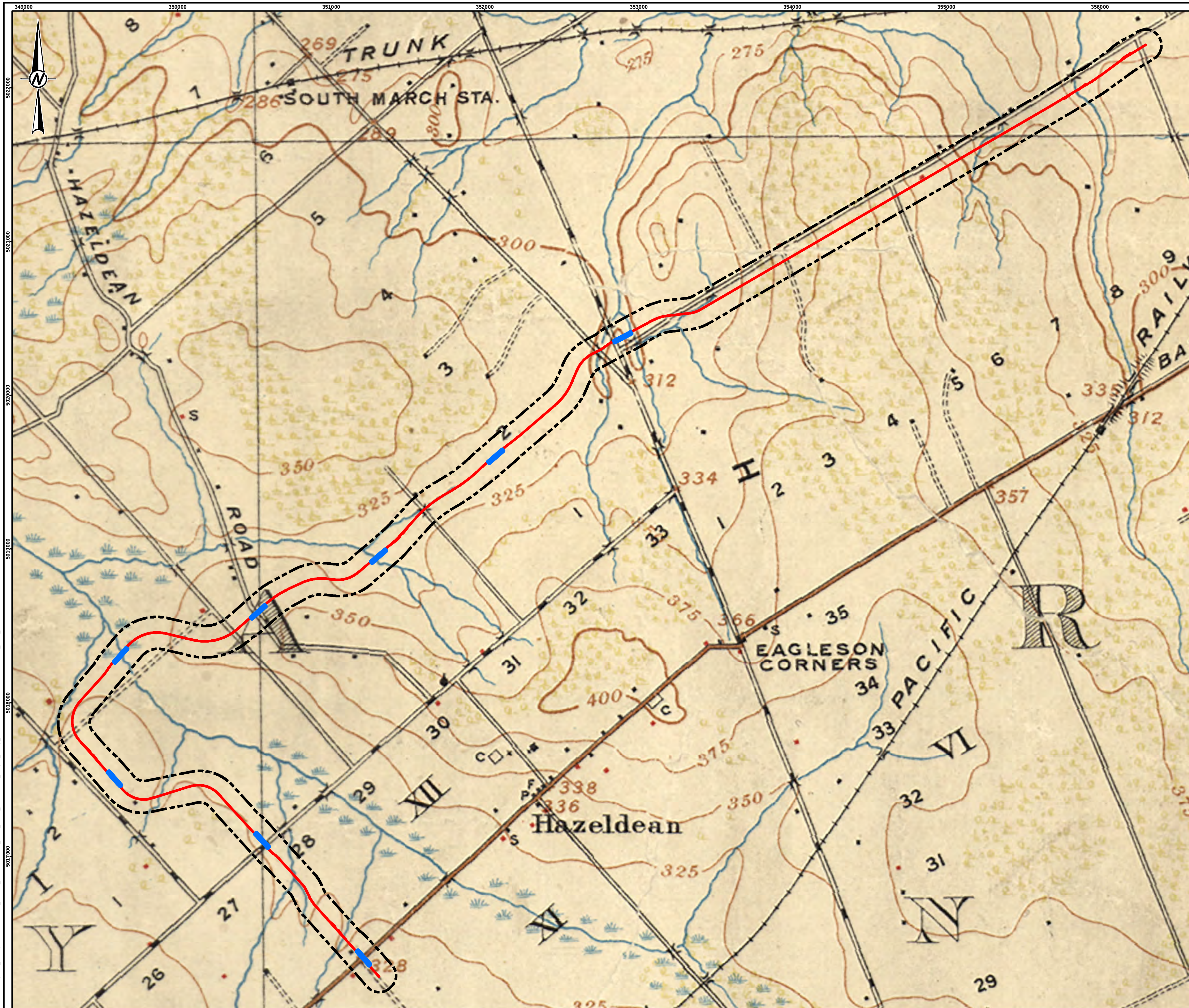

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PROPOSED ALIGNMENT

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STAGE 1 STUDY AREA

NOTE(S)

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CLIENT

PARSONS CORP

PROJECT

STAGE 1 ARCHAEOLOGICAL ASSESSMENT, KANATA LIGHT RAIL TRANSIT PLANNING AND EA STUDY, OTTAWA, ONTARIO

TITLE

1906 TOPOGRAPHIC PLAN OF CARLETON COUNTY

CONSULTANT

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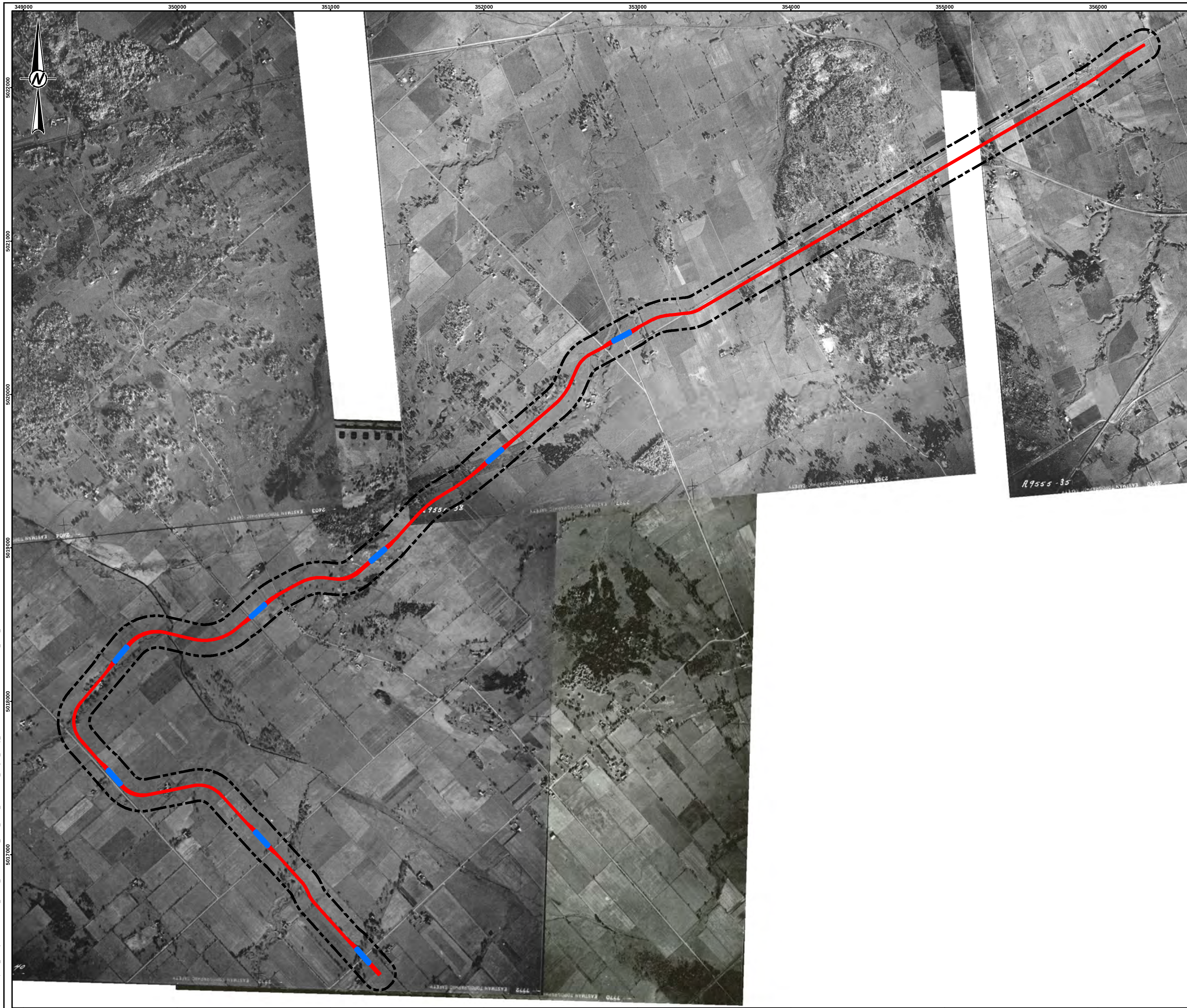

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PROPOSED ALIGNMENT

PROPOSED PLATFORM

STAGE 1 STUDY AREA

NOTE(S)

1. FOR INFORMATIONAL PURPOSES ONLY. NO EVALUATION OR ASSESSMENT PROVIDED.

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PARSONS CORP

PROJECT

STAGE 1 ARCHAEOLOGICAL ASSESSMENT, KANATA LIGHT RAIL TRANSIT PLANNING AND EA STUDY, OTTAWA, ONTARIO

TITLE

1945 AERIAL IMAGERY

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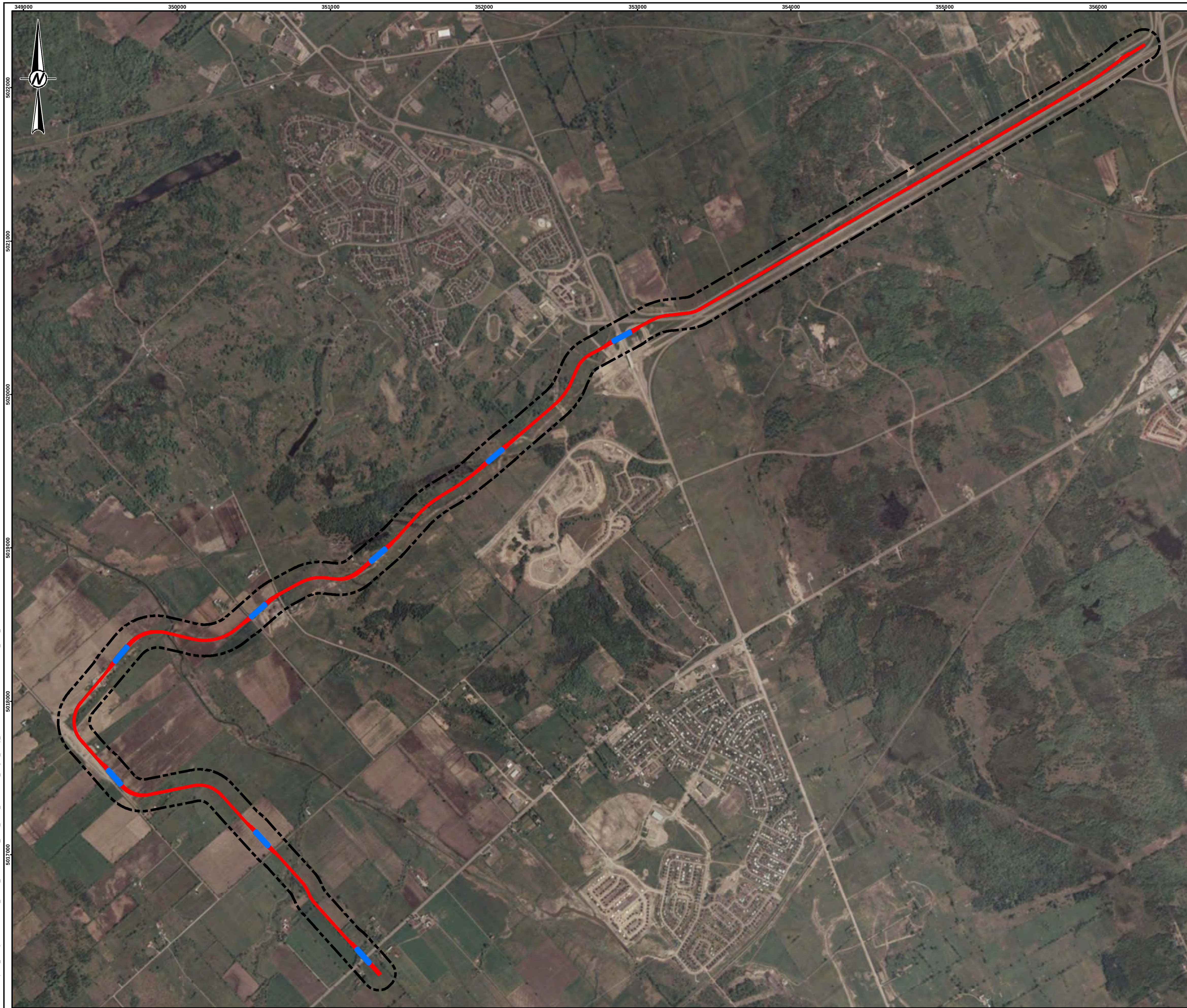

LEGEND

PROPOSED ALIGNMENT

PROPOSED PLATFORM

STAGE 1 STUDY AREA

NOTE(S)

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CLIENT

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STAGE 1 ARCHAEOLOGICAL ASSESSMENT, KANATA LIGHT RAIL TRANSIT PLANNING AND EA STUDY, OTTAWA, ONTARIO

TITLE

1976 AERIAL IMAGERY

CONSULTANT

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DESIGNED	AM
PREPARED	JEM
REVIEWED	AM
APPROVED	HJD

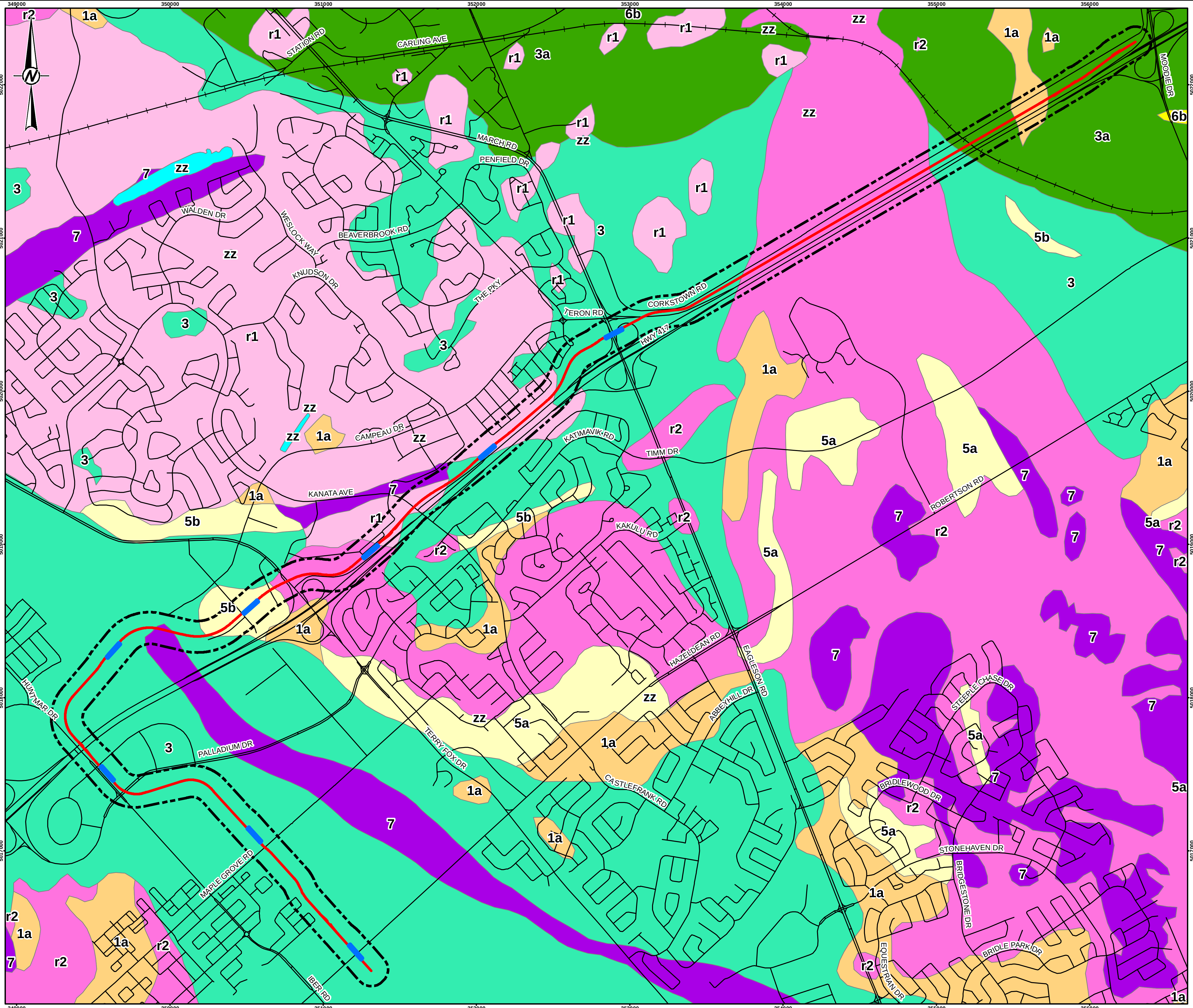
PROJECT NO.	CONTROL	REV.	MAP
1668654	0003	0	7

Path: N:\Active\Spatial_IM\CityofOttawa\Kanata_LRT\99_PROJ\1668654_CofO_EA\40_PROD\0003_Stage1_Archy_Assessment\1668654-0003-HA-0007_1976_AirPhoto.mxd

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM:

25mm

0



LEGEND

- ROADWAY
- RAILWAY
- PROPOSED ALIGNMENT
- PROPOSED PLATFORM
- STAGE 1 STUDY AREA
- 7. ORGANIC DEPOSITS: MUCK & PEAT
- 6b: ALLUVIAL DEPOSITS: MEDIUM GRAINED STRATIFIED SAND WITH SOME SILT
- 5a: NEARSHORE SEDIMENTS: GRAVEL, SAND & BOULDERS
- 5b: NEARSHORE SEDIMENTS: FINE TO MEDIUM GRAINED SAND
- 3. OFFSHORE MARINE DEPOSITS: CLAY, SILTY CLAY & SILT
- 3a. OFFSHORE MARINE DEPOSITS: CLAY, SILT UNDERLYING EROSIONAL TERRACES
- 1a. TILL, PLAIN WITH LOCAL RELIEF <5 m
- r1. BEDROCK: INSTRUSIVE & METAMORPHIC
- r2. BEDROCK: LIMESTONE, DOLOMITE, SANDSTONE & LOCAL SHALE
- zz. WATERBODY

NOTE(S)

1. FOR INFORMATIONAL PURPOSES ONLY. NO EVALUATION OR ASSESSMENT PROVIDED.

REFERENCE(S)

1. PROPOSED ALIGNMENT RECEIVED FROM PARSONS ON JANUARY 12, 2018, FILE NAME: 476242-01000-pln-ali-main line.dwg
2. BÉLANGER, J. R. 2008 URBAN GEOLOGY OF THE NATIONAL CAPITAL AREA, GEOLOGICAL SURVEY OF CANADA, OPEN FILE 5311, 1 DVD.
3. LAND INFORMATION ONTARIO (LIO) DATA PRODUCED BY GOLDER ASSOCIATES LTD. UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2014
4. PROJECTION: TRANSVERSE MERCATOR, DATUM: NAD 83, COORDINATE SYSTEM: MTM ZONE 9, VERTICAL DATUM: CGVD28

0 250 500 1,000

1:25,000 METRES

CLIENT

PARSONS CORP

PROJECT

STAGE 1 ARCHAEOLOGICAL ASSESSMENT, KANATA LIGHT RAIL TRANSIT PLANNING AND EA STUDY, OTTAWA, ONTARIO

TITLE

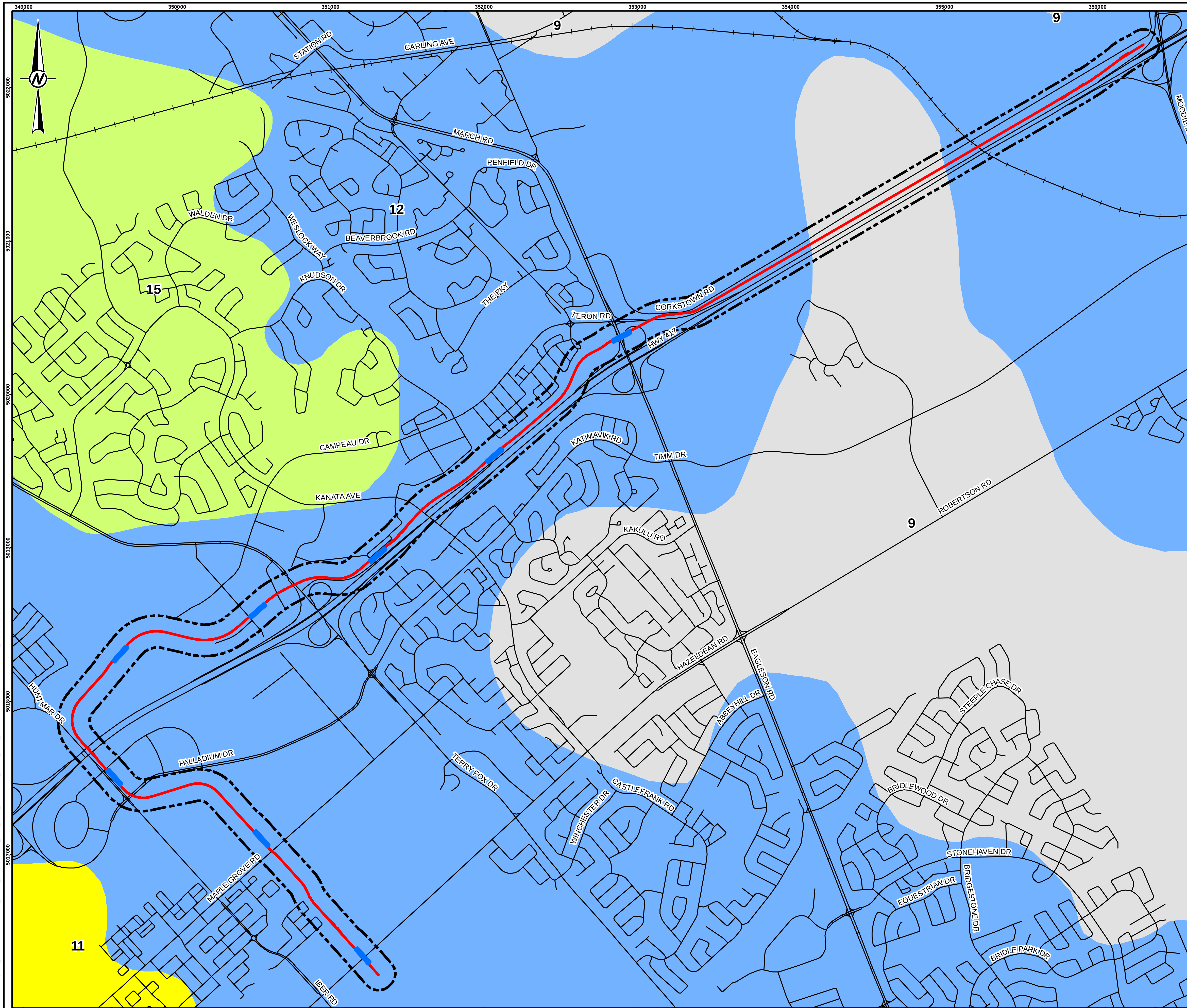
SURFICIAL GEOLOGY

CONSULTANT

GOLDER

YYYY-MM-DD	2018-01-19
DESIGNED	AM
PREPARED	JEM
REVIEWED	AM
APPROVED	HJD

PROJECT NO.	CONTROL	REV.	FIGURE
1668654	0003	0	8



LEGEND

ROADWAY

RAILWAY

PROPOSED ALIGNMENT

PROPOSED PLATFORM

STAGE 1 STUDY AREA

9: LIMESTONE PLAINS

11: SAND PLAINS

12: CLAY PLAINS

15:SHALLOW TILL AND ROCK RIDGES

NOTE(S)

1. FOR INFORMATIONAL PURPOSES ONLY. NO EVALUATION OR ASSESSMENT PROVIDED.

REFERENCE(S)

1. PROPOSED ALIGNMENT RECEIVED FROM PARSONS ON JANUARY 12, 2018, FILE NAME: 476242-01000-pln-ali-main line.dwg
2. CHAPMAN, L.J. AND PUTNAM, D.F. 2007. PHYSIOGRAPHY OF SOUTHERN ONTARIO; ONTARIO GEOLOGICAL SURVEY, MISCELLANEOUS RELEASE-DATA 228
3. LAND INFORMATION ONTARIO (LIO) DATA PRODUCED BY GOLDER ASSOCIATES LTD. UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2014
4. PROJECTION: TRANSVERSE MERCATOR, DATUM: NAD 83, COORDINATE SYSTEM: MTM ZONE 9, VERTICAL DATUM: CGVD28

0 250 500 1,000

1:25,000 METRES

CLIENT

PARSONS CORP

PROJECT

STAGE 1 ARCHAEOLOGICAL ASSESSMENT, KANATA LIGHT RAIL TRANSIT PLANNING AND EA STUDY, OTTAWA, ONTARIO

TITLE

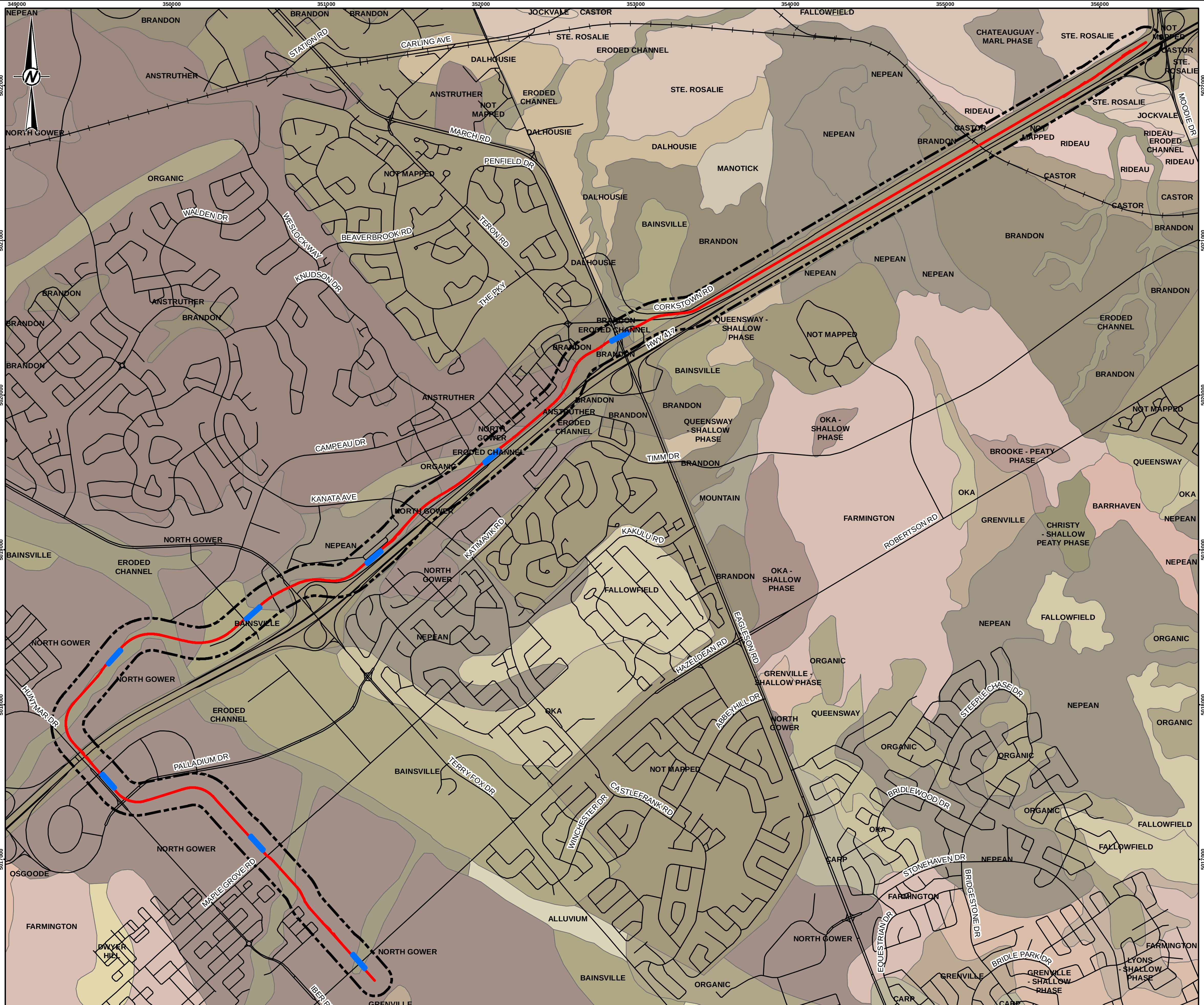
PHYSIOGRAPHY MAP

CONSULTANT

GOLDER

YYYY-MM-DD	2018-01-19
DESIGNED	AM
PREPARED	JEM
REVIEWED	AM
APPROVED	HJD

PROJECT NO.	CONTROL	REV.	FIGURE
1668654	0003	0	9



LEGEND

- ROADWAY
- RAILWAY
- PROPOSED ALIGNMENT
- PROPOSED PLATFORM
- STAGE 1 STUDY AREA

NOTE(S)

1. FOR INFORMATIONAL PURPOSES ONLY. NO EVALUATION OR ASSESSMENT PROVIDED.

REFERENCE(S)

1. PROPOSED ALIGNMENT RECEIVED FROM PARSONS ON JANUARY 12, 2018, FILE NAME: 476242-01000-pln-ali-main line.dwg
2. LAND INFORMATION ONTARIO (LIO) DATA PRODUCED BY GOLDER ASSOCIATES LTD. UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2014
4. PROJECTION: TRANSVERSE MERCATOR, DATUM: NAD 83, COORDINATE SYSTEM: MTM ZONE 9, VERTICAL DATUM: CGVD28

0 250 500 1,000

1:25,000 METRES

CLIENT

PARSONS CORP

PROJECT

STAGE 1 ARCHAEOLOGICAL ASSESSMENT, KANATA LIGHT RAIL TRANSIT PLANNING AND EA STUDY, OTTAWA, ONTARIO

TITLE

SOIL SURVEY COMPLEX (ONTARIO SOILS)

CONSULTANT

GOLDER

YYYY-MM-DD	2018-01-19
DESIGNED	AM
PREPARED	JEM
REVIEWED	AM
APPROVED	HJD

PROJECT NO.	CONTROL	REV.	FIGURE
1668654	0003	0	10

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 25mm

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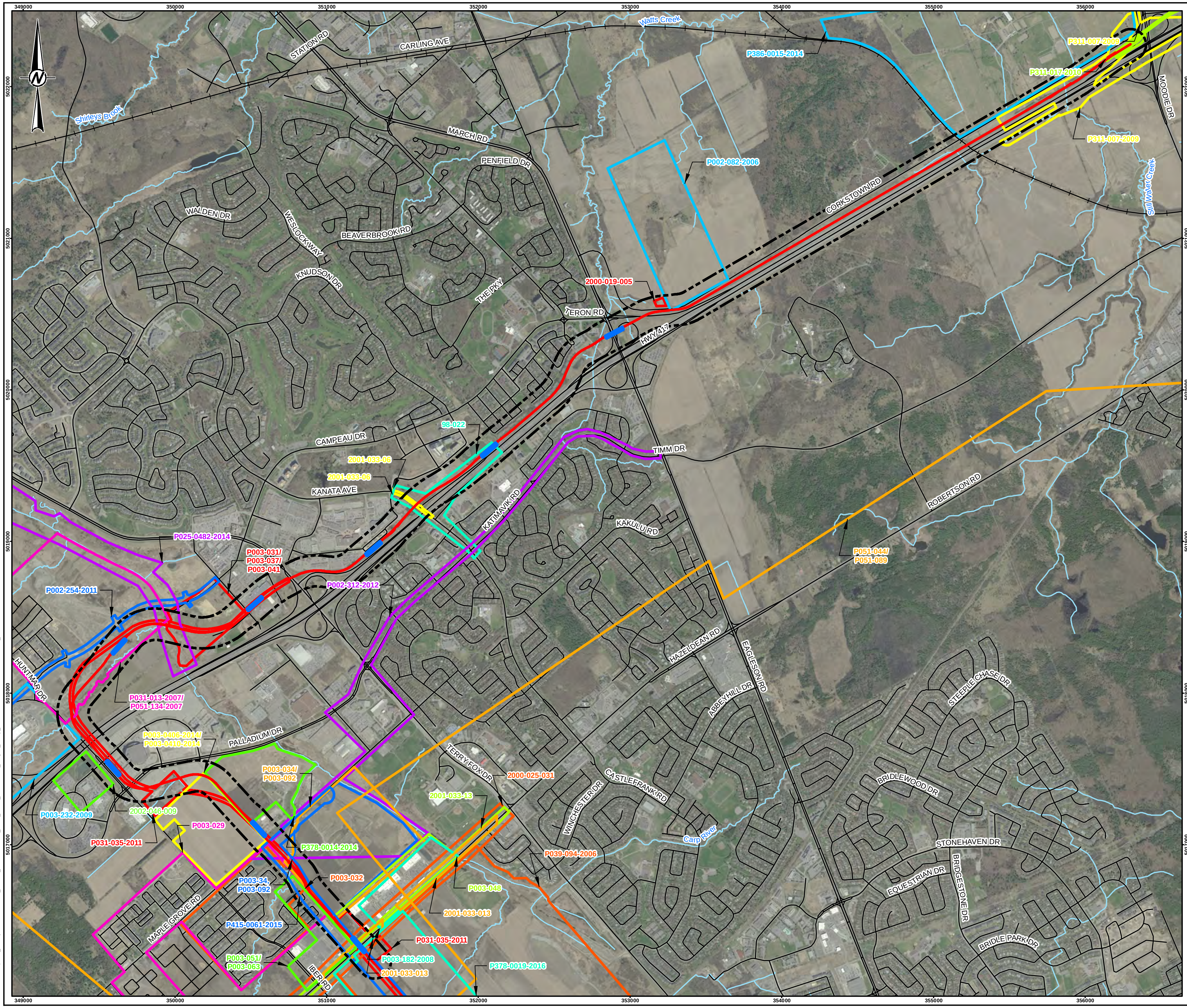


LEGEND

- WATERCOURSE
- ROADWAY
- RAILWAY
- PROPOSED ALIGNMENT
- PROPOSED PLATFORM
- STAGE 1 STUDY AREA

PREVIOUS ARCHAEOLOGICAL ASSESSMENT

- 2000-019-005
- 2000-025-031
- 2001-033-013
- 2001-033-06
- 2001-033-13
- 2002-046-009
- 98-022
- P002-082-2006
- P002-254-2011
- P002-312-2012
- P003-029
- P003-031/P003-037/P003-041
- P003-032
- P003-034/P003-092
- P003-0406-2014/P003-0410-2014
- P003-048
- P003-051/P003-063
- P003-182-2008
- P003-232-2009
- P003-34, P003-092
- P025-0482-2014
- P031-013-2007/P051-134-2007
- P031-035-2011
- P039-094-2006
- P051-044/P051-089
- P311-007-2009
- P311-017-2010
- P378-0014-2014
- P378-0019-2016
- P386-0015-2014
- P415-0061-2015

NOTE(S)

1. FOR INFORMATIONAL PURPOSES ONLY. NO EVALUATION OR ASSESSMENT PROVIDED.

REFERENCE(S)

1. PROPOSED ALIGNMENT RECEIVED FROM PARSONS ON JANUARY 12, 2018, FILE NAME: 476242-01000-pln-ali-main line.dwg
2. LAND INFORMATION ONTARIO (LIO) DATA PRODUCED BY GOLDER ASSOCIATES LTD. UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2014
3. PROJECTION: TRANSVERSE MERCATOR, DATUM: NAD 83, COORDINATE SYSTEM: MTM ZONE 9, VERTICAL DATUM: CGVD28

0 250 500 1,000

1:25,000 METRES

CLIENT
PARSONS CORP

PROJECT
STAGE 1 ARCHAEOLOGICAL ASSESSMENT, KANATA LIGHT RAIL TRANSIT PLANNING AND EA STUDY, OTTAWA, ONTARIO

TITLE
PREVIOUS ARCHAEOLOGICAL ASSESSMENTS WITHIN 50 METRES OF STUDY AREA

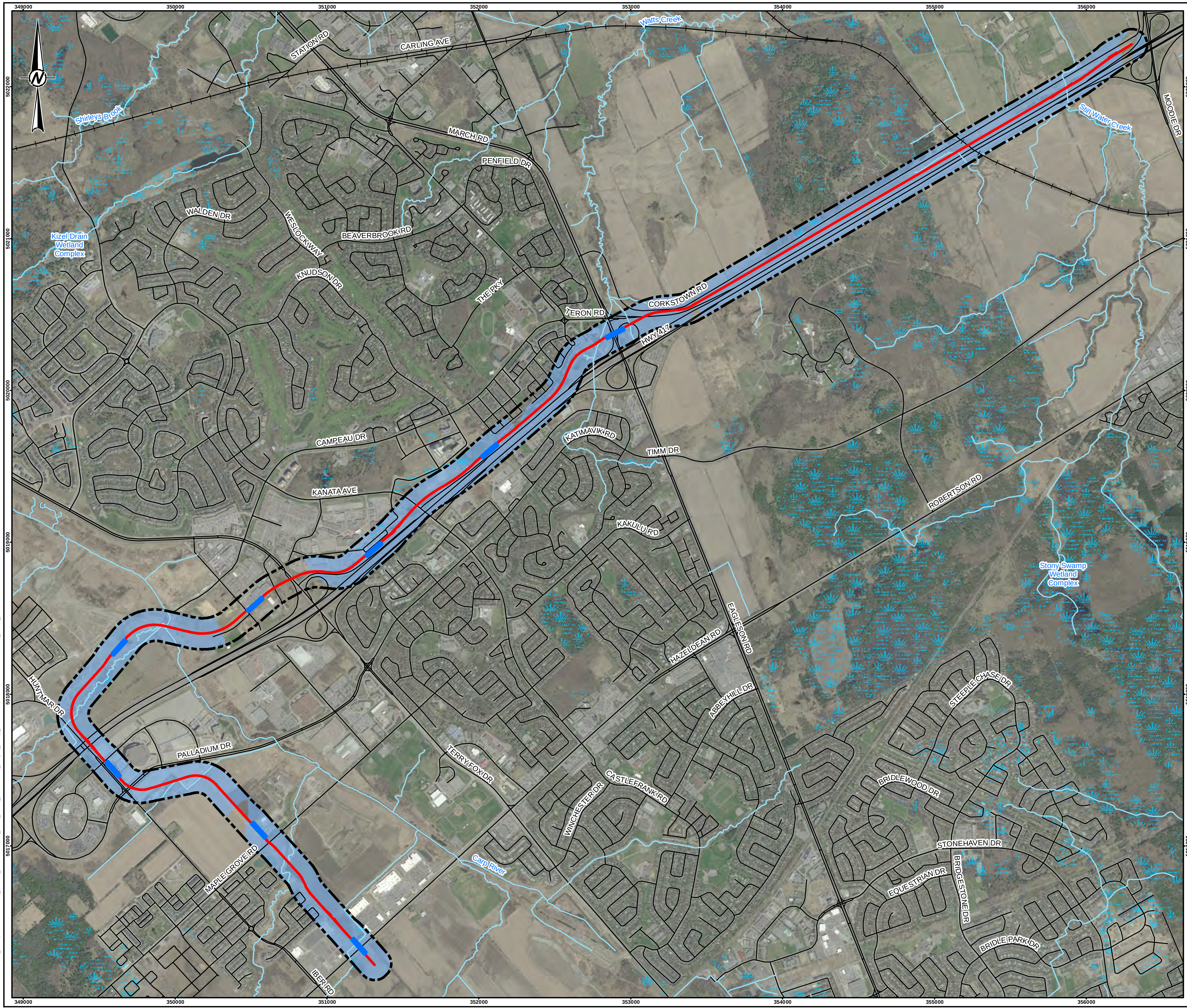
CONSULTANT

GOLDER

YYYY-MM-DD	2018-01-05
DESIGNED	AM
PREPARED	JEM
REVIEWED	AM
APPROVED	HJD

PROJECT NO.	CONTROL	REV.	MAP
1668654	0003	0	11

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 25mm



LEGEND

- WATERCOURSE
- ROADWAY
- RAILWAY
- WETLAND
- PROPOSED ALIGNMENT
- PROPOSED PLATFORM
- 300 m FROM NATURAL WATER SOURCE
- STAGE 1 STUDY AREA

NOTE(S)

1. FOR INFORMATIONAL PURPOSES ONLY. NO EVALUATION OR ASSESSMENT PROVIDED.

REFERENCE(S)

1. PROPOSED ALIGNMENT RECEIVED FROM PARSONS ON JANUARY 12, 2018, FILE NAME: 476242-01000-pln-ali-main line.dwg
2. LAND INFORMATION ONTARIO (LIO) DATA PRODUCED BY GOLDER ASSOCIATES LTD. UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2014
3. PROJECTION: TRANSVERSE MERCATOR, DATUM: NAD 83, COORDINATE SYSTEM: MTM ZONE 9, VERTICAL DATUM: CGVD28

0 250 500 1,000

1:25,000 METRES

CLIENT
PARSONS CORP

PROJECT
STAGE 1 ARCHAEOLOGICAL ASSESSMENT, KANATA LIGHT RAIL TRANSIT PLANNING AND EA STUDY, OTTAWA, ONTARIO

TITLE
ARCHAEOLOGICAL POTENTIAL - PROXIMITY TO NATURAL WATER SOURCE

CONSULTANT

GOLDER

YYYY-MM-DD	2018-01-05
DESIGNED	AM
PREPARED	JEM
REVIEWED	AM
APPROVED	HJD

PROJECT NO.	CONTROL	REV.	MAP
1668654	0003	0	12A

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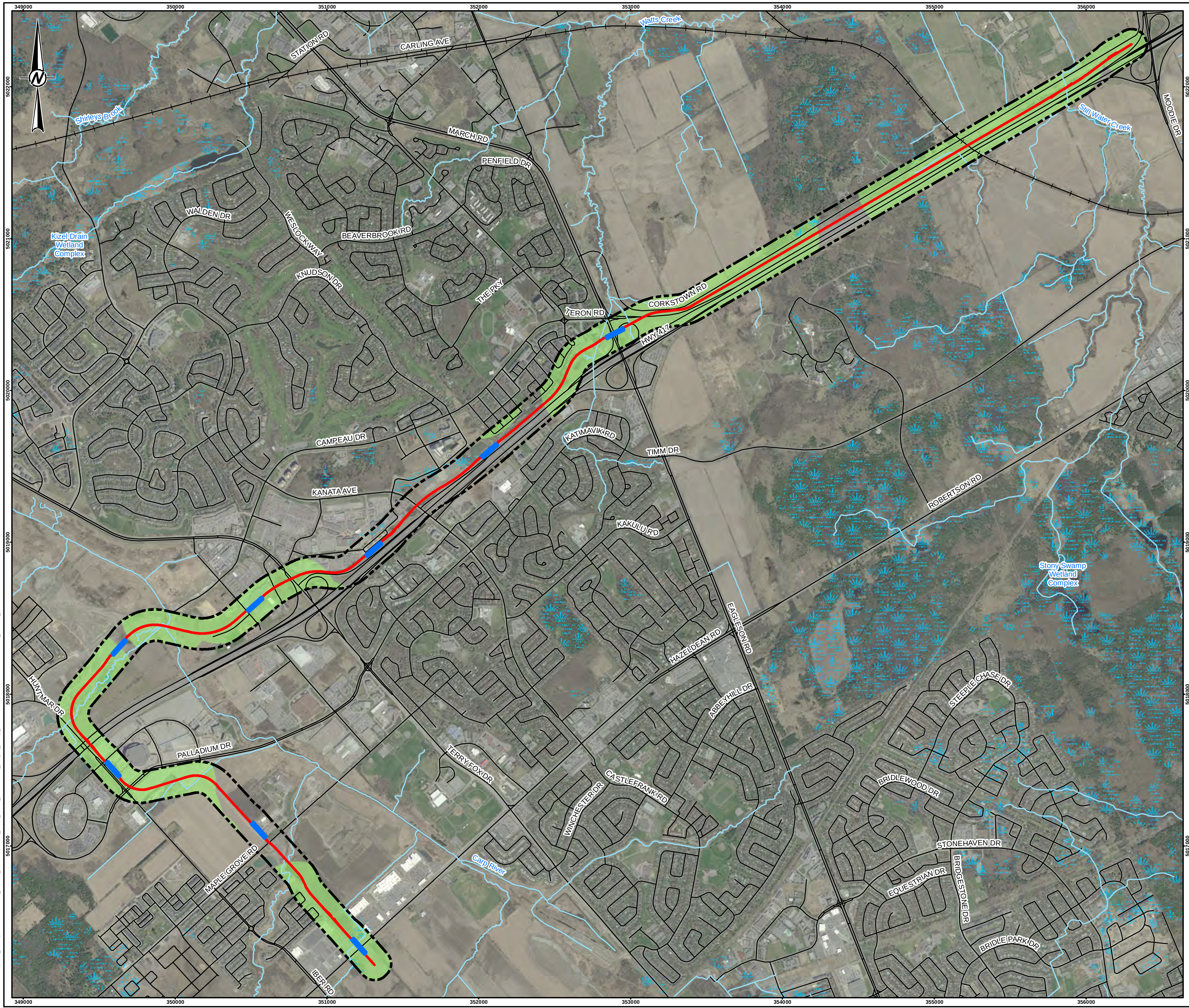
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 25mm 0



LEGEND

- WATERCOURSE
- ROADWAY
- RAILWAY
- WETLAND
- PROPOSED ALIGNMENT
- PROPOSED PLATFORM
- 300 m FROM HISTORIC OCCUPATION
- STAGE 1 STUDY AREA

NOTE(S)

1. FOR INFORMATIONAL PURPOSES ONLY. NO EVALUATION OR ASSESSMENT PROVIDED.

REFERENCE(S)

1. PROPOSED ALIGNMENT RECEIVED FROM PARSONS ON JANUARY 12, 2018, FILE NAME: 476242-01000-pln-ali-main line.dwg
2. LAND INFORMATION ONTARIO (LIO) DATA PRODUCED BY GOLDER ASSOCIATES LTD. UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2014
3. PROJECTION: TRANSVERSE MERCATOR, DATUM: NAD 83, COORDINATE SYSTEM: MTM ZONE 9, VERTICAL DATUM: CGVD28

0 250 500 1,000

1:25,000 METRES

CLIENT

PARSONS CORP

PROJECT

STAGE 1 ARCHAEOLOGICAL ASSESSMENT, KANATA LIGHT RAIL TRANSIT PLANNING AND EA STUDY, OTTAWA, ONTARIO

TITLE

ARCHAEOLOGICAL POTENTIAL - PROXIMITY TO HISTORIC OCCUPATION

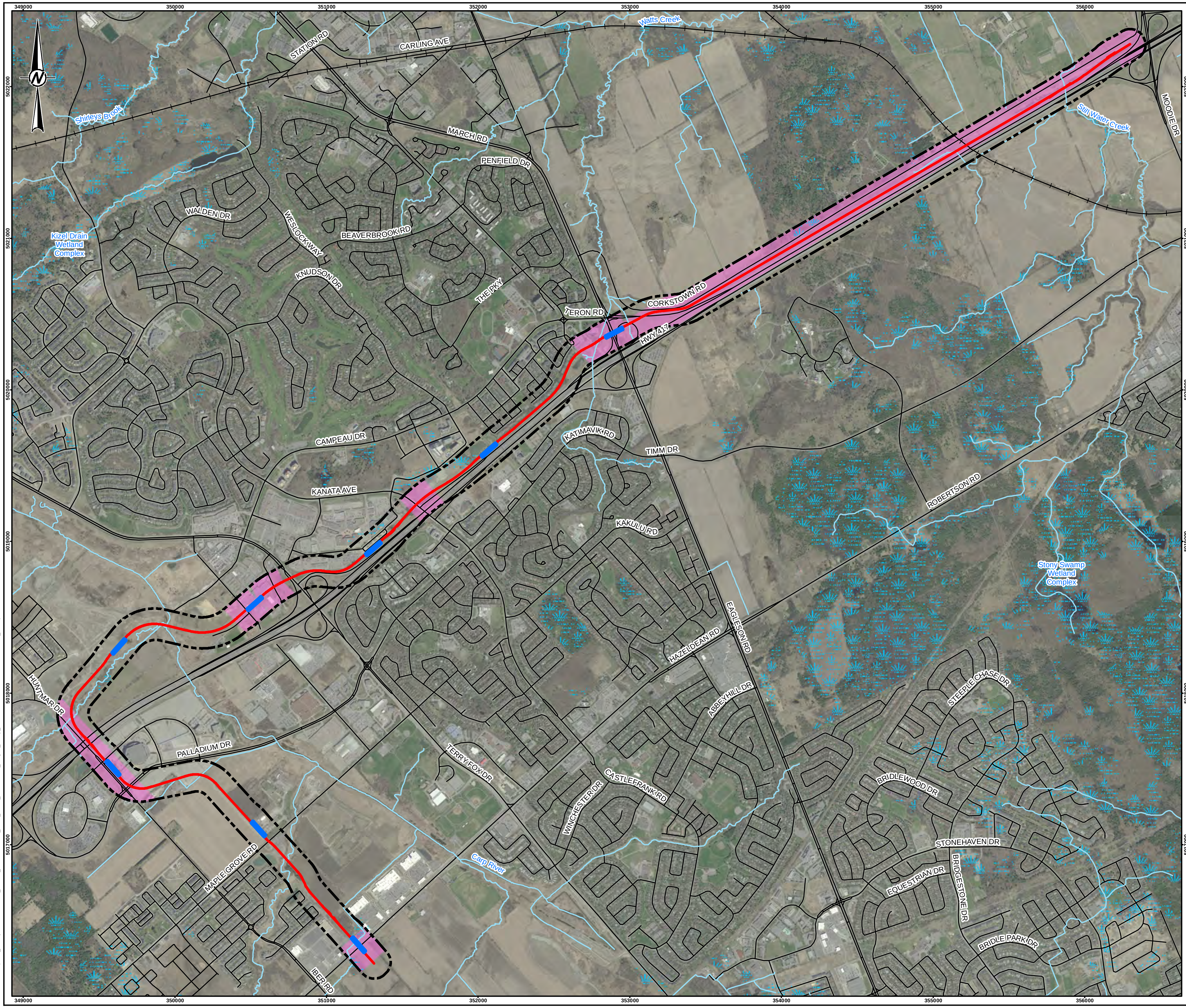
CONSULTANT

GOLDER

YYYY-MM-DD	2018-01-05
DESIGNED	AM
PREPARED	JEM
REVIEWED	AM
APPROVED	HJD

PROJECT NO.	CONTROL	REV.	MAP
1668654	0003	0	12B

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 25mm



LEGEND

- WATERCOURSE
- ROADWAY
- RAILWAY
- WETLAND
- PROPOSED ALIGNMENT
- PROPOSED PLATFORM
- 100 m FROM HISTORIC TRANSPORTATION ROUTES
- STAGE 1 STUDY AREA

NOTE(S)

1. FOR INFORMATIONAL PURPOSES ONLY. NO EVALUATION OR ASSESSMENT PROVIDED.

REFERENCE(S)

1. PROPOSED ALIGNMENT RECEIVED FROM PARSONS ON JANUARY 12, 2018, FILE NAME: 476242-01000-pln-ali-main line.dwg
2. LAND INFORMATION ONTARIO (LIO) DATA PRODUCED BY GOLDER ASSOCIATES LTD. UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2014
3. PROJECTION: TRANSVERSE MERCATOR, DATUM: NAD 83, COORDINATE SYSTEM: MTM ZONE 9, VERTICAL DATUM: CGVD28

0 250 500 1,000

1:25,000 METRES

CLIENT

PARSONS CORP

PROJECT

STAGE 1 ARCHAEOLOGICAL ASSESSMENT, KANATA LIGHT RAIL TRANSIT PLANNING AND EA STUDY, OTTAWA, ONTARIO

TITLE

ARCHAEOLOGICAL POTENTIAL - PROXIMITY TO HISTORIC TRANSPORTATION ROUTES

CONSULTANT

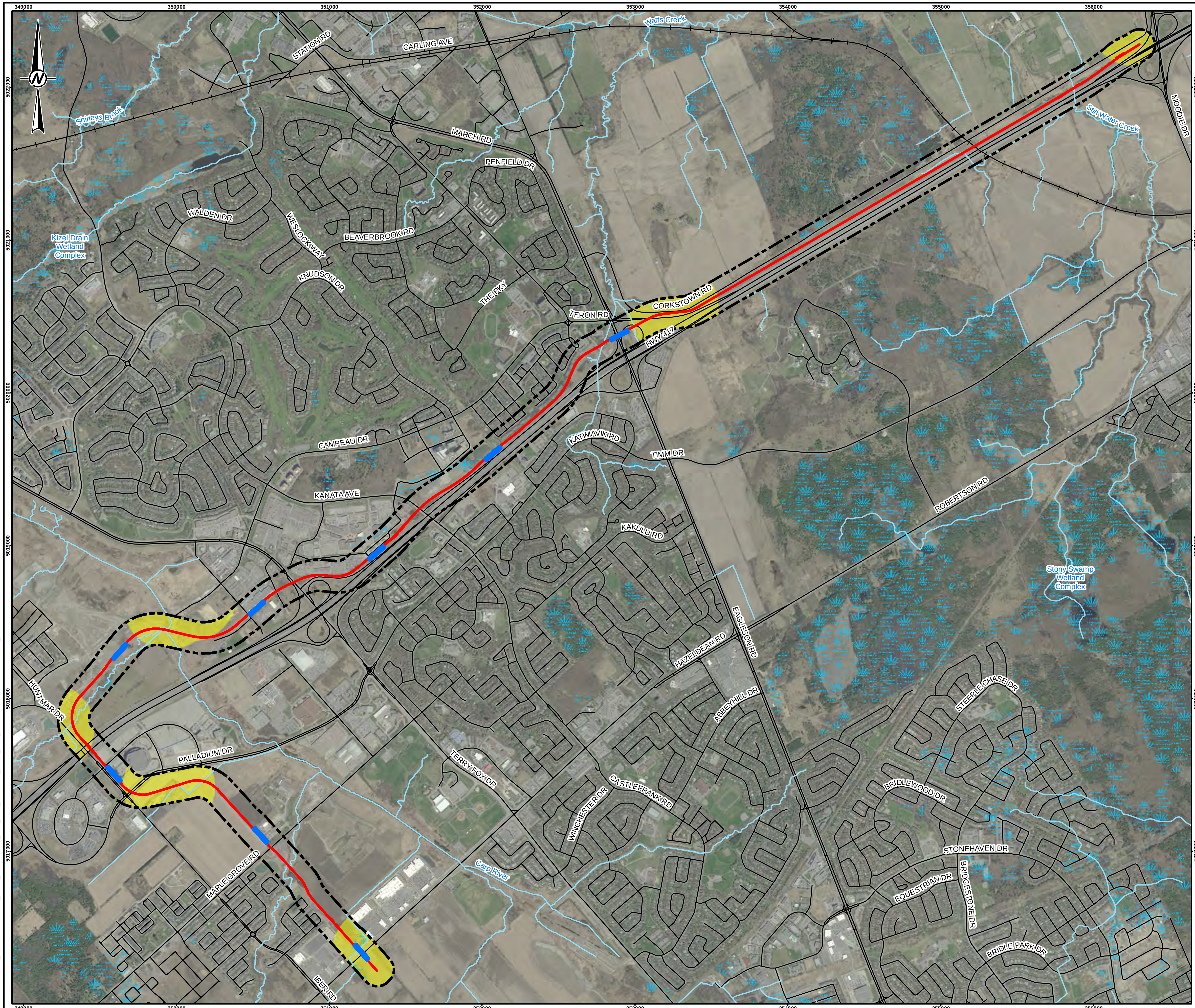
GOLDER

YYYY-MM-DD	2018-01-05
DESIGNED	AM
PREPARED	JEM
REVIEWED	AM
APPROVED	HJD

PROJECT NO.	CONTROL	REV.	MAP
1668654	0003	0	12C

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM:

25mm



LEGEND

- WATERCOURSE
- ROADWAY
- RAILWAY
- WETLAND
- PROPOSED ALIGNMENT
- PROPOSED PLATFORM
- 300 m FROM REGISTERED ARCHAEOLIGICAL SITES
- STAGE 1 STUDY AREA

NOTE(S)

1. FOR INFORMATIONAL PURPOSES ONLY. NO EVALUATION OR ASSESSMENT PROVIDED.

REFERENCE(S)

1. PROPOSED ALIGNMENT RECEIVED FROM PARSONS ON JANUARY 12, 2018, FILE NAME: 476242-01000-pln-ali-main line.dwg
2. LAND INFORMATION ONTARIO (LIO) DATA PRODUCED BY GOLDER ASSOCIATES LTD. UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2014
3. PROJECTION: TRANSVERSE MERCATOR, DATUM: NAD 83, COORDINATE SYSTEM: MTM ZONE 9, VERTICAL DATUM: CGVD28

0 250 500 1,000

1:25,000 METRES

CLIENT
PARSONS CORP

PROJECT
STAGE 1 ARCHAEOLOGICAL ASSESSMENT, KANATA LIGHT RAIL TRANSIT PLANNING AND EA STUDY, OTTAWA, ONTARIO

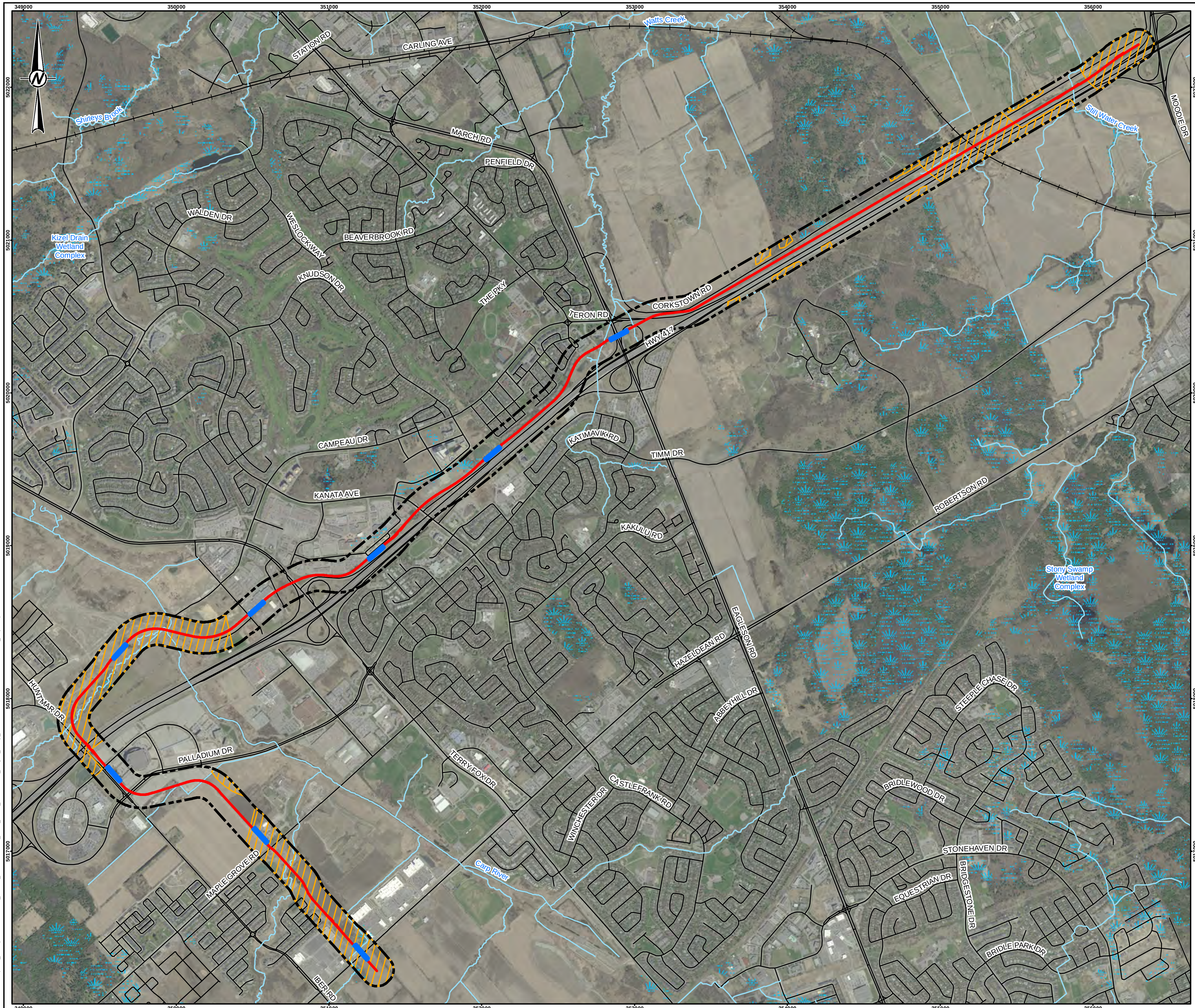
TITLE
ARCHAEOLOGICAL POTENTIAL - PROXIMITY TO REGISTERED ARCHAEOLOGICAL SITES

CONSULTANT

GOLDER

YYYY-MM-DD	2018-01-05
DESIGNED	AM
PREPARED	JEM
REVIEWED	AM
APPROVED	HJD

PROJECT NO.	CONTROL	REV.	MAP
1668654	0003	0	12D



LEGEND

- WATERCOURSE
- ROADWAY
- RAILWAY
- WETLAND
- PROPOSED ALIGNMENT
- PROPOSED PLATFORM
- CITY OF OTTAWA ARCHAEOLOGICAL POTENTIAL
- STAGE 1 STUDY AREA

NOTE(S)

1. FOR INFORMATIONAL PURPOSES ONLY. NO EVALUATION OR ASSESSMENT PROVIDED.

REFERENCE(S)

1. PROPOSED ALIGNMENT RECEIVED FROM PARSONS ON JANUARY 12, 2018, FILE NAME: 476242-01000-pln-ali-main line.dwg
2. LAND INFORMATION ONTARIO (LIO) DATA PRODUCED BY GOLDER ASSOCIATES LTD. UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2014
3. PROJECTION: TRANSVERSE MERCATOR, DATUM: NAD 83, COORDINATE SYSTEM: MTM ZONE 9, VERTICAL DATUM: CGVD28

CLIENT
PARSONS CORP

PROJECT
STAGE 1 ARCHAEOLOGICAL ASSESSMENT, KANATA LIGHT RAIL TRANSIT PLANNING AND EA STUDY, OTTAWA, ONTARIO

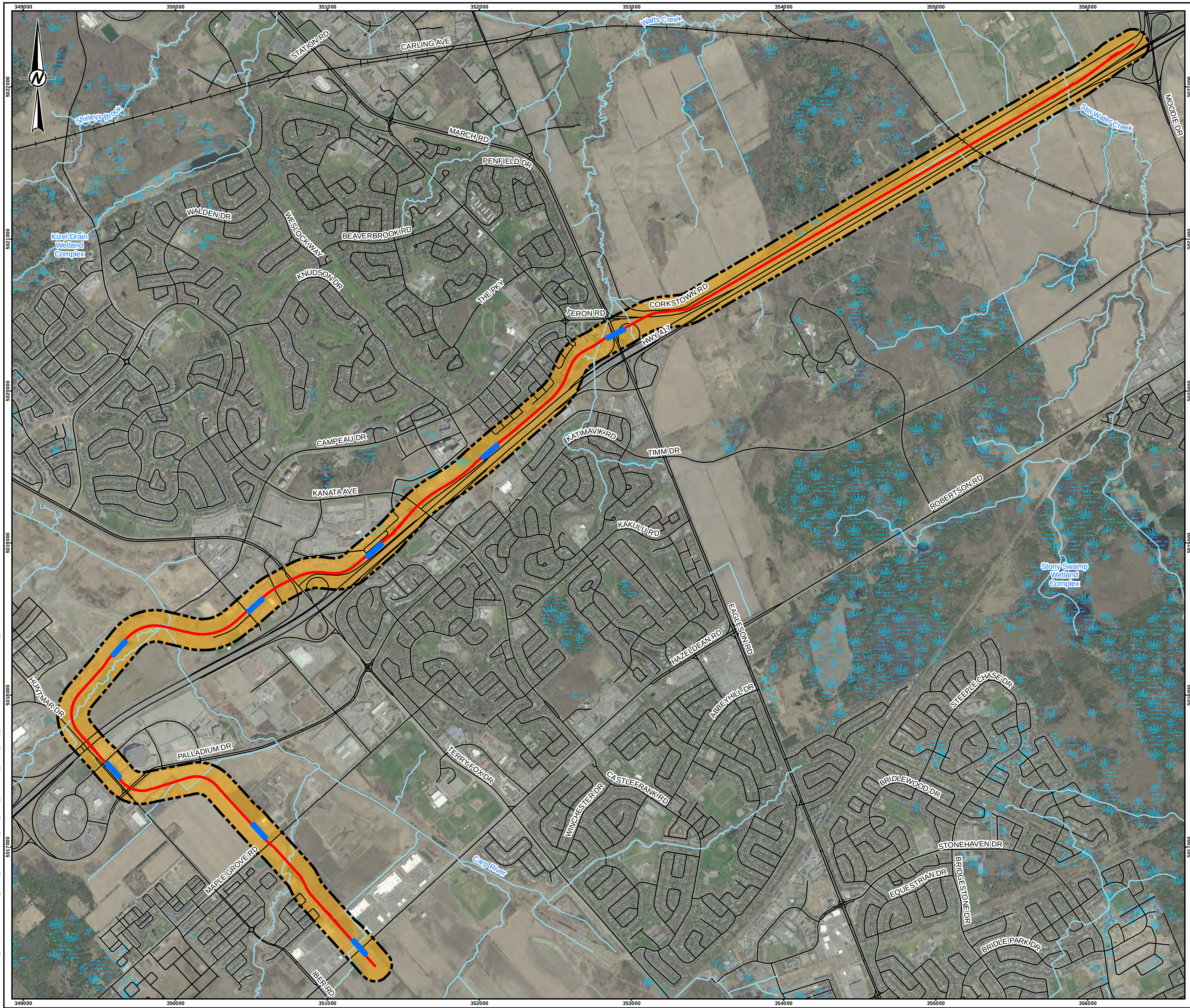
TITLE
ARCHAEOLOGICAL POTENTIAL - CITY OF OTTAWA ARCHAEOLOGICAL MASTER PLAN

CONSULTANT
GOLDER

YYYY-MM-DD	2018-01-05
DESIGNED	AM
PREPARED	JEM
REVIEWED	AM
APPROVED	HJD

PROJECT NO.	CONTROL	REV.	MAP
1668654	0003	0	12E

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 25mm



LEGEND

- WATERCOURSE
- ROADWAY
- RAILWAY
- WETLAND
- PROPOSED ALIGNMENT
- PROPOSED PLATFORM
- ARCHAEOLOGICAL POTENTIAL
- STAGE 1 STUDY AREA

NOTE(S)

1. FOR INFORMATIONAL PURPOSES ONLY. NO EVALUATION OR ASSESSMENT PROVIDED.

REFERENCE(S)

1. PROPOSED ALIGNMENT RECEIVED FROM PARSONS ON JANUARY 12, 2018,
FILE NAME: 476242-01000-pln-ali-main line.dwg
2. LAND INFORMATION ONTARIO (LIO) DATA PRODUCED BY GOLDER ASSOCIATES LTD. UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2014
3. PROJECTION: TRANSVERSE MERCATOR, DATUM: NAD 83, COORDINATE SYSTEM: MTM ZONE 9, VERTICAL DATUM: CGVD28

0 250 500 1,000

1:25,000 METRES

CLIENT

PARSONS CORP

PROJECT

KANATA LIGHT RAIL TRANSIT PLANNING AND EA STUDY
BAYSHORE STATION TO PALLADIUM DRIVE, OTTAWA, ONTARIO

TITLE

ARCHAEOLOGICAL POTENTIAL

CONSULTANT

GOLDER

YYYY-MM-DD	2018-01-05
DESIGNED	AJM
PREPARED	JEM
REVIEWED	AJM
APPROVED	HJD

PROJECT NO.	CONTROL	REV.	MAP
1668654	0003	0	12F

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM:

25mm

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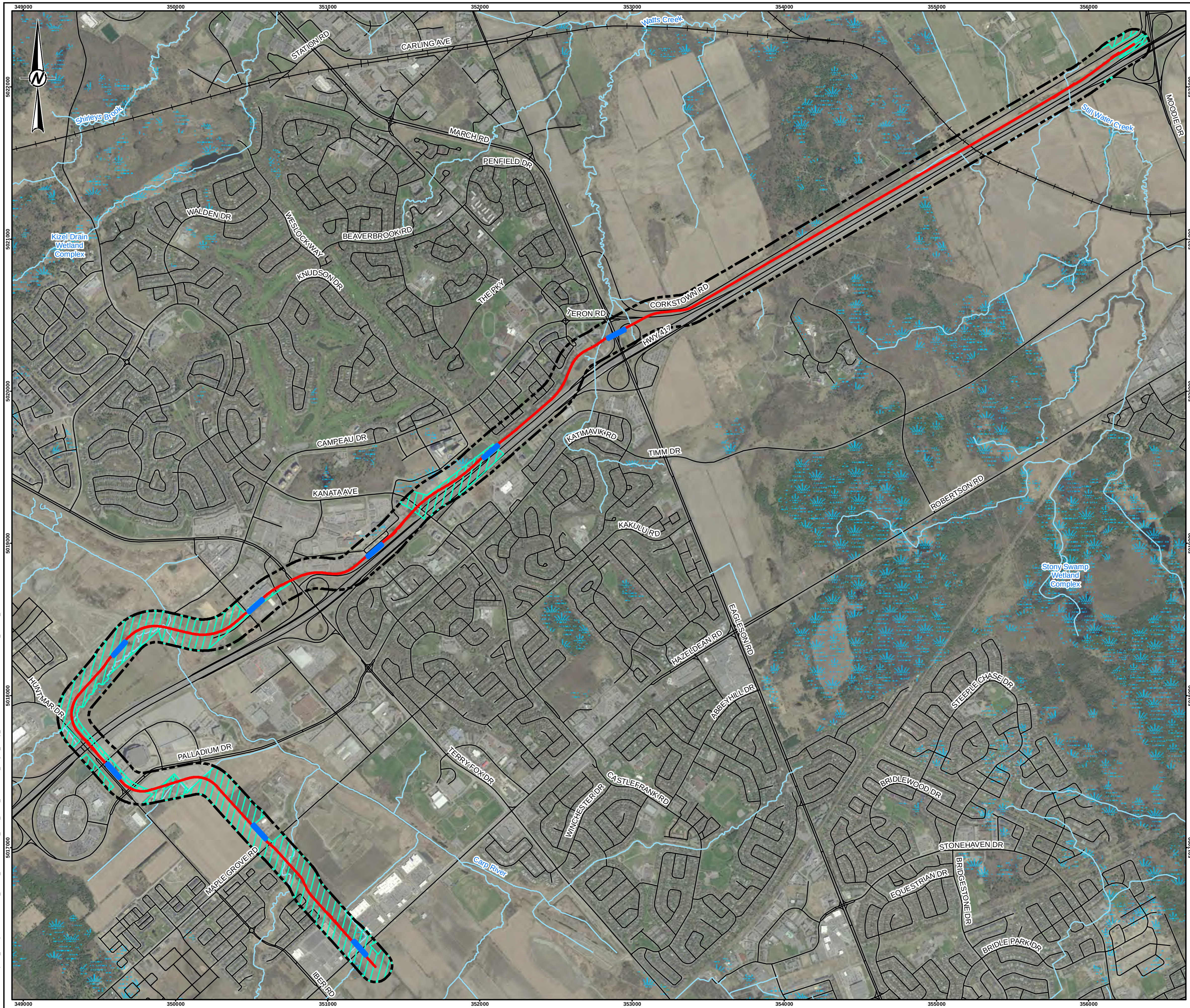

LEGEND

- WATERCOURSE
- ROADWAY
- RAILWAY
- WETLAND
- PROPOSED ALIGNMENT
- PROPOSED PLATFORM
- AREA PREVIOUSLY ASSESSED AND CLEARED BY MTCS
- STAGE 1 STUDY AREA

NOTE(S)

1. FOR INFORMATIONAL PURPOSES ONLY. NO EVALUATION OR ASSESSMENT PROVIDED.

REFERENCE(S)

1. PROPOSED ALIGNMENT RECEIVED FROM PARSONS ON JANUARY 12, 2018, FILE NAME: 476242-01000-pln-ali-main line.dwg
2. LAND INFORMATION ONTARIO (LIO) DATA PRODUCED BY GOLDER ASSOCIATES LTD. UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2014
3. PROJECTION: TRANSVERSE MERCATOR, DATUM: NAD 83, COORDINATE SYSTEM: MTM ZONE 9, VERTICAL DATUM: CGVD28

CLIENT
PARSONS CORP

PROJECT
STAGE 1 ARCHAEOLOGICAL ASSESSMENT, KANATA LIGHT RAIL TRANSIT PLANNING AND EA STUDY, OTTAWA, ONTARIO

TITLE
ARCHAEOLOGICAL POTENTIAL - AREAS PREVIOUSLY ASSESSED AND CLEARED BY MTCS

CONSULTANT
GOLDER

YYYY-MM-DD	2018-01-05
DESIGNED	AM
PREPARED	JEM
REVIEWED	AM
APPROVED	HJD

PROJECT NO.	CONTROL	REV.	MAP
1668654	0003	0	12G

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 25mm

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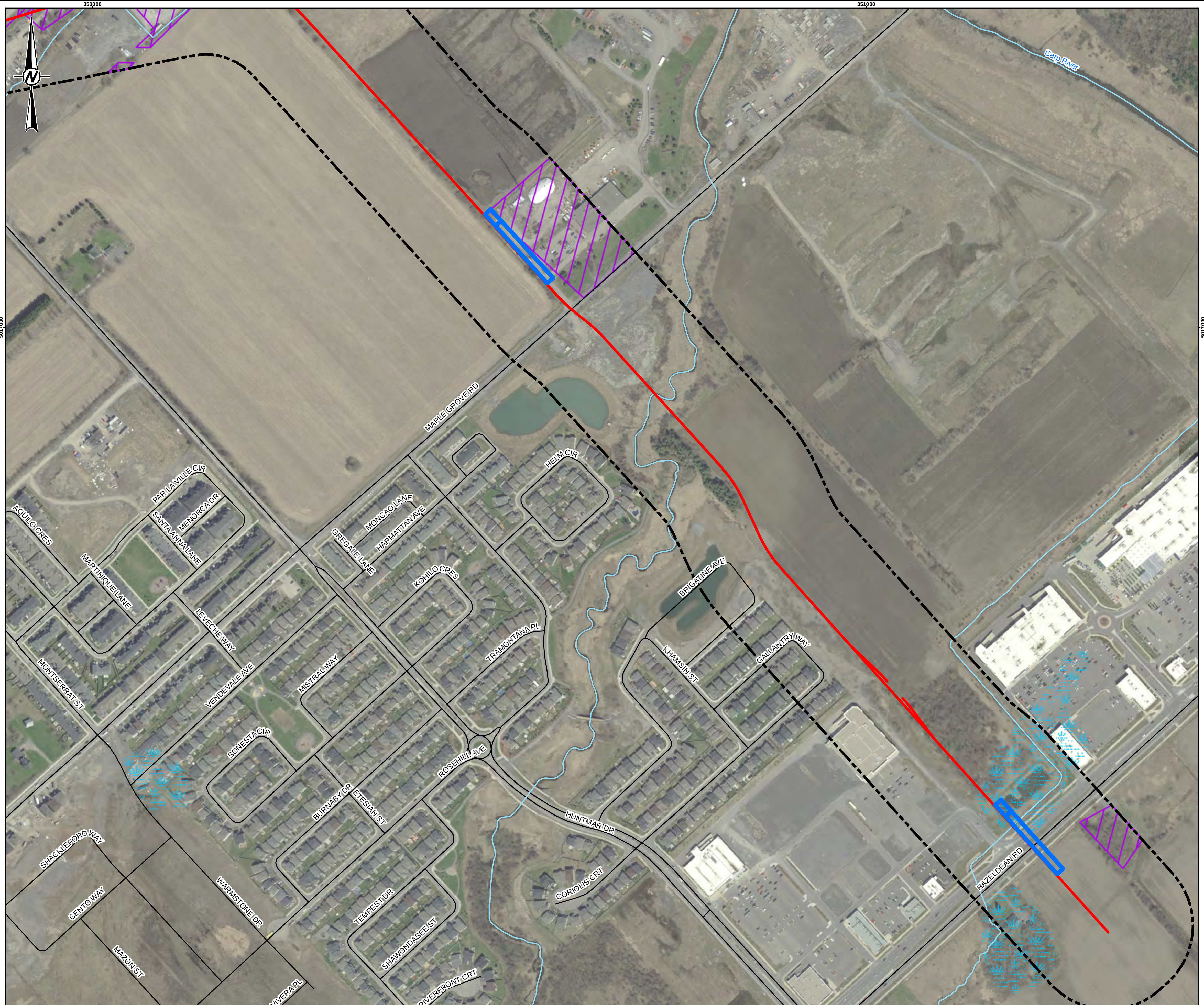

LEGEND

- WATERCOURSE
- ROADWAY
- RAILWAY
- WETLAND
- PROPOSED ALIGNMENT
- PROPOSED PLATFORM
- AREAS RECOMMENDED FOR ADDITIONAL ARCHAEOLOGICAL ASSESSMENT
- STAGE 1 STUDY AREA

NOTE(S)

1. FOR INFORMATIONAL PURPOSES ONLY. NO EVALUATION OR ASSESSMENT PROVIDED.

REFERENCE(S)

1. PROPOSED ALIGNMENT RECEIVED FROM PARSONS ON JANUARY 12, 2018, FILE NAME: 476242-01000-pln-ali-main line.dwg
2. LAND INFORMATION ONTARIO (LIO) DATA PRODUCED BY GOLDER ASSOCIATES LTD. UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2014
3. PROJECTION: TRANSVERSE MERCATOR, DATUM: NAD 83, COORDINATE SYSTEM: MTM ZONE 9, VERTICAL DATUM: CGVD28

0 50 100 200

1:5,000 METRES

CLIENT
PARSONS CORP

PROJECT
STAGE 1 ARCHAEOLOGICAL ASSESSMENT, KANATA LIGHT RAIL TRANSIT PLANNING AND EA STUDY, OTTAWA, ONTARIO

TITLE
AREAS RECOMMENDED FOR ADDITIONAL ARCHAEOLOGICAL ASSESSMENT

CONSULTANT

GOLDER

YYYY-MM-DD	2018-01-05
DESIGNED	AM
PREPARED	JEM
REVIEWED	AM
APPROVED	HJD

PROJECT NO.	CONTROL	REV.	MAP
1668654	0003	0	13A

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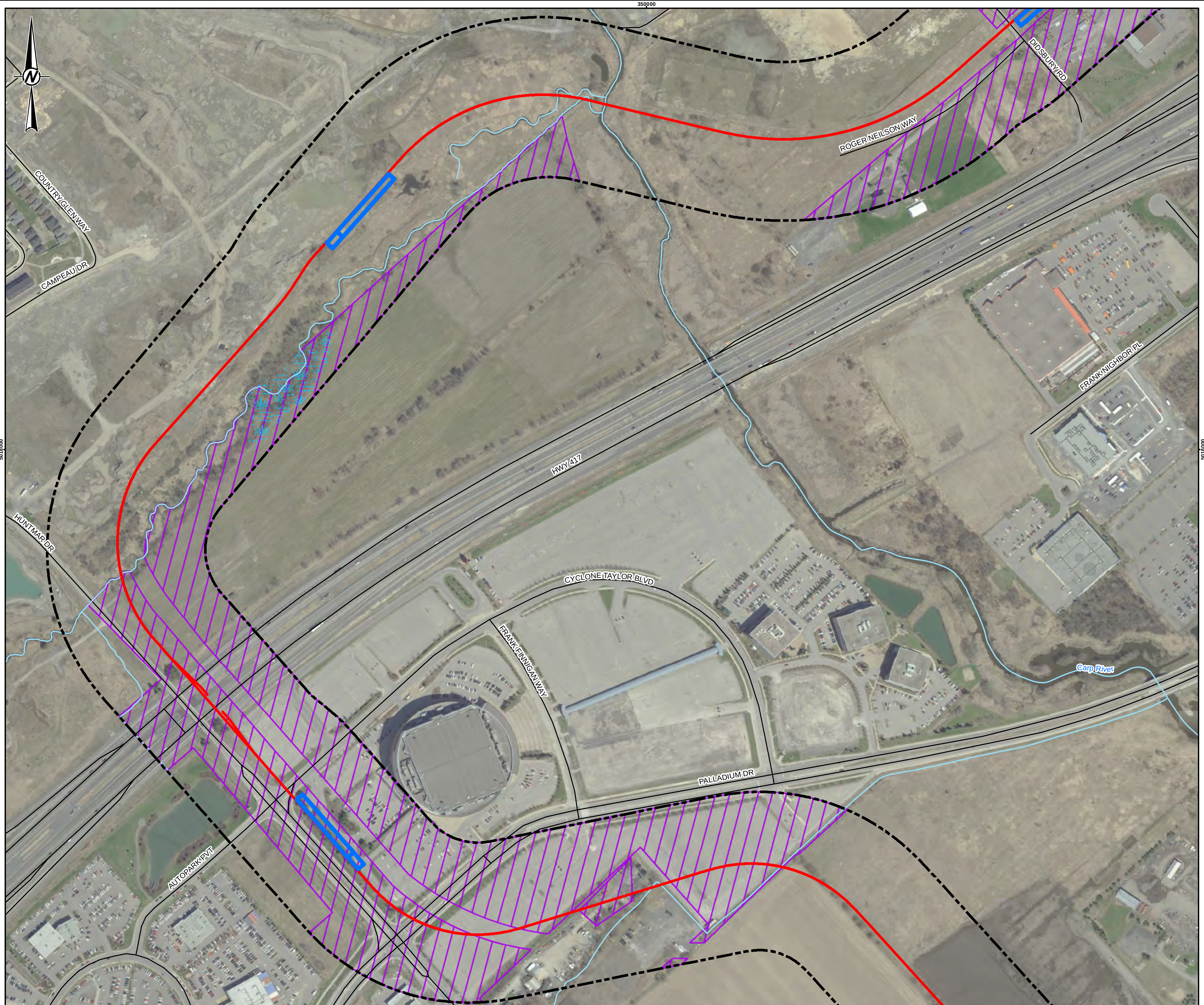
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 25mm



LEGEND

- WATERCOURSE
- ROADWAY
- RAILWAY
- WETLAND
- PROPOSED ALIGNMENT
- PROPOSED PLATFORM
- AREAS RECOMMENDED FOR ADDITIONAL ARCHAEOLOGICAL ASSESSMENT
- STAGE 1 STUDY AREA

NOTE(S)

1. FOR INFORMATIONAL PURPOSES ONLY. NO EVALUATION OR ASSESSMENT PROVIDED.

REFERENCE(S)

1. PROPOSED ALIGNMENT RECEIVED FROM PARSONS ON JANUARY 12, 2018, FILE NAME: 476242-01000-pln-ali-main line.dwg
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CLIENT

PARSONS CORP

PROJECT

STAGE 1 ARCHAEOLOGICAL ASSESSMENT, KANATA LIGHT RAIL TRANSIT PLANNING AND EA STUDY, OTTAWA, ONTARIO

TITLE

AREAS RECOMMENDED FOR ADDITIONAL ARCHAEOLOGICAL ASSESSMENT

CONSULTANT

GOLDER

YYYY-MM-DD	2018-01-05
DESIGNED	AM
PREPARED	JEM
REVIEWED	AM
APPROVED	HJD

PROJECT NO.	CONTROL	REV.	MAP
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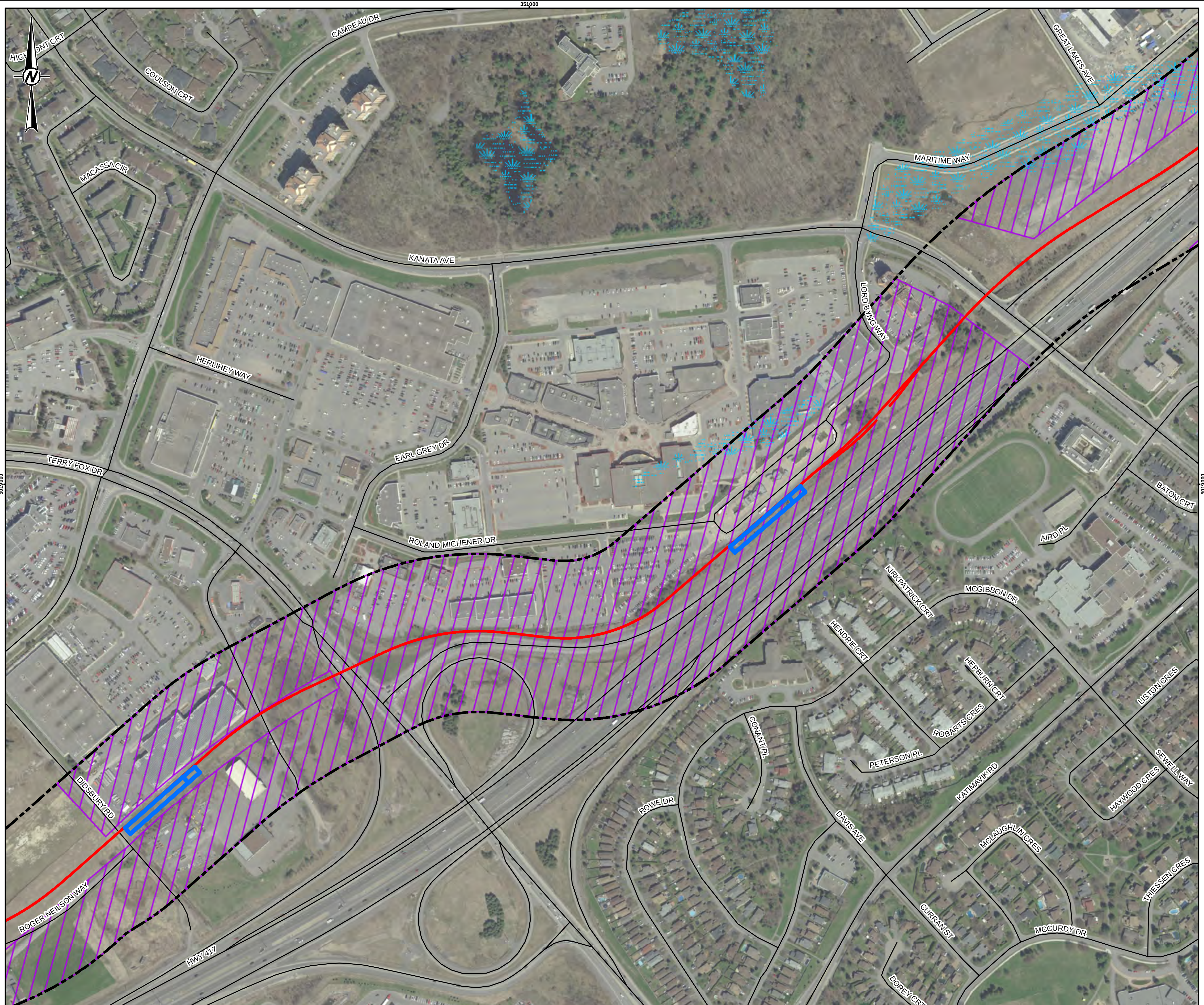

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- WETLAND
- PROPOSED ALIGNMENT
- PROPOSED PLATFORM
- AREAS RECOMMENDED FOR ADDITIONAL ARCHAEOLOGICAL ASSESSMENT
- STAGE 1 STUDY AREA

NOTE(S)

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PROJECT

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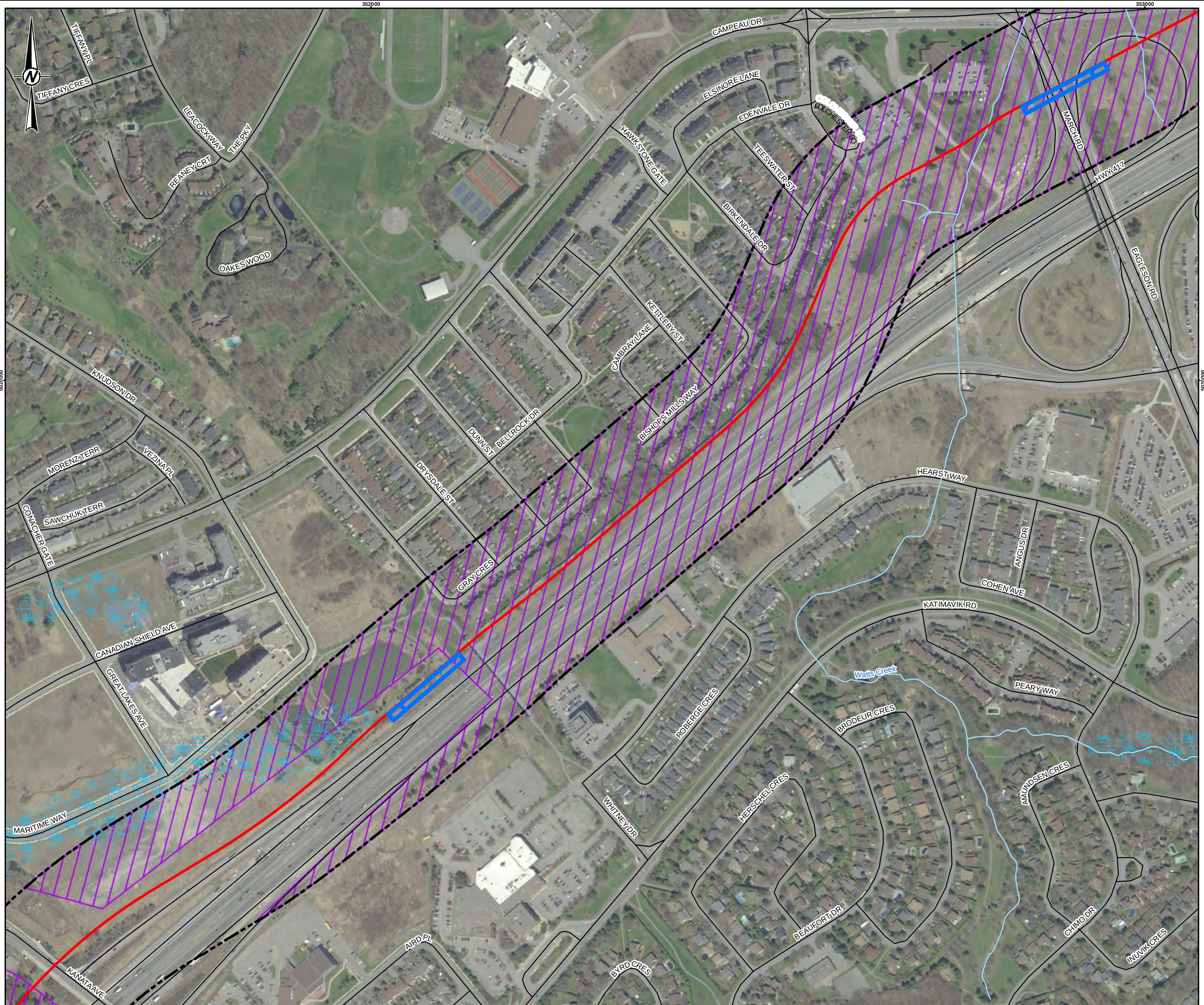

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PROJECT

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TITLE

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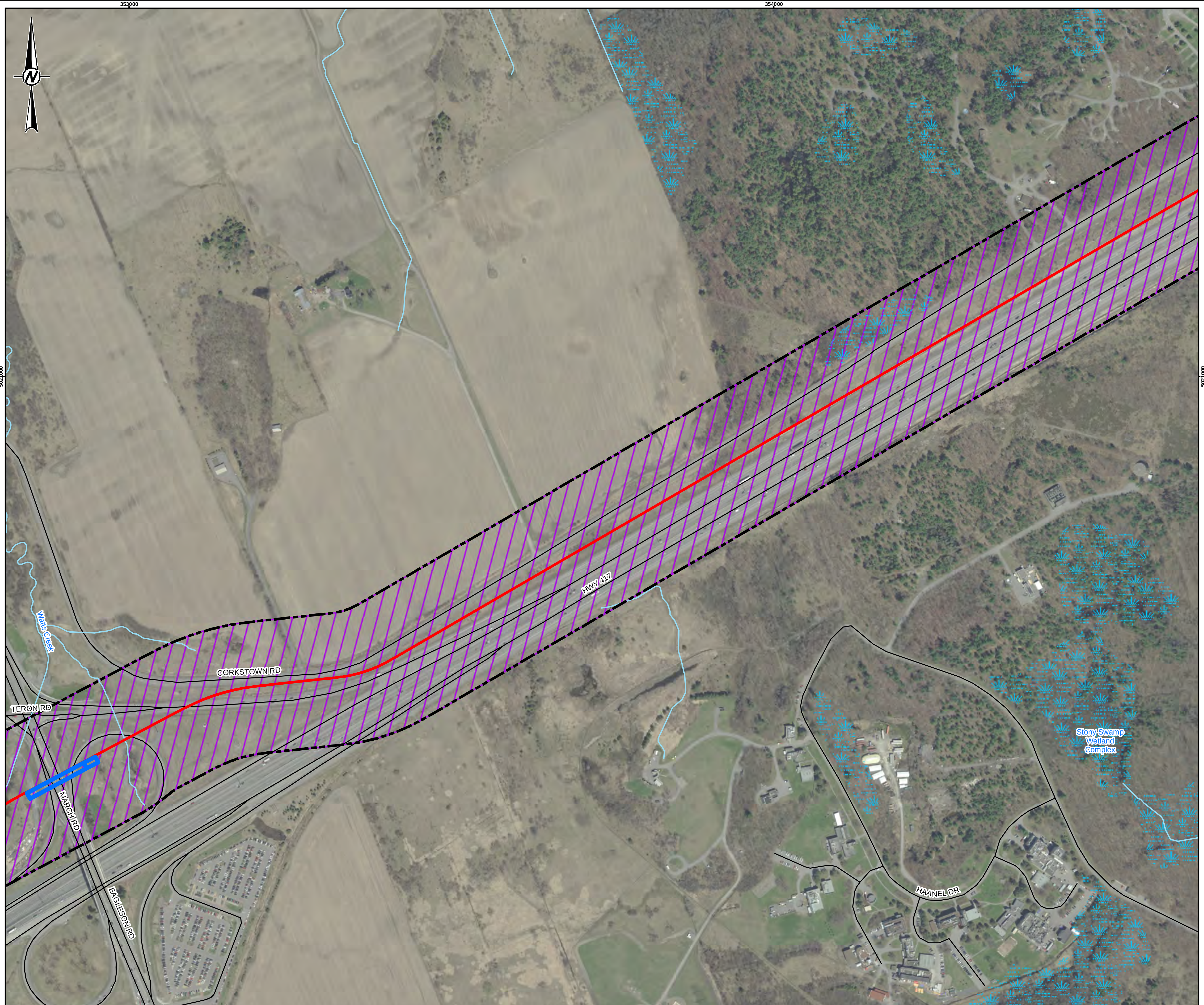

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PROJECT

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CLIENT
PARSONS CORP

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STAGE 1 ARCHAEOLOGICAL ASSESSMENT, KANATA LIGHT RAIL TRANSIT PLANNING AND EA STUDY, OTTAWA, ONTARIO

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CONSULTANT
GOLDER

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Signature Page

We trust that this report meets your current needs. If you have any questions, or if we may be of further assistance, please contact the undersigned.

Golder Associates Ltd.

Aaron Mior, M.MA.
Staff Archaeologist

Hugh J. Daechsel, M.A.
Principal, Senior Archaeologist

AM/HJD/ca

https://golderassociates.sharepoint.com/sites/11538g/shared documents/08_reports/stage 1 archaeology/original report/p1077-0042-2017_21november2018_re.docx

APPENDIX A

Previous Archaeological Assessments

PIF #	Consultant/ Licensee	Consulting Stage	Report Title	Township	Concession	Lot	CHVI Recommendations
P002-082-2006 & P002-101-2007	Jacques Whitford (Colin Varley)	1 and 2	Stages 1 and 2 Archaeological Assessment, Proposed Glen Cairn Biofilter Installation, Part of Lot 2, Concession 1, Ottawa Front, Township of Nepean, City of Ottawa, Ontario	Nepean	1	2	Archaeological potential identified within property. Stage 2 only completed for small (35 x 45 m area)
2000-019-005	Kinickinick Heritage Consulting (Ken Swayze)	1 and 2	A Stage 1 & 2 Archaeological Assessment of the Glen Cairns Biofilter System on the SE Part of Lot 6, Conc. 1 OF, Nepean (Geo) Township, in the NCC Greenbelt, RMOC	Nepean	1	1 (Report title indicates Lot 6, but report maps depict study area in Lot 1)	Additional assessment recommended
P386-0015-2014	Golder Associates (Brandy Lockhart)	1 and 2	Stage 1-2 Archaeological Assessment Wesley Clover Equestrian Park, Stage 1 Lots 6-10 Concession 1 and Stage 2 Lots 9-10, Concession 1, Historic Township of Nepean, Carleton County, Ottawa, Ontario	Nepean	1	6-10	Stage 3 assessment recommended for BiFx-21. Additional assessment recommended for areas not subjected to Stage 2 field testing
P386-0015-2014	Golder Associates (Brandy Lockhart)	2	Addendum: Stage 1-2 Archaeological Assessment Wesley Clover Equestrian Park, Craig Site (BiFx-21), Concession 1, Lot 10, Historic Township of Nepean, Carleton County, City of Ottawa	Nepean	1	10	Stage 3 assessment recommended for BiFx-21

PIF #	Consultant/ Licensee	Consulting Stage	Report Title	Township	Concession	Lot	CHVI Recommendations
P311-007-2009	Golder Associates (Bradley Drouin)	1	Stage 1 Archaeological Assessment, West Transitway Extension, Part Lots 8-11, Concession 1, Part Lots 8-16, Concession 2, Geographic Township of Nepean, Carleton County, Ontario	Nepean	1-2	8-11 & 8-16	Stage 2 assessment recommended for portion of study area
P311-017-2010	Golder Associates (Bradley Drouin)	2	Stage 2 Archaeological Assessment, West Transitway Extension, Part Lots 9-10, Concession 1, Part Lots 9-16, Concession 2, Geographic Township of Nepean, Carleton County, Ontario	Nepean	1-2	9-10 & 9-16	No additional assessment recommended
P378-0014-2014	Patterson Group (Nadine Kopp)	1 and 2	Stage 1 & 2 Archaeological Assessment, Kanata West Pond 4, Maple Grove Road, Lot 1, Concession 1, Geographic Township of March, Former Carleton County, Kanata, Ontario	March	1	1	No additional assessment recommended
P003-0406-2014 & P003-0410-2014	Adams Heritage (Nicholas Adams)	1 and 2	Stage 1 & 2 Archaeological Assessment, 130 Huntmar Drive, Part Lot 1, Concession 1, Geographic Township of March, City of Ottawa	March	1	1	No additional assessment recommended
P003-031, P003-037 & P003-041	Adams Heritage (Nicholas Adams)	1,2 and 3	Stage 1 & 2 A.A. "Taggart - Loblaws", Part of the South Half, Lot 3, Con. 1, Geographic Twp. of March, City of Ottawa & Stage 3 Arch. Assessments of the "Allen" Site (BhFx-26) & the "Corelview" Site (BhFx-27)	March	1	3	n/a

PIF #	Consultant/ Licensee	Consulting Stage	Report Title	Township	Concession	Lot	CHVI Recommendations
P051-134-2007	Heritage Quest (Hugh Daechsel)	1	Stage 1 Archaeological Assessment of the Arcadia Subdivision, Part Lots 3 & 4, Concession 1, Geographic Township of March, Carleton County, City of Ottawa	March	1	3-4	Stage 2 assessment recommended
P031-013-2007	Heritage Quest (Jeff Earl)	2	Stage 2 Archaeological Assessment, Arcadia Subdivision, Part Lots 3 & 4, Concession 1, Geographic Township of March, Ottawa, Carleton County	March	1	3-4	Stage 3 recommended for BhFx-35. No additional assessment for remainder of assessed property
P025-0482-2014	Northeastern Archaeological Associates Ltd (Lawrence Jackson)	1 and 2	Stage 1 and 2 Archaeological Assessment of Part Lot 3, 4, and 5, Concession 1, Geographic Township of March, City of Ottawa, Ontario	March	1	3-5	Stage 3 recommended for BhFx-62. No additional assessment for remainder of assessed property
98-022	Heritage Quest (Hugh Daechsel)	1	Highway 417/Castlefrank Overpass & Interchange Environmental Assessment: Stage 1 Archaeological Investigation of Lot 2, Concession 2 and 3, March Township	March	2-3	2	Stage 2 assessment recommended
2001-033-006	Heritage Quest (Hugh Daechsel)	2	Stage 2 Archaeological Assessment of Highway 417/Castlefrank Road, Lot 2, Concession 2, Former March Township & City of Kanata, City of Ottawa	March	2	2	No additional assessment recommended

PIF #	Consultant/ Licensee	Consulting Stage	Report Title	Township	Concession	Lot	CHVI Recommendations
P002-254-2011	Stantec (Colin Varley)	2	Stage 2 Archaeological Assessment, Proposed Campeau Drive Extension, Lot 3, Concession 1, Township of March and Lot 3, Concession 1, Township of Huntley, City of Ottawa, ON	March & Huntley	1 & 1	3 & 3	No additional assessment recommended
2002-046-009	Kinickinick Heritage Consulting (Ken Swayze)	1	Stage 1 A.A. of Palladium Auto Park on Part of Lot 2, Conc. 1, Huntley Twp (Geo), Cty of Ottawa	Huntley	1	2	No additional assessment recommended
P003-232-2009	Adams Heritage (Nicholas Adams)	1, 2 and 3	An Archaeological Assessment (Stage 1 to 3) of the proposed "Kanata West Business Park" (Terrace Lands) Part of the North Half, Lot 3, Concession 1 and Part of the South Half, Lot 3, Concession 1 Geographic Township of West Carleton (formerly Township of Huntley) City of Ottawa, County of Carleton, including Stage 3 Assessment of BhFx-40	Huntley	1	3	Avoidance/Protection or Stage 4 recommended for BhFx-40. No additional assessment for remainder of assessed property

PIF #	Consultant/ Licensee	Consulting Stage	Report Title	Township	Concession	Lot	CHVI Recommendations
P031-035-2011	Past Recovery (Jeff Earl)	1 and 2	Stage 1 & 2 Archaeological Assessments of the Proposed West Transitway Connection: Terry Fox Drive to Fernbank Road, Part of Lots 1, 2 & 3, Concession 1, and Part Lots 2 & 3, Concession 2, Geographic Township of March, and Part Lot 28, Concessions 10, 11 & 12, Geographic Township of Goulbourn, City of Ottawa, Ontario	March & Goulbourn	1, 2 & 10-12	1-3, 2-3 & 28	Stage 3 recommended for BhFx-47 and BhFx-49. Stage 2 recommended for areas not subjected to field testing. No additional assessment for remainder of assessed property
P002-312-2012	Stantec (Colin Varley)	1	Stage 1 Archaeological Assessment, Kanata West Pump Station and Forcemain, Lots 28 and 29, Concession 12, Goulbourn Township and Lot 1, Concessions 1-3, and Lot 2, Concession 3, March Township, City of Ottawa, On	March & Goulbourn	1-3 & 12	1-2 & 28-29	Stage 2 assessment recommended for portion of property
P1084-0002-2015	Stantec (Paige Glenen)	2	Stage 2 Archaeological Assessment: Kanata West Pump Station and Forcemain	March & Goulbourn	1-3 & 12	1-2 & 28-29	No additional assessment recommended
P003-029	Adams Heritage (Nicholas Adams)	1	Stage 1 Archaeological Assessment "Mattamy Homes - Kanata West", Part Lots 27 & 28, Conc. 12, Geographic Township of Goulbourn and part Lot 1, Conc. 1, Geographic Township of Huntley, City of Ottawa	Huntley & Goulbourn	1 & 12	1 & 27-28	Stage 2 assessment recommended

PIF #	Consultant/ Licensee	Consulting Stage	Report Title	Township	Concession	Lot	CHVI Recommendations
P003-032	Adams Heritage (Nicholas Adams)	2	Stage 2 Archaeological Assessment "Mattamy Homes - Kanata West", Part Lots 27 & 28, Conc. 12, Geographic Township of Goulbourn and part Lot 1, Conc. 1, Geographic Township of Huntley, City of Ottawa	Huntley & Goulbourn	1 & 12	1 & 27-28	n/a
P039-094-2006	Kinickinick Heritage Consulting (Ken Swayze)	1	A Stage 1 Archaeological Assessment of the Fernbank Community Lands, Lots 25-30, Concession 10 & 28-30 Concession 11, Goulbourn Twp. (Geo), City of Ottawa	Goulbourn	10 & 11	25-30 & 28-30	Stage 2 assessment recommended
P415-0061-2015	Stantec (Patrick Hoskins)	1	Stage 1 Archaeological Assessment: Stittsville Diversion Trunk Sewer	Goulbourn	10-12	28-29	Stage 2 assessment recommended for portion of property
P378-0019-2016	Patterson Group (Nadine Kopp)	2	Stage 2 Archaeological Assessment: DEL Lands (Fernbank) 5618 Hazeldean Road. Concession 11, Part Lot 28, Geogaphic Township of Goulbourn, City of Ottawa, Ontario	Goulbourn	11	28	Stage 3 recommended for BhFx-68. No additional assessment for remainder of assessed property
2000-025-031	Heritage Quest (Hugh Daechsel)	1	Stage 1 Archaeological Assessment of Hazeldean Road Corridor from Terry Fox Drive to the Carp Road Lots 23-30, Concessions 11 & 12, Former Township of Goulbourn & City of Kanata, City of Ottawa	Goulbourn	11 & 12	23-30	Stage 2 assessment recommended for portion of property

PIF #	Consultant/ Licensee	Consulting Stage	Report Title	Township	Concession	Lot	CHVI Recommendations
2001-033-13	Heritage Quest (Hugh Daechsel)	2	Stage 2 Archaeological Assessment of Hazeldean Road Corridor from Terry Fox Drive to the Carp Road Lots 23-30, Concessions 11 & 12, Former Township of Goulbourn & City of Kanata, City of Ottawa	Goulbourn	11 & 12	23-30	Archaeological monitoring recommended for portion of property. No additional assessment for remainder of assessed property
P003-051 & P003-063	Adams Heritage (Nicholas Adams)	1 and 2	Stage 1 and Stage 2 Archaeological Assessment “North American Acquisions Corporation- Kanata West” Part Lots 27 & 28, Concession 12, Geographic Township of Goulbourn, City of Ottawa	Goulbourn	12	27 & 28	No additional assessment recommended
P003-034 & P003-092	Adams Heritage (Nicholas Adams)	1 and 2	Stage 1 & Stage 2 Archaeological Assessment "Richcraft Homes - Kanata West" Part Lots 28 & 29, Concession 12, Geographic Township of Goulbourn, City of Ottawa	Goulbourn	12	28-29	No additional assessment recommended
P003-048	Adams Heritage (Nicholas Adams)	1	Stage 1 A.A. "Trinity Development Group Lands - Kanata West", Part Lots 28 & 29, Conc. 12, Geographic Township of Goulbourn, City of Ottawa	Goulbourn	12	28-29	Stage 2 assessment recommended
P003-182-2008	Adams Heritage (Nicholas Adams)	2	Stage 2 A.A. "Trinity Development Group Lands - Kanata West", Part Lots 28 & 29, Conc. 12, Geographic Township of Goulbourn, City of Ottawa	Goulbourn	12	28-29	No additional assessment recommended

PIF #	Consultant/ Licensee	Consulting Stage	Report Title	Township	Concession	Lot	CHVI Recommendations
P051-044 & P051-089	Heritage Quest (Hugh Daechsel)	1	Stage 1 Archaeological & Heritage Assessment of the Proposed East-West Corridor Light Rail Transit Project, Geographic Townships of Cumberland, Gloucester, Goulbourn, March & Nepean, City of Ottawa	Nepean, March & Goulbourn	Various	Various	Stage 2 assessment recommended for portion of study area

golder.com

IV. Cultural Heritage Overview Report

GOLDER

REPORT

Cultural Heritage Overview Report

Kanata Light Rail Transit Planning and Environmental Assessment Study, Bayshore Station to Hazeldean Road, Ottawa, Ontario

Submitted to:

Paul Croft, Project Planner

Parsons Corporation
100-1223 Michael Street
Ottawa, Ontario
K1J 7T2

Submitted by:

Golder Associates Ltd.

683 Innovation Drive, Unit 1, Kingston, Ontario, K7K 7E6, Canada

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1668654-2000-2020

November 21, 2018

Distribution List

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Executive Summary

This Executive Summary highlights key points from the report only; for complete information and findings the reader should examine the complete report.

In April 2017, Parsons Corporation retained Golder to conduct a cultural heritage overview report (CHOR) as part of the Planning and Environmental Assessment Study for the Kanata Light Rail Transit (LRT) from Moodie Drive to Palladium Drive. The study area, about 12 km in length, runs approximately northeast-southwest along the north side of Highway 417 between Moodie Drive and Huntmar Drive, then turns southeast and extends to Hazeldean Road. This Planning and Environmental Assessment Study is being conducted in support of the City of Ottawa's Transportation Master Plan, which includes LRT service to these locations.

This CHOR found that no properties along the study area are listed or designated properties on the City *Heritage Register*. However, the National Capital Commission has identified part of the Greenbelt as the Western Farmlands cultural landscape. This cultural landscape covers the study area between Moodie Drive and Eagleson Road/March Road. The study area through the Greenbelt runs next to Highway 417 and is more closely associated with the highway than with the rural agricultural character of the rest of the area but is adjacent to Corkstown Road, a rural roadscape that is part of the Western Farmlands cultural landscape in the Greenbelt. Construction of the LRT could adversely impact the rural character of Corkstown Road and there is a high risk of adverse impact to this cultural landscape that would be permanent but reversible, infrequent and localized.

In order to mitigate potential adverse impacts to the rural character of the Western Farmlands cultural landscape Golder recommends that during the:

- Pre-construction phase:
  - The existing landscape should be documented with georeferenced photographs and described in a heritage documentation report.
  - Incorporate landscape features into detailed design: Landscape features such as mature trees should be retained and incorporated into detailed design as much as is practical.
- Construction phase:
  - Maintain the gravel shoulders and shallow ditches along either side of Corkstown Road during construction.
- Post construction phase:
  - Restore the rural profile and heritage attributes of Corkstown Road to their pre-construction condition and revegetate the roadsides with native grass species.

Study Limitations

Golder Associates Ltd. has prepared this report in a manner consistent with the guidance developed by the Ontario Ministry of Tourism, Culture and Sport, Culture Division, Programs and Services Branch, Heritage Program Unit, subject to the time limits and physical constraints applicable to this report. No other warranty, expressed or implied is made.

This report has been prepared for the specific site, design objective, developments and purpose described to Golder Associates Ltd., by Parsons Corporation (the Client). The factual data, interpretations and recommendations pertain to a specific project as described in this report and are not applicable to any other project or site location.

The information, recommendations and opinions expressed in this report are for the sole benefit of the Client. No other party may use or rely on this report or any portion thereof without Golder Associates Ltd.'s express written consent. If the report was prepared to be included for a specific permit application process, then upon the reasonable request of the Client, Golder Associates Ltd. may authorize in writing the use of this report by the regulatory agency as an Approved User for the specific and identified purpose of the applicable permit review process. Any other use of this report by others is prohibited and is without responsibility to Golder Associates Ltd. The report, all plans, data, drawings and other documents as well as electronic media prepared by Golder Associates Ltd. are considered its professional work product and shall remain the copyright property of Golder Associates Ltd., who authorizes only the Client and Approved Users to make copies of the report, but only in such quantities as are reasonably necessary for the use of the report by those parties. The Client and Approved Users may not give, lend, sell, or otherwise make available the report or any portion thereof to any other party without the express written permission of Golder Associates Ltd. The Client acknowledges the electronic media is susceptible to unauthorized modification, deterioration and incompatibility and therefore the Client cannot rely upon the electronic media versions of Golder Associates Ltd.'s report or other work products.

Unless otherwise stated, the suggestions, recommendations and opinions given in this report are intended only for the guidance of the Client in the design of the specific project.

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FIGURES

APPENDICES

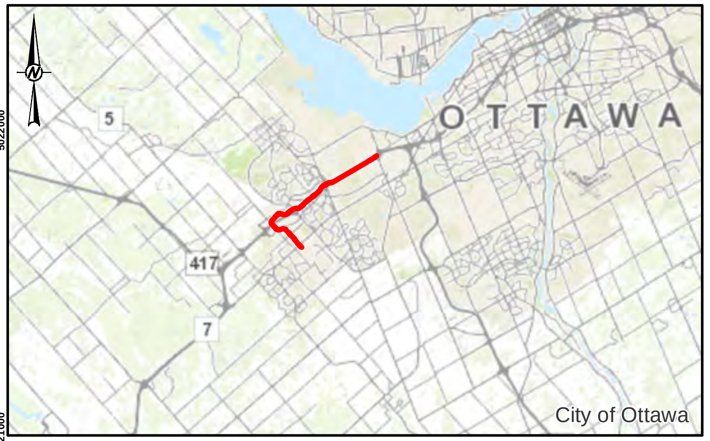
1.0 INTRODUCTION

In April 2017, Parsons Corporation retained Golder Associates Ltd. (Golder) to conduct a cultural heritage overview report (CHOR) as part of the Planning and Environmental Assessment Study for the Kanata Light Rail Transit (LRT) from Moodie Drive to Palladium Drive. The proposed LRT corridor is about 12 km in length, and runs approximately northeast-southwest along the north side of Highway 417 between Moodie Drive and Huntmar Drive, then turns southeast and extends to Hazeldean Road (Figure 1). The study area for this CHOR includes all properties crossed by the proposed LRT corridor. This Planning and Environmental Assessment Study is being conducted in support of the City of Ottawa's Transportation Master Plan, which includes LRT service to these locations.

To identify cultural heritage resources and constraints in the study area, this document provides:

- A background on the legislative framework, purpose and requirements of a CHOR and the methods that were used to investigate and evaluate cultural heritage resources in the study area;
- An overview of the study area's geographic context and history;
- An inventory and evaluation of built and landscape elements in the study area;
- A description of the proposed undertaking and a preliminary assessment of its predicted impacts and residual effects on known or newly identified cultural heritage resources in the study area; and,
- Recommendations to inform the detailed design and ensure that the heritage attributes of known or newly identified cultural heritage resources in the study area are conserved.

KEY MAP



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- ROADWAY
- WETLAND
- PROPOSED ALIGNMENT
- PROPOSED PLATFORM

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CLIENT
PARSONS CORP

PROJECT
KANATA LIGHT RAIL TRANSIT PLANNING AND EA STUDY
BAYSHORE STATION TO PALLADIUM DRIVE, OTTAWA, ONTARIO

TITLE
SITE PLAN

CONSULTANT

GOLDER

YYYY-MM-DD	2017-10-17
DESIGNED	BH
PREPARED	JEM
REVIEWED	BH
APPROVED	HJD

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2.0 SCOPE & METHOD

As mentioned in section 1.0 the study area for this CHOR was defined as properties crossed by the proposed LRT corridor. Property parcels adjacent to the corridor were also considered as part of this assessment following the Provincial Policy Statement 2014 and the City's *Official Plan*.

The scope of this CHOR was defined by guidance outlined in the Ministry of Tourism, Culture and Sport (MTCS) *Criteria for Evaluating Potential for Built Heritage Resources and Cultural Heritage Landscapes: A Checklist for the Non-Specialist* (2016; the MTCS *Checklist*). The MTCS *Checklist* provides a screening tool to identify all known or recognized cultural heritage resources in the study areas, commemorative plaques, cemeteries, Canadian Heritage River watersheds, properties with buildings 40 or more years old, or potential cultural heritage landscapes. Following the MTCS *Checklist,* Golder:

- Researched archival and published sources relevant to the history and geographic context of the study areas;
- Consulted federal, provincial, and municipal heritage registers, which included:
  - Canadian Register of Historic Places (www.historicplaces.ca);
  - Historic Sites and Monuments Board of Canada Directory of Federal Heritage Designations (http://www.pc.gc.ca/apps/dfhd/search-recherche_eng.aspx) and Directory of Heritage Railway Stations (http://www.pc.gc.ca/eng/clmhc-hsmbc/pat-her/gar-sta.aspx);
  - Ontario Heritage Trust Online Plaque Guide (http://www.heritagetrust.on.ca/en/index.php/online-plaque-guide) and Ontario Places of Worship Inventory (http://www.heritagetrust.on.ca/Ontario-s-Places-of-Worship/Inventory), and List of Easement Properties (http://www.heritagetrust.on.ca/en/property-types/easement-properties);
  - Ontario Ministry of Government and Consumer Services (OMGCS) Database of Registered Cemeteries (https://www.consumerbeware.mgs.gov.on.ca/esearch/start.do);
  - Canadian Heritage River System list of designated heritage river systems (http://chrs.ca/);
  - The Ontario Heritage Bridge List in the Ontario Heritage Bridge Guidelines for Provincially Owned Bridges (Interim) (Ministry of Transport 2008);
  - City of Ottawa Heritage Register (https://ottawa.ca/en/city-hall/planning-and-development/heritage-conservation/identifying-and-protecting-heritage-properties#individual-designation-list-properties);
  - The City of Ottawa geoOttawa public GIS site (http://maps.ottawa.ca/geoottawa/); and,
  - Historical Topographic Map Digitization Project (Ontario Council of University Libraries, main page: https://ocul.on.ca/topomaps/).
- Consulted the City
- Conducted field investigations to inventory and document all known and potential cultural heritage resources within the study areas and to understand the wider built and landscape context;
- Completed screening-level evaluations of properties with structures over 40 or more years old and evaluated their potential CHVI using the criteria prescribed in *Ontario Regulation 9/06*; and,
- Assessed the risk of impact to properties of known and potential CHVI, and recommended mitigation and conservation measures using MTCS and other guidance.

Primary and secondary sources, including historic maps, aerial imagery, photographs, research articles, were accessed from the National Air Photo Library, Library and Archives Canada, Archives of Ontario, and online sources, as well as the City's *Heritage Register* (the *Register*) and cultural heritage resource geospatial data.

Golder corresponded with Ashley Kotarba, a Heritage Planner with the Planning, Infrastructure and Economic Development Department of the City by e-mail on January 17, 2018 to inquire about specific cultural heritage constraints along the study area. Golder was provided with addresses for three properties on the *Register* close to the study area and information that several properties in or adjacent to the study area with buildings or uses that are over 40 years old, but not of concern to the City.

Field investigations were conducted by Cultural Heritage Specialist Benjamin Holthof on January 22, 2018. This included photographing streetscapes and properties in the study area from public rights of way with a Canon Rebel T3i DSLR camera.

The descriptions of known and potential cultural heritage resources use terms provided by the City, Blumenson (1990), Hubka (2013), and the *Canadian Inventory of Historic Buildings* (Parks Canada 1980). Potential cultural heritage landscapes were identified based on the criteria provided in the MTCS *Guidelines on the Man-Made Heritage Component of Environmental Assessments* (1980) and *Heritage Conservation Districts* (2006).

3.0 PLANNING, LEGAL, AND REGULATORY CONTEXT

Cultural heritage resources are recognized, protected, and managed through a number of provincial and municipal planning and policy regimes (Figure 2). These policies have varying levels of authority, though generally all inform decision-making to avoid or mitigate the adverse impacts of new development.

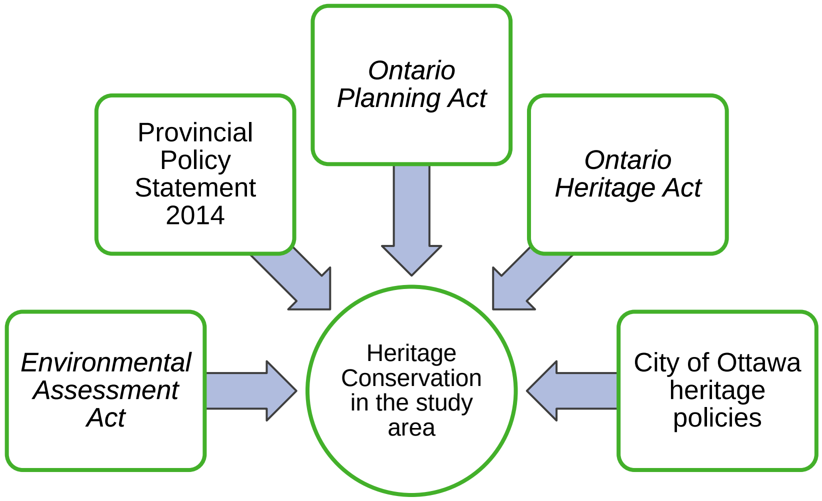

Figure 2: Provincial and municipal policies relevant to the heritage conservation in the study area.

3.1 Provincial Heritage Policies

3.1.1 *Environmental Assessment Act* and Municipal Class Environmental Assessments

The *Environmental Assessment Act* (EAA) was legislated to ensure that Ontario's environment is protected, conserved, and wisely managed. Under the EAA, 'environment' includes not only natural elements such as air, land, water and plant and animal life, but also the 'social, economic and cultural conditions that influence the life of humans or a community', and 'any building, structure, machine or other device or thing made by humans'.
To determine the potential environmental effects of a new development, the Environmental Assessment (EA) process was created to standardize decision-making. For municipal road, water, and wastewater projects this decision-making is streamlined in the Class EA process, which divides routine activities with predictable environmental effects into four 'schedules' (Government of Ontario 2014; MCEA 2015). The Project falls under the Schedule 'C' MCEA process since it involves construction of new facilities and major expansions to existing facilities.

The phases (up to five) and associated actions required for each of these schedules is outlined in the Ontario Municipal Engineers Association (MEA) Manual. Avoidance of cultural resources is the primary mitigation suggested in the manual, although other options are 'employing necessary steps to decrease harmful environmental impacts such as vibration, alterations of water table, etc.' and taking steps to 'record or salvage of information on features to be lost' (MEA 2015: Appendix 2). In all cases, the 'effects should be minimized where possible, and every effort made to mitigate adverse impacts, in accordance with provincial and municipal policies and procedures.' Some of these policies, such as the *Planning Act*, *Provincial Policy Statement*, and *Official Plans* and *Secondary Plans* (described below) are listed as 'Key Considerations' in the MEA Manual.

3.1.2 Planning Act and Provincial Policy Statement

The Ontario *Planning Act* (1990) and associated *Provincial Policy Statement, 2014* (PPS 2014) provide the legislative imperative for heritage conservation in land use planning. Both documents identify conservation of resources of significant architectural, cultural, historical, archaeological, or scientific interest as a provincial interest, and PPS 2014 further recognizes that protecting cultural heritage and archaeological resources has economic, environmental, and social benefits, and contributes to the long-term prosperity, environmental health, and social well-being of Ontarians. The *Planning Act* serves to integrate this interest with planning decisions at the provincial and municipal level, and states that all decisions affecting land use planning 'shall be consistent with' PPS 2014.

The importance of identifying and evaluating built heritage and cultural heritage landscapes is recognized in two sections of PPS 2014:

- Section 2.6.1 – 'Significant built heritage resources and significant heritage landscapes shall be conserved';
- Section 2.6.3 – 'Planning authorities shall not permit development and site alteration on adjacent lands to protected heritage property except where the proposed development and site alteration has been evaluated and it has been demonstrated that the heritage attributes of the protected heritage property will be conserved.'

PPS 2014 defines *significant* as resources 'determined to have cultural heritage value or interest for the important contribution they make to our understanding of the history of a place, an event, or a people', and *conserved* as 'the identification, protection, management and use of built heritage resources, cultural heritage landscapes, and archaeological resources in a manner that ensures their cultural heritage value of interest is retained under the *Ontario Heritage Act*.' The PPS also defines:

- ***Built heritage resources*****:** 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 Aboriginal [Indigenous] community. Built heritage resources are generally located on property that has been designated under Parts IV or V of the *Ontario Heritage Act*, or included on local, provincial and/or federal registers.
- ***Cultural heritage landscapes:*** 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 Aboriginal [Indigenous] community. The area may involve features such as structures, spaces, archaeological sites or natural elements that are valued together for their interrelationship, meaning or association. Examples may include, but are not limited to, heritage conservation districts designated under the *Ontario Heritage Act*; villages, parks, gardens, battlefields, mainstreets and neighbourhoods, cemeteries, trailways, viewsheds, natural areas and industrial complexes of heritage significance; and areas recognized by federal or international designation authorities (e.g., a National Historic Site or District designation, or a UNESCO World Heritage Site).
- ***Heritage attribute:*** the principal features or elements that contribute to a *protected heritage property*'s cultural heritage value or interest, and may include the property's built or manufactured elements, as well as natural landforms, vegetation, water features, and its visual setting (including significant views or vistas to or from a *protected heritage property*).

- ***Protected heritage property:*** property designated under Parts IV, V or VI of the *Ontario Heritage Act*; property subject to a heritage conservation easement under Parts II or IV of the *Ontario Heritage Act*; property identified by the Province and prescribed public bodies as provincial heritage property under the *Standards and Guidelines for Conservation of Provincial Heritage Properties*; property protected under federal legislation, and UNESCO World Heritage Sites.

For municipalities, PPS 2014 is implemented through an official plan, which may outline further heritage policies (see Section 3.2).

3.1.3 Ontario Heritage Act and Ontario Regulation 9/06

The Province and municipalities are enabled to conserve significant individual properties and areas through the *Ontario Heritage Act* (*OHA*). Under Part III of the *OHA*, compliance with the *Standards and Guidelines for the Conservation of Provincial Heritage Properties* is mandatory for provincially-owned and administered heritage properties, and holds the same authority for ministries and prescribed public bodies as a Management Board or Cabinet directive.

For municipalities, Part IV and Part V of the *OHA* enables council to 'designate' individual properties (Part IV), or properties within a heritage conservation district (HCD) (Part V), as being of 'cultural heritage value or interest' (CHVI). Evaluation for CHVI under the *OHA* is guided by *Ontario Regulation 9/06* (*O. Reg. 9/06*), which prescribes the *criteria for determining cultural heritage value or interest*.

The criteria are as follows:

1) The property has design value or physical value because it:

    i. Is a rare, unique, representative or early example of a style, type, expression, material or construction method;

    ii. Displays a high degree of craftsmanship or artistic merit; or,

    iii. Demonstrates a high degree of technical or scientific achievement.

2) The property has historic value or associative value because it:

    i. Has direct associations with a theme, event, belief, person, activity, organization, or institution that is significant to a community;

    ii. Yields, or has the potential to yield information that contributes to an understanding of a community or culture; or,

    iii. Demonstrates or reflects the work or ideas of an architect, artist, builder, designer, or theorist who is significant to a community.

3) The property has contextual value because it:

    i. Is important in defining, maintaining or supporting the character of an area;

    ii. Is physically, functionally, visually or historically linked to its surroundings; or,

    iii. Is a landmark.

If a property meets one or more of these criteria, it may be eligible for designation under Part IV, Section 29 of the *OHA*.

Designated properties, which are formally described and recognized through by-law, must then be included on a 'Register' maintained by the municipal clerk. At a secondary level, a municipality may 'list' a property on the register to indicate that it is of potential CHVI. Importantly, designation or listing in nearly all cases applies to an entire property, not only individual structures or features.

3.1.4 Provincial Guidance

The Province, through the MTCS, has developed a series of products to advise municipalities, organizations, and individuals on heritage protection and conservation. One product used primarily for EAs is the MTCS *Criteria for Evaluating Potential for Built Heritage Resources and Cultural Heritage Landscapes: A Checklist for the Non-Specialist* (MTCS *Checklist*) (2016). This checklist helps to identify if a study area contains —or is adjacent to— known cultural heritage resources, provides general direction on identifying potential built heritage resources and cultural heritage landscapes, and aids in determining the next stages of evaluation and assessment.

One criterion listed on the MTCS *Checklist* is if a property contains buildings or structures over 40 years old at the time of assessment. This 40 year 'rule of thumb' does not automatically assign cultural heritage value or interest or protection to buildings and structures older than 40 years, nor exclude those built in the last 40 years, but assumes that a property's heritage potential increases with age. If the 'rule of thumb' identifies potential cultural heritage resources in a study area, the MTCS *Checklist* advises that a Cultural Heritage Evaluation Report (CHER) be completed to evaluate if the built element or landscape meets *O. Reg. 9/06* criteria. If the MTCS *Checklist* further indicates that known or potential for heritage resources will be impacted by the proposed development in a study area, investigation as part of a Heritage Impact Assessment (HIA) is usually necessary.[1]

More detailed guidance on identifying, evaluating, and assessing impact to built heritage resources and cultural heritage landscapes is provided in the *Ontario Heritage Tool Kit* series. Of these, *Heritage Resources in the Land Use Planning Process* (MTCS 2006) provides an outline for the contents of a HIA, which it defines as:

- 'a study to determine if any cultural resources (including those previously identified and those found as part of the site assessment)…are impacted by a specific proposed development or site alteration. It can also demonstrate how the cultural resource will be conserved in the context of redevelopment or site alteration. Mitigative or avoidance measures or alternative development or site alteration approaches may be recommended.'

For Class EAs, the *Ontario Heritage Tool Kit* partially, but not entirely, supersedes earlier MTCS advice. Criteria to identify cultural landscapes is provided in greater detail in the *Guidelines on the Man-Made Heritage Component of Environmental Assessments* (1980:7), while recording and documentation procedures are outlined in the *Guideline for Preparing the Cultural Heritage Resource Component of Environmental Assessments* (1992:3-7). The latter document also stresses the importance of identifying and gauging the cumulative effects of a Class EA development (MTCS 1992:8).

[1] For many environmental assessments, including for the Project, a CHER and HIA are combined as a Cultural Heritage Overview Report (CHOR).

3.2 Municipal Heritage Policies

3.2.1 City of Ottawa *Official Plan*

Through its *Official Plan,* the City is committed to protecting, improving, and managing cultural heritage resources, and conserving properties of CHVI in planning and infrastructure developments. This includes setting a leadership example when managing City owned cultural heritage resources and undertaking public works projects.

In Section 1.3 of the *Official Plan,* cultural heritage resources are understood as important to community vitality, and local culture, and for providing citizens with a sense of who they are. Similarly, Section 2.1 states that cultural heritage resources are to be valued and protected during the process of change. Section 2.5.5 provides the general policies regarding cultural heritage resources, while Section 4.6 outlines the requirements for heritage studies as part of development applications. Heritage resources are defined in Section 4.6.1 as:

Buildings, structures, sites, landscapes, areas or environments which may have cultural, architectural, historical, contextual and/or natural interest, and which may warrant designation under the *Ontario Heritage Act*, and/or may warrant other means of cultural heritage recognition, for example, by the federal government. Heritage significance does not only flow from recognition but is dependent on a property's inherent values.

Cultural Heritage Impact Statements (or Heritage Impact Assessments) may be required when a development has the potential to adversely affect any designated heritage resource (S. 4.6.1). This includes projects adjacent to, or across the street, from a heritage resource (S. 4.6.1), or projects along the Rideau River or Canal (S. 4.6.3).

Conserving existing heritage properties, particularly institutional buildings, significant cultural landscapes, and landmarks, are also central to urban design policies in Section 2.5.1 of the *Official Plan*, which has objectives to:

- Enhance the sense of community by creating and maintaining places with their own distinct identity; and,
- Ensuring that new development respects the character of existing areas.

3.3 Canadian Heritage Rivers System

The Canadian Heritage Rivers System is a conservation program intended to give national recognition to Canada's outstanding rivers and encourages their long-term management to conserve their natural, cultural and recreational values. This program is a federal-provincial-territorial government program that works with local community-level river stewardship groups. A 590 km Ontario portion of the Ottawa River, from Lake Temiskaming to East Hawkesbury was designated to the Canadian Heritage River System in 2016 for its outstanding cultural heritage values (Ottawa River Heritage Designation Committee 2009:9). Although not nominated for its natural heritage values, the Ottawa River does possess significant natural heritage features as well. The River also has recreational values which strengthen the ability of visitors and residents to enjoy cultural heritage and natural heritage values of the River (Ottawa River Heritage Designation Committee 2009:9), but it has not been designated for its recreational values.

The goals of the *Heritage Strategy for the Ottawa River Ontario 2009* is "to support and complement the existing integrated resource management efforts that recognize, promote and sustain the cultural heritage, natural heritage and recreational values for which the Ontario portion of the Ottawa River was nominated to the Canadian Heritage Rivers System" (Ottawa River Heritage Designation Committee 2009:22). The intent of the heritage strategy is to conserve the heritage values of the River in-situ so that sites critical to the understanding of the cultural value of the River will be maintained (Ottawa River Heritage Designation Committee 2009:23).

4.0 GEOGRAPHIC & HISTORICAL CONTEXT

4.1 Geographic Context

The study area is in eastern Ontario, and within the Clay Plains section of the Ottawa Valley Clay Plains physiographic region, an area with underlying Paleozoic dolomite and limestone and a surface of gently undulating to rolling terrain of ice laid materials typically interrupted by ridges of rock or sand (Crins et al 2009: 47; Chapman and Putnam, 1984). Overall the study area is in the Ottawa River Watershed, and between 1.6 km and 9 km southwest of Britannia Bay.

It is also in the Lake Simcoe-Rideau Eco Region, a large segment of Ontario with a mild and moist climate and significant floral and faunal diversity (Crins et al 2009: 47), and in the Upper St. Lawrence sub-region of the Great Lake-St. Lawrence Forest Region. Trees characteristic of the Upper St. Lawrence sub-region include sugar maple, beech, red maple, yellow birch, basswood, white ash, largetooth aspen, and red and bur oak, and coniferous species such as eastern hemlock, eastern white pine, white spruce, and balsam fir (Rowe, 1977).

In reference to cultural boundaries and features, the study area crosses the Greenbelt, and the Katimavick-Hazeldean and Stittsville neighbourhoods in the City of Ottawa and crosses the following Lots and Concessions in the geographic townships of Nepean, March and Goulbourn:

- The line between Lots 1 through 11 Concession 1 on the Ottawa River and Lots 1 through 11 Concession 2 on the Ottawa River, Nepean Township;
- Lot 2 Concession 3, March Township;
- Lot 2 Concession 2, March Township;
- Lots 1 through 3 Concession 1, March Township; and,
- Lot 28 Concession 12, Goulbourn Township.

4.2 Historical Context

Following the Crawford Purchase in 1783, large sections of eastern Ontario were opened to settlement, and after the Toronto Purchase of 1787, the colony was divided into four political districts: Lunenburg, Mechlenburg, Nassau, and Hesse. These became part of the Province of Upper Canada in 1791, and renamed the Eastern, Midland, Home, and Western Districts, respectively. Each district was further sub-divided into counties and townships. The Eastern district included Carleton County which was created in 1800.

The first permanent European settler in the area was Philemon Wright, who settled in 1800 in Hull Township, Quebec, with five families and 33 men. By 1805 Wright had established a significant lumber business in the area (Bond 1984:24).

4.2.1 Nepean Township History

Nepean Township was initially surveyed in 1794 by John Stegman. A number of township lots were granted to military veterans, and United Empire Loyalists and their children. However, the first settlers found area very remote and most left for more established settlements, while most grant holders continued to live along the St. Lawrence and Lake Ontario waterfronts, holding their lands in Nepean as investment properties (Elliott 1991). These Nepean properties were the subject of considerable land speculation and many of the grants were consolidated into holdings by a few families. The largest landowners during this period were the Fraser family, who held 40 lots along the Rideau River and much of what was later to become the City of Ottawa (Elliot 1991).

The first road cut through the forests of Nepean Township into Goulbourn Township led to a military settlement known as Richmond Village, which had been established in 1818 (Elliott 1991). Known as the Richmond Road, the route is the oldest thoroughfare in Ottawa and its hinterland (Woods Jr 1980; Taylor 1986:12).

Construction of the Rideau Canal between 1826 and 1832 accelerated settlement on the south and east parts of the Township. Bytown developed at the junction of the Rideau and Ottawa Rivers where work on the canal began, and the influx of labourers increased the population of the township from 580 in 1827 to 2,758 just a year later. Although most of this population was transient and left the area after the canal was finished, some remained. By 1832, the population of Nepean was 940, with many of these residents settling within Bytown (Elliott 1991). Between 1851 and 1878, the Township's population expanded from 3,800 to 6,510 (Belden 1879), and many small communities developed including Jockvale, Britannia Heights, Westboro, Hintonburg, Rochesterville and Bell's Corners (Walker and Walker 1975).

The Canada Central Railway opened between Chaudiere and Carleton Place in 1870, cutting across both Nepean and Goulbourn Townships, and became part of the Canadian Pacific Railway (CPR) in 1882 (Churcher n.d.). The Ottawa, Arnprior and Parry Sound Railway opened between Chaudiere Junction and Arnprior in 1893, crossing Nepean and March Townships. This railway became part of the Canada Atlantic railway in 1901 and then part of the Grand Trunk Railway in 1905 (Churcher n.d.). In 1915 the Canadian Northern Railway opened from Rideau Junction to Pembroke, and crossed Nepean and March Townships (Churcher n.d.).

Until the 1920s, Nepean Township was primarily rural. Despite the City's annexation of the Township's urbanized portions in 1950, suburban development continued and by the end of 1953 nearly a 1,000 houses were built in Nepean, doubling the Township's population in only 3 years. This population doubled again by 1956, and by 1961 the Township population numbered 20,000 (Elliott 1991:267 & 305). Nevertheless, large parts of Nepean and Gloucester Townships were proposed as part of the Greenbelt in the 1950 Gréber Plan for Ottawa.

The Gréber Plan originally planned for the Greenbelt to be implemented using development regulations, but Nepean and Gloucester continued to permit un-serviced subdivision development on the proposed Greenbelt lands in the early 1950s (Gordon 2015:208). In 1958 the National Capital Commission (NCC) replaced the Federal District Commission and later that year the NCC was granted powers to borrow funds for the purchase of land in the Greenbelt or expropriation (Gordon 2015:21). All the Greenbelt lands had all been acquired by the end of the 1950s, but many farmers with poorer soils decided not to lease them back from the government, and the farmland was re-forested.

In the late 1960s urban and suburban interests dominated development in the Township (Elliott 1991:174), and the provincial government established the Regional Municipality of Ottawa-Carleton in 1968 t to co-ordinate urban and infrastructure planning amongst the various local governments. Provincial Highway 417 was laid through the Township in the 1970s, and the Township was incorporated as a city in 1978. As a result of Provincial efforts to reform local government in the late 1990s the various municipalities under the Regional Municipality of Ottawa-Carleton were amalgamated into the new City of Ottawa in 2001 (Gordon 2015:308).

4.2.2 March Township

March Township was surveyed in 1820, a year after the first settlers arrived. At this time, March Township was part of the District of Johnstown, but it became part of the District of Bathurst in 1822, and part of Carleton County in the 1840s.

Many of the initial settlers were British army veterans. They were given tools to start their farms including axes, shovels and nails, as well as a blanket, kettle and panes of glass. Each soldier who settled the area was also offered a year's rations (Belden 1879). The several distinguished British officers who decided to live in the Township selected plots adjacent to the river. Among them were Captains Landell, John B. Monk, Benjamin Street, Weatherby, Cox and Stephens, General Arthur Lloyd, and Lieutenant Thomas Reid (Belden 1879; Walker and Walker 1975; Burns *et al* 1972).

Another prominent early settler was Hamnett Kirkes Pinhey, an ex-merchant from Plymouth, England. As a civilian during the Napoleonic Wars, Pinhey had been recognized for being able to get messages through the French blockade, an honour that later earned him 1000 acres in March Township (Burns *et al* 1972). In 1820, he settled on Lot 23 of Concessions 6 and 7 with his wife Mary Ann. Pinhey used his considerable wealth to build an estate that suited his needs and those of the community. He financed construction of the first church, St. Mary's, on his land between 1824 and 1826, as well as a saw mill and grist mill (Walker and Walker 1975; Belden 1879). Pinhey's estate, known as Horaceville after his son, became the focus of the community, and Pinhey himself took on the natural role as a community leader, later serving as Reeve between 1850 and 1855 (Bond 1984; Walker and Walker 1975).

The first four concessions at the west end of the Township were settled by Irish farmers, tradesmen, and low-ranking veterans. Some of these settlers received the best arable land in the Township, whereas soil closer to the river was deceptively shallow (Burns *et al* 1972). In terms of soil, Belden observed in 1879, March Township was the poorest in Carleton County.

The first census of the Township was taken in 1823, and recorded 49 families of a population of over 200 (Walker and Walker 1975). Settlers continued to arrive even after the land grants were discontinued in 1824, and by the mid-19th century the population numbered 1,125 inhabitants including blacksmiths, cobblers, carpenters, tailors, innkeepers and merchants (Bond 1968; Burns *et al* 1972). Settlement was event aided by events such as the widespread fires during the summer of 1870, which cleared land, dried swamps and changed drainage patterns, and ultimately opened the land for agriculture (Burns *et al* 1972).

The Ottawa, Arnprior and Parry Sound Railway between Chaudiere Junction and Arnprior opened in 1893 and the Canadian Northern Railway opened from Rideau Junction to Pembroke in 1915. The township remained a rural agricultural area until the middle of the 20th century.

In 1964 William Teron, a developer and planner, began building an urban 'new town' development in March Township. This development involved creating clusters of houses in distinctive village communities that revolved around a city centre and were separated from each other by naturally landscaped open space (Elliot 2012). Two years later the Province established the Regional Municipality of Ottawa-Carleton to co-ordinate planning and infrastructure amongst the various local governments including March Township. Land set aside for research and development purposes became employment lands for technology-based industries in the 1970s. All of March Township and parts of Goulbourn Township and Nepean Township amalgamated and became the City of Kanata in 1978 (Gordon 2015:308), and in 2001 the City of Kanata was amalgamated into the new City of Ottawa.

4.2.3 Goulbourn Township

Goulbourn Township was part of a large tract of First Nations land purchased by the British Government in 1816 as part of a combined defense and settlement plan north of the Rideau River. The township was roughly surveyed over the following years, together with Bathurst, Drummond and Beckwith Townships in Lanark County (Walker & Walker 1975).

The first permanent community was established around the third concession near the southeast comer of the township. In 1818, 400 members of the British 99th Regiment and their families constructed a road from Bytown and, along with a number of tradespeople, settled in and around the carefully planned village of Richmond (Bond 1984). A trail was forced west to Perth in 1820 (Bottriell 1998) and the by the same year a grist mill and school house had been erected, with a sawmill constructed in 1821. Over the next few years an Episcopal and Catholic church were added.

Initially this military settlement was the most important in the County, and had up to twenty stores and a dozen breweries and distilleries. However, with construction of the Rideau Canal the military shifted focus to Bytown and the village —now called Richmond— went into a gradual but steady decline. The village was incorporated in 1850 and remained independent from Goulbourn Township for nearly 125 years. By 1879 Richmond had only four general stores, two harness shops, four blacksmith shops, two wagon shops, three shoe stores, one tailor, one combined grist and saw mill, one water mill, two hotels, four churches, a school and a town hall (Belden 1879).

Other early 19th century villages included Hazeldean, established between 1818 and 1819, and the village of Ashton and community of Stittsville, both established in the early 1820s (Walker & Walker 1975).

Hazeldean Road, originally 12th Line, was created when during the township survey and land grants between 1818 and 1828. By 1833 the road connected communities on the west side of Goulbourn Township to the more populated communities closer to Bytown.

The Canada Central Railway (later part of the Canadian Pacific Railway) was constructed across the township along the line between the Tenth and Eleventh Concessions in 1870, and railway stations were built at Stittsville and Ashton. The Canadian Northern Railway cut across the southeast corner of the Township in 1913.

Part of Goulbourn Township was incorporated into the new city of Kanata in 1978, with the remainder amalgamated into the new City of Ottawa in 2001.

4.2.4 Study Area

The 1863 Walling map of Carleton County shows most of the lots in Nepean, March and Goulbourn Townships as granted and had at least one building (Figure 3). By 1879, maps in the *Illustrated Historical Atlas of the County of Carleton* by H. Belden show that many of the lots crossed by the study area had been subdivided or consolidated, but many were still held by the same families listed on the 1863 Walling map (Figure 4).

Topographic maps from 1906, 1935, and early 1960s show little change in the area from the late 19th century (Figure 5 and Figure 6). Infrastructure such as the Grand Trunk Railway line, the Canadian Northern Ontario Railway line, and an electrical transmission corridor had been built by 1935, and by the 1960s a few more roads had been added or improved (Figure 7).

Land speculators bought large areas in Nepean, March and Goulbourn townships in the late 1950s and early 1960s. One of these, Valley Lands Development, was a consortium of builders who purchased land in 1963 between the village of Hazeldean and Eaglesons Corners for a development called Glen Cairn (Glen Cairn Community Association n.d.). As mentioned above, William Teron began his Kanata development in 1964 in March Township. Both communities, and the path of Provincial Highway 417 are illustrated on a 1971 topographic map (Figure 8). Land around the eastern half of the study area was later protected as part of the Greenbelt and saw little development. Over the course of the late 20th century and the early 21st century, the south east corner of March Township and the northeast corner of Goulbourn Townships, later the City of Kanata and now the western suburbs of the City of Ottawa,- have become increasingly suburban and urban (Figure 9).

LEGEND

PROPOSED ALIGNMENT

PROPOSED PLATFORM

NOTE(S)

1. FOR INFORMATIONAL PURPOSES ONLY. NO EVALUATION OR ASSESSMENT PROVIDED.

REFERENCE(S)

1. PROPOSED ALIGNMENT RECEIVED FROM PARSONS ON JANUARY 26, 2018, FILE NAME: 476242-01000-pln-ali-main line.dwg
2. PROJECTION: TRANSVERSE MERCATOR, DATUM: NAD 83, COORDINATE SYSTEM: MTM ZONE 9, VERTICAL DATUM: CGVD28

0 250 500 1,000

1:25,000 METRES

CLIENT

PARSONS CORP

PROJECT

KANATA LIGHT RAIL TRANSIT PLANNING AND EA STUDY
BAYSHORE STATION TO PALLADIUM DRIVE, OTTAWA, ONTARIO

TITLE

1863 WALLING MAP OF CARLETON COUNTY

CONSULTANT

GOLDER

YYYY-MM-DD	2018-01-05
DESIGNED	BH
PREPARED	JEM
REVIEWED	BH
APPROVED	HJD

PROJECT NO.	CONTROL	REV.	MAP
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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM:

25mm

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LEGEND

PROPOSED ALIGNMENT

PROPOSED PLATFORM

NOTE(S)

1. FOR INFORMATIONAL PURPOSES ONLY. NO EVALUATION OR ASSESSMENT PROVIDED.

REFERENCE(S)

1. PROPOSED ALIGNMENT RECEIVED FROM PARSONS ON JANUARY 26, 2018, FILE NAME: 476242-01000-pln-ali-main line.dwg
2. PROJECTION: TRANSVERSE MERCATOR, DATUM: NAD 83, COORDINATE SYSTEM: MTM ZONE 9, VERTICAL DATUM: CGVD28

0 250 500 1,000

1:25,000 METRES

CLIENT

PARSONS CORP

PROJECT

KANATA LIGHT RAIL TRANSIT PLANNING AND EA STUDY
BAYSHORE STATION TO PALLADIUM DRIVE, OTTAWA, ONTARIO

TITLE

1879 BELDEN MAP OF CARLETON COUNTY

CONSULTANT

GOLDER

YYYY-MM-DD	2018-01-05
DESIGNED	BH
PREPARED	JEM
REVIEWED	BH
APPROVED	HJD

PROJECT NO.	CONTROL	REV.	MAP
1668654	0004	0	4

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 25mm

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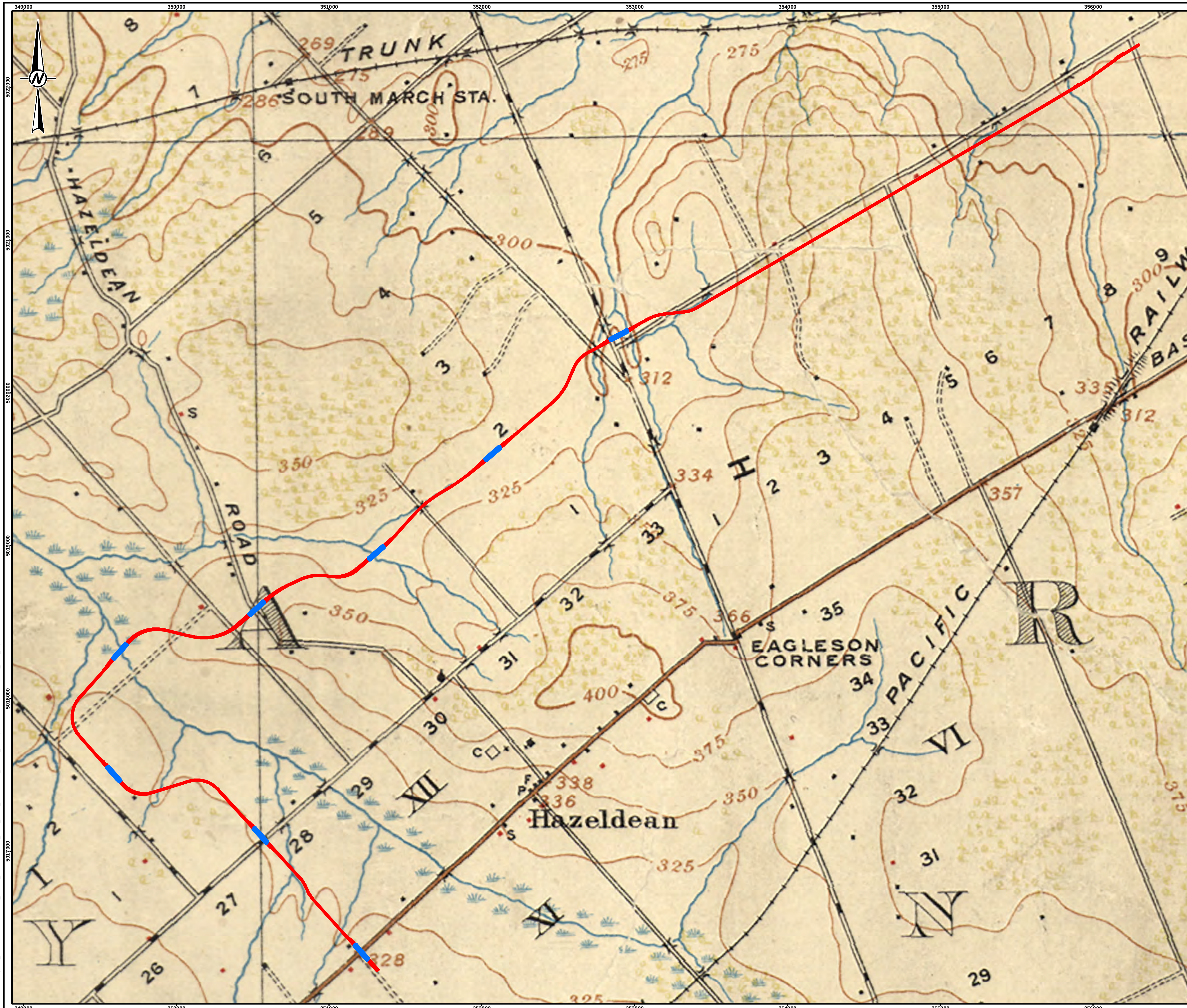

LEGEND

PROPOSED ALIGNMENT

PROPOSED PLATFORM

NOTE(S)

1. FOR INFORMATIONAL PURPOSES ONLY. NO EVALUATION OR ASSESSMENT PROVIDED.

REFERENCE(S)

1. PROPOSED ALIGNMENT RECEIVED FROM PARSONS ON JANUARY 26, 2018, FILE NAME: 476242-01000-pln-ali-main line.dwg
2. PROJECTION: TRANSVERSE MERCATOR, DATUM: NAD 83, COORDINATE SYSTEM: MTM ZONE 9, VERTICAL DATUM: CGVD28

0 250 500 1,000

1:25,000 METRES

CLIENT

PARSONS CORP

PROJECT

KANATA LIGHT RAIL TRANSIT PLANNING AND EA STUDY
BAYSHORE STATION TO PALLADIUM DRIVE, OTTAWA, ONTARIO

TITLE

1906 TOPOGRAPHIC PLAN OF CARLETON COUNTY

CONSULTANT

GOLDER

YYYY-MM-DD	2018-01-05
DESIGNED	BH
PREPARED	JEM
REVIEWED	BH
APPROVED	HJD

PROJECT NO.	CONTROL	REV.	MAP
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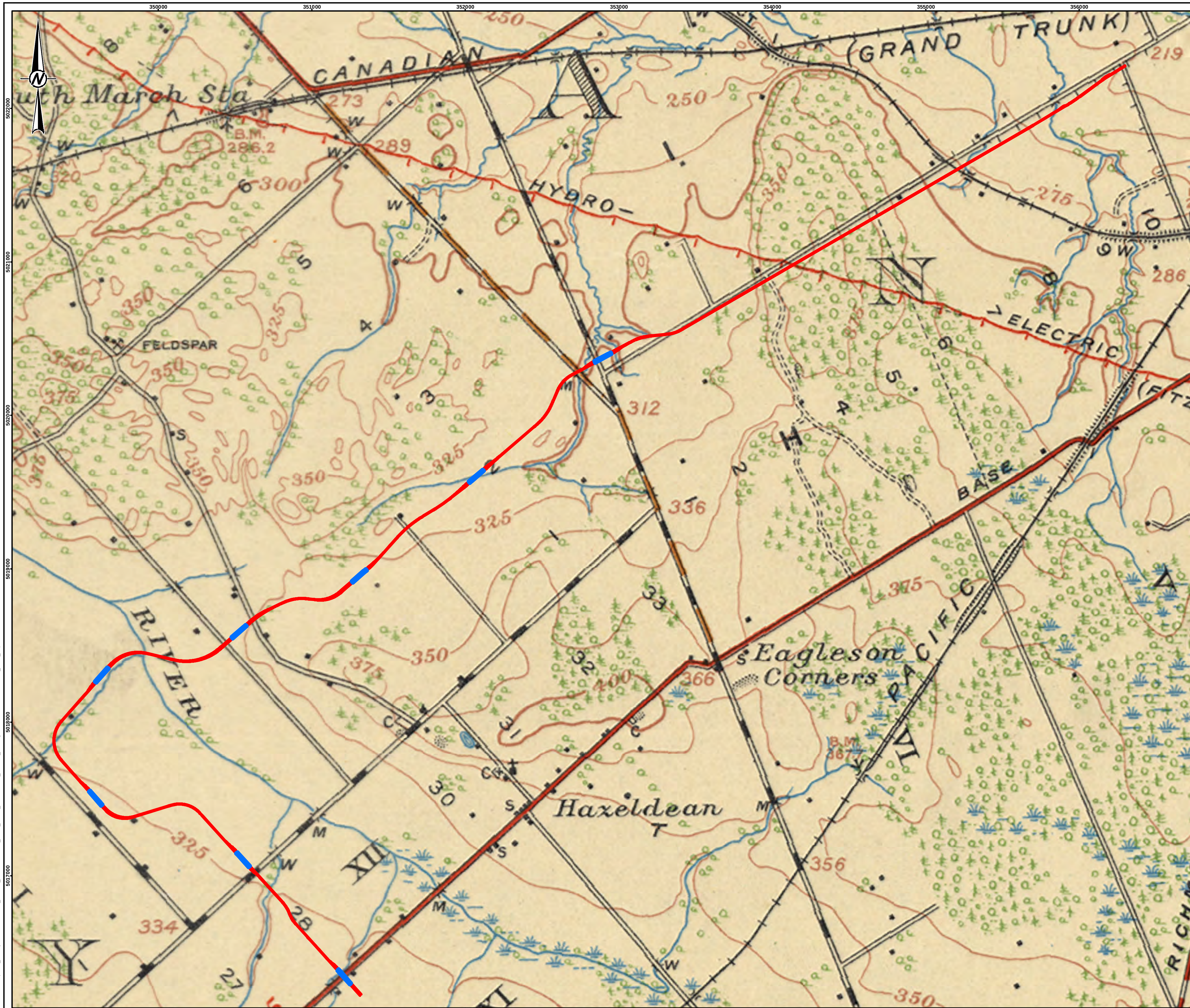

LEGEND

PROPOSED ALIGNMENT

PROPOSED PLATFORM

NOTE(S)

1. FOR INFORMATIONAL PURPOSES ONLY. NO EVALUATION OR ASSESSMENT PROVIDED.

REFERENCE(S)

1. PROPOSED ALIGNMENT RECEIVED FROM PARSONS ON JANUARY 26, 2018, FILE NAME: 476242-01000-pln-ali-main line.dwg
2. PROJECTION: TRANSVERSE MERCATOR, DATUM: NAD 83, COORDINATE SYSTEM: MTM ZONE 9, VERTICAL DATUM: CGVD28

0 250 500 1,000

1:25,000 METRES

CLIENT

PARSONS CORP

PROJECT

KANATA LIGHT RAIL TRANSIT PLANNING AND EA STUDY
BAYSHORE STATION TO PALLADIUM DRIVE, OTTAWA, ONTARIO

TITLE

1935 TOPOGRAPHIC PLAN OF CARLETON COUNTY

CONSULTANT

GOLDER

YYYY-MM-DD	2018-01-05
DESIGNED	BH
PREPARED	JEM
REVIEWED	BH
APPROVED	HJD

PROJECT NO.	CONTROL	REV.	MAP
1668654	0003	0	6

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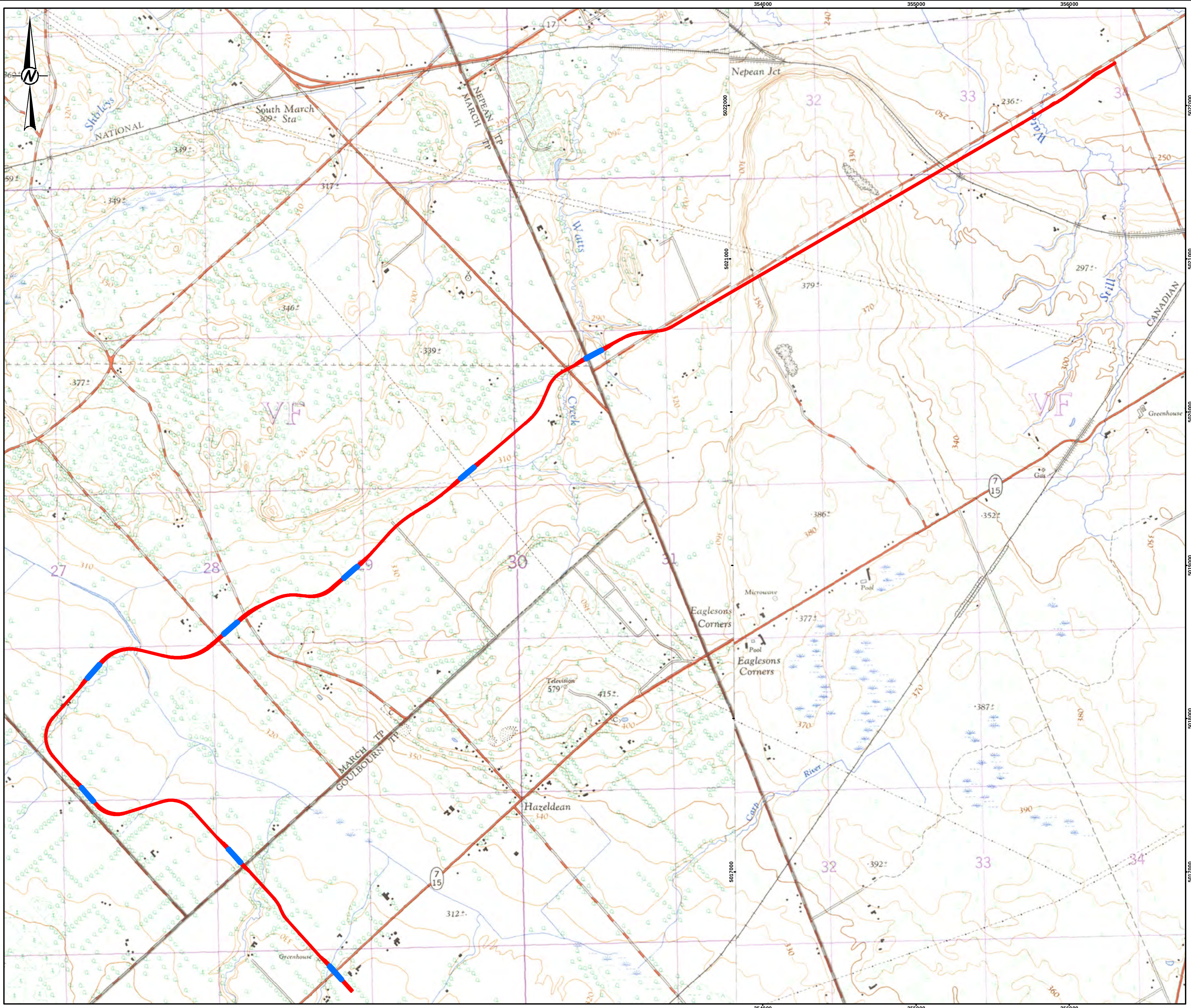

LEGEND

PROPOSED ALIGNMENT

PROPOSED PLATFORM

NOTE(S)

1. FOR INFORMATIONAL PURPOSES ONLY. NO EVALUATION OR ASSESSMENT PROVIDED.

REFERENCE(S)

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2. PROJECTION: TRANSVERSE MERCATOR, DATUM: NAD 83, COORDINATE SYSTEM: MTM ZONE 9, VERTICAL DATUM: CGVD28

0 250 500 1,000

1:25,000 METRES

CLIENT

PARSONS CORP

PROJECT

KANATA LIGHT RAIL TRANSIT PLANNING AND EA STUDY
BAYSHORE STATION TO PALLADIUM DRIVE, OTTAWA, ONTARIO

TITLE

1962/1963 TOPOGRAPHIC PLAN OF CARLETON COUNTY

CONSULTANT

GOLDER

YYYY-MM-DD	2018-01-05
DESIGNED	BH
PREPARED	JEM
REVIEWED	BH
APPROVED	HJD

PROJECT NO.	CONTROL	REV.	MAP
1668654	0003	0	7

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM:

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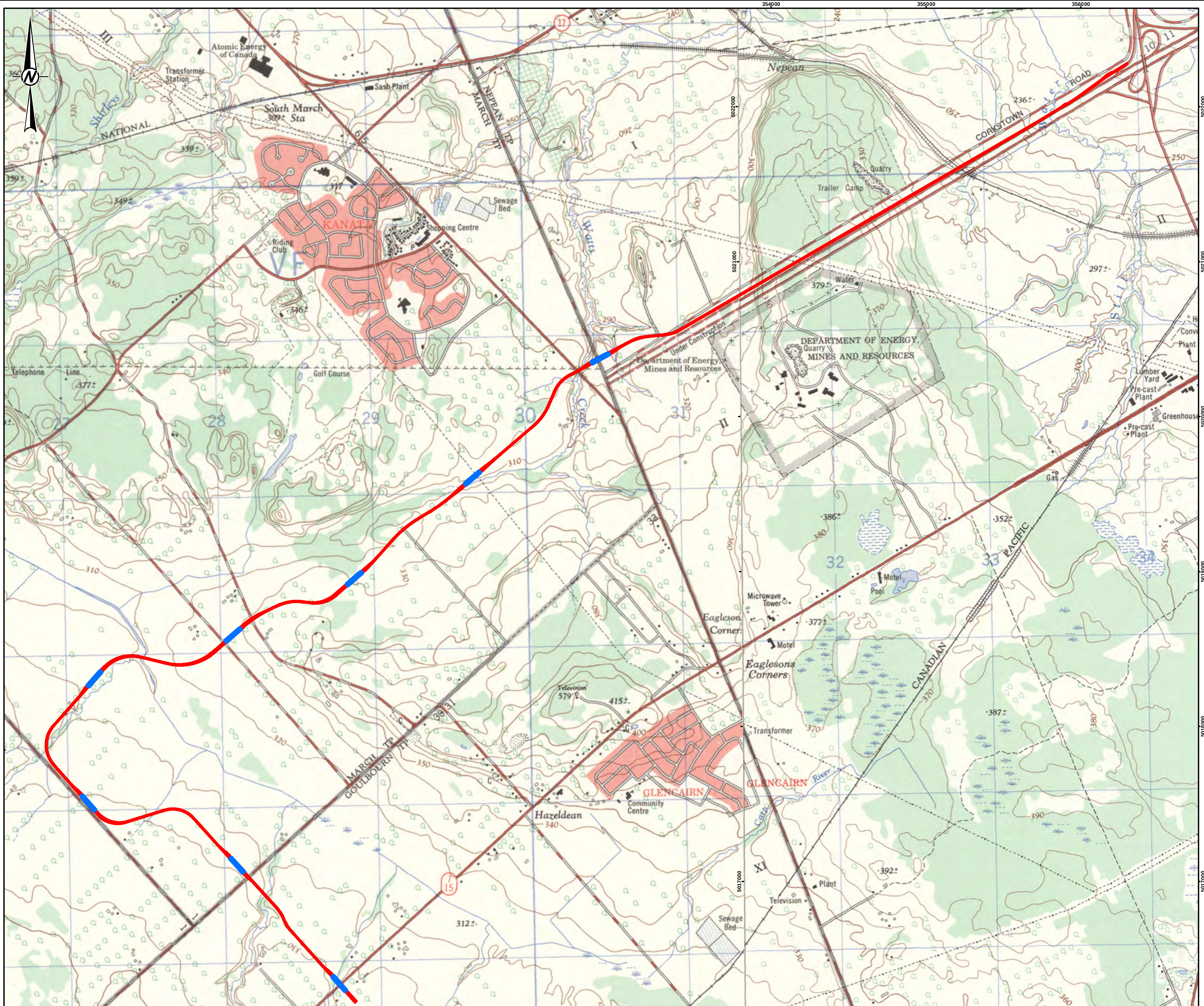

LEGEND

PROPOSED ALIGNMENT

PROPOSED PLATFORM

NOTE(S)

1. FOR INFORMATIONAL PURPOSES ONLY. NO EVALUATION OR ASSESSMENT PROVIDED.

REFERENCE(S)

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2. PROJECTION: TRANSVERSE MERCATOR, DATUM: NAD 83, COORDINATE SYSTEM: MTM ZONE 9, VERTICAL DATUM: CGVD28

0 250 500 1,000

1:25,000 METRES

CLIENT

PARSONS CORP

PROJECT

KANATA LIGHT RAIL TRANSIT PLANNING AND EA STUDY
BAYSHORE STATION TO PALLADIUM DRIVE, OTTAWA, ONTARIO

TITLE

1971 TOPOGRAPHIC PLAN OF CARLETON COUNTY

CONSULTANT

GOLDER

YYYY-MM-DD	2018-01-05
DESIGNED	BH
PREPARED	JEM
REVIEWED	BH
APPROVED	HJD

PROJECT NO.	CONTROL	REV.	MAP
1668654	0003	0	8

LEGEND

PROPOSED ALIGNMENT

PROPOSED PLATFORM

NOTE(S)

1. FOR INFORMATIONAL PURPOSES ONLY. NO EVALUATION OR ASSESSMENT PROVIDED.

REFERENCE(S)

1. PROPOSED ALIGNMENT RECEIVED FROM PARSONS ON JANUARY 26, 2018, FILE NAME: 476242-01000-pln-ali-main line.dwg
2. Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, © OpenStreetMap contributors, and the GIS User Community
3. PROJECTION: TRANSVERSE MERCATOR, DATUM: NAD 83, COORDINATE SYSTEM: MTM ZONE 9, VERTICAL DATUM: CGVD28

0 250 500 1,000

1:25,000 METRES

CLIENT

PARSONS CORP

PROJECT

KANATA LIGHT RAIL TRANSIT PLANNING AND EA STUDY
BAYSHORE STATION TO PALLADIUM DRIVE, OTTAWA, ONTARIO

TITLE

2017 TOPOGRAPHIC MAP

CONSULTANT

GOLDER

YYYY-MM-DD	2017-10-17
DESIGNED	BH
PREPARED	JEM
REVIEWED	BH
APPROVED	HJD

PROJECT NO.	CONTROL	REV.	MAP
1668654	0004	0	9

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 25mm

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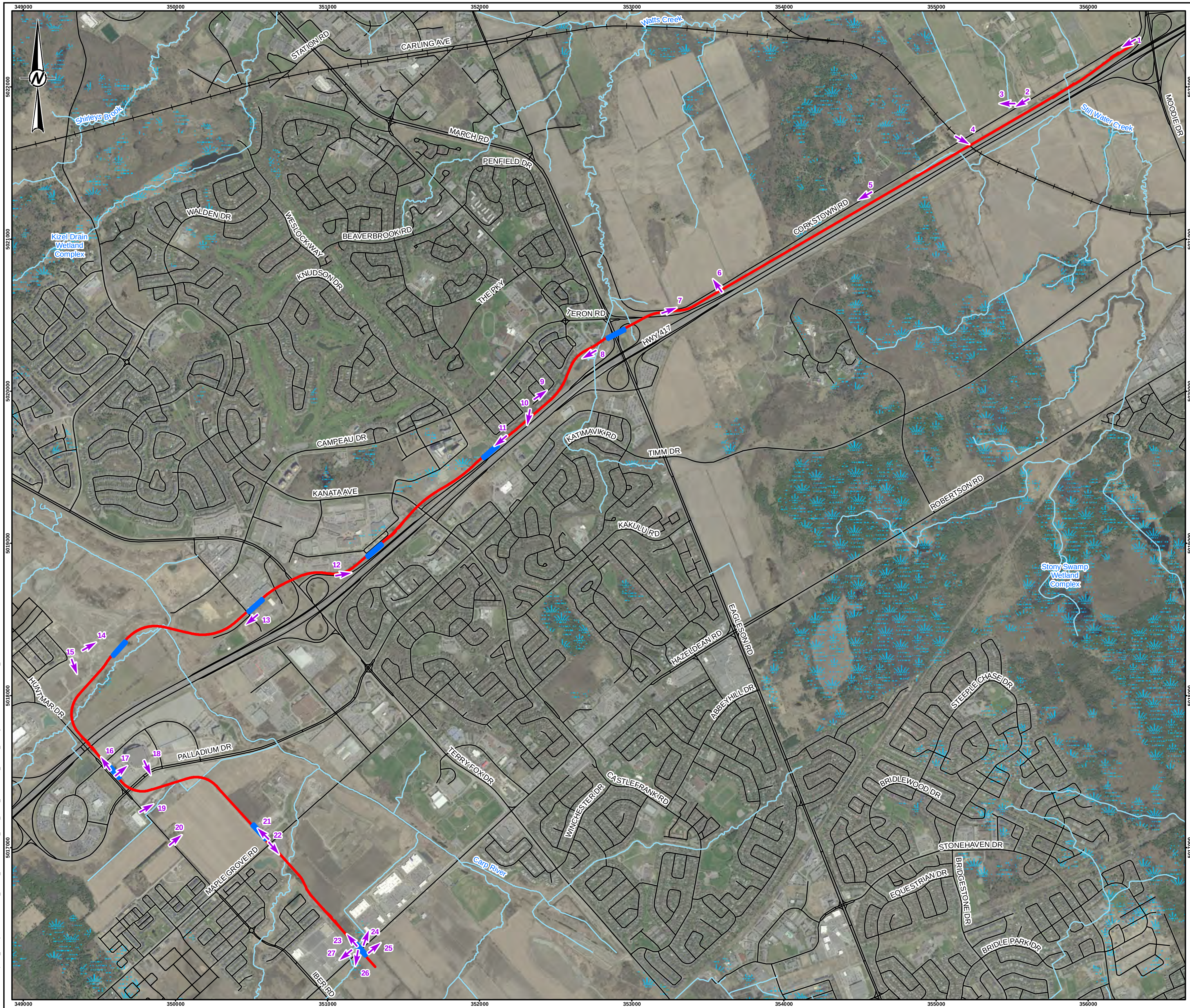
5.0 AFFECTED ENVIRONMENT

5.1 Existing Conditions

Overall the study area can be characterized as a mixed rural, urban, and transportation corridor. It is adjacent to Highway 417, and passes woodlots, agricultural fields, multi-unit residential buildings, institutional buildings, commercial buildings, parking lots, and municipal parks. It is crossed by several arterial and collector streets, highway ramps and a rail line. From east to west the setting of the study area can be divided into three main sections:

- Nepean rural, north side of Highway 417 between Moodie Drive and Eagleson Road/March Road;
- Kanata suburban, north side of Highway 417 between Eagleson Road/March Road and Huntmar Drive; and,
- Stittsville rural, from Highway 417 to Hazeldean Road.

Each of these zones are described below, and the photo points locations indicated on Figure 10.



LEGEND

- PHOTOGRAPH LOCATION AND DIRECTION
- RAILWAY
- WATERCOURSE
- ROADWAY
- WETLAND
- PROPOSED ALIGNMENT
- PROPOSED PLATFORM

NOTE(S)

1. FOR INFORMATIONAL PURPOSES ONLY. NO EVALUATION OR ASSESSMENT PROVIDED.

REFERENCE(S)

1. PROPOSED ALIGNMENT RECEIVED FROM PARSONS ON JANUARY 26, 2018, FILE NAME: 476242-01000-pln-ali-main line.dwg
2. LAND INFORMATION ONTARIO (LIO) DATA PRODUCED BY GOLDER ASSOCIATES LTD. UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2014
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0 250 500 1,000

1:25,000 METRES

CLIENT

PARSONS CORP

PROJECT

KANATA LIGHT RAIL TRANSIT PLANNING AND EA STUDY
BAYSHORE STATION TO PALLADIUM DRIVE, OTTAWA, ONTARIO

TITLE

PHOTOGRAPH LOCATIONS AND DIRECTIONS

CONSULTANT

GOLDER

YYYY-MM-DD	2017-10-17
DESIGNED	BH
PREPARED	JEM
REVIEWED	BH
APPROVED	HJD

PROJECT NO.	CONTROL	REV.	MAP
1668654	0004	0	10

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5.1.1 Nepean rural

The Nepean rural section is a strip of land approximately 40 metres wide between Highway 417 and Corkstown Road. This corridor is defined by slopes, ditches, and flat areas forming part of the highway to the south and municipal road to the north, and is covered in grasses, shrubs and coniferous trees. Corkstown Road has a rural cross section with wide gravel shoulders and ditches on either side, and is lined on both sides with wood telephone poles and power lines. A chain link fence separates the road from the highway. The Canadian National Railway line also crosses in this section.

North of Corkstown Road are sports fields, pastures, woodlots, campground and agricultural fields of the Wesley Clover Parks equestrian centre and campground. This section is part of the Greenbelt.

	*Photo Point 1: View facing southwest of the study area from next to Moodie Drive.*
	*Photo Point 2: View facing southwest along Corkstown Road from next to the entrance to the Wesley Clover Parks Equestrian Centre driveway.*

	*Photo Point 3: View facing west of the fields and pastures on the north side of Corkstown Road.*
	*Photo Point 4: View facing southeast where the railway tracks cross the study area.*
	*Photo Point 5: View facing southwest along the study area and Corkstown Road.*

	*Photo Point 6: View facing northwest, of the fields north of the study area.*
	*Photo Point 7: View facing east of the study area between Highway 417 and Corkstown Road, near the Hwy 417 and Eagleson Road/March Road interchange.*

5.1.2 Kanata suburban

The eastern half of the Kanata suburban section is bound by the highway to the south and suburban residential and commercial areas to the north, while the western half is transitioning from rural to residential and commercial. The topography has been shaped by the highway construction; some areas are relatively flat while much of the land along the north edge of the highway consists of a large ditch and earth berm separating the highway from the residential and commercial properties to the north. The land along the edge of the highway is covered in grasses and sumac trees.

A neighbourhood of two-storey townhouses and small parks back on to the study area near Eagleson Road. Five to twelve storey hotels, extended stay suites, condos and a retirement home are between the townhouses and Kanata Ave, and the area between Kanata Ave and Terry Fox Drive to the north is a large commercial complex and the Terry Fox OC Transpo station. Between Terry Fox Drive and Huntmar Drive the study area passes more commercial properties and crosses open space that changing from agricultural use to residential subdivisions and commercial developments. Views along the study area are channelled along the highway route.

<table>
<tr><td></td><td>Photo Point 8: View facing southwest, of the study area from the west side of the Highway 417 and Eagleson Road/March Road interchange. This is open space behind a commercial plaza and residential area.</td></tr>
<tr><td></td><td>Photo Point 9: View facing east of the townhouses that are north of and back onto the study area.</td></tr>
<tr><td></td><td>Photo Point 10: View facing south of the landscape alongside Highway 417 crossed by the study area</td></tr>
</table>

	*Photo Point 11: View facing southwest of the landscape alongside Highway 417 crossed by the study area.*
	*Photo Point 12: View facing east next to the study area across the parking lot for the Landmark Cinema from a point just east of the Highway 417 and Terry Fox Drive interchange.*
	*Photo Point 13: View facing southwest across the study area and Highway 417 at the point where the study area crosses Didsbury Road.*

	*Photo Point 14: View facing east of the landscape around the study area illustrating the changing nature of the landscape from rural agricultural to suburban.*
	*Photo Point 15: View facing south of the landscape around the study area illustrating the changing nature of the landscape from rural agricultural to suburban.*

5.1.3 Stittsville rural

The Stittsville section is characterized as rural, although it is also developing a suburban character. Overall the area is flat and is cut by a drain flowing north towards the Carp River. Vegetation in this area includes a mix of coniferous and deciduous trees, planted as part of contemporary landscaping or allowed to grow along the edges of fields. This section crosses agricultural fields that were used most recently to grow corn, but also includes wild and tended grasses.

This area also crosses parking lots, fields and woodlot and passes the Canadian Tire Centre arena, an older residential property at 210 Huntmar Drive, a newer residential area, and a commercial area. After passing the Canadian Tire Centre arena it follows the edge of historic fields down to Hazeldean Road, then crosses Palladium Drive, Maple Grove Road and Hazeldean Road. Most of the views here are open across the flat parking lots and fields. The end of the study area, just south of Hazeldean Road, is in a field surrounded by tree lines.

Views to the northeast along Hazeldean Road include a commercial area north of the road, and a nearby property on the south side of the road, 590 Hazeldean Road, is designated under Part IV of the *OHA* and can be seen from where the study area crosses Hazeldean Road. This property is approximately 350 metres northwest of the study area and separated by two intervening fields, each divided by tree lines. Views to the southwest of the study area include 5654 Hazeldean Road on the south side of the road, which includes a small house converted to office use. On the north side of the road is a commercial area with large parking lots and a bank.

	*Photo Point 16: View facing southeast of the study area next to Huntmar Drive (right side of photo). The parking lot for the Canadian Tire Centre is visible on the left of the photo.*
	*Photo Point 17: View facing northeast of the Canadian Tire Centre from the study area.*
	*Photo Point 18: View facing southeast from Palladium Drive at the barn on 210 Huntmar Drive.*
	*Photo Point 19: View facing northeast of the house on 210 Huntmar Drive.*

	*Photo Point 20: View facing northeast of a field next to Huntmar Drive crossed by the study area.*
	*Photo Point 21: View facing northwest from Maple Grove Road of the study area.*
	*Photo Point 22: View facing southeast from Maple Grove Road of the study area.*

	*Photo Point 23: View facing northwest from Hazeldean Road of the study area.*
	*Photo Point 24: View facing northeast of the area next to the study area on Hazeldean Road.*
	*Photo Point 25: View facing east-northeast where the study area crosses Hazeldean Road. This view is aimed at the nearby designated heritage property at 590 Hazeldean Road.*

	*Photo Point 26: View facing south from where the study area crosses Hazeldean Road of a small house converted to an office next to the study area.*
	*Photo Point 27: View facing southwest of the area next to the study area on Hazeldean Road.*

5.2 Identified Cultural Heritage Resources

5.2.1 MTCS Checklist Negative Results

Background research and field investigations based on the MTCS *Checklist* (APPENDIX A) determined that the study area **does not** contain:

- properties identified, designated or otherwise protected (listed) under the *Ontario Heritage* Act as being of cultural heritage value;
- national historic sites of Canada;
- railway stations designated under the *Heritage Railway Stations Protection Act*;
- lighthouses designated under the *Heritage Lighthouse Protection Act*;
- buildings classified or recognized by the Federal Heritage Buildings Review Office (FHBRO) as a federal heritage building;
- nor is the study area within a United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage Site.

Background research also found that the study area **does not** contain a property or parcel of land that:

- is the subject of a municipal, provincial or federal commemorative or interpretive plaque; or,
- has or is adjacent to a known burial site and/or cemetery.

This CHOR found no evidence of local or aboriginal knowledge or accessible documentation suggesting that the study area:

- is considered a landmark in the local community or contains any structures or sites that are important in defining the character of the area; or,
- has special association with a community, person or historical event.

5.2.2 MTCS Checklist Positive Results

This CHOR found that the study area:

- is within the watershed of the Ottawa River—a Canadian Heritage River; contains one property —210 Huntmar Drive— as mentioned in Section 5.1 with buildings or structures over 40 years old. 210 Huntmar Drive is mapped in Figure 11; and,
- the Nepean Rural section of the study area is within the Greenbelt and is part of an area identified by the NCC as the Western Farmland cultural landscape (Contentworks 2004:41).

5.2.3 Analysis of Identified Known and Potential Cultural Heritage Resources

5.2.3.1 The Ottawa River –Canadian Heritage River

The study area is technically within the watershed of the Ottawa River. The Ontario side of the Ottawa River from Lake Temiskaming to East Hawkesbury was designated to the Canadian Heritage Rivers System in 2016 for its cultural heritage value (CHRS 2017). The River was nominated for both cultural heritage and recreational values. Although it was not designated for its natural heritage and recreational values, the Ottawa River does possess significant natural heritage features and recreational values which strengthen the ability of visitors and residents to enjoy cultural heritage and natural heritage values of the River (Ottawa River Heritage Designation Committee 2009:9).

The history of the Ottawa River is important in understanding the development of Canada. Important aspects of the Ottawa River's heritage include:

- the history and contemporary understanding of the River as the cultural heartland of the Algonquin peoples;
- the history of the River as an important travel route for first nations, explorers and fur traders;
- the historical contribution of the French in North America along the River;
- the history of the river for industrial development of the area including logging and hydro electric power generation; and,
- the importance of the river for the development of Ottawa as the national capital (Ottawa River Heritage Designation Committee 2009:10).

Broad cultural heritage values include:

- Resource harvesting;
- Water transport;
- Riparian settlement;
- Cultural and recreation; and,
- Jurisdictional uses (Ottawa River Heritage Designation Committee 2009:11).

These values are expressed at historic and cultural sites found along the river.

Recreational values for the Ottawa River include a mix of natural and cultural appreciation and activities to experience both the natural and cultural environment of the river. These values include outdoor and water related recreational opportunities as well as views of the natural and cultural environment around the River and in the communities along the River.

The study area is over 1.5 km south of the River at its nearest point and there is no evidence of any connection between any properties in the study area and the River. No evidence of any significant connection between any properties crossed by the Project and the heritage values of the Ottawa River were found during background research of field investigation. The study area is not connected to the River for early exploration of Ontario, French settlement of Canada, transportation, resource harvesting, riparian settlement, recreation, water power, or water related industrial development in Ottawa.

5.2.3.2 210 Huntmar Drive

210 Huntmar Drive is a long, narrow property with its short axis fronting Huntmar Drive. It includes a barn and shed and a house –all over 40 years old— surrounded by trees that also line the back and sides of the property (Photo Point 18 and Photo Point 19). The house is a single detached, one-storey Standard Ranch with attached double garage and "T"-shape plan with the long axis oriented perpendicular to the road. The barn is a two-storey Wisconsin Barn with a Swedish Gambrel roof and vertical board cladding. On its southwest side is a small, single-storey addition with shed roof. The detached shed is a single storey, and has a metal clad walls and roof.

This property was once part of the Thomas James Farm. James was living in March Township by 1851 and eventually established a family farm with the farm buildings at the location of the current property 210 Huntmar Drive. Land registry records show that the family owned the property into the early 20th century. Archaeological investigations of the property indicate that this was a typical rural farm (Past Recovery 2013:45). Over the course of the 20th century the farm was subdivided and sold off. According to aerial photographs the original farmhouse and several outbuildings were demolished between the 1950s and early 1970s. The property has recently been office and storage for a construction company (Past Recovery 2013:35).

Golder could not access the property during the site visit but photographed the property from the road right-of-way. On the basis of the background study and field investigations conducted for this CHOR, this property was determined **not** to be of CHVI since it ***does not*** demonstrate:

Physical or Design Value:

- All structures on the property are built in a common architectural style or form found throughout the municipality, and were built in widely available materials without a high level of craftsmanship. The existing house on the property is not connected to the agricultural history of the property and historic barns and outbuildings have been moved, demolished and renovated over the course of the 20th century. There is no evidence to suggest that the buildings on this property are rare, unique, representative or early examples of the style, type expression, material or construction method. There is no evidence that the structures on this property display a high degree of craftsmanship or artistic merit. There is no evidence to suggest this property demonstrates a high degree of technical or scientific achievement.

Historical or Associative Value

- Based on municipal consultation and limited historical research, the property was not found to be directly associated with significant themes, events, beliefs, persons, organizations, or institutions, nor does it have potential to contribute to an understanding of the community or culture. The James family was a typical farm family of the 19th and early 20th century. The history of this farm is of an average farm in the area. There is no evidence to suggest that this property has direct associations with a theme, event, belief, person, activity, organization or institution that is significant to a community. There is no evidence to suggest that this property will yield or has the potential to yield information that contributes to an understanding of a community or culture and there is no evidence to suggest this property demonstrates or reflects the work or ideas of an architect, artist, builder, designer, or theorist who is significant to a community.

Contextual Value

- There is no evidence to suggest this property defines or supports the character of the area, or is physically, functionally, visually or historically linked to its surroundings. There is no evidence to suggest this property would be considered a cultural heritage landmark. The character of the area is undergoing fundamental change from rural to suburban. Based on historical research and field investigation this property is a typical 19th century farm that has evolved from agricultural and residential to industrial and commercial over time. The original character of the 19th century farm has slowly been stripped from the property since the mid-20th century when outbuildings and the original farmhouse were moved and demolished. New land uses in the area such as the adjacent stadium, police station and commercial properties have introduced a new character to the surrounding area entirely separate from the 19th century agricultural past of the area.

Furthermore consultation with a City of Ottawa Heritage Planner revealed that the City does not consider this property to be of CHVI.

5.2.3.3 NCC Western Farmlands Cultural Landscape

The NCC has recognized the Greenbelt as a medium-scale cultural landscape. Within the Greenbelt three smaller scale cultural landscapes have been identified including: Mer Bleue, the Western Farmland, and the Eastern Farmland (Smith 2004:41). This landscape in the Nepean Rural section of the study area is defined by the rural character observed around Corkstown Road, where the road has a rural cross section with grass covered swales, wood telephone poles, gravel shoulders and two-lane width (Photo Point 1 through Photo Point 7). This cultural heritage resource is summarized in Table 1, mapped in Figure 11 and described in **APPENDIX B**. The study area is within the right-of-way for Highway 417, between the highway and Corkstown Road. This area has rural characteristics but the historic integrity of the landscape as an agricultural landscape has been altered and compromised by the presence of the Provincial highway.

Cultural heritage resources of the Greenbelt include a combination of distinct landscape features and man-made structures having historic value (NCC 2013: 81). Cultural heritage characteristics of the Greenbelt include:

- Landscape features that visually express land stewardship, ecological diversity and the history of the Capital;
- Buildings structures and features of cultural and heritage value that celebrate the Capital's rural history; and,
- Rural cultural heritage (NCC 2013: 81).

The rural cultural heritage of the Greenbelt is present in the Nepean Rural section of the study area. The project crosses the Western Farmland small scale cultural landscape, which is identified as an evolved cultural landscape that is:

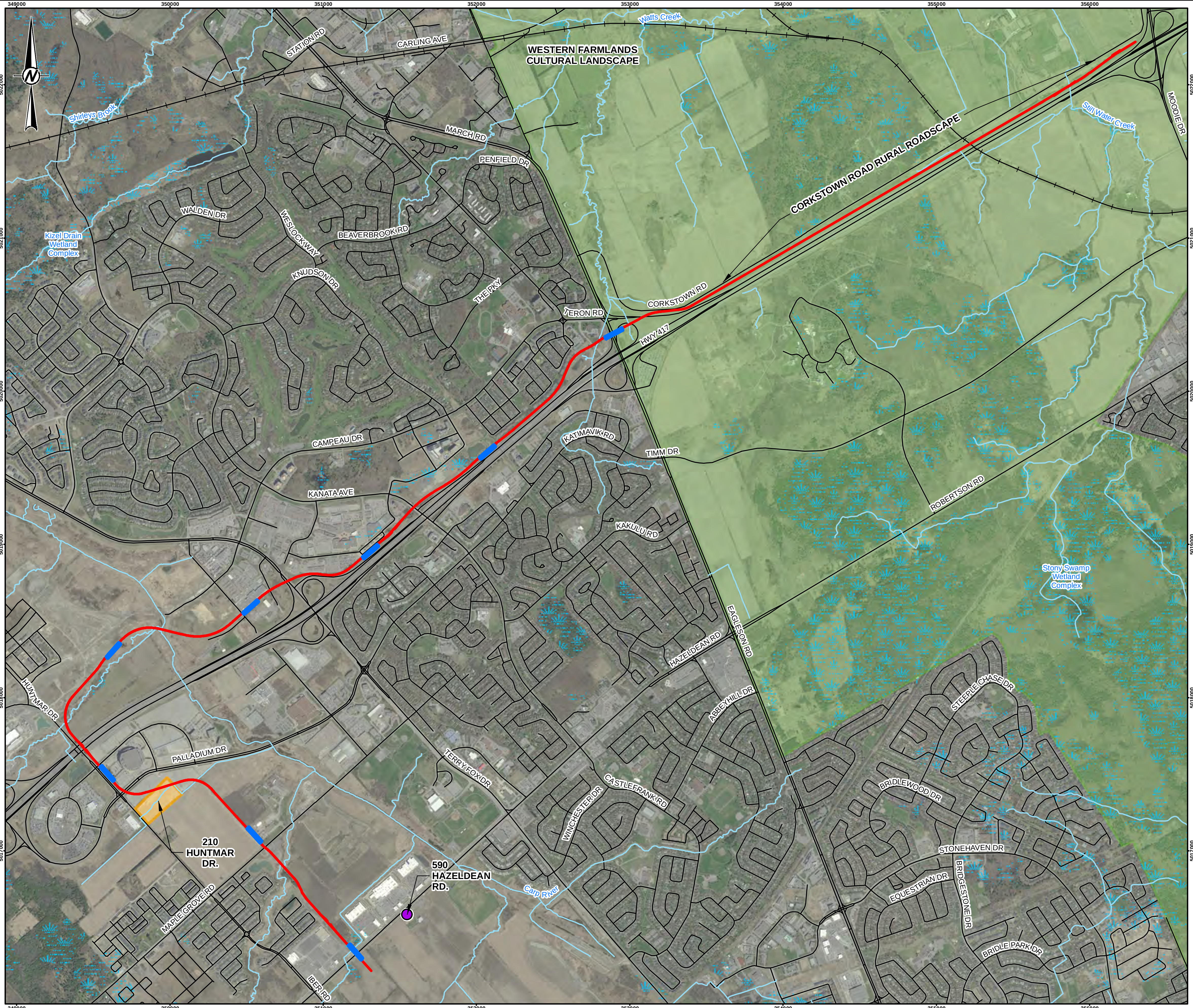
> "Essentially [a] 19th century, rural Ontario landscape subject to ongoing changes of a vernacular setting…. They project a relatively naturalized appearance and include substantial farming operations…. But still contains a sense of 19th century agricultural practices and patterns" (Smith 2004:44).

Characteristics of the rural cultural heritage landscape in, and adjacent to, the Project include:

- The historic and ongoing agricultural land use activities represented by the equestrian centre, fields and woodlot in the landscape;
- The field and ditch patterns on along Corkstown Road that demonstrate the historic rural landscape;
- Rural roadscape with two-lane width, wood telephone poles, gravel shoulders, grass covered swales and level railway crossing.

Table 1: Summary of cultural heritage resources identified in the study area.

Civic Address	Resource Name	Brief Description of heritage attributes	Heritage Protection/Status
Corkstown Road	Western Farmland cultural landscape	Rural roadscape with: ▪ two-lane width; ▪ wood telephone poles; ▪ gravel shoulders; ▪ grass covered swales; and. ▪ level railway crossing.	Identified by NCC within the Greenbelt



LEGEND

- PROPERTY DESIGNATED UNDER PART IV OF THE ONTARIO HERITAGE ACT
- RAILWAY
- WATERCOURSE
- ROADWAY
- WETLAND
- PROPOSED ALIGNMENT
- PROPOSED PLATFORM
- GREENBELT

NOTE(S)

1. FOR INFORMATIONAL PURPOSES ONLY. NO EVALUATION OR ASSESSMENT PROVIDED.

REFERENCE(S)

1. PROPOSED ALIGNMENT RECEIVED FROM PARSONS ON JANUARY 26, 2018, FILE NAME: 476242-01000-pln-ali-main line.dwg
2. LAND INFORMATION ONTARIO (LIO) DATA PRODUCED BY GOLDER ASSOCIATES LTD. UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2014
3. PROJECTION: TRANSVERSE MERCATOR, DATUM: NAD 83, COORDINATE SYSTEM: MTM ZONE 9, VERTICAL DATUM: CGVD28

0 250 500 1,000

1:25,000 METRES

CLIENT
PARSONS CORP

PROJECT
KANATA LIGHT RAIL TRANSIT PLANNING AND EA STUDY
BAYSHORE STATION TO PALLADIUM DRIVE, OTTAWA, ONTARIO

TITLE
POTENTIAL CULTURAL HERITAGE RESOURCES IN THE STUDY AREA

CONSULTANT

GOLDER

YYYY-MM-DD	2017-10-17
DESIGNED	BH
PREPARED	JEM
REVIEWED	BH
APPROVED	HJD

PROJECT NO.	CONTROL	REV.	MAP
1668654	0004	0	11

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5.2.4 Additional Cultural Heritage Considerations

Two properties designated under the *Ontario Heritage Act* are adjacent to or across the road from properties crossed by the study area.

A designated heritage property at 173 Huntmar Drive is across the road from and across a field crossed by the study area. This designated heritage property is over 400 metres from the proposed LRT corridor. Furthermore, the heritage attributes of this property are associated with the historic house on the lot, which is over 700 metres from the proposed LRT corridor. Consultation with a City Heritage Planner revealed that the City is not concerned about potential impacts of this project on this cultural heritage resource. If the LRT corridor were to change and move closer to this property additional consultation with the City and additional cultural heritage studies may be required.

A designated heritage property at 590 Hazeldean Road is adjacent to the end of the study area on the south side of Hazeldean Road. The proposed LRT corridor terminates on a property that is currently a large field next to 590 Hazeldean Road. This property is in the Stittsville rural section (Photo Point 25). The proposed LRT corridor is over 350 metres from the property line at 590 Hazeldean Road, and not predicted to be at risk of impact from the proposed development.

Additionally, the Canadian Tire Centre was determined not to be a potential built heritage resource. Although large stadiums or arenas for professional sports and large events are a relatively rare type of architect-designed structure that are often central to large scale urban planning efforts and the surrounding community, no evidence could be found to indicate that the arena, built in 1996, is yet considered a cultural heritage resource.

6.0 IMPACT ASSESSMENT

6.1 Description of Proposed Undertaking

The City's Transportation Master Plan (2013) envisions the extension of the western LRT line out to Palladium Drive. The proposed route of this LRT extension will run along the north side of Highway 417 from Moodie Drive to Huntmar Drive and then down to Hazeldean Road. The proposal includes an elevated railway line and approximately eight platforms. No specific concepts or designs have been drafted.

The goal of this LRT extension will be to provide fast, reliable service between downtown and communities to the west.

6.2 Impact Assessment and Recommendations

When determining the effects a development or site alteration may have on known or newly identified built heritage resources and cultural heritage landscapes, the MTCS *Heritage Resources in the Land Use Planning Process* advises that the following direct and indirect adverse impacts be considered:

- Direct impacts
  - *Destruction* of any, or part of any, significant heritage attributes, or features;
  - *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; or
  - *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.

Other potential direct impacts associated with the undertaking have also been considered. Historic structures, particularly those built in masonry, are susceptible to damage from vibration caused by pavement breakers, plate compactors, utility excavations, and increased heavy vehicle travel in the immediate vicinity. There is no standard approach or threshold for assessing construction or traffic vibration impact to historic buildings, but works within 60 m of a historic building is generally accepted to require precondition surveys, regular monitoring of the structures for visible signs of vibration damage, and traffic or construction separation (Carman *et al*. 2012:31). Like any structure, they are also threatened by collisions with heavy machinery or subsidence from utility line failures (Randl 2001:3-6).

The residual effects of the undertaking post construction, as outlined in the MTCS *Guideline for Preparing the Cultural Heritage Resource Component of Environmental Assessments*, were also evaluated. These are:

- Magnitude (amount of physical alteration or destruction);
- Severity (irreversibility or reversibility of impact);
- Duration (length of time an impact persists);

- Frequency (number of times an impact can be expected); and,
- Range (spatial distribution: widespread or site-specific)

An assessment of potential risks resulting from the proposed Project on cultural heritage resources, protected heritage properties, or properties of CHVI in the study area are presented in Table 2. For resources or properties where an impact has been identified, conservation measures are recommended.

Table 2: Impact Assessment & Conservation Recommendations.

Cultural Heritage Resource	Impact Assessment	Recommended Conservation or Mitigation Measures
Corkstown Road (Greenbelt, Western Farmlands cultural landscape)	Adverse impacts the rural character of Corkstown Road during construction of the LRT include alterations that are mot sympathetic or are incompatiblbe with the rural character of the road and surrounding landscape. Adverse impacts could include: removal of native vegetation and construction related changes to the shoulders and ditches along the road that are part of the rural character of the area. Adverse impacts to the rural character of Corkstown Road will be permanent, reversible, infrequent, and localized. The rural character of the area will not be destroyed by this project. Nor will any heritage attributes be isolated, have adverse shadows cast on them, or will any significant views or vistas be obstructed. The LRT will be built within an existing transportation corridor and could provide a beneficial impact by creating views from the train windows of the rural landscape north of the rail line.	However if mitigation measures are implemented adverse impacts from alteration of the landscape can be mitigated: The landscape can be restored. Once restored, the rural profile of Corkstown Road is not predicted to be adversely affected during operation of the LRT. The road will not be used to access an LRT station and therefore not expected to experience increased traffic volume. The rural character of the roadscape can be maintained. **PRE-CONSTRUCTION:** **Conduct Heritage Documentation Report:** The existing landscape should be documented with georeferenced photographs and described in a heritage documentation report. **Incorporate landscape features into detailed design:** Landscape features such as mature trees should be retained and incorporated into detailed design as much as is practical. **CONSTRUCTION PHASE:** Maintain the gravel shoulders and shallow ditches along either side of Corkstown Road during construction. **POST CONSTRUCTION:** Restore the rural profile and heritage attributes of Corkstown Road to their pre-construction condition and revegetate the roadsides with native grass species.

7.0 SUMMARY STATEMENT AND RECOMMENDATIONS

This CHOR found that no properties along the study area are listed or designated properties on the City *Heritage Register*. However, the NCC has identified part of the Greenbelt as the Western Farmlands cultural landscape. This cultural landscape covers the study area between Moodie Drive and Eagleson Road/March Road. The study area through the Greenbelt runs next to Highway 417 and is more closely associated with the highway than with the rural agricultural character of the rest of the area but is adjacent to Corkstown Road, a rural roadscape that is part of the Western Farmlands cultural landscape in the Greenbelt. Construction of the LRT could adversely impact the rural character of Corkstown Road and there is a high risk of adverse impact to this cultural landscape that would be permanent but reversible, infrequent and localized.

In order to mitigate potential adverse impacts to the rural character of the Western Farmlands cultural landscape Golder recommends that during the:

- Pre-construction phase:
  - The existing landscape should be documented with georeferenced photographs and described in a heritage documentation report.
  - Incorporate landscape features into detailed design: Landscape features such as mature trees should be retained and incorporated into detailed design as much as is practical.
- Construction phase:
  - Maintain the gravel shoulders and shallow ditches along either side of Corkstown Road during construction.
- Post construction phase:
  - Restore the rural profile and heritage attributes of Corkstown Road to their pre-construction condition and revegetate the roadsides with native grass species.

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Signature Page

We trust that this report meets your current needs. If you have any questions, or if we may be of further assistance, please contact the undersigned.

Golder Associates Ltd.

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Cultural Heritage Specialist

Hugh Daechsel, M.A.
Principal, Senior Archaeologist

BH/HD/ca

https://golderassociates.sharepoint.com/sites/11538g/shared documents/08_reports/cultural heritage/kanata lrt ch overview nov 2018.docx

APPENDIX A

MTCS *Criteria for Evaluating Potential for Built Heritage Resources and Cultural Heritage Landscapes* checklist.

Project or Property Name

Kanata LRT Planning and Environmental Assessment Study

Project or Property Location (upper and lower or single tier municipality)

City of Ottawa, ONTARIO

Proponent Name

Parsons Corporation.

Proponent Contact Information

Screening Questions

	Yes	No
1. Is there a pre-approved screening checklist, methodology or process in place?	☐	☒

If Yes, please follow the pre-approved screening checklist, methodology or process.

If No, continue to Question 2.

Part A: Screening for known (or recognized) Cultural Heritage Value

	Yes	No
2. Has the property (or project area) been evaluated before and found **not** to be of cultural heritage value?	☐	☒

If Yes, do not complete the rest of the checklist.

The proponent, property owner and/or approval authority will:

- summarize the previous evaluation and
- add this checklist to the project file, with the appropriate documents that demonstrate a cultural heritage evaluation was undertaken

The summary and appropriate documentation may be:

- submitted as part of a report requirement
- maintained by the property owner, proponent or approval authority

If No, continue to Question 3.

	Yes	No
3. Is the property (or project area):		
a. identified, designated or otherwise protected under the *Ontario Heritage Act* as being of cultural heritage value?	☐	☒
b. a National Historic Site (or part of)?	☐	☒
c. designated under the *Heritage Railway Stations Protection Act*?	☐	☒
d. designated under the *Heritage Lighthouse Protection Act*?	☐	☒
e. identified as a Federal Heritage Building by the Federal Heritage Buildings Review Office (FHBRO)?	☐	☒
f. located within a United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage Site?	☐	☒

If Yes to any of the above questions, you need to hire a qualified person(s) to undertake:

- a Cultural Heritage Evaluation Report, if a Statement of Cultural Heritage Value has not previously been prepared or the statement needs to be updated

If a Statement of Cultural Heritage Value has been prepared previously and if alterations or development are proposed, you need to hire a qualified person(s) to undertake:

- a Heritage Impact Assessment (HIA) – the report will assess and avoid, eliminate or mitigate impacts

If No, continue to Question 4.

Part B: Screening for Potential Cultural Heritage Value

	Yes	No
4. Does the property (or project area) contain a parcel of land that:		
a. is the subject of a municipal, provincial or federal commemorative or interpretive plaque?	☐	☒
b. has or is adjacent to a known burial site and/or cemetery?	☐	☒
c. is in a Canadian Heritage River watershed?	☐	☒
d. contains buildings or structures that are 40 or more years old?	☒	☐

Part C: Other Considerations

	Yes	No
5. Is there local or Aboriginal knowledge or accessible documentation suggesting that the property (or project area):		
a. is considered a landmark in the local community or contains any structures or sites that are important in defining the character of the area?	☐	☒
b. has a special association with a community, person or historical event?	☐	☒
c. contains or is part of a cultural heritage landscape?	☒	☐

If Yes to one or more of the above questions (Part B and C), there is potential for cultural heritage resources on the property or within the project area.

You need to hire a qualified person(s) to undertake:

- a Cultural Heritage Evaluation Report (CHER)

If the property is determined to be of cultural heritage value and alterations or development is proposed, you need to hire a qualified person(s) to undertake:

- a Heritage Impact Assessment (HIA) – the report will assess and avoid, eliminate or mitigate impacts

If No to all of the above questions, there is low potential for built heritage or cultural heritage landscape on the property.

The proponent, property owner and/or approval authority will:

- summarize the conclusion
- add this checklist with the appropriate documentation to the project file

The summary and appropriate documentation may be:

- submitted as part of a report requirement e.g. under the *Environmental Assessment Act, Planning Act* processes
- maintained by the property owner, proponent or approval authority

APPENDIX B

Cultural Heritage Resources in the study area.

GENERAL NOTE: The evaluation for cultural heritage value or interest (CHVI) of properties in the Study Area used all three criteria and sub-criteria prescribed under *O. Reg. 9/06*. However, in following inventory sheets only the applicable criteria for each property is included and described under each 'CHVI' section. Additionally, evaluation for historical or associative value was cursory unless supporting data could be readily accessed.

Civic Address	Photograph	Description	CHVI	Heritage Attributes	Recognition
Corkstown Road between Moodie Drive and Eagleson Road/March Road.	 View southwest from a point near Moodie Drive.  View southwest from a point near the railway tracks.  View southwest from a point on top of the rise in the previous photograph.	Cultural heritage landscape: Straight, two-lane rural profile road with soft shoulders, shallow ditches, wood telephone and power line poles along both sides of the road and a level railway crossing. The road is flanked by Highway 417 on the south and open fields and woodlot on the north.	3) Contextual value. This road is a part of the Western Farmlands cultural landscape in the Greenbelt and contributes to the character of the Greenbelt as part of a typical evolved vernacular rural 19th century Ontario landscape	▪ Two-lane rural road width; ▪ Soft (gravel) shoulders; ▪ Shallow swales; ▪ Wood telephone and power line poles on either side of the road; ▪ Level railway crossing.	National Capital Commission Greenbelt, Western Farmlands cultural landscape.

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V. Air Quality, Noise and Vibration Impact Assessment

Air Quality, Noise and Vibration Impact Assessment

Kanata LRT EA
Ottawa, Ontario

REPORT: GWE17-043 – EA

Prepared For:

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EXECUTIVE SUMMARY

Gradient Wind Engineering Inc. (Gradient Wind) was retained by Parsons to provide engineering support in the areas of air quality, noise, and ground vibrations for the Ontario and Federal Environmental Assessment (EA) and functional design phase of the City of Ottawa's Kanata Light Rail Transit (LRT) project. The Kanata LRT is a proposed extension of the Confederation Line rail system, of which Gradient Wind participated in the Environmental Assessments from Blair Station to Tunney's Pasture (Phase1) and Tunney's Pasture to Bayshore / Baseline (Phase 2). As part of the current project, a light maintenance and storage facility (MSF) located west of Moodie Drive is being considered, parallel and adjacent to the Kanata LRT corridor. This report describes the assessment, methodology and results for existing and future environmental air quality, noise and vibration impacts influenced by the project undertaking, and provides recommendations for mitigation where required.

Air Quality Impacts

The new LRT system will be electrically powered and will not produce any emissions on its own. Based on Gradient Wind's experience with the previous EA projects, it has been concluded that introduction of the Kanata LRT project will result in a slight improvement in air quality, partially due to the reduction in the number of diesel buses operating in the area. In general, air quality will improve despite an increase in traffic volumes due to the improvements in vehicle technology, more stringent government regulations and the introduction of electric rail to displace the City's existing Bus Rapid Transit (BRT) system

Air emissions from the MSF, as well as from expanded operations at the terminal stations, will be assessed and controlled during the detailed design and project implementation phases of the project according to the Ministry of the Environment, Conservation and Parks (MOECP) and City of Ottawa requirements.

Environmental Noise Impacts

Existing and future noise conditions were predicted using the MOECP road and rail analysis software STAMSON 5.04 based on current and projected traffic volumes to the year 2031. A comparison of existing and future conditions revealed that noise levels at most receptors remain dominated by existing sources, including Highway 417 and other proposed arterials (outside the scope of the Kanata LRT project).

Noise from station heating, ventilation and air conditioning equipment (HVAC) equipment is expected to be minor based on the current BRT station designs. Noise from the stations, terminal stations and MSF would be evaluated during the detailed design and implementation phase of the project according to the rules established by the City of Ottawa Environmental Noise Control Guidelines ENCG based on the MOECP protocol.

Ground Vibrations Impacts

The estimated vibration levels at the nearest residences based on the FTA protocol were found to be no greater than 0.084 mm/s RMS, falling below the level commonly considered perceptible by most building occupants (72 dBV, or equivalently 0.1 mm/s for frequent events). Furthermore, existing vibration levels are found to be negligible with respect to the risk of structural or even cosmetic damages to building finishes. Details of the calculations are provided in Appendix C. Since predicted vibration levels are below the criterion, no mitigation will be required. As vibration levels are low, correspondingly regenerated noise levels are also expected to be acceptable.

Construction Impacts

Varied construction activities along the Kanata LRT corridor are expected to create isolated and short-term noise, air quality and vibration impacts on the environment. The construction manager will be required to develop a strategy for mitigating the effects according to good practices intended to satisfy, as far as technically feasible, the fugitive dust limits specified in the Ambient Air Quality Criteria (AAQC), the noise limits specified in MOECP NPC-115[1] and City of Ottawa By-laws for Noise[2], and the limits on ground vibrations specified in MOECP NPC-119[3]. A list of common mitigation strategies adapted to the current project includes, but is not limited to, the following. Furthermore, monitoring of construction noise and vibrations should be conducted during the construction period, for sensitive areas within the 100 m buffer illustrated in Figures 2-8.

For air emissions:

(i) Monitor weather forecast, and plan operations to take advantage of calm wind periods;

(ii) Minimize site storage of granular material in height and extent;

(iii) Locate storage piles in sheltered areas that can be covered;

(iv) Provide movable wind breaks as necessary to minimize fugitive dust;

(v) Use water spray and suppression techniques to control fugitive dust;

---

[1] MOECP, Model Municipal Noise Control By-Law, NPC-115 Construction Equipment, August 1978
[2] City of Ottawa, Noise By-law NO. 2004-253
[3] MOECP, Model Municipal Noise Control By-Law, NPC-119 Blasting, August 1978

(vi) Cover haul trucks and wash down access routes to the construction site.

For noise and vibrations:

(i) Limit speeds of heavy vehicles within and upon approaching the site;

(ii) Provide compacted smooth surfaces, avoiding abrupt steps and ditches;

(iii) Keep equipment properly maintained according to manufacturer's procedures;

(iv) Implement a blast design program prepared by a blast design engineer, if necessary.

TABLE OF CONTENTS

1. INTRODUCTION

Gradient Wind Engineering Inc. (Gradient Wind) was retained by Parsons to provide engineering support in the areas of air quality, noise, and ground vibrations for the Ontario and Federal Environmental Assessment (EA) and functional design phase of the City of Ottawa's Kanata LRT project. The Kanata LRT is a proposed extension of the Confederation Line rail system, of which Gradient participated in the Environmental Assessments from Blair Station to Tunney's Pasture (Phase1) and Tunney's Pasture to Bayshore / Baseline (Phase 2). As part of the project, a light maintenance and storage facility (MSF) located west of Moodie Drive is being considered, parallel and adjacent to the Kanata LRT corridor. Figure 1 illustrates the study area and surrounding context.

The Kanata LRT project is undertaken in accordance with the Transit Project Assessment Process (TPAP) as prescribed in Ontario Regulation 231/08, Transit Projects. This report describes the assessment, methodology and results for existing and future environmental air quality, noise and vibration impacts influenced by the project undertaking.

2. TERMS OF REFERENCE

The focus of this environmental assessment is the proposed Kanata LRT project. The project is a proposed extension of the Confederation Line rail system from Moodie Drive to Kanata. Consideration is also being given to new stations along the LRT line, as well as to a light MSF. The purpose of the provincial EA is to develop a functional plan for extended light rail services to Kanata. The planning and EA studies will perform a needs assessment for the corridor, evaluate various alternative designs, and recommend a preferred design for the corridor. Following the development of a recommended plan, Gradient Wind has performed an impact assessment for the areas of Air Quality, Noise and Vibration, as outlined in this report.

The overall study area extends along Highway 417 to the north, Moodie Drive to the east, Huntmar Drive to the west and Hazeldean Road to the south. The major sources of air quality and noise emissions in the area are Highway 417, March Road, Eagleson Road, Terry Fox Drive, Hazeldeen Road as well as various proposed arterial and collector roadways. Highway 417 is also a source of minor ground vibrations and ground-borne noise, mainly due to heavy vehicles passing over uneven surfaces. The impact of such sources has been described in previous EA work, such as for the Western Light Rail Transit (LRT) project and Downtown Ottawa Transit Tunnel (DOTT) project.

3. OBJECTIVES

The Kanata LRT project will address the need for more public transit availability and will improve traffic conditions along local arterial roadways. The goals of this study are to assess existing and future conditions for air quality, traffic noise and ground vibrations resulting from the undertaking, and to provide recommendations for appropriate mitigation measures where comparisons show significant deterioration according to established provincial criteria.

4. METHODOLOGY

The following sections describe the methodology for assessing baseline existing conditions and predicted future conditions due to the Kanata LRT project for each of the subject areas.

4.1 Assessment of Air Quality

Vehicle traffic is a source of gasoline and diesel emissions from passenger vehicles, trucks and buses, and includes the contaminants of Carbon Monoxide (CO), Oxides of Nitrogen (NO_x), Benzene, Butadiene, Formaldehyde, Acetaldehyde chemicals and Particulate Matter (PM), in addition to other secondary compounds. Since the new LRT system will be electrically powered and will not produce any emissions on its own, air quality impacts are based on Gradient Wind's experience on previous EA for the Confederation Line.

4.1.1 Transit Terminals and Maintenance & Storage Facility

Future sources of air emissions related to the undertaking include the expanded activities at the terminal stations, as well as the new maintenance and storage facility (MSF). These sites could not be analyzed with any assurance of reasonable results during the EA phase of the project, due to the lack of design parameters. However, detailed analysis of impacts and mitigation measures are required during detailed design and project implementation following MOECP guidelines.

Only light maintenance activities such as cleaning are anticipated to occur at the MSF and significant emissions are not expected to be produced by the facility.

4.2 Assessment of Environmental Noise

Noise can be defined as any obtrusive sound. It is created at a source, transmitted through a medium such as air, and intercepted by a receiver. Noise may be characterized in terms of the power of the source or the sound pressure at a specific distance. While the power of a source is characteristic of that particular source, the sound pressure depends on the location of the receiver and the path that the noise takes to reach the receiver. Measurement of noise is based on the decibel unit, dBA, which is a logarithmic ratio referenced to a standard noise level (2×10^{-5} Pascals). The 'A' suffix refers to a weighting scale, which better represents how the noise is perceived by the human ear. With this scale, a doubling of power results in a 3 dBA increase in measured noise levels and is just perceptible to most people. An increase of 10 dBA is often perceived to be twice as loud.

4.2.1 Roadway and LRT Noise Criteria

Many municipalities consider daytime L_{EQ} of 55 dBA to be acceptable for outdoor living areas (OLA's), with mitigating measures being required if noise levels exceed 60 dBA. For capital works projects, such as LRT construction, the requirements for providing noise mitigation measures according to the City of Ottawa's Environmental Noise Control Guidelines (ENCG) and best practice are:

- For future noise levels less than or equal to 55 dBA, or the established ambient noise level at the start of construction (whichever is higher), no mitigation is required
- For future noise levels greater than 55, and less than or equal to 60 dBA, accompanied by an increase greater than 5 dBA over established ambient noise (start of project construction), noise mitigation shall be considered according to Table 1 adapted from the ENCG
- For future noise levels greater than 60 dBA, regardless of the amount of increase, noise mitigation shall be considered according to the requirements of Table 1 adapted from the ENCG

For vehicle traffic, the equivalent sound energy level, L_{EQ}, provides a measure of the time varying noise levels, which is well correlated with the annoyance of sound. It is defined as the continuous sound level, which has the same energy as a time varying noise level over a period of time. For roadways, the L_{EQ} is commonly calculated on the basis of a 16-hour (L_{EQ16}) daytime (07:00-23:00) / 8-hour (L_{EQ8}) nighttime (23:00-07:00) split to assess its impact on residential buildings.

TABLE 1: SUMMARY OF NOISE IMPACT RATING & MITIGATION[4]

Future Sound Level, L_{EQ} 16hr	Change Above Ambient (dBA)	Impact Rating	Mitigation
Greater than 55 dBA and less than or equal to 60 dBA	0-3	Insignificant	None
	3-5	Noticeable	None
	5-10	Significant	Investigate noise control measures to achieve retrofit criteria (minimum attenuation 6 dBA)
	10+	Very Significant	
Greater than 60 dBA	0-3	Insignificant	Investigate noise control measures to achieve retrofit criteria (minimum attenuation 6 dBA)
	3-5	Noticeable	
	5-10	Significant	
	10+	Very Significant	

According to Section 2.0 of the ENCG, retrofit sound barriers will be installed and maintained within the City's right of way, except for flanking walls where an easement may be requested. Sound barriers within the right of way will only be installed where it is feasible to achieve the minimum retrofit criteria of 6 dBA. The guideline also states 'off right-of-way noise control measures and nighttime (11:00 PM – 7:00 AM) assessment of the noise impact will not be considered as part of these guidelines'.

The Ministry of Transportation for Ontario (MTO) and the MOECP have also established guidelines and criteria for assessing noise from roadway and transportation sources. These guidelines are less stringent than the ENCG, and suggested mitigation should be investigated when future sound levels exceed 65 dBA, or when there is an increase of 5 dBA over the established ambient (future do-nothing) conditions. Since the project is being undertaken by the City of Ottawa, the more stringent ENCG guidelines were adopted as the standard for this project.

4.2.2 Roadway and LRT Noise Assessment Procedure

Existing and future noise levels at 13 receptors were based on existing traffic counts and traffic volume growth rates supplied by Parsons. Traffic mix was assumed based on the ENCG parameters for percentages of medium and heavy trucks including buses. These assumptions were considered both for

[4]Adopted from Table 3, City of Ottawa Environmental Noise Control Guidelines, January 2016

existing and future conditions. Figure 2 to 8 illustrate receptor locations along the Kanata LRT corridor. Traffic volumes are described in Table 2 and 3 below:

TABLE 2: AADT ROADWAY AND LRT TRAFFIC VOLUMES (EXISTING CONDITIONS)

Roadway	Segment	Traffic Volume (AADT)	Speed (km/h)
Highway 417	Moodie Dr to Eagleson Rd	157416	100
	Eagleson Rd to Kanata Ave	118892	100
	Kanata Ave to Terry Fox Dr	79660	100
	Terry Fox Dr to Palladium Dr	85436	100
Eagleson Rd / March Rd	Herzberg Rd to Campeau Dr	54066	80
Campeau Dr	March Rd to Teron Rd	17770	60
	Kanata Ave to Terry Fox Dr	5222	60
Kanata Ave	Hwy 417 EB ramp to Katimavik Rd	12944	50
Terry Fox Dr	Katimavik Rd to Maple Grove Rd	31052	70
Huntmar Dr	Campeau Dr to Palladium Dr	4501	50
Palladium Dr	Huntmar Dr (N) to Hwy 417 WB ramp	1346	60
Corkstown Rd	Moodie Dr to Eagleson Rd	797	80
Maple Grove Rd	Terry Fox to Huntmar	2507	50
Hazaeldean Rd	Terry Fox to Huntmar	17333	60

Note: 5,000 AADT is minimum allowable in STAMSON

TABLE 3: AADT ROADWAY AND LRT TRAFFIC VOLUMES (FUTURE CONDITIONS)

Roadway	Segment	Traffic Volume (AADT)	Speed (km/h)
Highway 417	Moodie Dr to Eagleson Rd	177978	100
	Eagleson Rd to Kanata Ave	149998	100
	Kanata Ave to Terry Fox Dr	102956	100
	Terry Fox Dr to Palladium Dr	100400	100
Eagleson Rd / March Rd	Herzberg Rd to Campeau Dr	54948	80
Campeau Dr	March Rd to Teron Rd	16436	60
	Kanata Ave to Terry Fox Dr	6604	60
Kanata Ave	Hwy 417 EB ramp to Katimavik Rd	16074	50
Terry Fox Dr	Katimavik Rd to Maple Grove Rd	36560	70
Huntmar Dr	Campeau Dr to Palladium Dr	8266	50
Palladium Dr	Huntmar Dr (N) to Hwy 417 WB ramp	1928	60
Corkstown Rd	Moodie Dr to Eagleson Rd	1031	80
Maple Grove Rd	Terry Fox Dr to Huntmar Dr	3243	50
Hazaeldean Rd	Terry Fox Dr to Huntmar Dr	22422	60
NS Arterial	Hazeldean Rd to Huntmar Dr	35000	70
Kanata LRT	Full Length	340	Variable

Note: 5,000 AADT is minimum allowable in STAMSON

Roadway noise calculations have been based on the Ontario Road Noise Analysis Method for Environment and Transportation (ORNAMENT) and calculated using the MOECP approved software STAMSON (5.04). This method calculates noise levels based on (i) AADT volumes, posted speed limits, and vehicle mix data for roadways, representing the source; and (ii) source-receiver distance, exposure angles and intermediate ground surface characteristics, and source-receiver ground elevation, as characterizing the path of noise. This method was developed by the MOECP and satisfies City of Ottawa requirements. Unless otherwise specified in Table 5, AADT volumes on surrounding streets were considered to be split 92% daytime and 8% nighttime for each roadway segment, as well as a vehicle mix of 7% and 5% for medium and heavy trucks, respectively, based on guidance in the ENCG. Speed limits used in the calculations are presented in Table 2 and 3.

To provide a general sense of noise across the site, the software program *Predictor-Lima* was used, which incorporates the United States Federal Highway Administration's (FHWA) Transportation Noise Model (TNM) 2.5. This computer program is capable of representing three-dimensional surface and first reflections of sound waves over a suitable spectrum for human hearing. A receptor grid with 5 × 5 m spacing was placed across the study site, along with a number of discrete receptors at key sensitive areas. This program outputs noise contours, however, is not the approved model for roadway predictions by the City of Ottawa. Therefore, the results were confirmed by performing discrete noise calculations, coinciding with the 12 receptor locations illustrated in Figure 2 to 8.

4.2.3 Stationary Noise

Background noise levels in the urban area will also be influenced by stationary sources such as building mechanical systems. In theory, new stationary noise sources are subject to an approval process enforced by the MOECP with a maximum exclusionary noise limit of 50 dBA daytime and 45 dBA nighttime, or background noise levels typically produced by traffic and other sources. As a result, contributions of existing noise sources to the total noise environment are considered as secondary and have not been specifically considered in this study.

According to the City of Ottawa noise guidelines, the MSF, as well as the current BRT stations and future LRT stations, are to be considered as stationary noise sources. However, a reliable noise assessment will be confirmed in detailed design, prior to construction commencing. However, future activity levels around each station are expected to remain similar to existing conditions. A qualitative analysis for the LRT stations and MSF is provided in Section 5.2.2. A detailed noise assessment for these stationary noise sources will be required during the detailed design phase of the project, once source data at each location are identified.

Noise from the MSF will be created by marshalling activities of the LRT vehicles in the rail yard, as well as maintenance work. The United States Federal Transportation Authority (FTA) provides methodology for a general screen level noise assessment of stationary noise produced from fixed transit systems. The methodology is based on series of measurements conducted at a variety of MSF facilities throughout the United States. Based on the anticipated level of activity, using a reference sound power level for train yards and shops and the hourly volume of trains, it is possible to determine a 1-hour L_{EQ} at an equivalent distance of 15 m (50 feet) from the centre of the yard. A more detailed assessment during detailed design of the facility will be required once noise sources and locations have been identified. The following equation was used to extrapolate the 1-hour L_{EQ} to points of reception, on surrounding noise sensitive land.

$L_2 = L_1 - 20 \log(R_2/R_1)$

Where:

L_1 is the measured sound level

L_2 is the extrapolated sound level

R_1 is the distance from source to measurement location

R_2 is the distance from source to point of reception

4.3 Assessment of Ground Vibrations

Transit systems and heavy vehicles on roadways can produce perceptible levels of ground vibrations, especially when they are in close proximity to residential neighbourhoods. Similar to sound waves in air, vibrations in solids are generated at a source, propagated through the medium, and intercepted by a receiver. In the case of ground vibrations, the medium can be uniform, or more often, a complex layering of soils and rock strata. Also, similar to sound waves in air, ground vibrations produce perceptible motions and regenerated noise known as 'ground-borne noise' when the vibrations encounter a hollow structure such as a building. Ground-borne noise and vibrations are generated when there is excitation of the ground, from a train for instance. Repetitive motion of the wheels on the track, or rubber tires passing over an uneven surface causes vibration to propagate through the soil. When they encounter a building, vibrations pass along the structure of the building beginning at the foundation and propagating to all floors. Air inside the building excited by the vibrating walls and floors represents regenerated airborne noise. Characteristics of the soil and the building are imparted to the noise thereby creating a unique noise signature.

Human response to ground vibrations is dependent on the magnitude of the vibrations, which is measured by the root mean square (RMS) of the movement of a particle on a surface. Typical units of ground vibration measures are millimeters per second (mm/s), or inch per second (in/s). Since vibrations can vary over a wide range, it is also convenient to represent them in decibel units, or dBV. In North America, it is common practice to use the reference value of one micro-inch per second (μin/s) to represent vibration levels for this purpose. The threshold level of human perception to vibrations is about 0.10 mm/s RMS or about 72 dBV. Although somewhat variable, the threshold of annoyance for continuous vibrations is (0.5 mm/s RMS or 85 dBV), ten times higher than the perception threshold, whereas the threshold for significant structural damage is (10 mm/s RMS or 112 dBV) at least one hundred times higher than the annoyance threshold level.

4.3.1 Vibration Criteria

Generic vibration criteria for a variety of building functions have been established based on years of experience and fundamental research performed by the International Standards Organization (ISO) 2631-2, and similar groups. The ISO criteria are primarily used when dealing with human response to vibrations. Similarly, vibration criteria (VC) curves have been developed by industry for highly sensitive equipment common in high-technology manufacturing and some university facilities. A survey of the Kanata LRT corridor around the study area revealed no highly sensitive buildings within 200 m of the corridor that would require ISO Vibration Criteria.

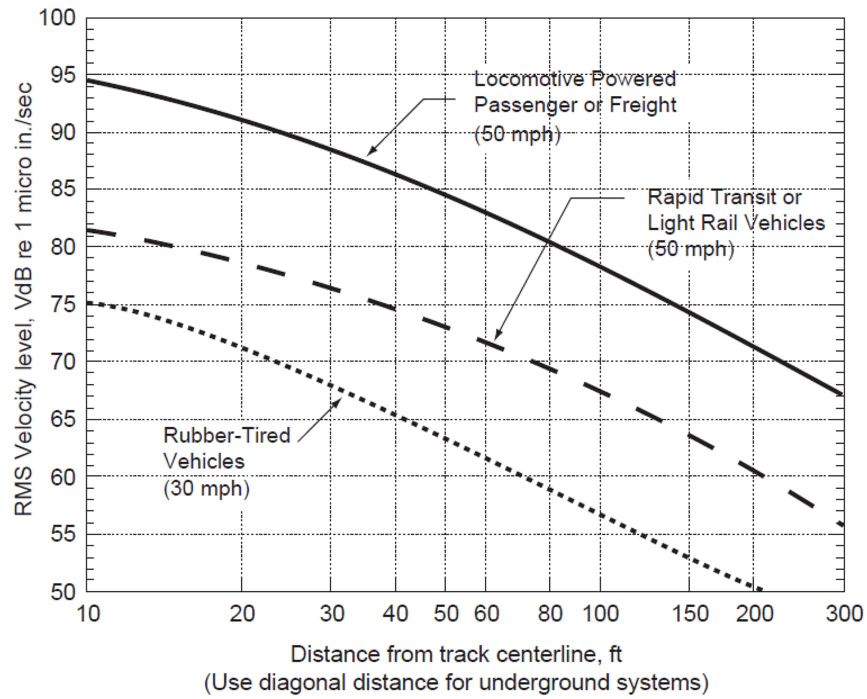
In the United States, the Federal Transportation Authority (FTA) has set vibration criteria for sensitive land use next to transit corridors. Similar standards have been developed by a partnership of MOECP and Toronto Transit Commission (TTC), which were adopted as the appropriate standard for most buildings along the Kanata LRT corridor. For frequent events, such as those associated with the LRT, the appropriate criteria for residential buildings is 0.1 mm/s RMS (72 dBV) for vibrations and 35 dBA for ground borne noise. The FTA also sets slightly higher standards for occasional events of 0.14 mm/s (75 dBV) and 38 dBA. The criterion on 0.1 mm/s RMS for frequent events would be appropriate for the Kanata LRT project.

4.3.2 Theoretical Ground Vibration Prediction Procedure

Potential vibration impacts of the existing roadways and future LRT were predicted using the FTA's Transit Noise and Vibration Impact Assessment[5] protocol. The FTA general vibration assessment is based on an upper bound generic set of curves that show vibration level attenuation with distance. These curves, illustrated in the figure below, are based on ground vibration measurements at various transit systems throughout North America. Vibration levels at points of reception are adjusted by various factors to incorporate known characteristics of the system being analyzed; such as operating speeds of vehicles,

[5] C. E. Hanson; D. A. Towers; and L. D. Meister, Transit Noise and Vibration Impact Assessment, Federal Transit Administration, May 2006.

conditions of the track, construction of the track and geology; as well as the structural type of the impacted building structures. Based on the setback distance of the receptor, initial vibration levels were deduced from the curves for either light rail trains or rubber wheeled vehicles. An adjustment factor is applied to account for the appropriate operational speed of the vehicle. Other factors considered for the Kanata LRT line; the track was assumed to be jointed with no welds.



FTA GENERALIZED CURVES OF VIBRATION LEVELS VERSUS DISTANCE (ADOPTED FROM FIGURE 10-1, FTA TRANSIT NOISE AND VIBRATION IMPACT ASSESSMENT)

5. RESULTS AND DISCUSSION

This section describes the baseline existing conditions and predicted future impacts after implementing the Kanata LRT project relating to air quality, roadway noise and ground vibrations. Impacts during the construction process are discussed qualitatively in Section 6.

5.1 Air Quality Impacts

5.1.1 Operational Impacts

Based on Gradient Wind's experience with the Western LRT project and Phase 1 of the Confederation Line LRT project, it has been concluded that introduction of the Kanata LRT project will result in a slight improvement in air quality, partially due to the reduction in the number of diesel buses operating in the area. In general, air quality will improve despite an increase in traffic volumes, due to the improvements in vehicle technology, more stringent government regulations and the introduction of electric rail to displace the City's existing Bus Rapid Transit (BRT) system.

5.1.2 Transit Terminals and Maintenance & Storage Facility

The Kanata LRT MSF is expected to generate emissions consistent with a light industrial use building. The impacts on air pollution levels would be evaluated, and controlled if necessary, through detailed design and project implementation phase of the project. As the MSF is only anticipated to be used for cleaning and other light maintenance activities, the impacts are not expected to be significant.

No significant impacts from the Kanata LRT stations are expected. The only expected source of emissions would be from heating equipment as previously discussed. For terminal stations, where extended bus idling is expected to occur, more detailed studies of air quality impacts should be considered around the station during detailed design.

5.2 Environmental Noise Impacts

5.2.1 Roadway and LRT Traffic Noise Impacts

Existing and future noise levels due to vehicle traffic around the Kanata LRT corridor are summarized in Table 4 for daytime (7:00 AM to 11:00 PM) periods with reference to receptors illustrated in Figure 2 to 8. There is a column in Table 4 showing the change in overall noise levels, the contribution of the LRT line, as well as existing barrier information. Appendix A and B provide the detailed input parameters and calculation results from STAMSON for existing and future conditions, also illustrated in Figure 9 to 13. Noise contours throughout noise sensitive areas within the study area are illustrated for the daytime period in Figure 14 to 19.

According to the City of Ottawa ENCG, mitigation should be investigated and implemented where feasible when future daytime noise levels exceed 60 dBA, or when there is a change of more than 5 dBA and future noise levels exceed 55 dBA or the established ambient noise level at the start of construction (whichever is higher), as per Table 1. At all receptors contributions of the LRT are bellow the established ambient noise levels, therefore no mitigation is required as part of the Kanata LRT project. Receptor 2, 3 and 6-12 were found to be above 60 dBA; however, this is the result of the construction of new roads and elevated noise levels due to Highway 417, not the project undertaking. Noise control measures associated with new roadway construction will be under the scope of the respective construction projects. Receptors with elevated noise levels due to Highway 417 already have noise barriers in place that currently meet the City of Ottawa's maximum height for retrofit considerations, therefore additional mitigation is not feasible.

TABLE 4: OUTDOOR LIVING AREA NOISE LEVELS, EXISTING VERSUS FUTURE (DAYTIME)

Receptor	Location	Noise Level (L_{EQ})					Impact from LRT	Existing Barrier
		Existing	Future Ambient	Future with LRT	Increase above ambient	LRT Contribution		
1	5654 Hazeldean Road	49	53	53	0	40	Insignificant	No
2	358 Gallantry Way	36	64	64	0	45	Insignificant	No
3	230 Helm Circle	44	60	60	0	43	Insignificant	No
4	210 Huntmar Drive	42	46	46	0	37	Insignificant	No
5	434 Country Glen Way	34	53	53	0	34	Insignificant	No
6	186 McGibbon Drive	64	65	65	0	36	Insignificant	Yes
7	177 Gray Crescent	61	62	62	0	41	Insignificant	No
8	99 Gray Crescent	62	63	63	0	47	Insignificant	Yes
9	411 Corkstown Road	66	70	70	0	40	Insignificant	Berm
10	5618 Hazeldean Road	69	71	71	0	53	Insignificant	No
11	1620 Maple Grove Road	42	66	66	0	56	Insignificant	No
12	450 Huntmar Drive	37	62	62	0	36	Insignificant	No
13	78 Birkendale Drive	60	61	61	0	44	Insignificant	No

† - Values are rounded to the nearest whole number

5.2.2 Stationary Noise

The activity and traffic patterns around existing bus stations and proposed LRT stations are expected to remain similar to the current function of each station. Given the location of the stations being away from sensitive receivers, any increase in noise levels between existing and future conditions would be negligible.

Although the increased activity at each of these stations can increase the noise impact to the surrounding sensitive areas, the actual impacts are likely to be minor. The nearest station to any dwelling is Kanata Town Station, which is 109 m from the nearest dwelling. All other stations would be located in busy commercial areas, while also containing more significant setback distances. Furthermore, most stations are in close proximity to Highway 417 or major arterial roadways; as such, any increase in bus activity would likely be overcome by roadway traffic noise.

Using FTA general noise assessment methodology, noise from a transit centre was calculated to be potentially up to 48 dBA during the daytime period at a distance of 109 m. This methodology was also used to determine that noise from the MSF was calculated to be potentially up to 45 dBA during the daytime period at the noise sensitive area associated with the campgrounds at 411 Corkstown Road. This method is based on generic set of measurements around transit centres and MSF facilities throughout the US and are likely conservative given the stations are expected to be weather protected platforms with minimal HVAC equipment, similar to the current design used for the Confederation Line. Additionally, only light maintenance and cleaning is expected at the Kanata LRT MSF. Although this calculation does not exceed the ENCG criteria for stationary noise, it should be taken into consideration during the design phase. In conformance with the MOECP and City of Ottawa ENCG, the facility would be subject to a detailed stationary noise analysis during detailed design and project implementation. Potential noise mitigation strategies include equipment silencers and offsetting layover tracks as far as possible from the Wesley Clover Camp Ground or incorporating a noise wall or berm around the perimeter of the property.

5.3 Ground Vibrations Impacts

The estimated vibration levels at the nearest residences based on the FTA protocol are presented below in Table 5, and the vibration receptor locations are illustrated in Figure 2 to 8. Details of the calculations are provided in Appendix C. Since predicted vibration levels are below the criterion of 0.1 mm/s RMS, no mitigation will be required. As vibration levels are low, correspondingly regenerated noise levels are also expected to be acceptable.

TABLE 5: VIBRATION MEASUREMENT RESULTS FOR EXISTING CONDITIONS

Receptor	Location Description	Calculated Vibration Level (RMS)					
		Existing Sources			LRT Line		
		(dBV)	(mm/s)	Distance from Edge of Road (m)	(dBV)	(mm/s)	Distance from Edge of LRT (m)
V1	358 Gallantry Way	51	0.009	380	55	0.014	57.0
V2	210 Huntmar Drive	54	0.013	44.5	49	0.007	102
V3	99 Gray Crescent	58	0.020	44.7	70	0.084	18.0
V4	411 Corkstown Road	55	0.014	84.0	59	0.023	64.0

Vibration levels as a result of the Kanata LRT project generally do not exceed the level commonly considered perceptible by most building occupants (72 dBV, or equivalently 0.1 mm/s for frequent events). Furthermore, existing vibration levels are found to be negligible with respect to the risk of structural or even cosmetic damages to building finishes.

According to the United States Federal Transit Authority's vibration assessment protocol, ground borne noise can be estimated by subtracting 35 dB from the velocity vibration level in dBV. Since calculated vibration levels were found to be 70 dBV, ground borne noise levels of 35 dBA are expected to fall below the ground borne noise criteria of 35 dBA.

6. IMPACTS OF CONSTRUCTION

Construction will involve surface works for construction of the LRT line. As such, many areas along the corridor are expected to experience some degree of air quality, noise and vibration impacts during construction. In most cases, however, the impacts will be controlled, minor and intermittent over short cycles of activity.

The expected impacts from construction of the LRT line will be limited to isolated and local surface construction projects generating occasional minor ground vibrations, fumes and dust, as well as intermittent noise. Common mitigation measures should make use of moveable noise barriers around the perimeter of the work areas, extensive water spraying to control dust, and implementing daytime hours of operation to avoid nighttime impacts when background noise is lowest. In all cases, air quality, noise and ground vibrations are not expected to be overly disruptive to commonly occurring regular activities.

Suggested methods to control air emissions include, but are not limited to:

(ii) Monitor wind conditions and plan operations to take advantage of calm wind periods;
(ii) Minimize site storage of granular material in height and extent;
(iii) Locate storage piles in sheltered areas that can be covered;
(iv) Provide movable windbreaks;
(iv) Use water spray and suppression techniques to control fugitive dust;
(vi) Cover haul trucks and keep access routes to the construction site clean of debris.

For noise and vibrations, common control methods include but are not limited to:

(i) Limit speeds of heavy vehicles within and approaching the site;
(ii) Provide compacted smooth surfaces, avoiding abrupt steps and ditches;
(iii) Install movable barriers or temporary enclosures, around blast sites for instance;
(iv) Keep equipment properly maintained and functioning as intended by the manufacturer;
(v) If required, implement a blast design program prepared by a blast design engineer.

The construction manager will be responsible for preparing and implementing a mitigation strategy with the intent of satisfying the requirements of Ontario Regulations 419 for dust emissions, MOECP NPC-115 and City of Ottawa By-laws for noise, and MOECP NPC-119 for ground vibrations. Proper planning will also require that pre-construction surveys be undertaken for selected buildings along the corridor. Furthermore, monitoring of construction noise and vibrations should be conducted during the construction period, for sensitive areas within the 100 m buffer illustrated in Figures 2-8.

7. SUMMARY & CONCLUSIONS

The work summarized in this report compares existing and predicted future conditions for noise, air quality and ground vibrations, in support of the Kanata LRT Environmental Assessment. The project involves a proposed extension of the Confederation Line rail system from Moodie Drive to Kanata. As part of the project, consideration is also being given to new stations along the LRT line, as well as to a light MSF of Moodie Drive.

7.1 Operational Impacts

7.1.1 Air Quality Impacts

The new LRT system will be electrically powered and will not produce any emissions on its own. Based on Gradient Wind's experience with the Western LRT project and the Confederation Line LRT projects, it can be concluded that the introduction of the Kanata LRT project will have a slight improvement in air quality, partially to the reduction in the number of diesel buses operating in the area. In general, air quality will improve despite an increase in traffic volumes, due to the improvements in vehicle technology, more stringent government regulations and the introduction of electric rail to displace the City's existing BRT systems.

Air emissions from the MSF, as well as from expanded operations at the terminal stations, will be assessed and controlled during the detailed design and project implementation phases of the project according to MOECP and City of Ottawa requirements.

7.1.2 Environmental Noise Impacts

Existing and future noise conditions were predicted using the MOECP road and rail analysis software STAMSON 5.04 based on current and projected traffic volumes to the year 2031. A comparison of existing and future conditions revealed that noise levels at most receptors remain dominated by existing sources, including Highway 417 and other proposed arterials (outside the scope of the Kanata LRT project).

Noise from station HVAC equipment will be mitigated to acceptable levels, as prat of detailed design according to the MOECP and the City of Ottawa ENCG guidelines. In a similar way, noise from expanded operations at the terminal stations and from the future MSF would be evaluated during the detailed design and implementation phase of the project according to the rules established by the City of Ottawa ENCG based on the MOECP protocol.

7.1.3 Ground Vibrations Impacts

The estimated vibration levels at the nearest residences based on the FTA protocol were found to be no greater than 0.084 mm/s RMS, falling below the level commonly considered perceptible by most building occupants (72 dBV, or equivalently 0.1 mm/s for frequent events). Furthermore, existing vibration levels are found to be negligible with respect to the risk of structural damages or even cosmetic damages to building finishes. Details of the calculations are provided in Appendix C. Since predicted vibration levels are below the criterion, no mitigation will be required. As vibration levels are low, correspondingly regenerated noise levels are also expected to be acceptable.

7.1.4 Construction Impacts

Varied construction activities along the Kanata LRT corridor are expected to create isolated and short-term noise, air quality and vibration impacts on the environment. The construction manager will be required to develop a strategy for mitigating the effects according to good practices intended to satisfy, as far as technically feasible, the fugitive dust limits specified in the AAQC, the noise limits specified in MOECP NPC-115[6] and City of Ottawa By-laws for Noise[7], and the limits on ground vibrations specified in MOECP NPC-119[8]. A list of common mitigation strategies adapted to the current project includes, but is not limited to, the following. Furthermore, monitoring of construction noise and vibrations should be conducted during the construction period, for sensitive areas within the 100 m buffer illustrated in Figures 2-8.

For air emissions:

(i) Monitor weather forecast, and plan operations to take advantage of calm wind periods;

(ii) Minimize site storage of granular material in height and extent;

(iii) Locate storage piles in sheltered areas that can be covered;

(iv) Provide movable wind breaks as necessary to minimize fugitive dust;

(v) Use water spray and suppression techniques to control fugitive dust;

(vi) Cover haul trucks and wash down access routes to the construction site.

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[6] MOECP, Model Municipal Noise Control By-Law, NPC-115 Construction Equipment, August 1978

[7] City of Ottawa, Noise By-law NO. 2004-253

[8] MOECP, Model Municipal Noise Control By-Law, NPC-119 Blasting, August 1978

For noise and vibrations:

(i) Limit speeds of heavy vehicles within and upon approaching the site;

(ii) Provide compacted smooth surfaces, avoiding abrupt steps and ditches;

(iii) Keep equipment properly maintained according to manufacturer's procedures;

(iv) Implement a blast design program prepared by a blast design engineer, if necessary.

This concludes our assessment of existing and future environmental conditions in the area of air quality, noise and ground vibrations. Please contact the undersigned for questions or clarifications.

Yours truly,

Gradient Wind Engineering Inc.

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Nov 22, 2018
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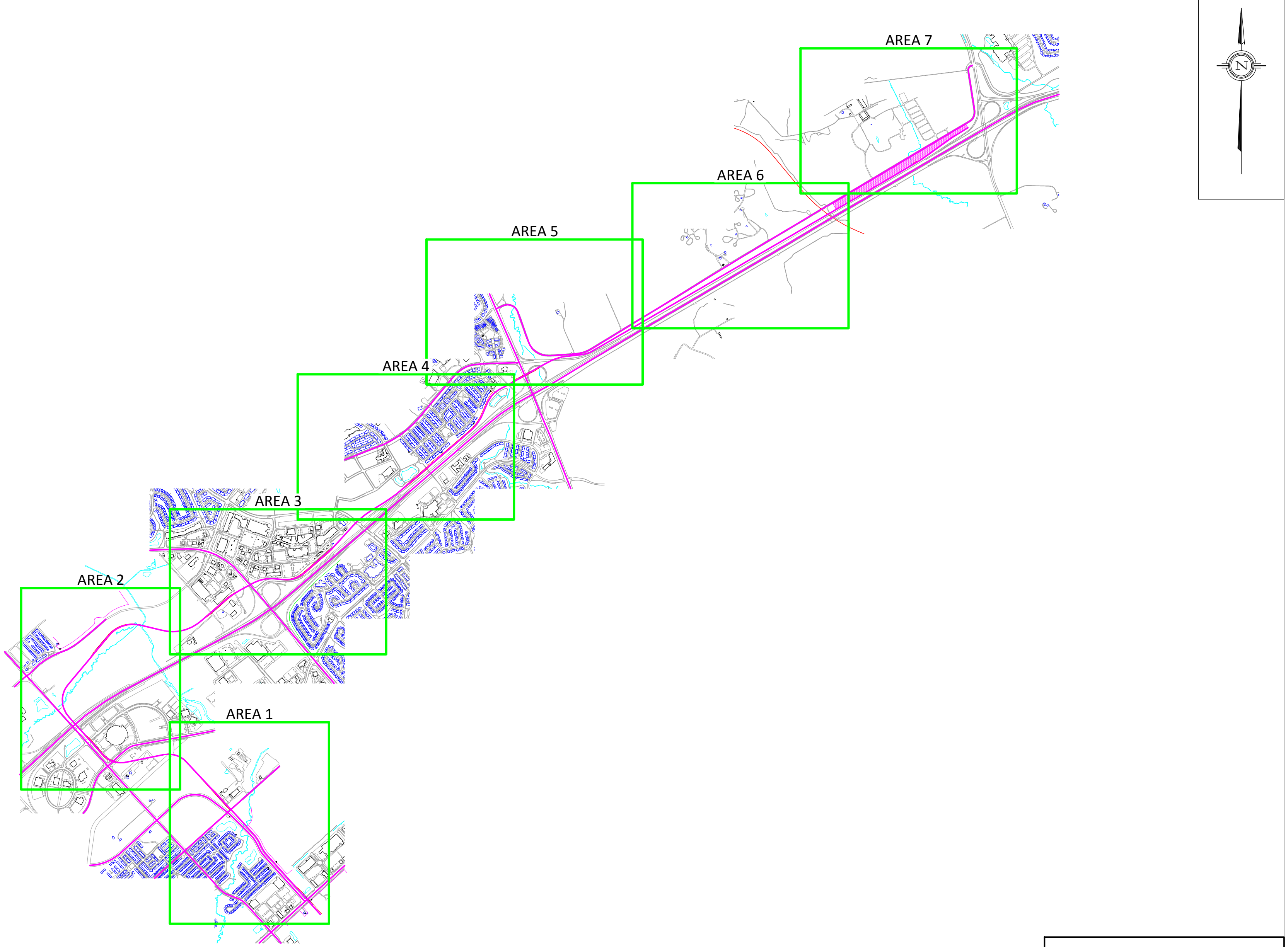
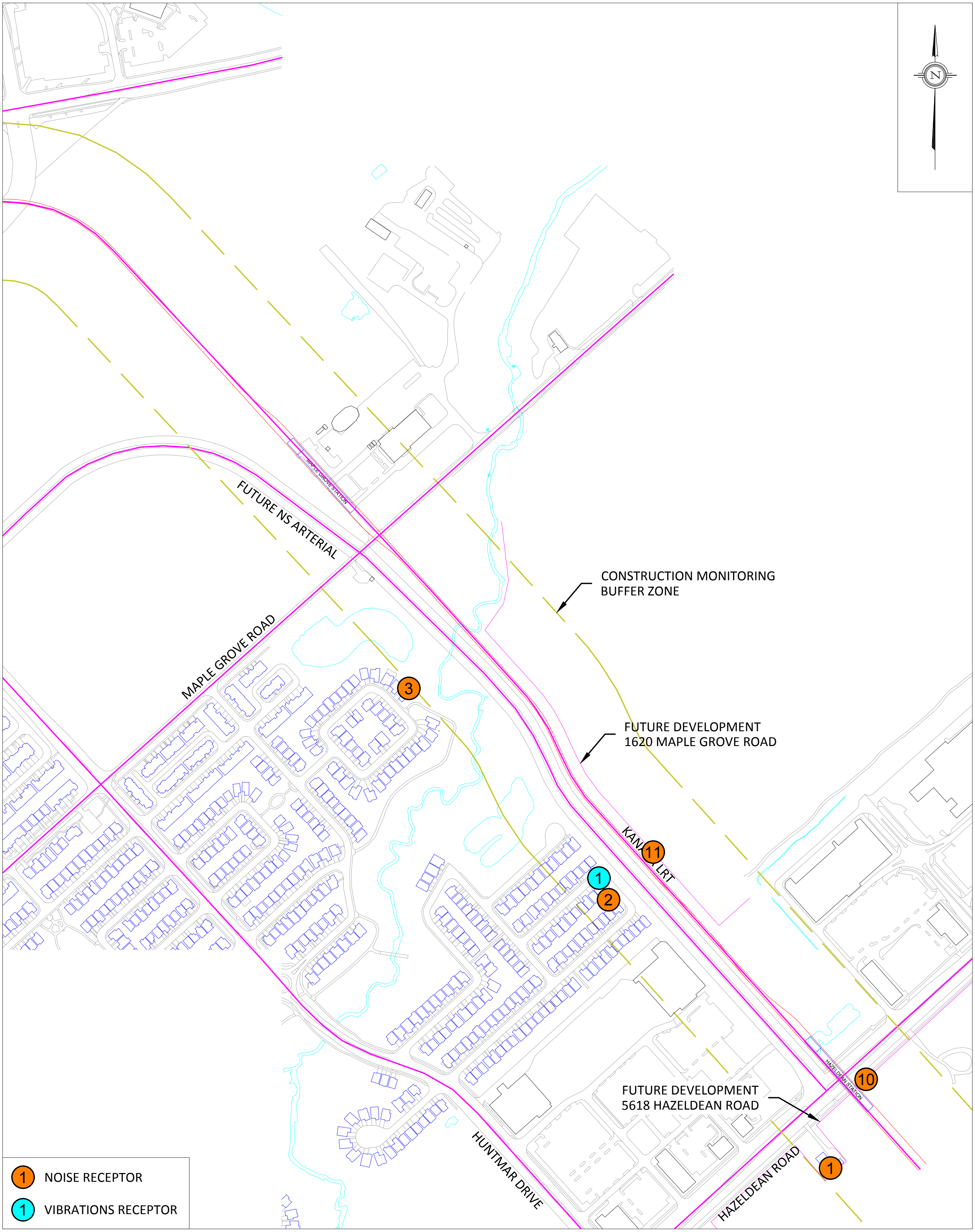


NOISE SENSITIVE PROPERTIES APPEAR IN BLUE

127 Walgreen Road
Ottawa, Ontario
(613) 836 0934

GRADIENT WIND ENGINEERING INC

PROJECT	KANATA LRT AIR QUALITY, NOISE AND VIBRATION IMPACT ASSESSMENT
SCALE	1:45000 (APPROX.)
DRAWING NO.	GWE17-043-1
DATE	AUGUST 21, 2018
DRAWN BY	M.L.
DESCRIPTION	FIGURE 1: STUDY AREA AND SURROUNDING CONTEXT



127 Walgreen Road
Ottawa, Ontario
(613) 836 0934

GRADIENT WIND ENGINEERING INC

PROJECT	KANATA LRT AIR QUALITY, NOISE AND VIBRATION ASSESSMENT		DESCRIPTION FIGURE 2: RECEPTOR LOCATIONS - AREA 1
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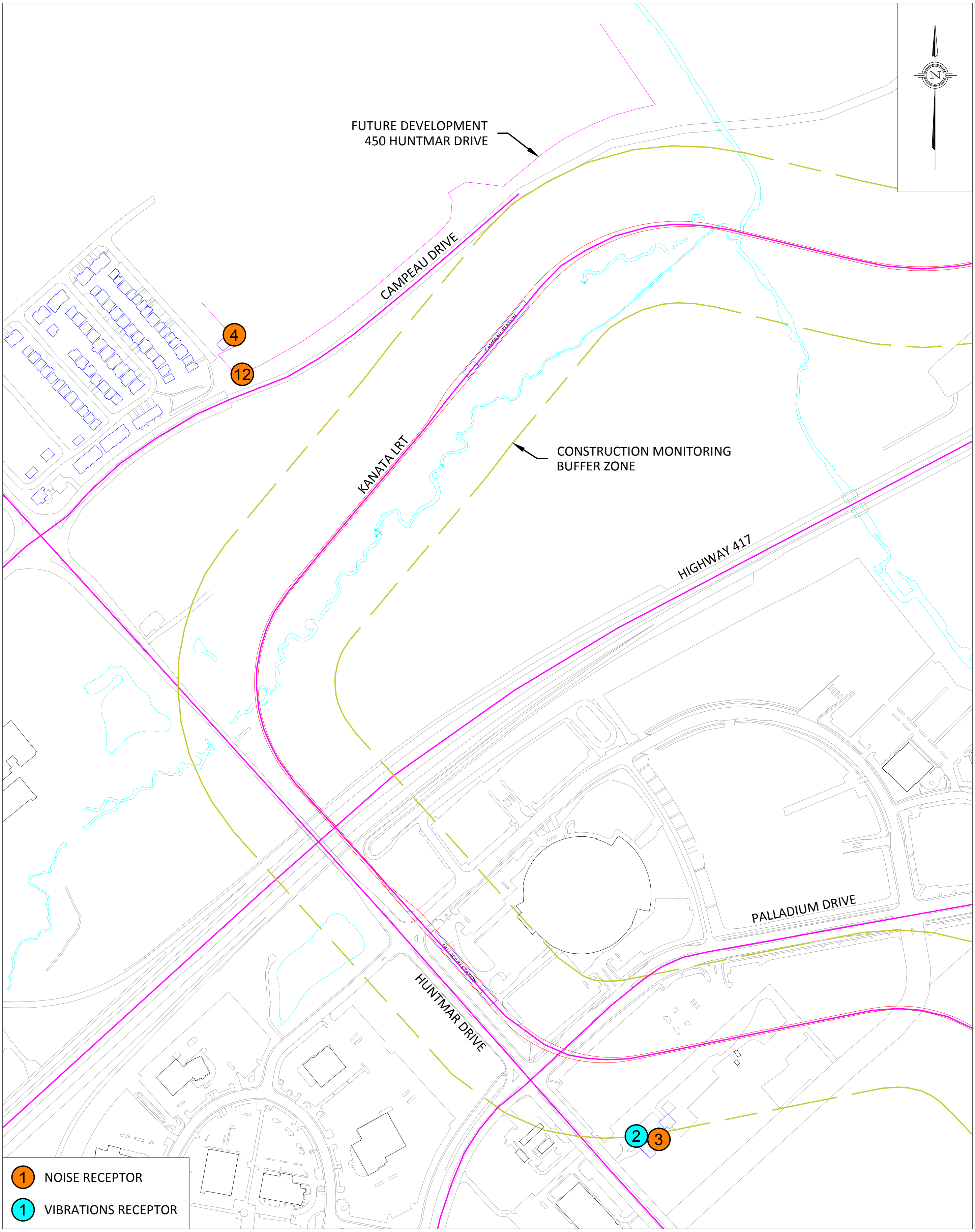
DATE	AUGUST 21, 2018	DRAWN BY M.L.	



127 Walgreen Road
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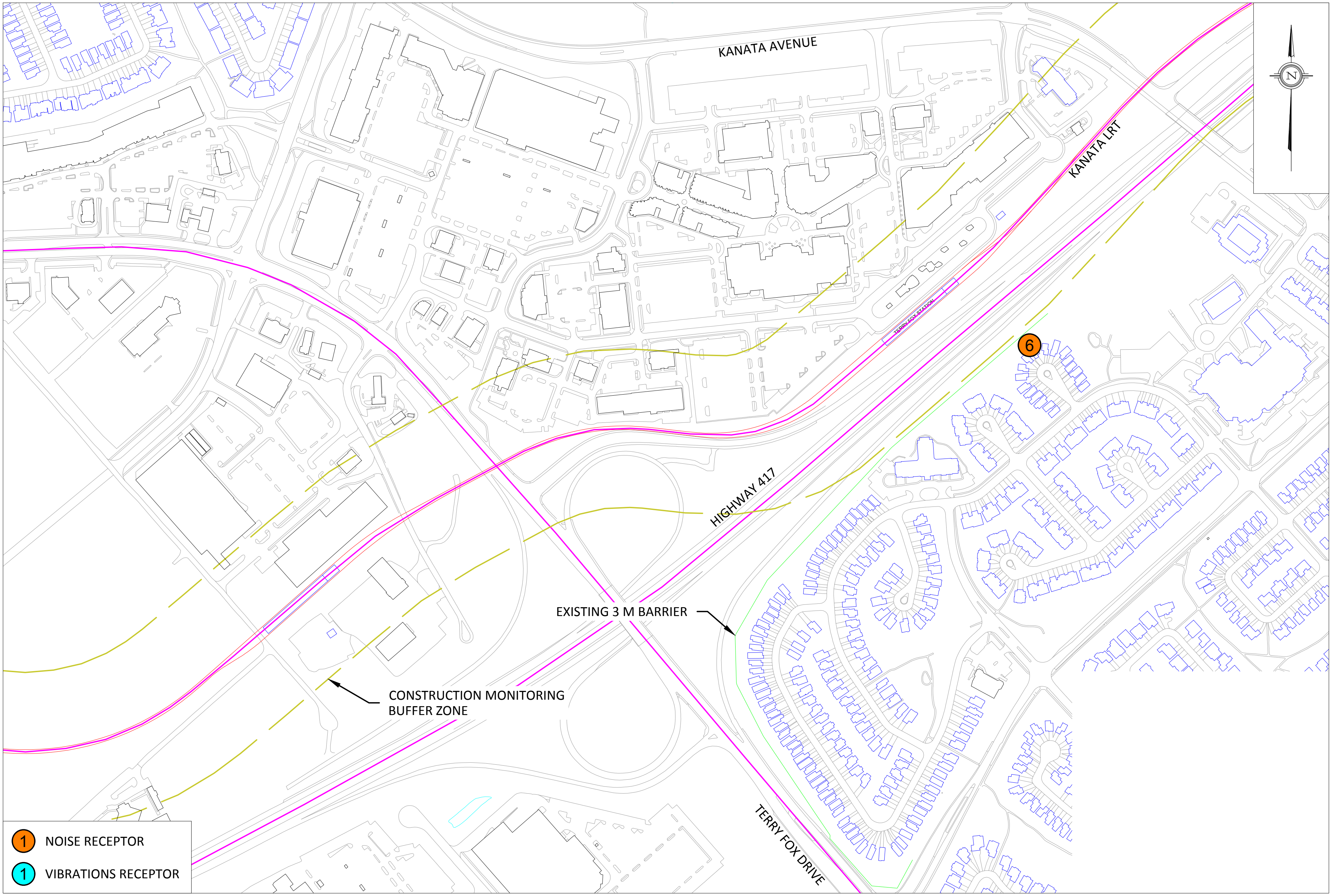
GRADIENT WIND ENGINEERING INC

PROJECT	KANATA LRT AIR QUALITY, NOISE AND VIBRATION ASSESSMENT		
SCALE	1:6500 (APPROX.)	DRAWING NO.	GWE17-043-3
DATE	AUGUST 21, 2018	DRAWN BY	M.L.

DESCRIPTION

FIGURE 3:
RECEPTOR LOCATIONS - AREA 2



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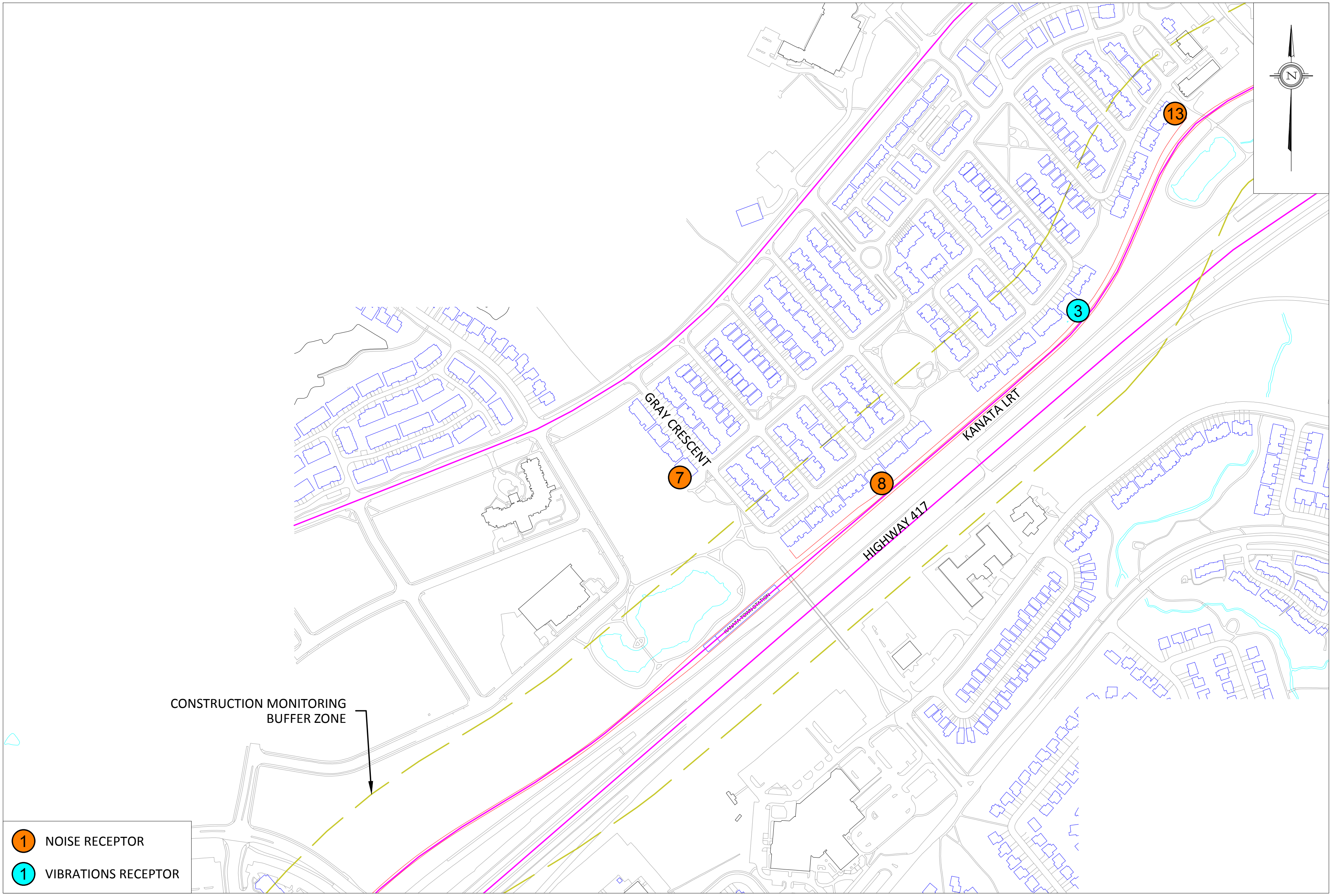
(613) 836 0934

PROJECT	KANATA LRT AIR QUALITY, NOISE AND VIBRATION IMPACT ASSESSMENT		
SCALE	1:6500 (APPROX.)	DRAWING NO.	GWE17-043-6
DATE	AUGUST 21, 2018	DRAWN BY	M.L.

DESCRIPTION

FIGURE 4:
RECEPTOR LOCATIONS - AREA 3



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PROJECT	KANATA LRT AIR QUALITY, NOISE AND VIBRATION IMPACT ASSESSMENT		
SCALE	1:6500 (APPROX.)	DRAWING NO.	GWE17-043-5
DATE	AUGUST 21, 2018	DRAWN BY	M.L.

DESCRIPTION

FIGURE 5:
RECEPTOR LOCATIONS - AREA 4

1 NOISE RECEPTOR

1 VIBRATIONS RECEPTOR

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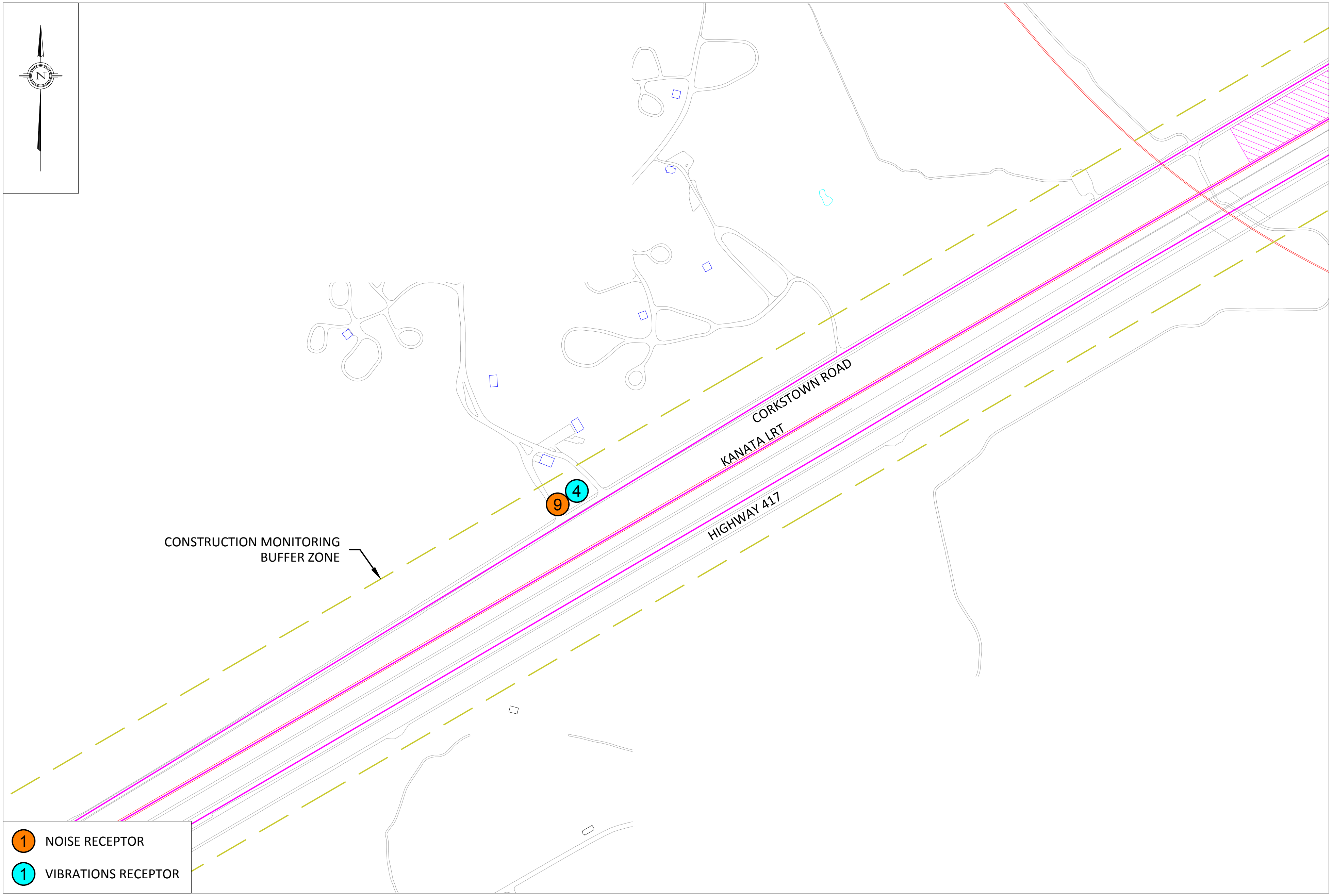
PROJECT	KANATA LRT AIR QUALITY, NOISE AND VIBRATION IMPACT ASSESSMENT
SCALE	1:6500 (APPROX.)
DRAWING NO.	GWE17-043-6
DATE	AUGUST 21, 2018
DRAWN BY	M.L.
DESCRIPTION	FIGURE 6: RECEPTOR LOCATIONS - AREA 5



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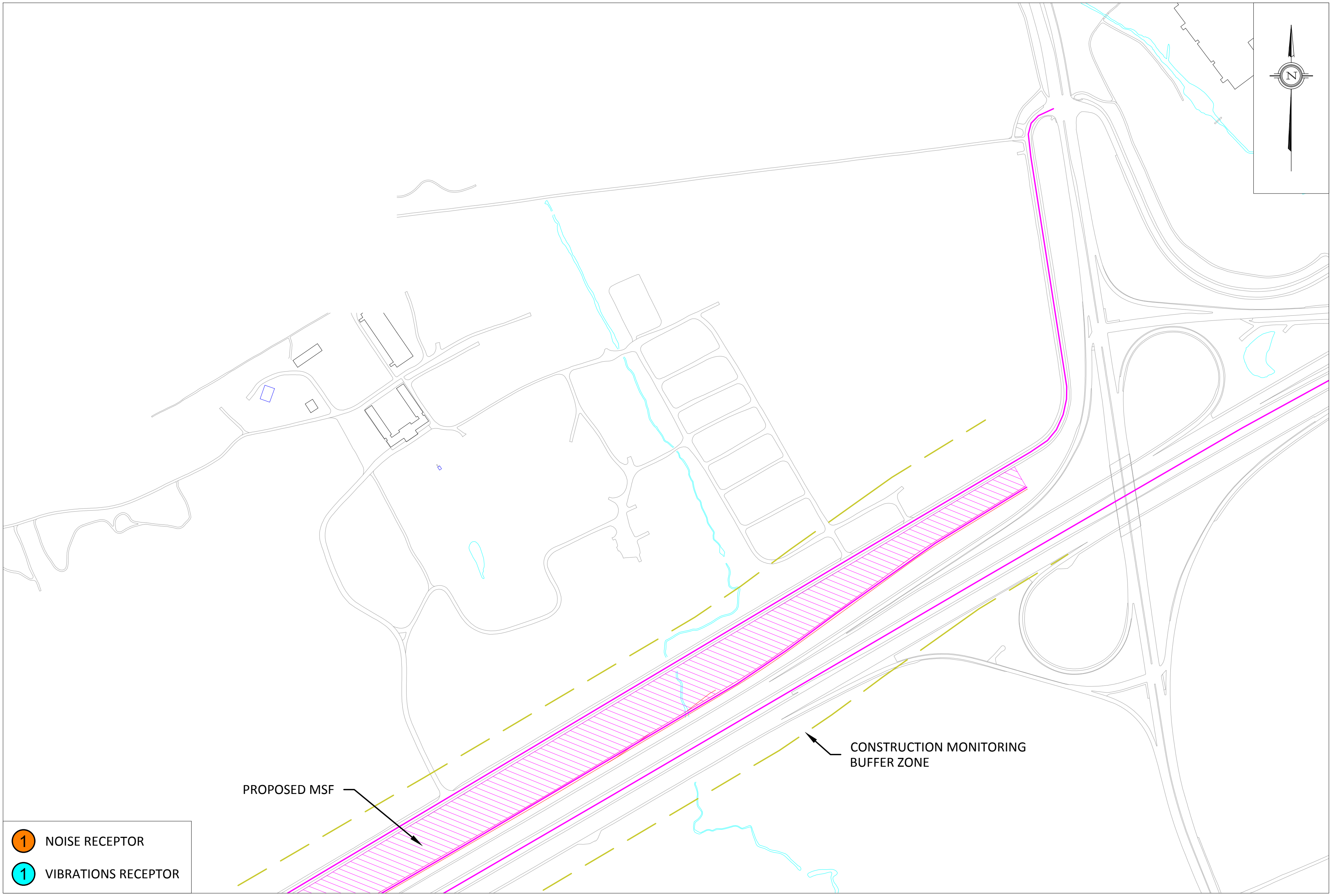
PROJECT	KANATA LRT AIR QUALITY, NOISE AND VIBRATION IMPACT ASSESSMENT		
SCALE	1:6500 (APPROX.)	DRAWING NO.	GWE17-043-7
DATE	AUGUST 21, 2018	DRAWN BY	M.L.

DESCRIPTION

FIGURE 7:
RECEPTOR LOCATIONS - AREA 6



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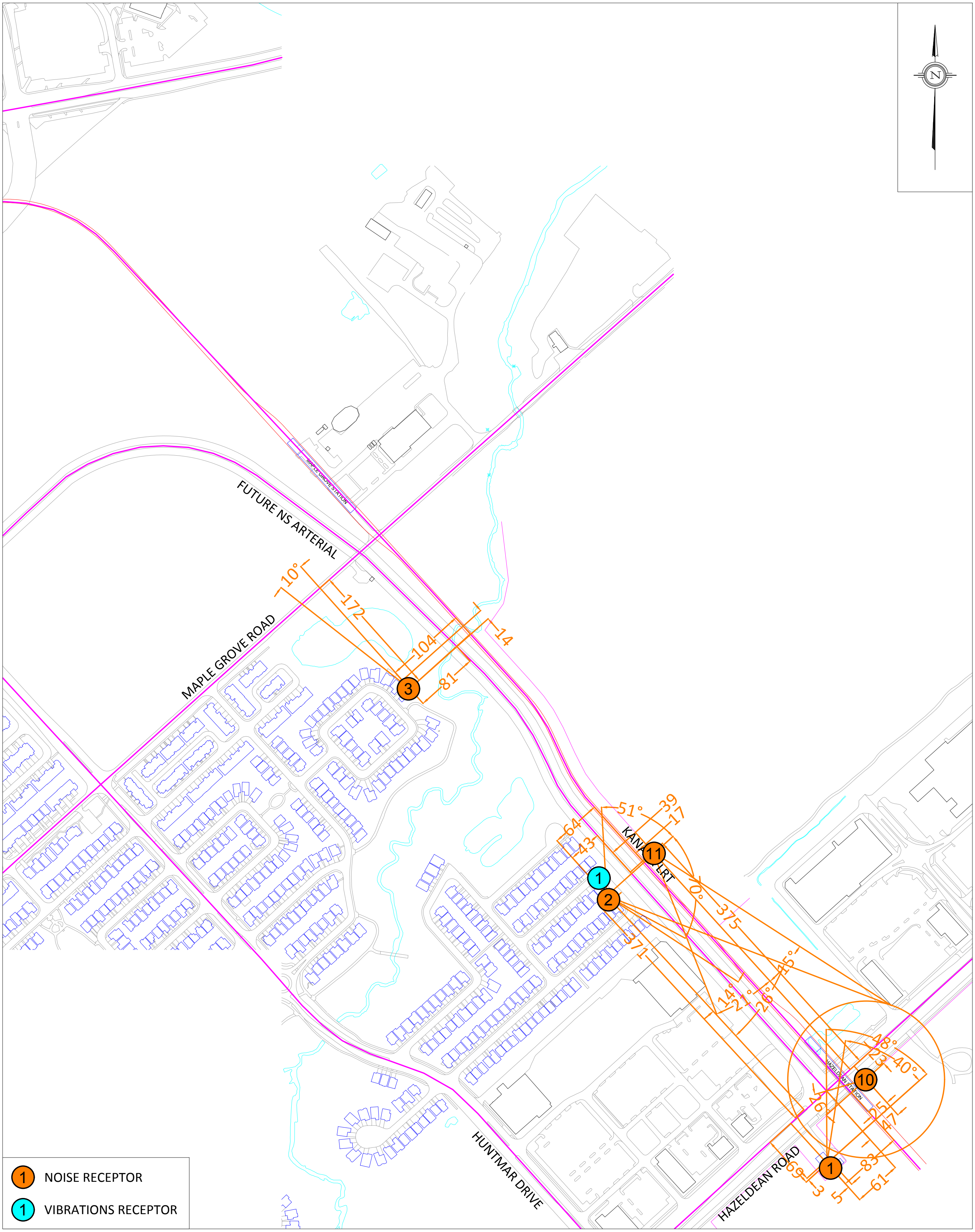
(613) 836 0934

PROJECT	KANATA LRT AIR QUALITY, NOISE AND VIBRATION IMPACT ASSESSMENT
SCALE	1:6500 (APPROX.)
DRAWING NO.	GWE17-043-8
DATE	AUGUST 21, 2018
DRAWN BY	M.L.
DESCRIPTION	FIGURE 8: RECEPTOR LOCATIONS - AREA 7



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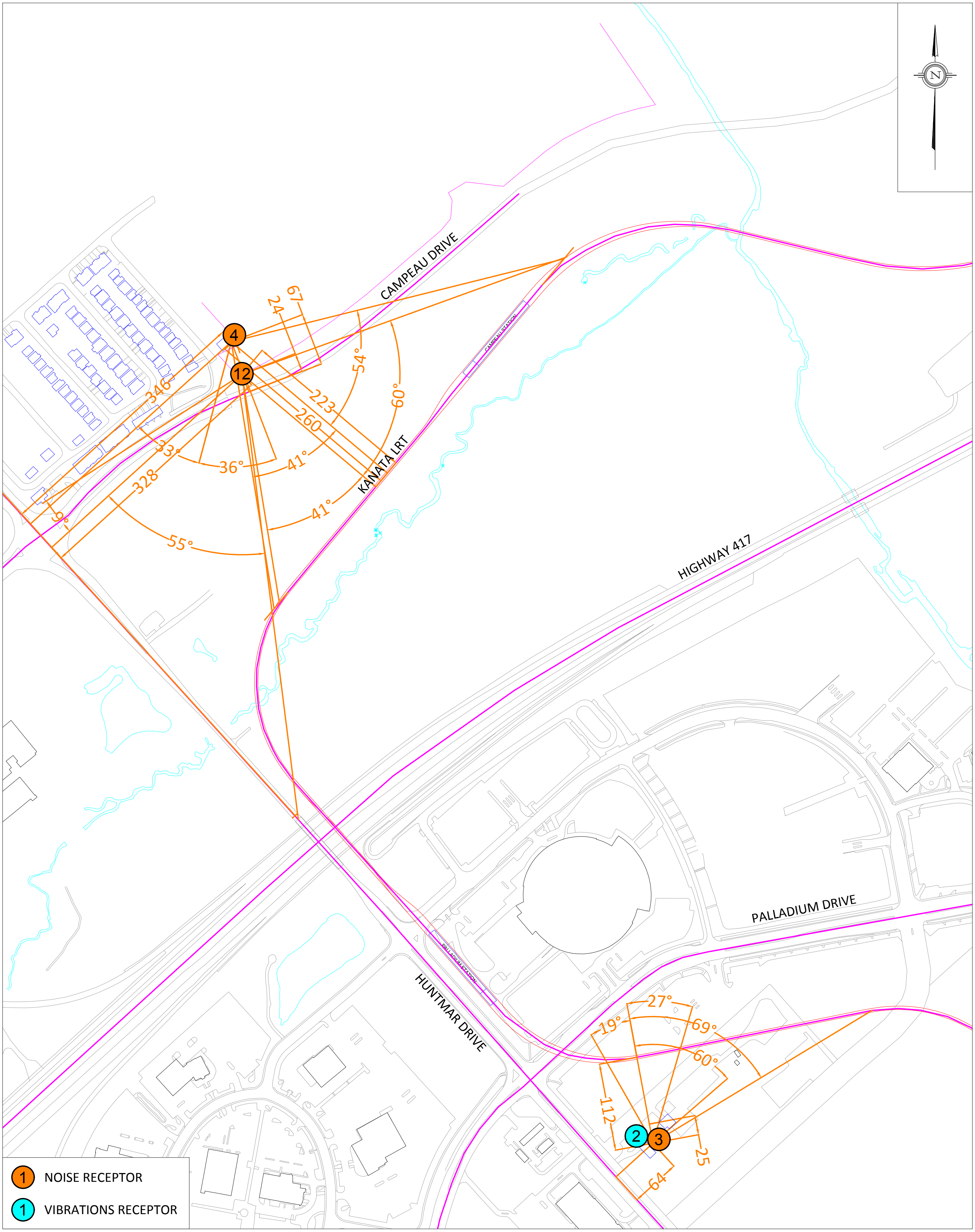
PROJECT		DESCRIPTION
KANATA LRT AIR QUALITY, NOISE AND VIBRATION ASSESSMENT		FIGURE 9: STAMSON INPUT - AREA 1
SCALE 1:6500 (APPROX.)	DRAWING NO. GWE17-043-9	
DATE AUGUST 21, 2018	DRAWN BY M.L.	



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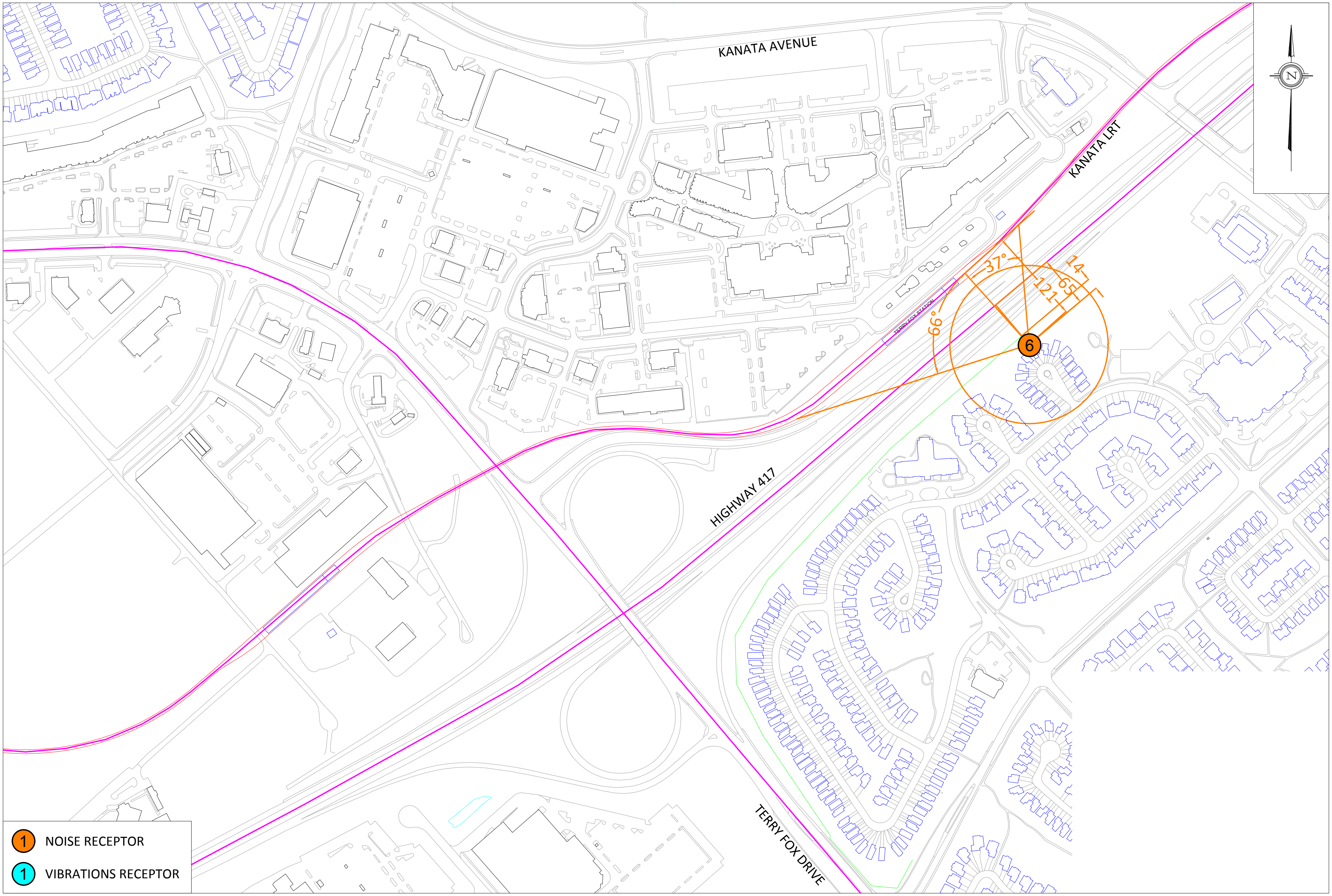
PROJECT	KANATA LRT AIR QUALITY, NOISE AND VIBRATION ASSESSMENT
SCALE	1:6500 (APPROX.)
DRAWING NO.	GWE17-043-10
DATE	FEBRUARY 23, 2018
DRAWN BY	M.L.
DESCRIPTION	FIGURE 10: STAMSON INPUT - AREA 2



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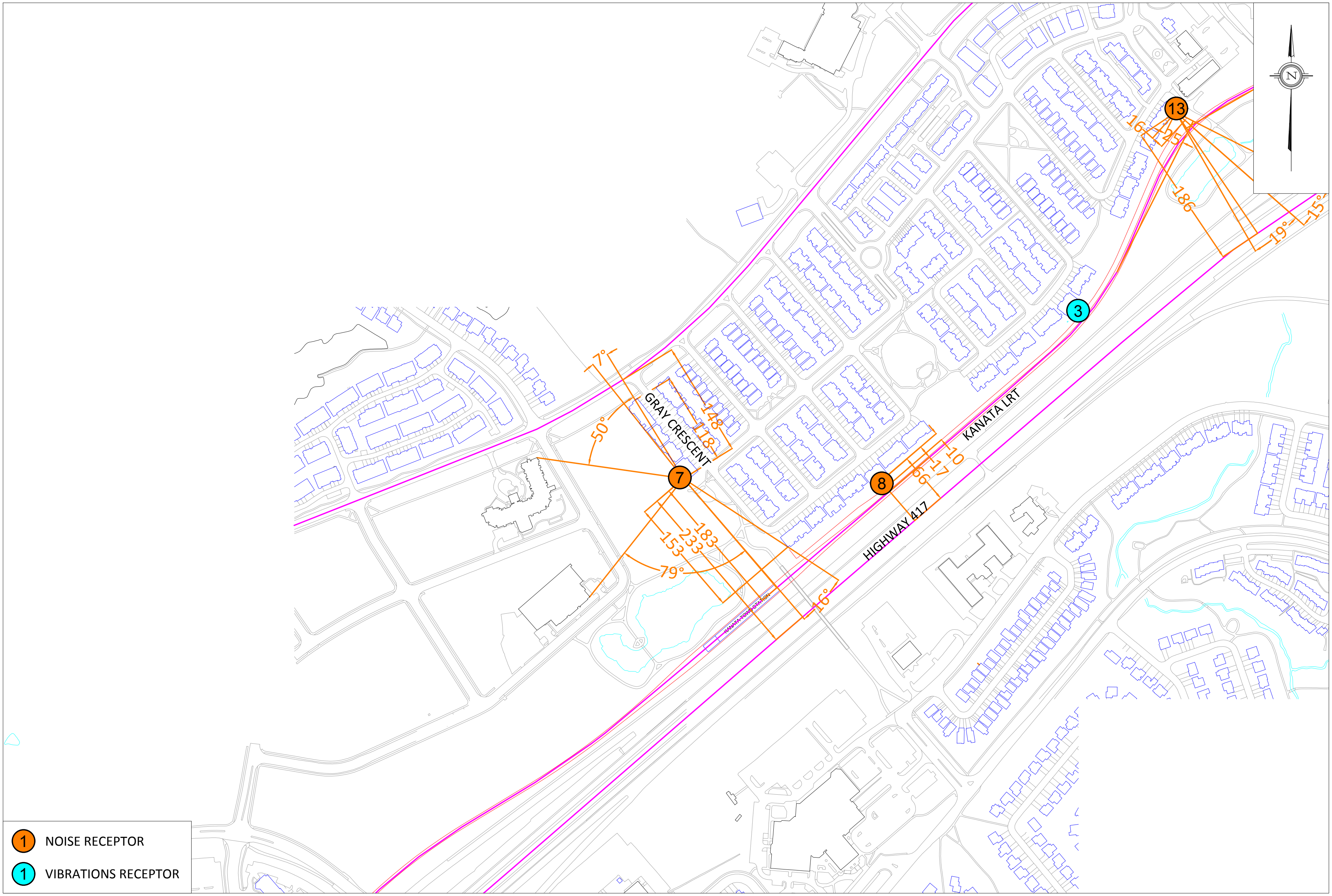
PROJECT	KANATA LRT AIR QUALITY, NOISE AND VIBRATION IMPACT ASSESSMENT		
SCALE	1:6500 (APPROX.)	DRAWING NO.	GWE17-043-11
DATE	AUGUST 21, 2018	DRAWN BY	M.L.

DESCRIPTION

FIGURE 11:
STAMSON INPUT - AREA 3



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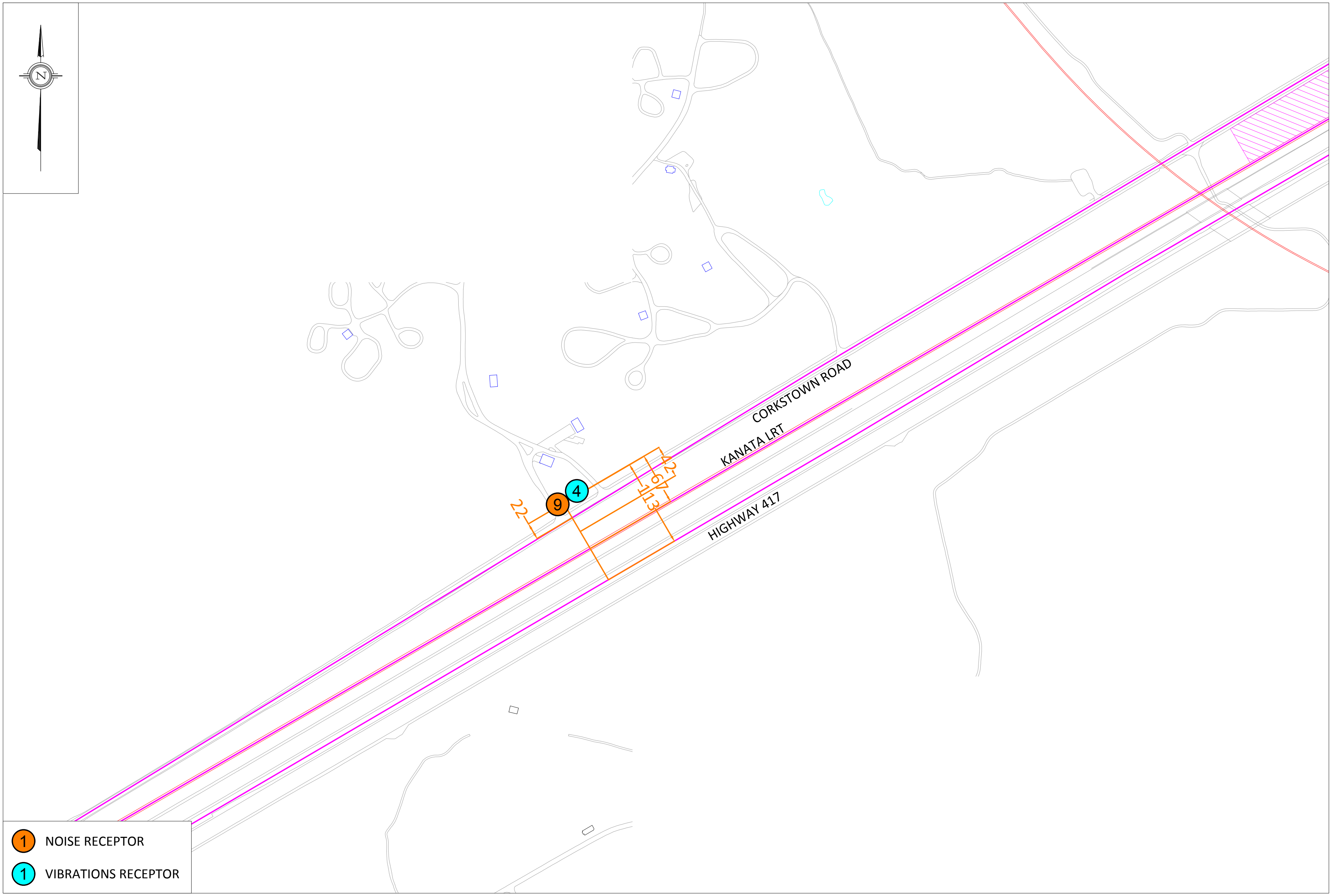
PROJECT		DESCRIPTION
KANATA LRT AIR QUALITY, NOISE AND VIBRATION IMPACT ASSESSMENT		FIGURE 12: STAMSON INPUT - AREA 4
SCALE 1:6500 (APPROX.)	DRAWING NO. GWE17-043-12	
DATE AUGUST 21, 2018	DRAWN BY M.L.	



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PROJECT KANATA LRT AIR QUALITY, NOISE AND VIBRATION IMPACT ASSESSMENT		DESCRIPTION FIGURE 13: STAMSON INPUT - AREA 6
SCALE 1:6500 (APPROX.)	DRAWING NO. GWE17-043-13	
DATE AUGUST 21, 2018	DRAWN BY M.L.	

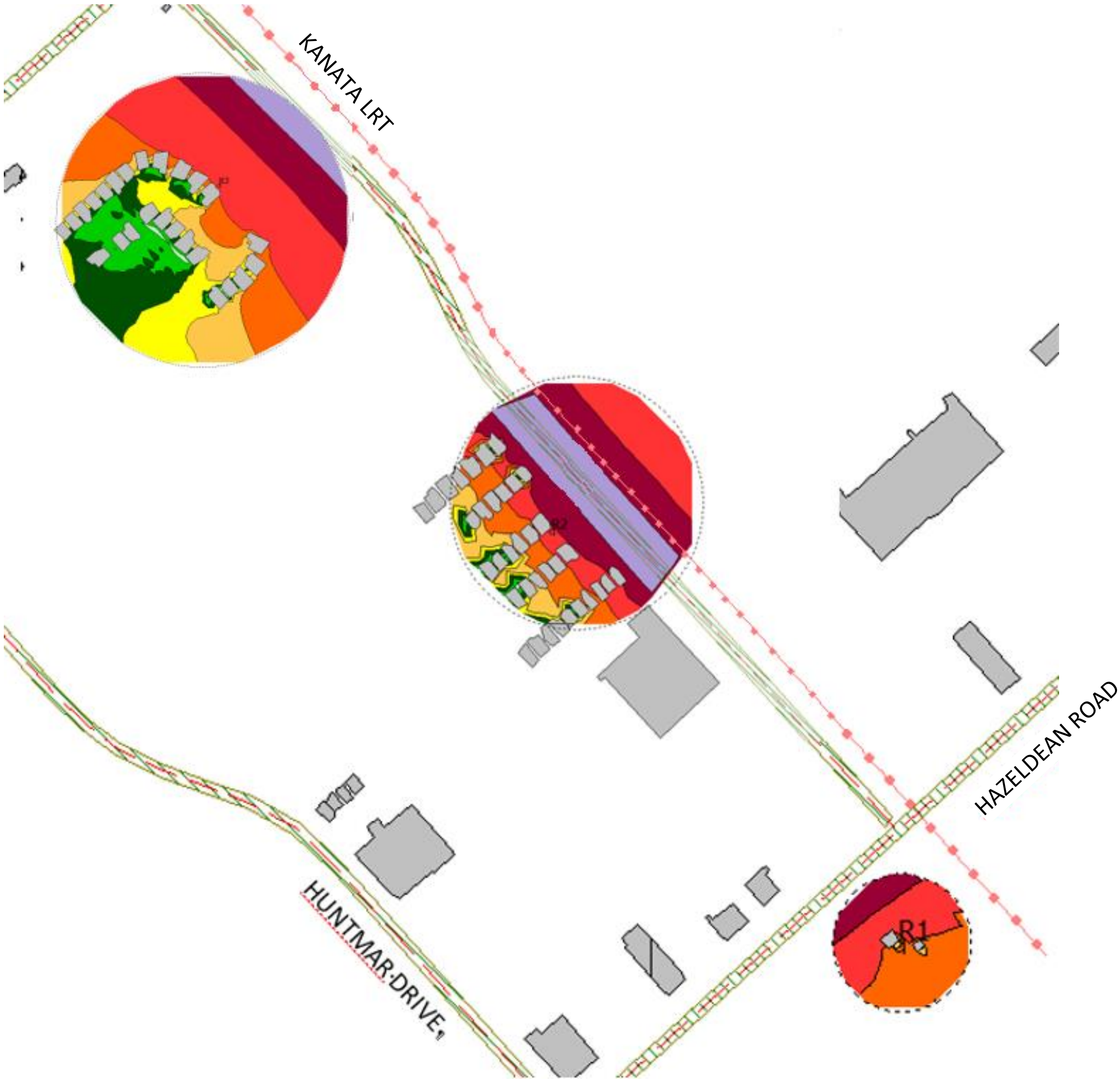
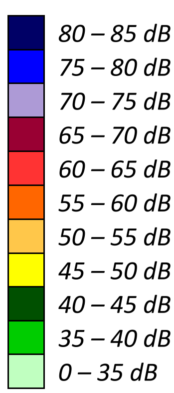


FIGURE 14: DAYTIME FUTURE NOISE CONTOURS 1



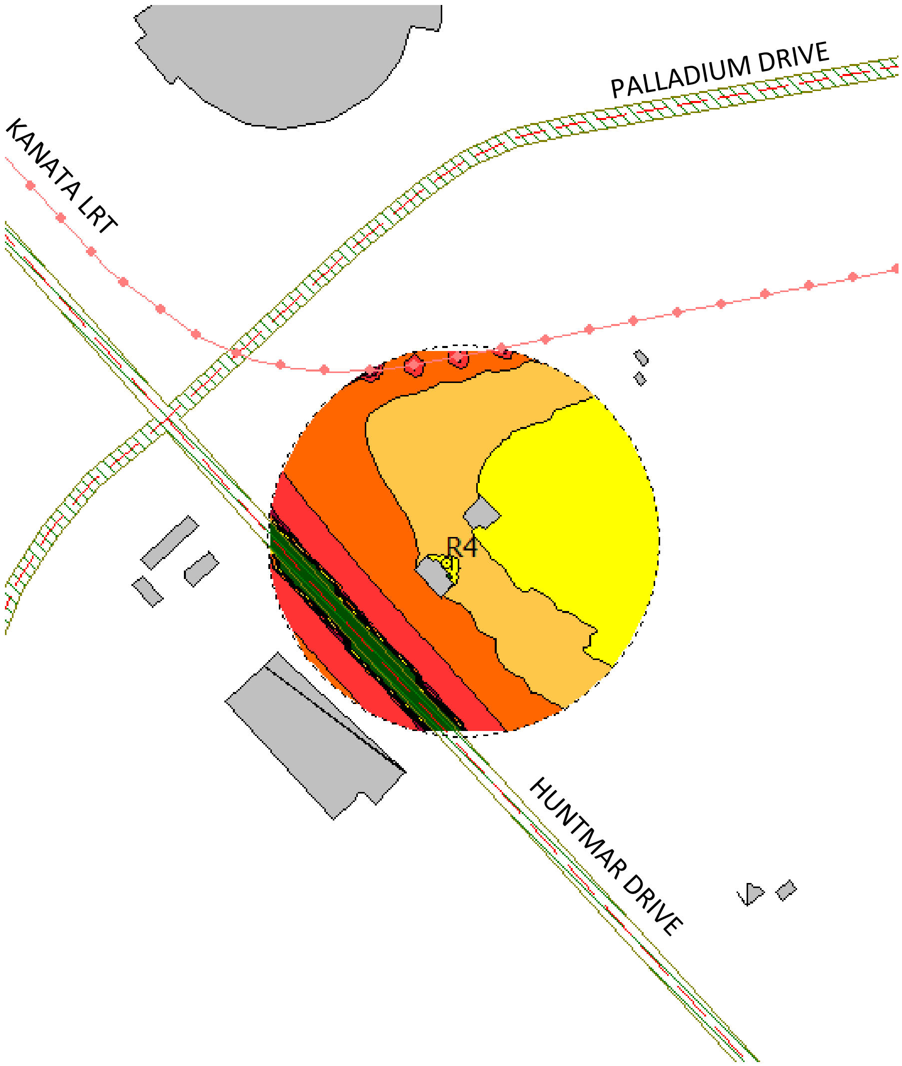


FIGURE 15: FIGURE 14: DAYTIME FUTURE NOISE CONTOURS 2

	80 – 85 dB
	75 – 80 dB
	70 – 75 dB
	65 – 70 dB
	60 – 65 dB
	55 – 60 dB
	50 – 55 dB
	45 – 50 dB
	40 – 45 dB
	35 – 40 dB
	0 – 35 dB

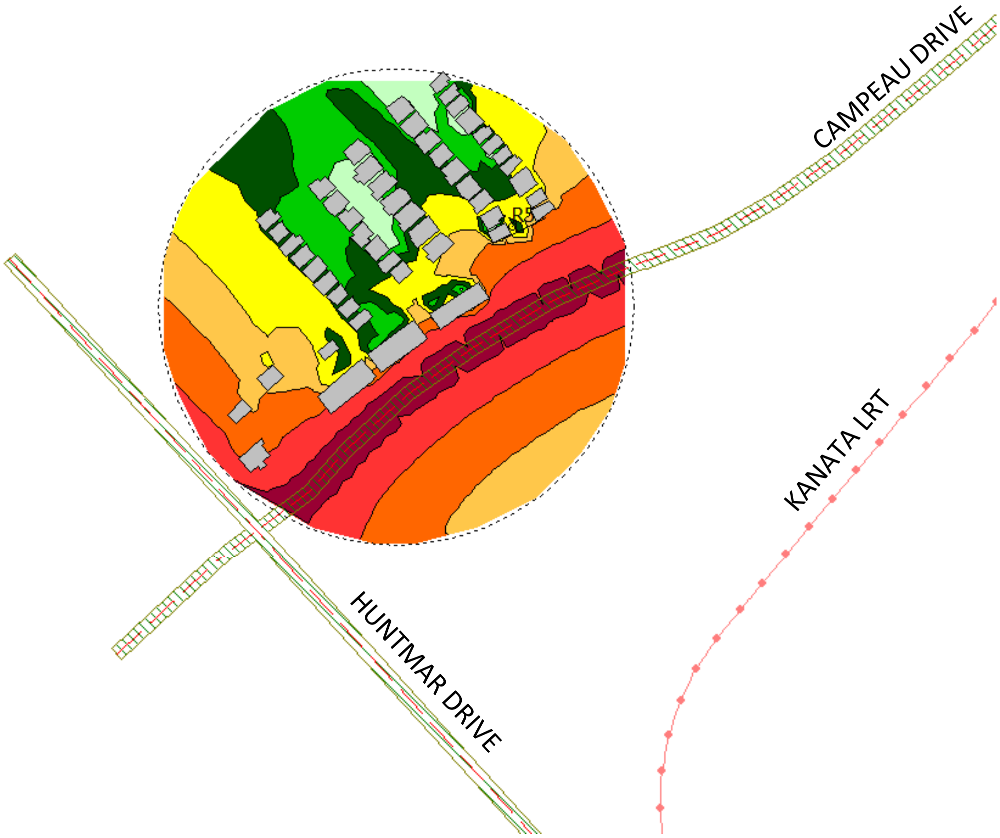
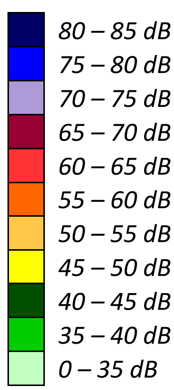


FIGURE 16: DAYTIME FUTURE NOISE CONTOURS 3



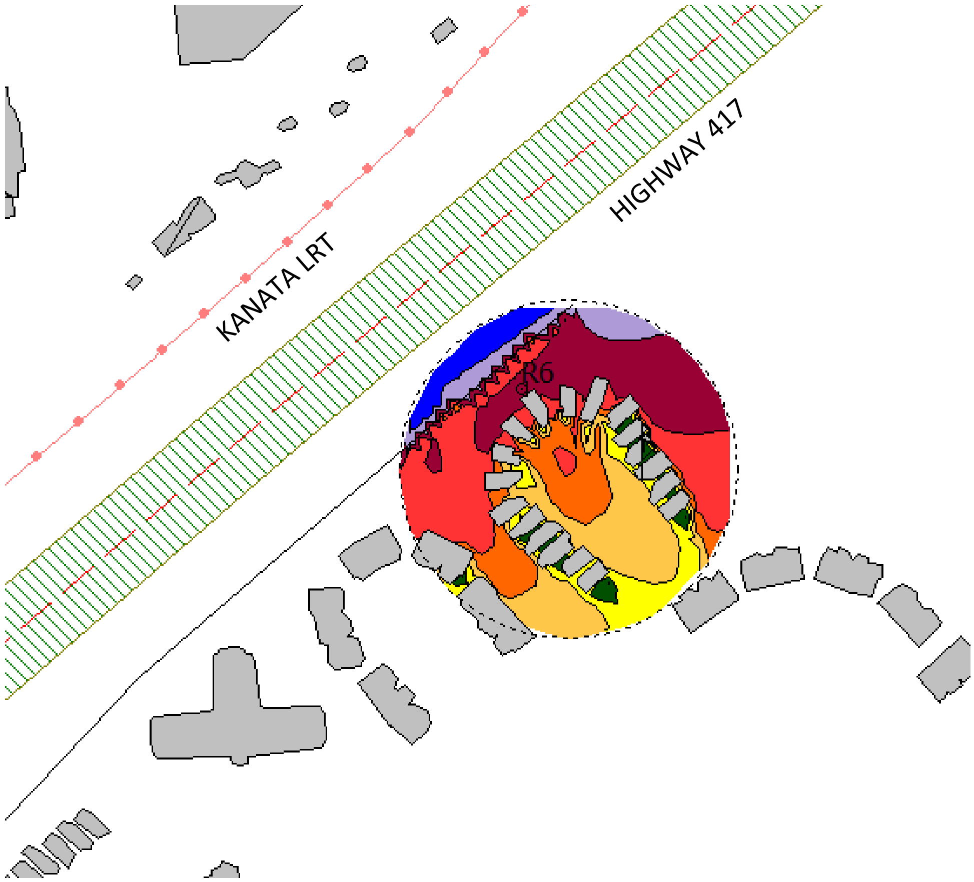


FIGURE 17: DAYTIME FUTURE NOISE CONTOURS 4

	80 – 85 dB
	75 – 80 dB
	70 – 75 dB
	65 – 70 dB
	60 – 65 dB
	55 – 60 dB
	50 – 55 dB
	45 – 50 dB
	40 – 45 dB
	35 – 40 dB
	0 – 35 dB

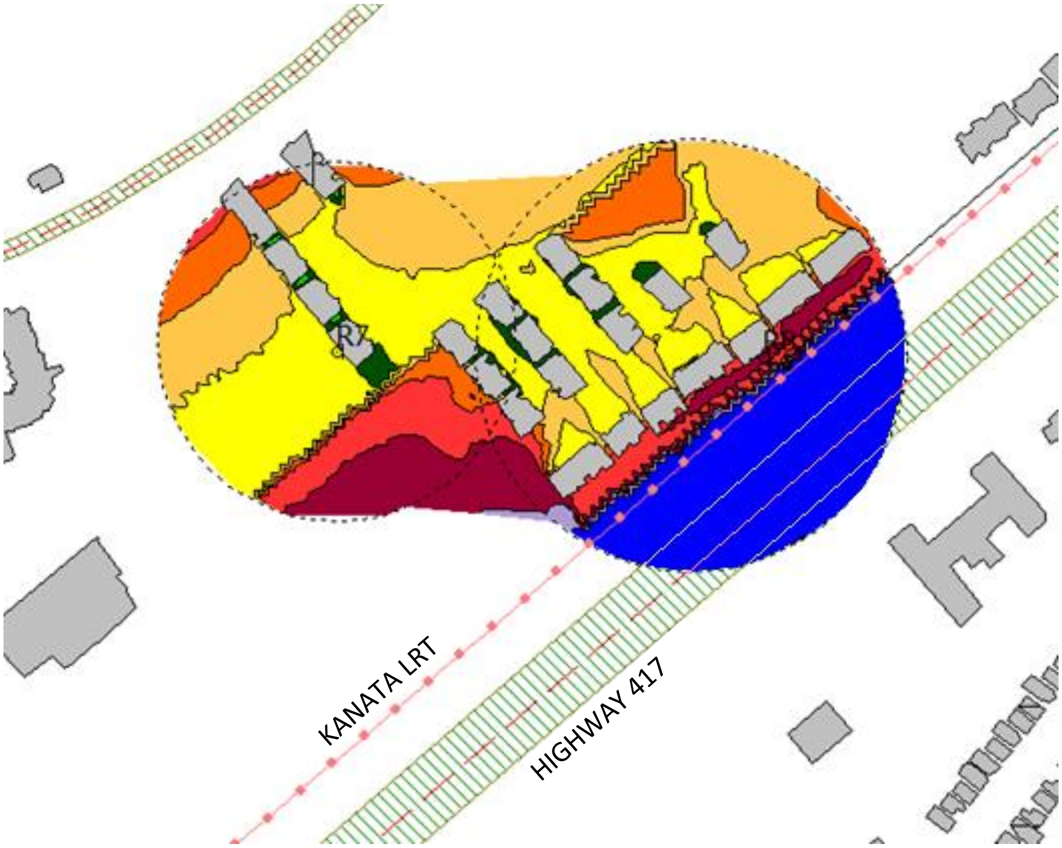


FIGURE 18: DAYTIME FUTURE NOISE CONTOURS 5

80 – 85 dB
75 – 80 dB
70 – 75 dB
65 – 70 dB
60 – 65 dB
55 – 60 dB
50 – 55 dB
45 – 50 dB
40 – 45 dB
35 – 40 dB
0 – 35 dB

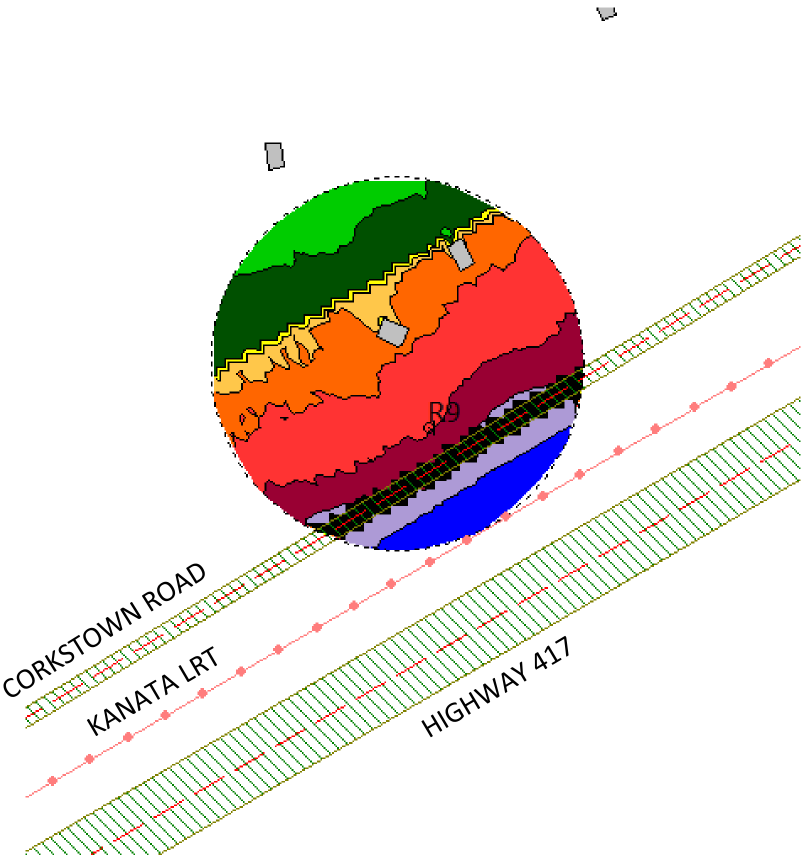
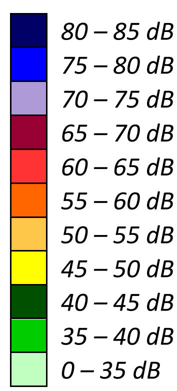


FIGURE 19: DAYTIME FUTURE NOISE CONTOURS 6



APPENDIX A

STAMSON 5.04 - INPUT AND OUTPUT DATA
(Existing Conditions)

```
STAMSON 5.0        NORMAL REPORT        Date: 23-02-2018 16:46:10
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r1e.te                Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: Hazeldean (day/night)
---------------------------------------------
Car traffic volume  : 14033/1220  veh/TimePeriod  *
Medium truck volume :  1116/97    veh/TimePeriod  *
Heavy truck volume  :   797/69    veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  17333
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: Hazeldean (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  :  69.00 / 69.00  m
Receiver height           :   1.50 / 1.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 90.00 deg
Barrier height            :   3.00 m
Barrier receiver distance :   3.00 / 3.00   m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Results segment # 1: Hazeldean (day)
------------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source       ! Receiver     ! Barrier      ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top  (m)
-------------+--------------+--------------+---------------
       1.50 !        1.50 !        1.50 !         1.50

ROAD (0.00 + 49.16 + 0.00) = 49.16 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     90   0.48  70.62   0.00  -9.81  -1.14   0.00   0.00 -10.51
49.16
--------------------------------------------------------------------------
--

Segment Leq : 49.16 dBA

Total Leq All Segments: 49.16 dBA
```

```
Results segment # 1: Hazeldean (night)
--------------------------------------

Source height = 1.49 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+---------------
       1.49 !        1.50 !        1.50 !         1.50

ROAD (0.00 + 41.55 + 0.00) = 41.55 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     90   0.48  63.01   0.00  -9.81  -1.14   0.00   0.00 -10.51
41.55
--------------------------------------------------------------------------
--

Segment Leq : 41.55 dBA

Total Leq All Segments: 41.55 dBA




TOTAL Leq FROM ALL SOURCES (DAY): 49.16
                         (NIGHT): 41.55
```

```
STAMSON 5.0        NORMAL REPORT        Date: 23-02-2018 16:46:20
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r2e.te               Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: Hazeldean (day/night)
---------------------------------------------
Car traffic volume  : 14033/1220  veh/TimePeriod  *
Medium truck volume :  1116/97    veh/TimePeriod  *
Heavy truck volume  :   797/69    veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  17333
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: Hazeldean (day/night)
-------------------------------------------
Angle1   Angle2           : -26.00 deg   -14.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 371.00 / 371.00 m
Receiver height           :   1.50 / 1.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Results segment # 1: Hazeldean (day)
------------------------------------

Source height = 1.50 m

ROAD (0.00 + 35.55 + 0.00) = 35.55 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -26    -14   0.66  70.62   0.00 -23.13 -11.94   0.00   0.00   0.00
35.55
--------------------------------------------------------------------------
--

Segment Leq : 35.55 dBA

Total Leq All Segments: 35.55 dBA
```

```
Results segment # 1: Hazeldean (night)
--------------------------------------

Source height = 1.49 m

ROAD (0.00 + 27.94 + 0.00) = 27.94 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -26    -14   0.66  63.01   0.00 -23.13 -11.94   0.00   0.00   0.00
27.94
--------------------------------------------------------------------------
--

Segment Leq : 27.94 dBA

Total Leq All Segments: 27.94 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 35.55
                         (NIGHT): 27.94
```

```
STAMSON 5.0        NORMAL REPORT        Date: 23-02-2018 16:46:31
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r3e.te               Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: Maple (day/night)
-----------------------------------------
Car traffic volume  :  4048/352   veh/TimePeriod  *
Medium truck volume :   322/28    veh/TimePeriod  *
Heavy truck volume  :   230/20    veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):   5000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: Maple (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  : 172.00 / 172.00 m
Receiver height           :   1.50 / 1.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : -10.00 deg
Barrier height            :   6.00 m
Barrier receiver distance :  14.00 / 14.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Results segment # 1: Maple (day)
--------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+---------------
       1.50 !        1.50 !        1.50 !         1.50

ROAD (0.00 + 34.64 + 43.80) = 44.29 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
----------------------------------------------------------------------------
--
   -90    -10   0.30  65.22   0.00 -13.77  -4.40   0.00   0.00 -12.41
34.64
----------------------------------------------------------------------------
--
   -10     90   0.66  65.22   0.00 -17.59  -3.84   0.00   0.00   0.00
43.80
----------------------------------------------------------------------------
--

Segment Leq : 44.29 dBA

Total Leq All Segments: 44.29 dBA
```

```
Results segment # 1: Maple (night)
----------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+---------------
       1.50 !        1.50 !        1.50 !         1.50

ROAD (0.00 + 27.05 + 36.20) = 36.70 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90    -10   0.30  57.63   0.00 -13.77  -4.40   0.00   0.00 -12.41
27.05
--------------------------------------------------------------------------
--
   -10     90   0.66  57.63   0.00 -17.59  -3.84   0.00   0.00   0.00
36.20
--------------------------------------------------------------------------
--

Segment Leq : 36.70 dBA

Total Leq All Segments: 36.70 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 44.29
                         (NIGHT): 36.70
```

```
STAMSON 5.0        NORMAL REPORT        Date: 23-02-2018 16:46:57
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r4e.te               Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: Huntmar (day/night)
-------------------------------------------
Car traffic volume  :  3644/317   veh/TimePeriod  *
Medium truck volume :   290/25    veh/TimePeriod  *
Heavy truck volume  :   207/18    veh/TimePeriod  *
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):   4501
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: Huntmar (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  :  64.00 / 64.00  m
Receiver height           :   1.50 / 1.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 90.00 deg
Barrier height            :   3.00 m
Barrier receiver distance :   3.00 / 3.00   m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Results segment # 1: Huntmar (day)
----------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !        1.50 !        1.50 !         1.50

ROAD (0.00 + 42.26 + 0.00) = 42.26 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     90   0.48  63.25   0.00  -9.33  -1.14   0.00   0.00 -10.52
42.26
--------------------------------------------------------------------------
--

Segment Leq : 42.26 dBA

Total Leq All Segments: 42.26 dBA
```

```
Results segment # 1: Huntmar (night)
------------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+---------------
       1.50 !        1.50 !        1.50 !         1.50

ROAD (0.00 + 34.66 + 0.00) = 34.66 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
----------------------------------------------------------------------------
--
   -90     90   0.48  55.65   0.00  -9.33  -1.14   0.00   0.00 -10.52
34.66
----------------------------------------------------------------------------
--

Segment Leq : 34.66 dBA

Total Leq All Segments: 34.66 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 42.26
                         (NIGHT): 34.66
```

```
STAMSON 5.0        NORMAL REPORT        Date: 23-02-2018 16:47:07
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r5e.te               Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: Huntmar (day/night)
-------------------------------------------
Car traffic volume  :  3644/317   veh/TimePeriod  *
Medium truck volume :   290/25    veh/TimePeriod  *
Heavy truck volume  :   207/18    veh/TimePeriod  *
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):   4501
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: Huntmar (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  : 346.00 / 346.00 m
Receiver height           :   1.50 / 1.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -33.00 deg   Angle2 : 90.00 deg
Barrier height            :   6.00 m
Barrier receiver distance :   3.00 / 3.00   m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Results segment # 1: Huntmar (day)
----------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !        1.50 !        1.50 !         1.50

ROAD (33.20 + 26.23 + 0.00) = 34.00 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90    -33   0.66  63.25   0.00 -22.63  -7.43   0.00   0.00   0.00
33.20
--------------------------------------------------------------------------
--
   -33     90   0.30  63.25   0.00 -17.72  -2.23   0.00   0.00 -17.07
26.23
--------------------------------------------------------------------------
--

Segment Leq : 34.00 dBA

Total Leq All Segments: 34.00 dBA
```

```
Results segment # 1: Huntmar (night)
------------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+---------------
       1.50 !        1.50 !        1.50 !         1.50

ROAD (25.60 + 18.63 + 0.00) = 26.39 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90    -33   0.66  55.65   0.00 -22.63  -7.43   0.00   0.00   0.00
25.60
--------------------------------------------------------------------------
--
   -33     90   0.30  55.65   0.00 -17.72  -2.23   0.00   0.00 -17.07
18.63
--------------------------------------------------------------------------
--

Segment Leq : 26.39 dBA

Total Leq All Segments: 26.39 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 34.00
                         (NIGHT): 26.39
```

```
STAMSON 5.0        NORMAL REPORT        Date: 23-02-2018 16:47:21
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r6e.te               Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: 417 (day/night)
---------------------------------------
Car traffic volume  : 64493/5608  veh/TimePeriod  *
Medium truck volume :  5130/446   veh/TimePeriod  *
Heavy truck volume  :  3664/319   veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  79660
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: 417 (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  :  65.00 / 65.00  m
Receiver height           :   1.50 / 1.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 90.00 deg
Barrier height            :   3.00 m
Barrier receiver distance :  14.00 / 14.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Results segment # 1: 417 (day)
------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+---------------
       1.50 !        1.50 !        1.50 !         1.50

ROAD (0.00 + 63.73 + 0.00) = 63.73 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     90   0.48  81.76   0.00  -9.43  -1.14   0.00   0.00  -7.47
63.73
--------------------------------------------------------------------------
--

Segment Leq : 63.73 dBA

Total Leq All Segments: 63.73 dBA
```

```
Results segment # 1: 417 (night)
--------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !        1.50 !        1.50 !         1.50

ROAD (0.00 + 56.13 + 0.00) = 56.13 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     90   0.48  74.16   0.00  -9.43  -1.14   0.00   0.00  -7.47
56.13
--------------------------------------------------------------------------
--

Segment Leq : 56.13 dBA

Total Leq All Segments: 56.13 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 63.73
                         (NIGHT): 56.13
```

```
STAMSON 5.0        NORMAL REPORT        Date: 23-02-2018 16:48:01
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r7e.te               Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: 417 (day/night)
---------------------------------------
Car traffic volume  : 96255/8370  veh/TimePeriod  *
Medium truck volume :  7657/666   veh/TimePeriod  *
Heavy truck volume  :  5469/476   veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT): 118892
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: 417 (day/night)
-------------------------------------
Angle1   Angle2           : -90.00 deg   79.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 233.00 / 233.00 m
Receiver height           :   1.50 / 1.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : -16.00 deg
Barrier height            :   6.00 m
Barrier receiver distance : 153.00 / 153.00 m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Road data, segment # 2: Campeau (day/night)
-------------------------------------------
Car traffic volume  : 14387/1251  veh/TimePeriod  *
Medium truck volume :  1144/100   veh/TimePeriod  *
Heavy truck volume  :   817/71    veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  17770
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 2: Campeau (day/night)
-----------------------------------------
Angle1   Angle2           : -50.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 148.00 / 148.00 m
Receiver height           :   1.50 / 1.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            :  -7.00 deg   Angle2 : 90.00 deg
Barrier height            :   6.00 m
Barrier receiver distance : 118.00 / 118.00 m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Results segment # 1: 417 (day)
------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !        1.50 !        1.50 !         1.50

ROAD (0.00 + 54.73 + 60.09) = 61.20 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90    -16   0.30  83.50   0.00 -15.49  -4.81   0.00   0.00  -8.46
54.73
--------------------------------------------------------------------------
--
   -16     79   0.66  83.50   0.00 -19.77  -3.63   0.00   0.00   0.00
60.09
--------------------------------------------------------------------------
--

Segment Leq : 61.20 dBA
```

```
Results segment # 2: Campeau (day)
----------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !        1.50 !        1.50 !         1.50

ROAD (47.56 + 43.37 + 0.00) = 48.96 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -50     -7   0.66  70.73   0.00 -16.50  -6.66   0.00   0.00   0.00
47.56
--------------------------------------------------------------------------
--
    -7     90   0.30  70.73   0.00 -12.93  -3.40   0.00   0.00 -11.04
43.37
--------------------------------------------------------------------------
--

Segment Leq : 48.96 dBA

Total Leq All Segments: 61.45 dBA
```

```
Results segment # 1: 417 (night)
--------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+---------------
       1.50 !        1.50 !        1.50 !         1.50

ROAD (0.00 + 47.14 + 52.49) = 53.60 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90    -16   0.30  75.90   0.00 -15.49  -4.81   0.00   0.00  -8.46
47.14
--------------------------------------------------------------------------
--
   -16     79   0.66  75.90   0.00 -19.77  -3.63   0.00   0.00   0.00
52.49
--------------------------------------------------------------------------
--

Segment Leq : 53.60 dBA
```

```
Results segment # 2: Campeau (night)
------------------------------------

Source height = 1.49 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+---------------
       1.49 !        1.50 !        1.50 !         1.50

ROAD (39.97 + 35.77 + 0.00) = 41.37 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -50     -7   0.66  63.14   0.00 -16.50  -6.66   0.00   0.00   0.00
39.97
--------------------------------------------------------------------------
--
    -7     90   0.30  63.14   0.00 -12.93  -3.40   0.00   0.00 -11.04
35.77
--------------------------------------------------------------------------
--

Segment Leq : 41.37 dBA

Total Leq All Segments: 53.85 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 61.45
                         (NIGHT): 53.85
```

```
STAMSON 5.0        NORMAL REPORT        Date: 23-02-2018 16:47:39
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r8e.te              Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: 417 (day/night)
---------------------------------------
Car traffic volume  : 96255/8370  veh/TimePeriod  *
Medium truck volume :  7657/666   veh/TimePeriod  *
Heavy truck volume  :  5469/476   veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT): 118892
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: 417 (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  :  66.00 / 66.00  m
Receiver height           :   1.50 / 1.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 90.00 deg
Barrier height            :   2.50 m
Barrier receiver distance :  10.00 / 10.00  m
Source elevation          :  95.75 m
Receiver elevation        :  94.50 m
Barrier elevation         :  96.25 m
Reference angle           :   0.00
```

```
Results segment # 1: 417 (day)
------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !        1.50 !       -0.06 !        96.19

ROAD (0.00 + 62.01 + 0.00) = 62.01 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     90   0.51  83.50   0.00  -9.72  -1.19   0.00   0.00 -10.58
62.01
--------------------------------------------------------------------------
--

Segment Leq : 62.01 dBA

Total Leq All Segments: 62.01 dBA
```

```
Results segment # 1: 417 (night)
--------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !        1.50 !       -0.06 !        96.19

ROAD (0.00 + 54.41 + 0.00) = 54.41 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     90   0.51  75.90   0.00  -9.72  -1.19   0.00   0.00 -10.58
54.41
--------------------------------------------------------------------------
--

Segment Leq : 54.41 dBA

Total Leq All Segments: 54.41 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 62.01
                         (NIGHT): 54.41
```

```
STAMSON 5.0        NORMAL REPORT        Date: 23-02-2018 16:47:49
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r9e.te               Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: 417 (day/night)
---------------------------------------
Car traffic volume  : 127444/11082 veh/TimePeriod  *
Medium truck volume : 10138/882   veh/TimePeriod  *
Heavy truck volume  :  7241/630   veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT): 157416
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: 417 (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   : 113.00 / 113.00 m
Receiver height            :   1.50 / 1.50   m
Topography                 :      2       (Flat/gentle slope; with barrier)
Barrier angle1             : -90.00 deg   Angle2 : 90.00 deg
Barrier height             :   0.00 m
Barrier receiver distance  :  42.00 / 42.00  m
Source elevation           :  -6.00 m
Receiver elevation         :   0.00 m
Barrier elevation          :   0.00 m
Reference angle            :   0.00
```

```
Road data, segment # 2: Corkstown (day/night)
---------------------------------------------
Car traffic volume  :  4048/352   veh/TimePeriod  *
Medium truck volume :   322/28    veh/TimePeriod  *
Heavy truck volume  :   230/20    veh/TimePeriod  *
Posted speed limit  :    80 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):   5000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 2: Corkstown (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   :  22.00 / 22.00   m
Receiver height            :   1.50 / 1.50    m
Topography                 :      1       (Flat/gentle slope; no barrier)
Reference angle            :   0.00
```

```
Results segment # 1: 417 (day)
------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !        1.50 !       -0.73 !        -0.73

ROAD (0.00 + 63.37 + 0.00) = 63.37 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     90   0.66  84.71   0.00 -14.56  -1.46   0.00   0.00  -5.33
63.37
--------------------------------------------------------------------------
--

Segment Leq : 63.37 dBA
```

```
Results segment # 2: Corkstown (day)
------------------------------------

Source height = 1.50 m

ROAD (0.00 + 63.50 + 0.00) = 63.50 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     90   0.66  67.72   0.00  -2.76  -1.46   0.00   0.00   0.00
63.50
--------------------------------------------------------------------------
--

Segment Leq : 63.50 dBA

Total Leq All Segments: 66.45 dBA
```

```
Results segment # 1: 417 (night)
--------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+---------------
       1.50 !        1.50 !       -0.73 !        -0.73

ROAD (0.00 + 55.78 + 0.00) = 55.78 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     90   0.66  77.12   0.00 -14.56  -1.46   0.00   0.00  -5.33
55.78
--------------------------------------------------------------------------
--

Segment Leq : 55.78 dBA
```

```
Results segment # 2: Corkstown (night)
--------------------------------------

Source height = 1.50 m

ROAD (0.00 + 55.90 + 0.00) = 55.90 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     90   0.66  60.12   0.00  -2.76  -1.46   0.00   0.00   0.00
55.90
--------------------------------------------------------------------------
--

Segment Leq : 55.90 dBA

Total Leq All Segments: 58.85 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 66.45
                         (NIGHT): 58.85
```

```
STAMSON 5.0        NORMAL REPORT        Date: 20-08-2018 15:48:10
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r10e.te              Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: Hazeldean (day/night)
---------------------------------------------
Car traffic volume  : 14033/1220  veh/TimePeriod  *
Medium truck volume :  1116/97    veh/TimePeriod  *
Heavy truck volume  :   797/69    veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  17333
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: Hazeldean (day/night)
-------------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  23.00 / 23.00  m
Receiver height           :   4.50 / 4.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Results segment # 1: Hazeldean (day)
------------------------------------

Source height = 1.50 m

ROAD (0.00 + 68.77 + 0.00) = 68.77 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
----------------------------------------------------------------------------
--
   -90     90   0.00  70.62   0.00  -1.86   0.00   0.00   0.00   0.00
68.77
----------------------------------------------------------------------------
--

Segment Leq : 68.77 dBA

Total Leq All Segments: 68.77 dBA
```

```
Results segment # 1: Hazeldean (night)
--------------------------------------

Source height = 1.49 m

ROAD (0.00 + 61.16 + 0.00) = 61.16 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     90   0.00  63.01   0.00  -1.86   0.00   0.00   0.00   0.00
61.16
--------------------------------------------------------------------------
--

Segment Leq : 61.16 dBA

Total Leq All Segments: 61.16 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 68.77
                         (NIGHT): 61.16
```

```
STAMSON 5.0        NORMAL REPORT        Date: 20-08-2018 15:48:24
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r11e.te               Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: Hazeldean (day/night)
---------------------------------------------
Car traffic volume  : 14033/1220  veh/TimePeriod  *
Medium truck volume :  1116/97    veh/TimePeriod  *
Heavy truck volume  :   797/69    veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  17333
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: Hazeldean (day/night)
-------------------------------------------
Angle1   Angle2            : -15.00 deg   21.00 deg
Wood depth                 :      0       (No woods.)
No of house rows           :      0 / 0
Surface                    :      1       (Absorptive ground surface)
Receiver source distance   : 375.00 / 375.00 m
Receiver height            :   4.50 / 4.50   m
Topography                 :      1       (Flat/gentle slope; no barrier)
Reference angle            :   0.00
```

```
Results segment # 1: Hazeldean (day)
------------------------------------

Source height = 1.50 m

ROAD (0.00 + 41.64 + 0.00) = 41.64 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -15     21   0.57  70.62   0.00 -21.95  -7.03   0.00   0.00   0.00
41.64
--------------------------------------------------------------------------
--

Segment Leq : 41.64 dBA

Total Leq All Segments: 41.64 dBA
```

```
Results segment # 1: Hazeldean (night)
--------------------------------------

Source height = 1.49 m

ROAD (0.00 + 34.03 + 0.00) = 34.03 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -15     21   0.57  63.01   0.00 -21.95  -7.03   0.00   0.00   0.00
34.03
--------------------------------------------------------------------------
--

Segment Leq : 34.03 dBA

Total Leq All Segments: 34.03 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 41.64
                         (NIGHT): 34.03
```

```
STAMSON 5.0        NORMAL REPORT        Date: 20-08-2018 15:48:36
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r12e.te              Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: Huntmar (day/night)
-------------------------------------------
Car traffic volume  :  3644/317   veh/TimePeriod  *
Medium truck volume :   290/25    veh/TimePeriod  *
Heavy truck volume  :   207/18    veh/TimePeriod  *
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):   4501
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: Huntmar (day/night)
-----------------------------------------
Angle1   Angle2           : -55.00 deg   9.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 328.00 / 328.00 m
Receiver height           :   4.50 / 4.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Results segment # 1: Huntmar (day)
----------------------------------

Source height = 1.50 m

ROAD (0.00 + 37.38 + 0.00) = 37.38 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -55      9   0.57  63.25   0.00 -21.04  -4.84   0.00   0.00   0.00
37.38
--------------------------------------------------------------------------
--

Segment Leq : 37.38 dBA

Total Leq All Segments: 37.38 dBA
```

```
Results segment # 1: Huntmar (night)
------------------------------------

Source height = 1.50 m

ROAD (0.00 + 29.77 + 0.00) = 29.77 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -55      9   0.57  55.65   0.00 -21.04  -4.84   0.00   0.00   0.00
29.77
--------------------------------------------------------------------------
--

Segment Leq : 29.77 dBA

Total Leq All Segments: 29.77 dBA




TOTAL Leq FROM ALL SOURCES (DAY): 37.38
                         (NIGHT): 29.77
```

```
STAMSON 5.0        NORMAL REPORT        Date: 22-08-2018 12:41:26
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r13e.te              Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: 417 (day/night)
---------------------------------------
Car traffic volume  : 96255/8370  veh/TimePeriod  *
Medium truck volume :  7657/666   veh/TimePeriod  *
Heavy truck volume  :  5469/476   veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT): 118892
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: 417 (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  : 186.00 / 186.00 m
Receiver height           :   1.50 / 1.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 90.00 deg
Barrier height            :   2.50 m
Barrier receiver distance :  16.00 / 16.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Results segment # 1: 417 (day)
------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source       ! Receiver     ! Barrier      ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top   (m)
-------------+--------------+--------------+---------------
       1.50 !        1.50 !        1.50 !         1.50

ROAD (0.00 + 59.78 + 0.00) = 59.78 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     90   0.51  83.50   0.00 -16.51  -1.19   0.00   0.00  -6.01
59.78
--------------------------------------------------------------------------
--

Segment Leq : 59.78 dBA

Total Leq All Segments: 59.78 dBA
```

```
Results segment # 1: 417 (night)
--------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source       ! Receiver     ! Barrier      ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top  (m)
-------------+--------------+--------------+---------------
       1.50 !        1.50 !        1.50 !         1.50

ROAD (0.00 + 52.18 + 0.00) = 52.18 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     90   0.51  75.90   0.00 -16.51  -1.19   0.00   0.00  -6.01
52.18
--------------------------------------------------------------------------
--

Segment Leq : 52.18 dBA

Total Leq All Segments: 52.18 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 59.78
                          (NIGHT): 52.18
```

APPENDIX B

STAMSON 5.04 - INPUT AND OUTPUT DATA
(Future Conditions)

```
STAMSON 5.0        NORMAL REPORT        Date: 23-02-2018 16:46:05
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r1.te                Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: Hazeldean (day/night)
---------------------------------------------
Car traffic volume  : 18153/1579  veh/TimePeriod  *
Medium truck volume :  1444/126   veh/TimePeriod  *
Heavy truck volume  :  1031/90    veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  22422
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: Hazeldean (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  :  69.00 / 69.00  m
Receiver height           :   1.50 / 1.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 90.00 deg
Barrier height            :   3.00 m
Barrier receiver distance :   3.00 / 3.00   m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Road data, segment # 2: NSART (day/night)
-----------------------------------------
Car traffic volume  : 28336/2464  veh/TimePeriod  *
Medium truck volume :  2254/196   veh/TimePeriod  *
Heavy truck volume  :  1610/140   veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  35000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 2: NSART (day/night)
---------------------------------------
Angle1   Angle2           : -90.00 deg   -48.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  61.00 / 61.00  m
Receiver height           :   1.50 / 1.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : -48.00 deg
Barrier height            :   3.00 m
Barrier receiver distance :   5.00 / 5.00   m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Results segment # 1: Hazeldean (day)
------------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+---------------
       1.50 !        1.50 !        1.50 !         1.50

ROAD (0.00 + 50.28 + 0.00) = 50.28 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     90   0.48  71.74   0.00  -9.81  -1.14   0.00   0.00 -10.51
50.28
--------------------------------------------------------------------------
--

Segment Leq : 50.28 dBA
```

```
Results segment # 2: NSART (day)
--------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !        1.50 !        1.50 !         1.50

ROAD (0.00 + 48.03 + 0.00) = 48.03 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
----------------------------------------------------------------------------
--
   -90    -48   0.48  73.68   0.00  -9.02  -8.75   0.00   0.00  -7.88
48.03
----------------------------------------------------------------------------
--

Segment Leq : 48.03 dBA

Total Leq All Segments: 52.31 dBA
```

```
Results segment # 1: Hazeldean (night)
--------------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !        1.50 !        1.50 !         1.50

ROAD (0.00 + 42.70 + 0.00) = 42.70 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     90   0.48  64.16   0.00  -9.81  -1.14   0.00   0.00 -10.51
42.70
--------------------------------------------------------------------------
--

Segment Leq : 42.70 dBA
```

```
Results segment # 2: NSART (night)
----------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source       ! Receiver     ! Barrier      ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top   (m)
-------------+--------------+--------------+---------------
       1.50 !        1.50 !        1.50 !         1.50

ROAD (0.00 + 40.43 + 0.00) = 40.43 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90    -48   0.48  66.08   0.00  -9.02  -8.75   0.00   0.00  -7.88
40.43
--------------------------------------------------------------------------
--

Segment Leq : 40.43 dBA

Total Leq All Segments: 44.72 dBA
```

```
RT/Custom data, segment # 1: LRT (day/night)
--------------------------------------------
1 - 4-car SRT:
Traffic volume    :   313/27    veh/TimePeriod
Speed             :    50 km/h

Data for Segment # 1: LRT (day/night)
-------------------------------------
Angle1   Angle2           : -90.00 deg   0.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  83.00 / 83.00  m
Receiver height           :   1.50 / 1.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : -40.00 deg
Barrier height            :   3.00 m
Barrier receiver distance :   5.00 / 5.00   m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Results segment # 1: LRT (day)
------------------------------

Source height = 0.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       0.50 !        1.50 !        1.44 !         1.44

RT/Custom (0.00 + 30.83 + 39.04) = 39.65 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90    -40   0.51  58.15 -11.22  -7.78   0.00   0.00  -8.32  30.83
----------------------------------------------------------------------
   -40      0   0.66  58.15 -12.33  -6.77   0.00   0.00   0.00  39.04
----------------------------------------------------------------------

Segment Leq : 39.65 dBA

Total Leq All Segments: 39.65 dBA
```

```
Results segment # 1: LRT (night)
--------------------------------

Source height = 0.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+---------------
       0.50 !        1.50 !        1.44 !         1.44

RT/Custom (0.00 + 23.20 + 31.41) = 32.02 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90    -40   0.51  50.51 -11.22  -7.78   0.00   0.00  -8.32  23.20
----------------------------------------------------------------------
   -40      0   0.66  50.51 -12.33  -6.77   0.00   0.00   0.00  31.41
----------------------------------------------------------------------

Segment Leq : 32.02 dBA

Total Leq All Segments: 32.02 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 52.54
                         (NIGHT): 44.95
```

```
STAMSON 5.0        NORMAL REPORT        Date: 23-02-2018 16:46:15
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r2.te                 Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: NSART (day/night)
-----------------------------------------
Car traffic volume  : 28336/2464  veh/TimePeriod  *
Medium truck volume :  2254/196   veh/TimePeriod  *
Heavy truck volume  :  1610/140   veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  35000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: NSART (day/night)
---------------------------------------
Angle1   Angle2           : -90.00 deg   70.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  43.00 / 43.00  m
Receiver height           :   1.50 / 1.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : -51.00 deg
Barrier height            :   6.00 m
Barrier receiver distance :   2.00 / 2.00   m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Results segment # 1: NSART (day)
--------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !        1.50 !        1.50 !         1.50

ROAD (0.00 + 44.61 + 63.74) = 63.79 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90    -51   0.30  73.68   0.00  -5.95  -8.32   0.00   0.00 -14.80
44.61
--------------------------------------------------------------------------
--
   -51     70   0.66  73.68   0.00  -7.59  -2.34   0.00   0.00   0.00
63.74
--------------------------------------------------------------------------
--

Segment Leq : 63.79 dBA

Total Leq All Segments: 63.79 dBA
```

```
Results segment # 1: NSART (night)
----------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source       ! Receiver     ! Barrier      ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top   (m)
-------------+--------------+--------------+---------------
       1.50 !        1.50 !        1.50 !         1.50

ROAD (0.00 + 37.01 + 56.14) = 56.20 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
---------------------------------------------------------------------------
--
   -90    -51   0.30  66.08   0.00  -5.95  -8.32   0.00   0.00 -14.80
37.01
---------------------------------------------------------------------------
--
   -51     70   0.66  66.08   0.00  -7.59  -2.34   0.00   0.00   0.00
56.14
---------------------------------------------------------------------------
--

Segment Leq : 56.20 dBA

Total Leq All Segments: 56.20 dBA
```

```
RT/Custom data, segment # 1: LRT (day/night)
--------------------------------------------
1 - 4-car SRT:
Traffic volume    :   313/27    veh/TimePeriod
Speed             :    50 km/h

Data for Segment # 1: LRT (day/night)
-------------------------------------
Angle1   Angle2           : -90.00 deg   70.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  64.00 / 64.00  m
Receiver height           :   1.50 / 1.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : -51.00 deg
Barrier height            :   6.00 m
Barrier receiver distance :   2.00 / 2.00   m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Results segment # 1: LRT (day)
------------------------------

Source height = 0.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       0.50 !        1.50 !        1.47 !         1.47

RT/Custom (0.00 + 26.51 + 45.34) = 45.40 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90    -51   0.33  58.15  -8.38  -8.48   0.00   0.00 -14.78  26.51
----------------------------------------------------------------------
   -51     70   0.66  58.15 -10.46  -2.34   0.00   0.00   0.00  45.34
----------------------------------------------------------------------

Segment Leq : 45.40 dBA

Total Leq All Segments: 45.40 dBA
```

```
Results segment # 1: LRT (night)
--------------------------------

Source height = 0.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       0.50 !        1.50 !        1.47 !        1.47

RT/Custom (0.00 + 18.87 + 37.71) = 37.77 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90    -51   0.33  50.51  -8.38  -8.48   0.00   0.00 -14.78  18.87
----------------------------------------------------------------------
   -51     70   0.66  50.51 -10.46  -2.34   0.00   0.00   0.00  37.71
----------------------------------------------------------------------

Segment Leq : 37.77 dBA

Total Leq All Segments: 37.77 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 63.85
                         (NIGHT): 56.26
```

```
STAMSON 5.0        NORMAL REPORT        Date: 23-02-2018 16:46:26
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r3.te               Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: Maple (day/night)
-----------------------------------------
Car traffic volume  :  6477/563   veh/TimePeriod  *
Medium truck volume :   515/45    veh/TimePeriod  *
Heavy truck volume  :   368/32    veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):   8000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: Maple (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  : 172.00 / 172.00 m
Receiver height           :   1.50 / 1.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : -10.00 deg
Barrier height            :   6.00 m
Barrier receiver distance :  14.00 / 14.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Road data, segment # 2: NSART (day/night)
-----------------------------------------
Car traffic volume  : 28336/2464  veh/TimePeriod  *
Medium truck volume :  2254/196   veh/TimePeriod  *
Heavy truck volume  :  1610/140   veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  35000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 2: NSART (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  :  81.00 / 81.00  m
Receiver height           :   1.50 / 1.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Results segment # 1: Maple (day)
--------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !        1.50 !        1.50 !         1.50

ROAD (0.00 + 36.69 + 45.84) = 46.34 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90    -10   0.30  67.27   0.00 -13.77  -4.40   0.00   0.00 -12.41
36.69
--------------------------------------------------------------------------
--
   -10     90   0.66  67.27   0.00 -17.59  -3.84   0.00   0.00   0.00
45.84
--------------------------------------------------------------------------
--

Segment Leq : 46.34 dBA
```

```
Results segment # 2: NSART (day)
--------------------------------

Source height = 1.50 m

ROAD (0.00 + 60.06 + 0.00) = 60.06 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     90   0.66  73.68   0.00 -12.16  -1.46   0.00   0.00   0.00
60.06
--------------------------------------------------------------------------
--

Segment Leq : 60.06 dBA

Total Leq All Segments: 60.24 dBA
```

```
Results segment # 1: Maple (night)
----------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+---------------
       1.50 !        1.50 !        1.50 !         1.50

ROAD (0.00 + 29.09 + 38.25) = 38.74 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90    -10   0.30  59.67   0.00 -13.77  -4.40   0.00   0.00 -12.41
29.09
--------------------------------------------------------------------------
--
   -10     90   0.66  59.67   0.00 -17.59  -3.84   0.00   0.00   0.00
38.25
--------------------------------------------------------------------------
--

Segment Leq : 38.74 dBA
```

```
Results segment # 2: NSART (night)
----------------------------------

Source height = 1.50 m

ROAD (0.00 + 52.47 + 0.00) = 52.47 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     90   0.66  66.08   0.00 -12.16  -1.46   0.00   0.00   0.00
52.47
--------------------------------------------------------------------------
--

Segment Leq : 52.47 dBA

Total Leq All Segments: 52.65 dBA
```

```
RT/Custom data, segment # 1: LRT (day/night)
--------------------------------------------
1 - 4-car SRT:
Traffic volume    :   313/27    veh/TimePeriod
Speed             :    50 km/h

Data for Segment # 1: LRT (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  : 104.00 / 104.00 m
Receiver height           :   1.50 / 1.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Results segment # 1: LRT (day)
------------------------------

Source height = 0.50 m

RT/Custom (0.00 + 42.73 + 0.00) = 42.73 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90     90   0.66  58.15 -13.96  -1.46   0.00   0.00   0.00  42.73
----------------------------------------------------------------------

Segment Leq : 42.73 dBA

Total Leq All Segments: 42.73 dBA
```

```
Results segment # 1: LRT (night)
--------------------------------

Source height = 0.50 m

RT/Custom (0.00 + 35.10 + 0.00) = 35.10 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90     90   0.66  50.51 -13.96  -1.46   0.00   0.00   0.00  35.10
----------------------------------------------------------------------

Segment Leq : 35.10 dBA

Total Leq All Segments: 35.10 dBA




TOTAL Leq FROM ALL SOURCES (DAY): 60.32
                         (NIGHT): 52.73
```

```
STAMSON 5.0        NORMAL REPORT        Date: 23-02-2018 16:46:49
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r4.te                 Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: Huntmar (day/night)
-------------------------------------------
Car traffic volume  :  6692/582   veh/TimePeriod  *
Medium truck volume :   532/46    veh/TimePeriod  *
Heavy truck volume  :   380/33    veh/TimePeriod  *
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):   8266
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: Huntmar (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  :  64.00 / 64.00  m
Receiver height           :   1.50 / 1.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 90.00 deg
Barrier height            :   3.00 m
Barrier receiver distance :   3.00 / 3.00   m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Results segment # 1: Huntmar (day)
----------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+---------------
       1.50 !        1.50 !        1.50 !         1.50

ROAD (0.00 + 44.90 + 0.00) = 44.90 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     90   0.48  65.89   0.00  -9.33  -1.14   0.00   0.00 -10.52
44.90
--------------------------------------------------------------------------
--

Segment Leq : 44.90 dBA

Total Leq All Segments: 44.90 dBA
```

```
Results segment # 1: Huntmar (night)
------------------------------------

Source height = 1.49 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.49 !        1.50 !        1.50 !         1.50

ROAD (0.00 + 37.30 + 0.00) = 37.30 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     90   0.48  58.28   0.00  -9.33  -1.14   0.00   0.00 -10.52
37.30
--------------------------------------------------------------------------
--

Segment Leq : 37.30 dBA

Total Leq All Segments: 37.30 dBA
```

```
RT/Custom data, segment # 1: LRT (day/night)
--------------------------------------------
1 - 4-car SRT:
Traffic volume    :   313/27    veh/TimePeriod
Speed             :    50 km/h

Data for Segment # 1: LRT (day/night)
-------------------------------------
Angle1   Angle2           : -19.00 deg   69.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 112.00 / 112.00 m
Receiver height           :   1.50 / 1.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            :  27.00 deg   Angle2 : 60.00 deg
Barrier height            :   3.00 m
Barrier receiver distance :  25.00 / 25.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Results segment # 1: LRT (day)
------------------------------

Source height = 0.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       0.50 !        1.50 !        1.28 !          1.28

RT/Custom (37.64 + 29.49 + 28.22) = 38.67 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -19     27   0.66  58.15 -14.49  -6.01   0.00   0.00   0.00  37.64
----------------------------------------------------------------------
    27     60   0.51  58.15 -13.18  -8.12   0.00   0.00  -7.35  29.49
----------------------------------------------------------------------
    60     69   0.66  58.15 -14.49 -15.43   0.00   0.00   0.00  28.22
----------------------------------------------------------------------

Segment Leq : 38.67 dBA

Total Leq All Segments: 38.67 dBA
```

```
Results segment # 1: LRT (night)
--------------------------------

Source height = 0.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+---------------
       0.50 !        1.50 !        1.28 !         1.28

RT/Custom (30.01 + 21.86 + 20.59) = 31.04 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -19     27   0.66  50.51 -14.49  -6.01   0.00   0.00   0.00  30.01
----------------------------------------------------------------------
    27     60   0.51  50.51 -13.18  -8.12   0.00   0.00  -7.35  21.86
----------------------------------------------------------------------
    60     69   0.66  50.51 -14.49 -15.43   0.00   0.00   0.00  20.59
----------------------------------------------------------------------

Segment Leq : 31.04 dBA

Total Leq All Segments: 31.04 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 45.83
                         (NIGHT): 38.22
```

```
STAMSON 5.0       NORMAL REPORT       Date: 23-02-2018 16:47:02
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r5.te                Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: Campeau (day/night)
-------------------------------------------
Car traffic volume  :  5347/465   veh/TimePeriod  *
Medium truck volume :   425/37    veh/TimePeriod  *
Heavy truck volume  :   304/26    veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):   6604
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: Campeau (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  :  67.00 / 67.00  m
Receiver height           :   1.50 / 1.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            :  36.00 deg   Angle2 : 90.00 deg
Barrier height            :   6.00 m
Barrier receiver distance :   3.00 / 3.00   m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Road data, segment # 2: Huntmar (day/night)
-------------------------------------------
Car traffic volume  :  6692/582   veh/TimePeriod  *
Medium truck volume :   532/46    veh/TimePeriod  *
Heavy truck volume  :   380/33    veh/TimePeriod  *
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):   8266
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 2: Huntmar (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  : 346.00 / 346.00 m
Receiver height           :   1.50 / 1.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -33.00 deg   Angle2 : 90.00 deg
Barrier height            :   6.00 m
Barrier receiver distance :   3.00 / 3.00   m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Results segment # 1: Campeau (day)
----------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !        1.50 !        1.50 !         1.50

ROAD (53.04 + 36.34 + 0.00) = 53.13 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     36   0.66  66.43   0.00 -10.79  -2.61   0.00   0.00   0.00
53.04
--------------------------------------------------------------------------
--
    36     90   0.30  66.43   0.00  -8.45  -6.52   0.00   0.00 -15.12
36.34
--------------------------------------------------------------------------
--

Segment Leq : 53.13 dBA
```

```
Results segment # 2: Huntmar (day)
----------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source       ! Receiver     ! Barrier      ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top  (m)
-------------+--------------+--------------+---------------
       1.50 !         1.50 !         1.50 !          1.50

ROAD (35.84 + 28.87 + 0.00) = 36.63 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90    -33   0.66  65.89   0.00 -22.63  -7.43   0.00   0.00   0.00
35.84
--------------------------------------------------------------------------
--
   -33     90   0.30  65.89   0.00 -17.72  -2.23   0.00   0.00 -17.07
28.87
--------------------------------------------------------------------------
--

Segment Leq : 36.63 dBA

Total Leq All Segments: 53.23 dBA
```

```
Results segment # 1: Campeau (night)
------------------------------------

Source height = 1.49 m

Barrier height for grazing incidence
------------------------------------
Source       ! Receiver     ! Barrier      ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top  (m)
-------------+--------------+--------------+---------------
       1.49 !        1.50 !        1.50 !         1.50

ROAD (45.40 + 28.70 + 0.00) = 45.49 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     36   0.66  58.80   0.00 -10.79  -2.61   0.00   0.00   0.00
45.40
--------------------------------------------------------------------------
--
    36     90   0.30  58.80   0.00  -8.45  -6.52   0.00   0.00 -15.12
28.70
--------------------------------------------------------------------------
--

Segment Leq : 45.49 dBA
```

```
Results segment # 2: Huntmar (night)
------------------------------------

Source height = 1.49 m

Barrier height for grazing incidence
------------------------------------
Source       ! Receiver     ! Barrier      ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top  (m)
-------------+--------------+--------------+---------------
       1.49 !        1.50 !        1.50 !         1.50

ROAD (28.23 + 21.26 + 0.00) = 29.03 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90    -33   0.66  58.28   0.00 -22.63  -7.43   0.00   0.00   0.00
28.23
--------------------------------------------------------------------------
--
   -33     90   0.30  58.28   0.00 -17.72  -2.23   0.00   0.00 -17.07
21.26
--------------------------------------------------------------------------
--

Segment Leq : 29.03 dBA

Total Leq All Segments: 45.59 dBA
```

```
RT/Custom data, segment # 1: LRT (day/night)
--------------------------------------------
1 - 4-car SRT:
Traffic volume    :   313/27    veh/TimePeriod
Speed             :    50 km/h

Data for Segment # 1: LRT (day/night)
-------------------------------------
Angle1   Angle2             : -54.00 deg   41.00 deg
Wood depth                  :      0       (No woods.)
No of house rows            :      0 / 0
Surface                     :      1       (Absorptive ground surface)
Receiver source distance  : 260.00 / 260.00 m
Receiver height             :   1.50 / 1.50   m
Topography                  :      1       (Flat/gentle slope; no barrier)
Reference angle             :   0.00
```

```
Results segment # 1: LRT (day)
------------------------------

Source height = 0.50 m

RT/Custom (0.00 + 34.44 + 0.00) = 34.44 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -54     41   0.66  58.15 -20.57  -3.14   0.00   0.00   0.00  34.44
----------------------------------------------------------------------

Segment Leq : 34.44 dBA

Total Leq All Segments: 34.44 dBA
```

```
Results segment # 1: LRT (night)
--------------------------------

Source height = 0.50 m

RT/Custom (0.00 + 26.81 + 0.00) = 26.81 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -54     41   0.66  50.51 -20.57  -3.14   0.00   0.00   0.00  26.81
----------------------------------------------------------------------

Segment Leq : 26.81 dBA

Total Leq All Segments: 26.81 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 53.28
                         (NIGHT): 45.64
```

```
STAMSON 5.0        NORMAL REPORT        Date: 23-02-2018 16:47:14
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r6.te                Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: 417 (day/night)
---------------------------------------
Car traffic volume  : 83353/7248  veh/TimePeriod  *
Medium truck volume :  6630/577   veh/TimePeriod  *
Heavy truck volume  :  4736/412   veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT): 102956
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: 417 (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  :  65.00 / 65.00  m
Receiver height           :   1.50 / 1.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 90.00 deg
Barrier height            :   3.00 m
Barrier receiver distance :  14.00 / 14.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Results segment # 1: 417 (day)
------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !        1.50 !        1.50 !         1.50

ROAD (0.00 + 64.84 + 0.00) = 64.84 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     90   0.48  82.87   0.00  -9.43  -1.14   0.00   0.00  -7.47
64.84
--------------------------------------------------------------------------
--

Segment Leq : 64.84 dBA

Total Leq All Segments: 64.84 dBA
```

```
Results segment # 1: 417 (night)
--------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+---------------
       1.50 !        1.50 !        1.50 !         1.50

ROAD (0.00 + 57.24 + 0.00) = 57.24 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     90   0.48  75.28   0.00  -9.43  -1.14   0.00   0.00  -7.47
57.24
--------------------------------------------------------------------------
--

Segment Leq : 57.24 dBA

Total Leq All Segments: 57.24 dBA
```

```
RT/Custom data, segment # 1: LRT (day/night)
--------------------------------------------
1 - 4-car SRT:
Traffic volume    :   313/27    veh/TimePeriod
Speed             :    70 km/h

Data for Segment # 1: LRT (day/night)
-------------------------------------
Angle1   Angle2           : -66.00 deg   37.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 121.00 / 121.00 m
Receiver height           :   1.50 / 1.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -66.00 deg   Angle2 : 37.00 deg
Barrier height            :   3.00 m
Barrier receiver distance :  14.00 / 14.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Results segment # 1: LRT (day)
------------------------------

Source height = 0.50 m

Barrier height for grazing incidence
------------------------------------
Source       ! Receiver     ! Barrier      ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top  (m)
-------------+--------------+--------------+---------------
       0.50 !        1.50 !        1.38 !         1.38

RT/Custom (0.00 + 36.14 + 0.00) = 36.14 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -66     37   0.51  61.07 -13.69  -2.83   0.00   0.00  -8.41  36.14
----------------------------------------------------------------------

Segment Leq : 36.14 dBA

Total Leq All Segments: 36.14 dBA
```

```
Results segment # 1: LRT (night)
--------------------------------

Source height = 0.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       0.50 !        1.50 !        1.38 !         1.38

RT/Custom (0.00 + 28.51 + 0.00) = 28.51 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -66     37   0.51  53.44 -13.69  -2.83   0.00   0.00  -8.41  28.51
----------------------------------------------------------------------

Segment Leq : 28.51 dBA

Total Leq All Segments: 28.51 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 64.85
                         (NIGHT): 57.25
```

```
STAMSON 5.0        NORMAL REPORT        Date: 23-02-2018 16:47:26
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r7.te                 Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: 417 (day/night)
---------------------------------------
Car traffic volume  : 121438/10560 veh/TimePeriod  *
Medium truck volume :  9660/840   veh/TimePeriod  *
Heavy truck volume  :  6900/600   veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT): 149998
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: 417 (day/night)
-------------------------------------
Angle1   Angle2           : -90.00 deg   79.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 233.00 / 233.00 m
Receiver height           :   1.50 / 1.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : -16.00 deg
Barrier height            :   6.00 m
Barrier receiver distance : 153.00 / 153.00 m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Road data, segment # 2: Campeau (day/night)
-------------------------------------------
Car traffic volume  : 13307/1157  veh/TimePeriod  *
Medium truck volume :  1059/92    veh/TimePeriod  *
Heavy truck volume  :   756/66    veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  16437
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 2: Campeau (day/night)
-----------------------------------------
Angle1   Angle2            : -50.00 deg   90.00 deg
Wood depth                 :      0       (No woods.)
No of house rows           :      0 / 0
Surface                    :      1       (Absorptive ground surface)
Receiver source distance   : 148.00 / 148.00 m
Receiver height            :   1.50 / 1.50   m
Topography                 :      2       (Flat/gentle slope; with barrier)
Barrier angle1             :  -7.00 deg   Angle2 : 90.00 deg
Barrier height             :   6.00 m
Barrier receiver distance  : 118.00 / 118.00 m
Source elevation           :   0.00 m
Receiver elevation         :   0.00 m
Barrier elevation          :   0.00 m
Reference angle            :   0.00
```

```
Results segment # 1: 417 (day)
------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+---------------
       1.50 !        1.50 !        1.50 !         1.50

ROAD (0.00 + 55.74 + 61.10) = 62.21 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90    -16   0.30  84.50   0.00 -15.49  -4.81   0.00   0.00  -8.46
55.74
--------------------------------------------------------------------------
--
   -16     79   0.66  84.50   0.00 -19.77  -3.63   0.00   0.00   0.00
61.10
--------------------------------------------------------------------------
--

Segment Leq : 62.21 dBA
```

```
Results segment # 2: Campeau (day)
----------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+---------------
       1.50 !        1.50 !        1.50 !         1.50

ROAD (47.23 + 43.03 + 0.00) = 48.63 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -50     -7   0.66  70.39   0.00 -16.50  -6.66   0.00   0.00   0.00
47.23
--------------------------------------------------------------------------
--
    -7     90   0.30  70.39   0.00 -12.93  -3.40   0.00   0.00 -11.04
43.03
--------------------------------------------------------------------------
--

Segment Leq : 48.63 dBA

Total Leq All Segments: 62.40 dBA
```

```
Results segment # 1: 417 (night)
--------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !        1.50 !        1.50 !         1.50

ROAD (0.00 + 48.15 + 53.50) = 54.61 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90    -16   0.30  76.91   0.00 -15.49  -4.81   0.00   0.00  -8.46
48.15
--------------------------------------------------------------------------
--
   -16     79   0.66  76.91   0.00 -19.77  -3.63   0.00   0.00   0.00
53.50
--------------------------------------------------------------------------
--

Segment Leq : 54.61 dBA
```

```
Results segment # 2: Campeau (night)
------------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+---------------
       1.50 !        1.50 !        1.50 !         1.50

ROAD (39.64 + 35.44 + 0.00) = 41.04 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -50     -7   0.66  62.81   0.00 -16.50  -6.66   0.00   0.00   0.00
39.64
--------------------------------------------------------------------------
--
    -7     90   0.30  62.81   0.00 -12.93  -3.39   0.00   0.00 -11.04
35.44
--------------------------------------------------------------------------
--

Segment Leq : 41.04 dBA

Total Leq All Segments: 54.80 dBA
```

```
RT/Custom data, segment # 1: LRT (day/night)
--------------------------------------------
1 - 4-car SRT:
Traffic volume    :   313/27    veh/TimePeriod
Speed             :    80  km/h

Data for Segment # 1: LRT (day/night)
-------------------------------------
Angle1   Angle2           : -90.00 deg   79.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 183.00 / 183.00 m
Receiver height           :   1.50 / 1.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : -16.00 deg
Barrier height            :   6.00 m
Barrier receiver distance : 153.00 / 153.00 m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Results segment # 1: LRT (day)
------------------------------

Source height = 0.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       0.50 !        1.50 !        0.66 !         0.66

RT/Custom (0.00 + 31.62 + 40.56) = 41.08 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90    -16   0.33  62.23 -14.45  -4.89   0.00   0.00 -11.26  31.62
----------------------------------------------------------------------
   -16     79   0.66  62.23 -18.03  -3.63   0.00   0.00   0.00  40.56
----------------------------------------------------------------------

Segment Leq : 41.08 dBA

Total Leq All Segments: 41.08 dBA
```

```
Results segment # 1: LRT (night)
--------------------------------

Source height = 0.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       0.50 !        1.50 !        0.66 !         0.66

RT/Custom (0.00 + 23.99 + 32.93) = 33.45 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90    -16   0.33  54.60 -14.45  -4.89   0.00   0.00 -11.26  23.99
----------------------------------------------------------------------
   -16     79   0.66  54.60 -18.03  -3.63   0.00   0.00   0.00  32.93
----------------------------------------------------------------------

Segment Leq : 33.45 dBA

Total Leq All Segments: 33.45 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 62.43
                         (NIGHT): 54.83
```

```
STAMSON 5.0        NORMAL REPORT        Date: 23-02-2018 16:47:32
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r8.te               Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: 417 (day/night)
---------------------------------------
Car traffic volume  : 121438/10560 veh/TimePeriod  *
Medium truck volume :  9660/840   veh/TimePeriod  *
Heavy truck volume  :  6900/600   veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT): 149998
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: 417 (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  :  66.00 / 66.00  m
Receiver height            :   1.50 / 1.50   m
Topography                 :      2       (Flat/gentle slope; with barrier)
Barrier angle1             : -90.00 deg   Angle2 : 90.00 deg
Barrier height             :   2.50 m
Barrier receiver distance :  10.00 / 10.00  m
Source elevation           :  95.75 m
Receiver elevation         :  94.50 m
Barrier elevation          :  96.25 m
Reference angle            :   0.00
```

```
Results segment # 1: 417 (day)
------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !        1.50 !       -0.06 !        96.19

ROAD (0.00 + 63.02 + 0.00) = 63.02 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     90   0.51  84.50   0.00  -9.72  -1.19   0.00   0.00 -10.58
63.02
--------------------------------------------------------------------------
--

Segment Leq : 63.02 dBA

Total Leq All Segments: 63.02 dBA
```

```
Results segment # 1: 417 (night)
--------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source       ! Receiver     ! Barrier      ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top  (m)
-------------+--------------+--------------+---------------
       1.50 !        1.50 !        -0.06 !         96.19

ROAD (0.00 + 55.42 + 0.00) = 55.42 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     90   0.51  76.91   0.00  -9.72  -1.19   0.00   0.00 -10.58
55.42
--------------------------------------------------------------------------
--

Segment Leq : 55.42 dBA

Total Leq All Segments: 55.42 dBA
```

```
RT/Custom data, segment # 1: LRT (day/night)
--------------------------------------------
1 - 4-car SRT:
Traffic volume    :   313/27    veh/TimePeriod
Speed             :    80 km/h

Data for Segment # 1: LRT (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  :  17.00 / 17.00  m
Receiver height           :   1.50 / 1.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 90.00 deg
Barrier height            :   2.50 m
Barrier receiver distance :  10.00 / 10.00  m
Source elevation          :  95.25 m
Receiver elevation        :  94.50 m
Barrier elevation         :  96.25 m
Reference angle           :   0.00
```

```
Results segment # 1: LRT (day)
------------------------------

Source height = 0.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       0.50 !        1.50 !       -0.40 !        95.85

RT/Custom (0.00 + 46.60 + 0.00) = 46.60 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90     90   0.54  62.23  -0.84  -1.25   0.00   0.00 -13.54  46.60
----------------------------------------------------------------------

Segment Leq : 46.60 dBA

Total Leq All Segments: 46.60 dBA
```

```
Results segment # 1: LRT (night)
--------------------------------

Source height = 0.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       0.50 !        1.50 !       -0.40 !        95.85

RT/Custom (0.00 + 38.97 + 0.00) = 38.97 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90     90   0.54  54.60  -0.84  -1.25   0.00   0.00 -13.54  38.97
----------------------------------------------------------------------

Segment Leq : 38.97 dBA

Total Leq All Segments: 38.97 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 63.12
                         (NIGHT): 55.52
```

```
STAMSON 5.0        NORMAL REPORT        Date: 23-02-2018 16:47:44
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r9.te                Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: 417 (day/night)
---------------------------------------
Car traffic volume  : 144091/12530 veh/TimePeriod  *
Medium truck volume : 11462/997   veh/TimePeriod  *
Heavy truck volume  :  8187/712   veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT): 177978
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: 417 (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  : 113.00 / 113.00 m
Receiver height           :   1.50 / 1.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 90.00 deg
Barrier height            :   0.00 m
Barrier receiver distance :  42.00 / 42.00  m
Source elevation          :  -6.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Road data, segment # 2: Corkstown (day/night)
---------------------------------------------
Car traffic volume  : 12144/1056  veh/TimePeriod  *
Medium truck volume :   966/84    veh/TimePeriod  *
Heavy truck volume  :   690/60    veh/TimePeriod  *
Posted speed limit  :    80 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  15000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 2: Corkstown (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  :  22.00 / 22.00  m
Receiver height           :   1.50 / 1.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Results segment # 1: 417 (day)
------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       1.50 !        1.50 !       -0.73 !        -0.73

ROAD (0.00 + 63.91 + 0.00) = 63.91 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     90   0.66  85.25   0.00 -14.56  -1.46   0.00   0.00  -5.33
63.91
--------------------------------------------------------------------------
--

Segment Leq : 63.91 dBA
```

```
Results segment # 2: Corkstown (day)
------------------------------------

Source height = 1.50 m

ROAD (0.00 + 68.27 + 0.00) = 68.27 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     90   0.66  72.49   0.00  -2.76  -1.46   0.00   0.00   0.00
68.27
--------------------------------------------------------------------------
--

Segment Leq : 68.27 dBA

Total Leq All Segments: 69.63 dBA
```

```
Results segment # 1: 417 (night)
--------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source       ! Receiver     ! Barrier      ! Elevation of
Height   (m) ! Height   (m) ! Height   (m) ! Barrier Top   (m)
------------+-------------+-------------+---------------
       1.50 !        1.50 !       -0.73 !        -0.73

ROAD (0.00 + 56.31 + 0.00) = 56.31 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     90   0.66  77.65   0.00 -14.56  -1.46   0.00   0.00  -5.33
56.31
--------------------------------------------------------------------------
--

Segment Leq : 56.31 dBA
```

```
Results segment # 2: Corkstown (night)
--------------------------------------

Source height = 1.50 m

ROAD (0.00 + 60.67 + 0.00) = 60.67 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     90   0.66  64.89   0.00  -2.76  -1.46   0.00   0.00   0.00
60.67
--------------------------------------------------------------------------
--

Segment Leq : 60.67 dBA

Total Leq All Segments: 62.03 dBA
```

```
RT/Custom data, segment # 1: LRT (day/night)
--------------------------------------------
1 - 4-car SRT:
Traffic volume    :   313/27    veh/TimePeriod
Speed             :    80 km/h

Data for Segment # 1: LRT (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  :  67.00 / 67.00  m
Receiver height           :   1.50 / 1.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 90.00 deg
Barrier height            :   0.00 m
Barrier receiver distance :  42.00 / 42.00  m
Source elevation          :  -6.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Results segment # 1: LRT (day)
------------------------------

Source height = 0.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       0.50 !        1.50 !       -2.89 !        -2.89

RT/Custom (0.00 + 40.44 + 0.00) = 40.44 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90     90   0.66  62.23 -10.79  -1.46   0.00   0.00  -9.54  40.44
----------------------------------------------------------------------

Segment Leq : 40.44 dBA

Total Leq All Segments: 40.44 dBA
```

```
Results segment # 1: LRT (night)
--------------------------------

Source height = 0.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       0.50 !        1.50 !       -2.89 !        -2.89

RT/Custom (0.00 + 32.81 + 0.00) = 32.81 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90     90   0.66  54.60 -10.79  -1.46   0.00   0.00  -9.54  32.81
----------------------------------------------------------------------

Segment Leq : 32.81 dBA

Total Leq All Segments: 32.81 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 69.63
                         (NIGHT): 62.03
```

```
STAMSON 5.0        NORMAL REPORT        Date: 20-08-2018 15:48:05
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r10.te               Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: Hazeldean (day/night)
---------------------------------------------
Car traffic volume  : 18153/1579  veh/TimePeriod  *
Medium truck volume :  1444/126   veh/TimePeriod  *
Heavy truck volume  :  1031/90    veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  22422
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: Hazeldean (day/night)
-------------------------------------------
Angle1   Angle2           : -90.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  23.00 / 23.00  m
Receiver height           :   4.50 / 4.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Road data, segment # 2: NSART (day/night)
-----------------------------------------
Car traffic volume  : 28336/2464  veh/TimePeriod  *
Medium truck volume :  2254/196   veh/TimePeriod  *
Heavy truck volume  :  1610/140   veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  35000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 2: NSART (day/night)
---------------------------------------
Angle1   Angle2           :  26.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  47.00 / 47.00  m
Receiver height           :   4.50 / 4.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Results segment # 1: Hazeldean (day)
------------------------------------

Source height = 1.50 m

ROAD (0.00 + 69.88 + 0.00) = 69.88 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     90   0.00  71.74   0.00  -1.86   0.00   0.00   0.00   0.00
69.88
--------------------------------------------------------------------------
--

Segment Leq : 69.88 dBA
```

```
Results segment # 2: NSART (day)
--------------------------------

Source height = 1.50 m

ROAD (0.00 + 64.22 + 0.00) = 64.22 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
    26     90   0.00  73.68   0.00  -4.96  -4.49   0.00   0.00   0.00
64.22
--------------------------------------------------------------------------
--

Segment Leq : 64.22 dBA

Total Leq All Segments: 70.92 dBA
```

```
Results segment # 1: Hazeldean (night)
--------------------------------------

Source height = 1.50 m

ROAD (0.00 + 62.30 + 0.00) = 62.30 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     90   0.00  64.16   0.00  -1.86   0.00   0.00   0.00   0.00
62.30
--------------------------------------------------------------------------
--

Segment Leq : 62.30 dBA
```

```
Results segment # 2: NSART (night)
----------------------------------

Source height = 1.50 m

ROAD (0.00 + 56.63 + 0.00) = 56.63 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
    26     90   0.00  66.08   0.00  -4.96  -4.49   0.00   0.00   0.00
56.63
--------------------------------------------------------------------------
--

Segment Leq : 56.63 dBA

Total Leq All Segments: 63.34 dBA
```

```
RT/Custom data, segment # 1: LRT (day/night)
--------------------------------------------
1 - 4-car SRT:
Traffic volume    :   313/27    veh/TimePeriod
Speed             :    50 km/h

Data for Segment # 1: LRT (day/night)
-------------------------------------
Angle1   Angle2           :   0.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      2       (Reflective ground surface)
Receiver source distance  :  25.00 / 25.00  m
Receiver height           :   4.50 / 4.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Results segment # 1: LRT (day)
------------------------------

Source height = 0.50 m

RT/Custom (0.00 + 52.92 + 0.00) = 52.92 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
     0     90   0.00  58.15  -2.22  -3.01   0.00   0.00   0.00  52.92
----------------------------------------------------------------------

Segment Leq : 52.92 dBA

Total Leq All Segments: 52.92 dBA
```

```
Results segment # 1: LRT (night)
--------------------------------

Source height = 0.50 m

RT/Custom (0.00 + 45.29 + 0.00) = 45.29 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
     0     90   0.00  50.51  -2.22  -3.01   0.00   0.00   0.00  45.29
----------------------------------------------------------------------

Segment Leq : 45.29 dBA

Total Leq All Segments: 45.29 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 70.99
                         (NIGHT): 63.41
```

```
STAMSON 5.0        NORMAL REPORT        Date: 20-08-2018 15:48:16
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r11.te              Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: NSART (day/night)
-----------------------------------------
Car traffic volume  : 28336/2464  veh/TimePeriod  *
Medium truck volume :  2254/196   veh/TimePeriod  *
Heavy truck volume  :  1610/140   veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):  35000
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: NSART (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  :  39.00 / 39.00  m
Receiver height           :   4.50 / 4.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Results segment # 1: NSART (day)
--------------------------------

Source height = 1.50 m

ROAD (0.00 + 65.86 + 0.00) = 65.86 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     90   0.57  73.68   0.00  -6.52  -1.30   0.00   0.00   0.00
65.86
--------------------------------------------------------------------------
--

Segment Leq : 65.86 dBA

Total Leq All Segments: 65.86 dBA
```

```
Results segment # 1: NSART (night)
----------------------------------

Source height = 1.50 m

ROAD (0.00 + 58.26 + 0.00) = 58.26 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     90   0.57  66.08   0.00  -6.52  -1.30   0.00   0.00   0.00
58.26
--------------------------------------------------------------------------
--

Segment Leq : 58.26 dBA

Total Leq All Segments: 58.26 dBA
```

```
RT/Custom data, segment # 1: LRT (day/night)
--------------------------------------------
1 - 4-car SRT:
Traffic volume    :   313/27    veh/TimePeriod
Speed             :    50 km/h

Data for Segment # 1: LRT (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  :  17.00 / 17.00  m
Receiver height           :   4.50 / 4.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Results segment # 1: LRT (day)
------------------------------

Source height = 0.50 m

RT/Custom (0.00 + 55.92 + 0.00) = 55.92 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90     90   0.60  58.15  -0.87  -1.35   0.00   0.00   0.00  55.92
----------------------------------------------------------------------

Segment Leq : 55.92 dBA

Total Leq All Segments: 55.92 dBA
```

```
Results segment # 1: LRT (night)
--------------------------------

Source height = 0.50 m

RT/Custom (0.00 + 48.29 + 0.00) = 48.29 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90     90   0.60  50.51  -0.87  -1.35   0.00   0.00   0.00  48.29
----------------------------------------------------------------------

Segment Leq : 48.29 dBA

Total Leq All Segments: 48.29 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 66.28
                         (NIGHT): 58.68
```

```
STAMSON 5.0        NORMAL REPORT        Date: 20-08-2018 15:48:30
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r12.te              Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: Campeau (day/night)
-------------------------------------------
Car traffic volume  :  5347/465   veh/TimePeriod  *
Medium truck volume :   425/37    veh/TimePeriod  *
Heavy truck volume  :   304/26    veh/TimePeriod  *
Posted speed limit  :    60 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):   6604
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: Campeau (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           :   4.50 / 4.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Road data, segment # 2: Huntmar (day/night)
-------------------------------------------
Car traffic volume  :  6692/582   veh/TimePeriod  *
Medium truck volume :   532/46    veh/TimePeriod  *
Heavy truck volume  :   380/33    veh/TimePeriod  *
Posted speed limit  :    50 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT):   8266
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 2: Huntmar (day/night)
-----------------------------------------
Angle1   Angle2            : -55.00 deg   9.00 deg
Wood depth                 :      0       (No woods.)
No of house rows           :      0 / 0
Surface                    :      1       (Absorptive ground surface)
Receiver source distance   : 328.00 / 328.00 m
Receiver height            :   4.50 / 4.50   m
Topography                 :      1       (Flat/gentle slope; no barrier)
Reference angle            :   0.00
```

```
Results segment # 1: Campeau (day)
----------------------------------

Source height = 1.50 m

ROAD (0.00 + 61.93 + 0.00) = 61.93 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     90   0.57  66.43   0.00  -3.20  -1.30   0.00   0.00   0.00
61.93
--------------------------------------------------------------------------
--

Segment Leq : 61.93 dBA
```

```
Results segment # 2: Huntmar (day)
----------------------------------

Source height = 1.50 m

ROAD (0.00 + 40.01 + 0.00) = 40.01 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -55      9   0.57  65.89   0.00 -21.04  -4.84   0.00   0.00   0.00
40.01
--------------------------------------------------------------------------
--

Segment Leq : 40.01 dBA

Total Leq All Segments: 61.96 dBA
```

```
Results segment # 1: Campeau (night)
------------------------------------

Source height = 1.49 m

ROAD (0.00 + 54.29 + 0.00) = 54.29 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     90   0.57  58.80   0.00  -3.21  -1.30   0.00   0.00   0.00
54.29
--------------------------------------------------------------------------
--

Segment Leq : 54.29 dBA
```

```
Results segment # 2: Huntmar (night)
------------------------------------

Source height = 1.49 m

ROAD (0.00 + 32.41 + 0.00) = 32.41 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -55      9   0.57  58.28   0.00 -21.04  -4.84   0.00   0.00   0.00
32.41
--------------------------------------------------------------------------
--

Segment Leq : 32.41 dBA

Total Leq All Segments: 54.32 dBA
```

```
RT/Custom data, segment # 1: LRT (day/night)
--------------------------------------------
1 - 4-car SRT:
Traffic volume    :   313/27    veh/TimePeriod
Speed             :    50 km/h

Data for Segment # 1: LRT (day/night)
-------------------------------------
Angle1   Angle2           : -60.00 deg   41.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  : 223.00 / 223.00 m
Receiver height           :   4.50 / 4.50   m
Topography                :      1       (Flat/gentle slope; no barrier)
Reference angle           :   0.00
```

```
Results segment # 1: LRT (day)
------------------------------

Source height = 0.50 m

RT/Custom (0.00 + 36.49 + 0.00) = 36.49 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -60     41   0.60  58.15 -18.76  -2.91   0.00   0.00   0.00  36.49
----------------------------------------------------------------------

Segment Leq : 36.49 dBA

Total Leq All Segments: 36.49 dBA
```

```
Results segment # 1: LRT (night)
--------------------------------

Source height = 0.50 m

RT/Custom (0.00 + 28.85 + 0.00) = 28.85 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -60     41   0.60  50.51 -18.76  -2.91   0.00   0.00   0.00  28.85
----------------------------------------------------------------------

Segment Leq : 28.85 dBA

Total Leq All Segments: 28.85 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 61.97
                         (NIGHT): 54.33
```

```
STAMSON 5.0        NORMAL REPORT        Date: 22-08-2018 12:41:20
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: r13.te              Time Period: Day/Night 16/8 hours
Description:


Road data, segment # 1: 417 (day/night)
---------------------------------------
Car traffic volume  : 121438/10560 veh/TimePeriod  *
Medium truck volume :  9660/840   veh/TimePeriod  *
Heavy truck volume  :  6900/600   veh/TimePeriod  *
Posted speed limit  :   100 km/h
Road gradient       :     0 %
Road pavement       :     1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

    24 hr Traffic Volume (AADT or SADT): 149998
    Percentage of Annual Growth        :   0.00
    Number of Years of Growth          :   0.00
    Medium Truck % of Total Volume     :   7.00
    Heavy Truck  % of Total Volume     :   5.00
    Day (16 hrs) % of Total Volume     :  92.00

Data for Segment # 1: 417 (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  : 186.00 / 186.00 m
Receiver height           :   1.50 / 1.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            : -90.00 deg   Angle2 : 90.00 deg
Barrier height            :   2.50 m
Barrier receiver distance :  16.00 / 16.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Results segment # 1: 417 (day)
------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+---------------
       1.50 !        1.50 !        1.50 !         1.50

ROAD (0.00 + 60.79 + 0.00) = 60.79 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
--------------------------------------------------------------------------
--
   -90     90   0.51  84.50   0.00 -16.51  -1.19   0.00   0.00  -6.01
60.79
--------------------------------------------------------------------------
--

Segment Leq : 60.79 dBA

Total Leq All Segments: 60.79 dBA
```

```
Results segment # 1: 417 (night)
--------------------------------

Source height = 1.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+---------------
       1.50 !        1.50 !        1.50 !          1.50

ROAD (0.00 + 53.19 + 0.00) = 53.19 dBA
Angle1 Angle2  Alpha RefLeq  P.Adj  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj
SubLeq
---------------------------------------------------------------------------
--
   -90     90   0.51  76.91   0.00 -16.51  -1.19   0.00   0.00  -6.01
53.19
---------------------------------------------------------------------------
--

Segment Leq : 53.19 dBA

Total Leq All Segments: 53.19 dBA
```

```
RT/Custom data, segment # 1: LRT1 (day/night)
---------------------------------------------
1 - 4-car SRT:
Traffic volume    :   313/27    veh/TimePeriod
Speed             :    80 km/h

Data for Segment # 1: LRT1 (day/night)
--------------------------------------
Angle1   Angle2            : -90.00 deg   -19.00 deg
Wood depth                 :      0       (No woods.)
No of house rows           :      0 / 0
Surface                    :      1       (Absorptive ground surface)
Receiver source distance   :  25.00 / 25.00  m
Receiver height            :   1.50 / 1.50   m
Topography                 :      2       (Flat/gentle slope; with barrier)
Barrier angle1             : -90.00 deg   Angle2 : -19.00 deg
Barrier height             :   2.50 m
Barrier receiver distance  :  16.00 / 16.00  m
Source elevation           :   0.00 m
Receiver elevation         :   0.00 m
Barrier elevation          :   0.00 m
Reference angle            :   0.00
```

```
RT/Custom data, segment # 2: LRT2 (day/night)
---------------------------------------------
1 - 4-car SRT:
Traffic volume    :   313/27    veh/TimePeriod
Speed             :    80 km/h

Data for Segment # 2: LRT2 (day/night)
--------------------------------------
Angle1   Angle2           :  15.00 deg   90.00 deg
Wood depth                :      0       (No woods.)
No of house rows          :      0 / 0
Surface                   :      1       (Absorptive ground surface)
Receiver source distance  :  25.00 / 25.00  m
Receiver height           :   1.50 / 1.50   m
Topography                :      2       (Flat/gentle slope; with barrier)
Barrier angle1            :  15.00 deg   Angle2 : 90.00 deg
Barrier height            :   2.50 m
Barrier receiver distance :  16.00 / 16.00  m
Source elevation          :   0.00 m
Receiver elevation        :   0.00 m
Barrier elevation         :   0.00 m
Reference angle           :   0.00
```

```
Results segment # 1: LRT1 (day)
-------------------------------

Source height = 0.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       0.50 !        1.50 !        0.86 !         0.86

RT/Custom (0.00 + 44.34 + 0.00) = 44.34 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90    -19   0.54  62.23  -3.42  -5.68   0.00   0.00  -8.79  44.34
----------------------------------------------------------------------

Segment Leq : 44.34 dBA
```

```
Results segment # 2: LRT2 (day)
-------------------------------

Source height = 0.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       0.50 !        1.50 !        0.86 !         0.86

RT/Custom (0.00 + 44.57 + 0.00) = 44.57 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
    15     90   0.54  62.23  -3.42  -5.34   0.00   0.00  -8.90  44.57
----------------------------------------------------------------------

Segment Leq : 44.57 dBA

Total Leq All Segments: 47.47 dBA
```

```
Results segment # 1: LRT1 (night)
---------------------------------

Source height = 0.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       0.50 !        1.50 !        0.86 !         0.86

RT/Custom (0.00 + 36.71 + 0.00) = 36.71 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
   -90    -19   0.54  54.60  -3.42  -5.68   0.00   0.00  -8.79  36.71
----------------------------------------------------------------------

Segment Leq : 36.71 dBA
```

```
Results segment # 2: LRT2 (night)
---------------------------------

Source height = 0.50 m

Barrier height for grazing incidence
------------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       0.50 !        1.50 !        0.86 !         0.86

RT/Custom (0.00 + 36.94 + 0.00) = 36.94 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
----------------------------------------------------------------------
    15     90   0.54  54.60  -3.42  -5.34   0.00   0.00  -8.90  36.94
----------------------------------------------------------------------

Segment Leq : 36.94 dBA

Total Leq All Segments: 39.84 dBA



TOTAL Leq FROM ALL SOURCES (DAY): 60.99
                         (NIGHT): 53.39
```

APPENDIX C

FTA VIBRATION CALCULATIONS

Receptor V1 Existing
GME17-043 06-Mar-18

Projected vibration levels Kanata LRT
Perdicted using FTA General Assesment

Train Speed 60 km/h 37.2 mph

	Distance from C/L	
	(m)	(ft)
Hazeldean	380.0	1246.7

		Vibration	
From FTA Manual Fig 10-1			
	Vibration Levels at distance from track	50	dBV re 1 micro in/sec
Adjustment Factors FTA Table 10-1			
	Speed reference 50 mph	1.9	Speed Limit of 40 km/h (25 mph)
	Vehicle Parameters	0	Soft primary suspension, wheels run true
	Track Condition	0	Track not worn or corrugated
	Track Treatments	0	None
	Type of Transit Structure	0	N/A
	Efficient vibration Propagation	0	Propagation through rock
	Vibration Levels at Fdn	52	
	Coupling to Building Foundation	-5	Large masonry on piles
	Floor to Floor Attenuation	-2.0	Ground Floor Ocupied
	Amplification of Floor and Walls	6	
	Total Vibration Level	50.9	dBV or 0.009 mm/s
	Noise Level in dBA	15.9	dBA

Receptor V2 Existing

GME17-043 06-Mar-18

Projected vibration levels Kanata LRT
Perdicted using FTA General Assesment

Train Speed 60 km/h 37.2 mph

	Distance from C/L	
	(m)	(ft)
Huntmar	44.5	146.0

		Vibration	
From FTA Manual Fig 10-1			
	Vibration Levels at distance from track	53	dBV re 1 micro in/sec
Adjustment Factors FTA Table 10-1			
	Speed reference 50 mph	1.9	Speed Limit of 40 km/h (25 mph)
	Vehicle Parameters	0	Soft primary suspension, wheels run true
	Track Condition	0	Track not worn or corrugated
	Track Treatments	0	None
	Type of Transit Structure	0	N/A
	Efficient vibration Propagation	0	Propagation through rock
	Vibration Levels at Fdn	55	
	Coupling to Building Foundation	-5	Large masonry on piles
	Floor to Floor Attenuation	-2.0	Ground Floor Ocupied
	Amplification of Floor and Walls	6	
	Total Vibration Level	53.9	dBV or 0.013 mm/s
	Noise Level in dBA	18.9	dBA

Receptor V3 Existing

GME17-043 06-Mar-18

Projected vibration levels Kanata LRT
Perdicted using FTA General Assesment

Train Speed 100 km/h 60 mph

	Distance from C/L	
	(m)	(ft)
417	44.7	146.7

	Vibration	
From FTA Manual Fig 10-1		
Vibration Levels at distance from track	53	dBV re 1 micro in/sec
Adjustment Factors FTA Table 10-1		
Speed reference 50 mph	6.0	Speed Limit of 40 km/h (25 mph)
Vehicle Parameters	0	Soft primary suspension, wheels run true
Track Condition	0	Track not worn or corrugated
Track Treatments	0	None
Type of Transit Structure	0	N/A
Efficient vibration Propagation	0	Propagation through rock
Vibration Levels at Fdn	59	
Coupling to Building Foundation	-5	Large masonry on piles
Floor to Floor Attenuation	-2.0	Ground Floor Ocupied
Amplification of Floor and Walls	6	
Total Vibration Level	58	dBV or 0.020 mm/s
Noise Level in dBA	23	dBA

Receptor V4 Existing

GME17-043 06-Mar-18

Projected vibration levels Kanata LRT
Perdicted using FTA General Assesment

Train Speed 100 km/h 60 mph

	Distance from C/L	
	(m)	(ft)
LRT	84.0	275.6

		Vibration	
From FTA Manual Fig 10-1			
	Vibration Levels at distance from track	50	dBV re 1 micro in/sec
Adjustment Factors FTA Table 10-1			
	Speed reference 50 mph	6.0	Speed Limit of 40 km/h (25 mph)
	Vehicle Parameters	0	Soft primary suspension, wheels run true
	Track Condition	0	Track not worn or corrugated
	Track Treatments	0	None
	Type of Transit Structure	0	N/A
	Efficient vibration Propagation	0	Propagation through rock
	Vibration Levels at Fdn	56	
	Coupling to Building Foundation	-5	Large masonry on piles
	Floor to Floor Attenuation	-2.0	Ground Floor Ocupied
	Amplification of Floor and Walls	6	
	Total Vibration Level	55	dBV or 0.014 mm/s
	Noise Level in dBA	20	dBA

Receptor V1 Future

GME17-043 06-Mar-18

Projected vibration levels Kanata LRT
Perdicted using FTA General Assesment

Train Speed 40 km/h 25 mph

	Distance from C/L	
	(m)	(ft)
LRT	57.0	187.0

	Vibration	
From FTA Manual Fig 10-1		
Vibration Levels at distance from track	62	dBV re 1 micro in/sec
Adjustment Factors FTA Table 10-1		
Speed reference 50 mph	-6.0	Speed Limit of 40 km/h (25 mph)
Vehicle Parameters	0	Soft primary suspension, wheels run true
Track Condition	0	Track not worn or corrugated
Track Treatments	0	None
Type of Transit Structure	0	N/A
Efficient vibration Propagation	0	Propagation through rock
Vibration Levels at Fdn	56	
Coupling to Building Foundation	-5	Large masonry on piles
Floor to Floor Attenuation	-2.0	Ground Floor Ocupied
Amplification of Floor and Walls	6	
Total Vibration Level	55	dBV or 0.014 mm/s
Noise Level in dBA	20	dBA

Receptor V2 Future

GME17-043

06-Mar-18

Projected vibration levels Kanata LRT
Perdicted using FTA General Assesment

Train Speed 45 km/h 28 mph

	Distance from C/L	
	(m)	(ft)
LRT	102.0	334.6

	Vibration	
From FTA Manual Fig 10-1		
Vibration Levels at distance from track	55	dBV re 1 micro in/sec
Adjustment Factors FTA Table 10-1		
Speed reference 50 mph	-5.0	Speed Limit of 40 km/h (25 mph)
Vehicle Parameters	0	Soft primary suspension, wheels run true
Track Condition	0	Track not worn or corrugated
Track Treatments	0	None
Type of Transit Structure	0	N/A
Efficient vibration Propagation	0	Propagation through rock
Vibration Levels at Fdn	50	
Coupling to Building Foundation	-5	Large masonry on piles
Floor to Floor Attenuation	-2.0	Ground Floor Ocupied
Amplification of Floor and Walls	6	
Total Vibration Level	49	dBV or 0.007 mm/s
Noise Level in dBA	14	dBA

Receptor V3 Future

GME17-043

06-Mar-18

Projected vibration levels Kanata LRT
Perdicted using FTA General Assesment

Train Speed 75 km/h 46.6 mph

	Distance from C/L	
	(m)	(ft)
LRT	18.0	59.1

		Vibration	
From FTA Manual Fig 10-1			
	Vibration Levels at distance from track	72	dBV re 1 micro in/sec
Adjustment Factors FTA Table 10-1			
	Speed reference 50 mph	-0.6	Speed Limit of 40 km/h (25 mph)
	Vehicle Parameters	0	Soft primary suspension, wheels run true
	Track Condition	0	Track not worn or corrugated
	Track Treatments	0	None
	Type of Transit Structure	0	N/A
	Efficient vibration Propagation	0	Propagation through rock
	Vibration Levels at Fdn	71	
	Coupling to Building Foundation	-5	Large masonry on piles
	Floor to Floor Attenuation	-2.0	Ground Floor Ocupied
	Amplification of Floor and Walls	6	
	Total Vibration Level	70.4	dBV or 0.084 mm/s
	Noise Level in dBA	35.4	dBA

Receptor V4 Future

GME17-043 06-Mar-18

Projected vibration levels Kanata LRT
Perdicted using FTA General Assesment

Train Speed 80 km/h 50 mph

	Distance from C/L	
	(m)	(ft)
LRT	64.0	210.0

		Vibration	
From FTA Manual Fig 10-1			
	Vibration Levels at distance from track	60	dBV re 1 micro in/sec
Adjustment Factors FTA Table 10-1			
	Speed reference 50 mph	0.0	Speed Limit of 40 km/h (25 mph)
	Vehicle Parameters	0	Soft primary suspension, wheels run true
	Track Condition	0	Track not worn or corrugated
	Track Treatments	0	None
	Type of Transit Structure	0	N/A
	Efficient vibration Propagation	0	Propagation through rock
	Vibration Levels at Fdn	60	
	Coupling to Building Foundation	-5	Large masonry on piles
	Floor to Floor Attenuation	-2.0	Ground Floor Ocupied
	Amplification of Floor and Walls	6	
	Total Vibration Level	59	dBV or 0.023 mm/s
	Noise Level in dBA	24	dBA

VI. Transportation Impact Assessment

1 TRANSPORTATION IMPACT ASSESSMENT

Once the Kanata LRT is in operation, it is not expected to have a large direct impact on the functioning of the road network, given that the LRT will be completely grade separated. This means that the LRT tracks will not cross any roadways at-grade, either going below grade or above grade to avoid impacts.

Impacts to the road network are expected in the form of an increase of vehicular, pedestrian and cyclist demand in and around the LRT stations and LRT park and rides. Therefore this transportation impact assessment focuses on the areas directly around the stations, specifically stations where roadway modifications are anticipated in order to support new or revised bus terminals, kiss and ride, and park and ride facilities. These locations include March Station, Terry Fox Station, Palladium Station and Hazeldean Station. Refer to Section 4.3 of this report for a description of the existing conditions of the transportation network.

1.1 INTERSECTION LEVEL OF SERVICE

The performance of study area intersections were evaluated based on an overall Level of Service (LOS) rating for each intersection within a given segment. LOS is indicated by a letter grade of A, B, C, D, E or F, which provides an indication of a given intersection's operating conditions, including vehicle delays, queue lengths and available traffic volume capacity, ranging from excellent (LOS A) to failing (LOS F) conditions.

Based on the City's 2006 Transportation Impact Assessment Guidelines, the LOS of an intersection is derived by evaluating a weighted volume-to-capacity (v/c) ratio, calculated by averaging critical turning movement v/c ratios (weighted by the associated turning movement volume), and matching the result with the corresponding letter grade using the following Table 1.

Table 1 – Level of Service / Volume to Capacity Ratios

Level of Service	Volume To Capacity Ratio
A	0 to 0.60
B	0.61 to 0.70
C	0.71 to 0.80
D	0.81 to 0.90
E	0.91 to 1.00
F	> 1.00

1.2 MULTI-MODAL LEVEL OF SERVICE (MMLOS)

The City of Ottawa recognizes that transportation facilities are used by a number of different modes of travel, such as pedestrians, cyclists, transit, automobiles and in some cases, heavy trucks. The City has recently developed a process to quantify the level of safety and comfort experienced by all roadway users over a particular roadway segment or intersection. This process is summarized/presented in a report entitled *Multi-Modal Level of Service (MMLOS) Guidelines - Supplement to the TIA Guidelines*, which was approved by City Council in October 2015. Relevant sections of the report are included in this document.

The MMLOS guidelines indicate that for each travel mode, LOS measures are proposed for both road segments and signalized intersections. Road segments are defined as the roadway links between signalized intersections. The report also noted that in some cases it may be necessary to determine separate segment LOS scores for each direction of travel. Only signalized intersections are considered for the intersection LOS measures. The factors and methodology used to develop the LOS ratings are provided in the guidelines.

The MMLOS guidelines allows for comparison of modes in order to evaluate trade-offs by assessing the critical parameters that determine the relative attractiveness and comfort for particular mode. Although the LOS methodology enables trade-offs to be made between modes, it is still important to consider the scales of each mode as independent from one another. In other words, because the level of service tools measure different factors, they do not necessarily cover the same spectrum of conditions. A vehicle experiencing LOS “F” with high lane utilization will likely encounter long delays and congested conditions. However this does not necessarily represent the lack of comfort, higher risk or stress that LOS “F” represents for cyclists, or lack of comfort, longer delays or higher risk that LOS “F” represents for pedestrians.

Figure 1 illustrates the minimum desirable LOS by mode. Efforts should be made to exceed these minimum targets whenever possible, without negatively impacting the ability to achieve the minimum targets for other modes. Although the LOS methodology enables trade-offs to be made, the guidelines indicate that it is important to consider the scales of each mode as independent from one another.

Figure 1 – Minimum Desirable MMLOS Targets by Official Plan Policy / Designation and Road Class

OP Designation / Policy Area	Road Class	PLOS	Bicycle - BLOS				Transit - TLOS [3]			Truck - TrLOS		Auto - LOS [4]
			Cross-town Bikeway	Spine Route	Local Route	Elsewhere	Rapid Transit Corridor	TP - Continuous Lanes	TP - Isolated Measures	Truck Route	Other	
Land-Use Designation												
Central Area	Arterial	A	A	C	B	D	A	C	D	D	E	E
	Collector	A	A	B	B	D	A	C	D	D	No target	E
	Local	A	A	B	B	D	A	C	D	E	No target	E
Developing Community	Arterial	C	B	C	B	D	B	C	D	D	No target	D
	Collector	C	B	C	B	D	B	C	D	D	No target	D
	Local	C	B	C	B	D	B	C	D	N/A	No target	D
Employment Area	Arterial	C	B	C	C	E	B	C	D	B	D	D
	Collector	C	B	C	C	E	B	C	D	B	D	D
	Local	C	B	D	C	No target	B	C	D	D	E	D
Entreprise Area	Arterial	C	B	C	B	D	B	C	D	B	E	D
	Collector	C	B	C	B	D	B	C	D	B	E	D
	Local	C	B	C	B	No target	B	C	D	D	No target	D
General Rural Area	Arterial	No target	N/A	D	D	No target	N/A	N/A	N/A	C	E	D
	Collector	No target	N/A	D	D	No target	N/A	N/A	N/A	C	No target	D
	Local	No target	N/A	D	D	No target	N/A	N/A	N/A	No target	No target	D
General Urban Area	Arterial	C	B	C	B	D	B	C	D	D	E	D
	Collector	C	B	C	B	D	B	C	D	D	No target	D
	Local	C	B	C	B	D	B	C	D	N/A	No target	D
Mixed Use Centre	Arterial	C	A	C	B	D	B	C	D	D	E	D
	Collector	C	A	B	B	D	B	C	D	D	No target	D
	Local	C	A	B	B	D	B	C	D	N/A	No target	D
Village	Arterial	C	B	C	B	D	N/A	N/A	N/A	D	No target	D
	Collector	C	B	C	B	D	N/A	N/A	N/A	D	No target	D
	Local	C	B		B	D	N/A	N/A	N/A	N/A	No target	D
Traditional Main Street	Arterial	B	A	C	C	D	B	C	D	D	E	D
	Collector	B	A	C	C	D	B	C	D	D	No target	D
Arterial Main Street	Arterial	C	B	C	D	D	B	C	D	D	E	D
All Other Designations	Arterial	D	B	C	C	D	B	C	D	D	No target	D
	Collector	D	B	C	C	D	B	C	D	D	No target	D
	Local	D	B	C	C	D	B	C	D	N/A	No target	D
Policy Area [2]												
Within 600m of a rapid transit station	Arterial	A	A	C	B	D	A	C	D	D	E	E
	Collector	A	A	B	B	D	A	C	D	D	No target	E
	Local	A	A	B	B	D	A	C	D	N/A	No target	E
Within 300m of a school	Arterial	A	A	C	B	D	A	C	D	D	E	E
	Collector	A	A	B	B	D	A	C	D	D	No target	E
	Local	A	A	B	B	D	A	C	D	N/A	No target	E

The target LOS is LOS ‘E’ within 600m of a rapid transit station LOS ‘D’ elsewhere. Therefore for this study, a LOS ‘E’ will be the target for intersections within 600m of Kanata LRT stations. It should be noted that LOS determination using the MMLOS methodology is based on average peak period demand and not peak hour demand.

1.3 ROAD TRAFFIC VOLUMES AND CAPACITIES

Table 2 – Existing Roadway Peak Hour Traffic Volumes and Capacity (vehicles per hour)[1]

Road Name	Segment	Directional Capacity	AM Peak Hour Volume		PM Peak Hour Volume	
			EB	WB	EB	WB
Highway 417	*Moodie Dr to Eagleson Rd*	4400	6530	3790	3790	6530
	Eagleson Rd to Kanata Ave	4400	4930	2400	2400	4930
	Kanata Ave to Terry Fox Dr	4400	3310	1290	1290	3310
	Terry Fox Dr to Palladium Dr	4400	3550	1550	1550	3550
Campeau Dr	*March Rd to Teron Rd*	1050	780	510	580	690
	Teron Rd to Knudson Dr	800	390	230	330	610
	Knudson Dr to Kanata Ave	800	360	310	360	430
	Kanata Ave to Terry Fox Dr	800	320	420	510	550
Palladium Dr	*Hwy 417 EB to Huntmar Dr*	2000	380	410	630	680
	Huntmar Dr to Terry Fox Dr	2000	340	180	390	650
Maple Grove Rd	*Montserrat St to Huntmar Dr*	800	340	120	220	400
	Huntmar Dr to Silver Seven Rd	800	160	90	140	190
Hazeldean Rd	*Stittsville Main St to Huntmar Dr*	2000	1030	510	830	1400
	Huntmar Dr to Terry Fox Dr	2000	1120	570	1030	1470
Road Name	Segment	Directional Capacity	AM Peak Hour Volume		PM Peak Hour Volume	
			NB	SB	NB	SB
March Rd / Eagleson Rd	*Corkstown Rd to Campeau Dr*	2600	3370	980	1380	2540
	Campeau Dr to Eagleson Park + Ride	1730	1900	870	1600	1490
	Eagleson Park + Ride to Katimavik Rd	2600	1510	930	1230	1790
Kanata Ave	*Campeau Dr to Highway 417 WB*	800	590	600	300	580
	Highway 417 WB to Highway 417 EB	800	280	890	550	1230
Terry Fox Dr	*Kanata Ave to Campeau Dr*	2000	750	750	1050	1030
	Campeau Dr to Highway 417 WB	2000	850	900	1080	1090
	Highway 417 WB to Highway 417 EB	2000	880	1390	1260	1770
Huntmar Dr	*Campeau Dr to Palladium Dr*	800	290	240	380	530
	Palladium Dr to Maple Grove Rd	800	580	340	510	860
	Maple Grove Rd to Hazeldean Rd	800	400	420	590	700
	Hazeldean Rd to Abbott St	800	480	460	610	600

Table 2 summarizes the morning and afternoon peak hour traffic volumes currently operating on the aforementioned major road network in the vicinity of the study corridors. The table also includes the estimated directional capacity of the road link in question.

[1] Where possible, the capacity and volumes were taken from the City of Ottawa's EMME model. Other roadways were supplemented from the City's 2013 and 2008 Transportation Master Plans

2 KANATA LRT STATIONS

2.1 MARCH STATION

March Station will be located south of the existing intersection of March Road at Campeau Drive, with the station platforms spanning under March Road. This configuration generally matches the previous station design identified as part of the *Kanata North BRT Planning and EA Study*, completed in 2012. Modifications to this approved plan to accommodate a change from bus to rail technology include provision of a bus terminal facility, to be located on the west side of March Road and south of the LRT alignment.

The station will include a new multi-use pathway (MUP) structure spanning over Highway 417 to connect the proposed LRT station with the existing Eagleson Park and Ride lots, located on the east and west sides of Eagleson Road, south of Highway 417. To provide for improved community connectivity, as well as to serve transit riders accessing LRT via the Park and Ride facility, the new MUP overpass is proposed to be located on the west side of the March Road / Eagleson Road overpass, with an overhead crossing of Eagleson Road provided south of Highway 417 to connect to the east Park and Ride lot.

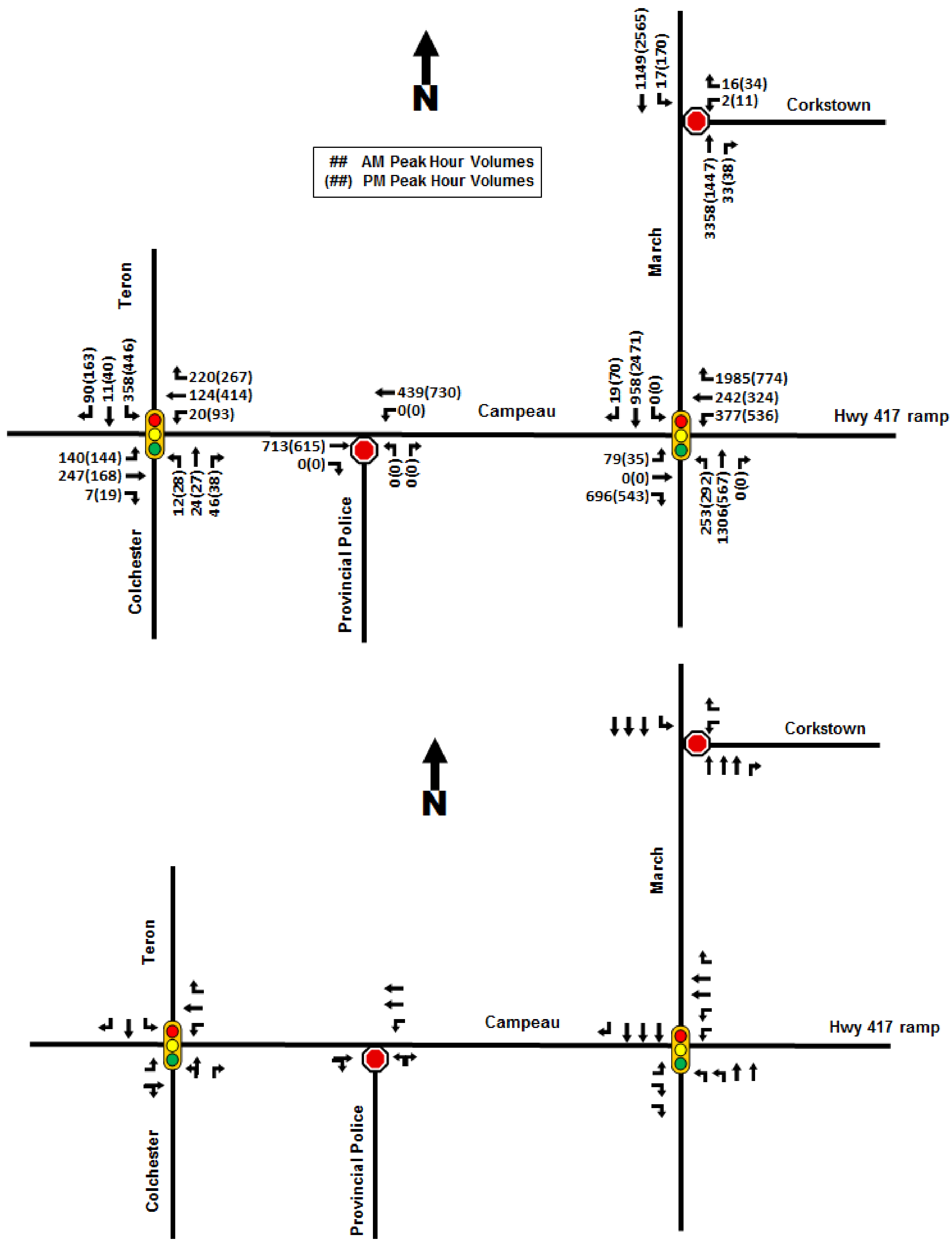
Bus routes (both local and rapid transit) will connect to the LRT at key locations to facilitate passenger transfers and provide a seamless network serving Kanata. The Kanata North BRT between Corkstown Road and Solandt Road, identified as part of the City's Affordable Rapid Transit Network, will connect to March Station. This facility will provide for frequent and reliable bus connections between the LRT, the Kanata North Business Park and Morgan's Grant areas of Kanata. Implementation of the segment of BRT between Corkstown Road and March Station is recommended as part of the Kanata LRT project to provide for a seamless connection to the LRT.

The intersections of March Road/Eagleson Road at Campeau Drive/Highway 417 westbound off-ramps and Campeau Drive at Provincial Police Lane are in close proximity to both the proposed Kanata LRT alignment, as well as the proposed Kanata North BRT alignment. The following section explores potential alternatives for the BRT-LRT interface in this area.

2.1.1 EXISTING CONDITIONS

The existing conditions scenario for March Station analyzed four intersections within the vicinity of March Station: March Road at Campeau Drive, Campeau Drive at Provincial Police Lane, Campeau Drive at Teron Road and March Road at Corkstown Road. Turning movement volumes and lane arrangements for the existing conditions analysis are indicated in Figure 2 below.

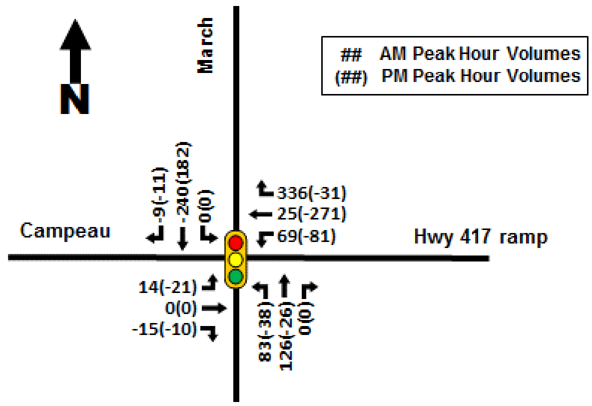
Figure 2 – Existing (2017) Turning Movement Volumes and Lane Configuration



EXISTING TRAFFIC COUNTS VS 2010 TRAFFIC COUNTS

The most recent turning movement counts (2017) from the City of Ottawa at the intersection of March Road and Campeau Drive show varying differences in turning movement volumes relative to the traffic counts used in the *West Transitway Connection: March Road – Preliminary Transportation Assessment* memo from April 2010. Some vehicular movements, such as the AM northbound through and westbound right turn, saw a large increase in volumes, while other movements, such as the PM southbound through and westbound through saw a large decrease in volumes. The difference in traffic volumes for the intersection of March Road at Campeau Drive is indicated in the figure below.

Figure 3 – 2017 vs 2010 Turning Movement Volumes[2]



An increase of approximately 480 northbound vehicles in the AM peak hour is noted, with a less pronounced increase in the southbound direction in the PM peak hour, of approximately 200 vehicles.

Given the rapid growth in Kanata North in the time since the original *West Transitway Connection: March Road – Preliminary Transportation Assessment* memo, it was deemed reasonable to use the turning movement counts from March 2017 as they would provide a more accurate indication of the current traffic patterns at this intersection.

EXISTING INTERSECTION OPERATIONS

The analysis of intersection operations was completed using Trafficware Synchro Version 9 software, following the methodology outlined in Sections 1.2 and 1.3 above. Intersection performance within the study area is shown in Table 3. Figure 4 below indicates the signal phasing used for the intersection of March Road at Campeau Drive, obtained from the City of Ottawa.

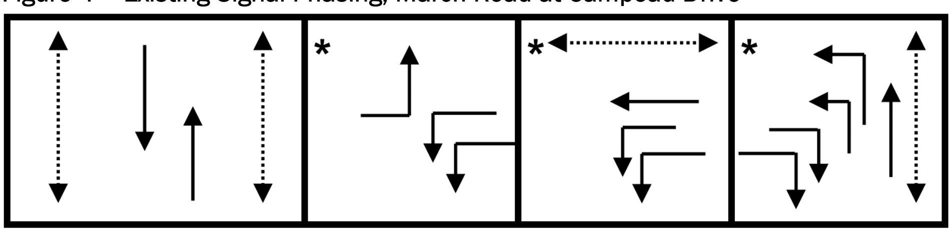
Table 3 – Existing Conditions Analysis – AM (PM) Peak Hours

Intersections	Intersection Performance			Critical Movements			
	Delay (s)	v/c ratio	LOS	Mvmt	v/c ratio	LOS	95th Queue (m)
March at Campeau	38 (89)	0.82 (1.09)	D (F)	WBR (EBR)	1.39 (1.20)	F (F)	#317 (#148)
Campeau at Teron	18 (27)	0.51 (0.78)	A (C)	WBR (SBL)	0.57 (0.95)	A (E)	16 (#137)
March at Corkstown	2 (4)	-	A (A)	WBL (WBL)	1.21 (1.53)	F (F)	6 (17)

[2] Unadjusted for day of week and month of year. Turning movement count from 2017 was taken on Thursday, March 30, which would see a factor of 1.0 applied.

Intersections	Mvmt	Delay (s)	Delay LOS	v/c Ratio	v/c LOS	95th Queue (m)
March at Campeau	EBL	58 (77)	E (E)	0.52 (0.38)	A (A)	29 (21)
	EBR	49 (157)	D (F)	0.88 (1.20)	D (F)	#131 (#148)
	WBL	35 (67)	C (E)	0.47 (0.83)	A (D)	42 (94)
	WBT	51 (77)	D (E)	0.61 (0.80)	B (C)	37 (#79)
	WBR	194 (1)	F (A)	1.39 (0.54)	F (A)	#317 (0)
	NBL	30 (58)	C (E)	0.26 (0.51)	A (A)	32 (54)
	NBT	17 (9)	B (A)	0.66 (0.26)	B (A)	132 (38)
	SBT	55 (105)	E (F)	0.92 (1.14)	E (F)	#97 (#322)
	SBR	0 (1)	A (A)	0.04 (0.10)	A (A)	0 (2)
Campeau at Teron	EBL	27 (19)	C (B)	0.47 (0.53)	A (A)	28 (21)
	EBTR	27 (13)	C (B)	0.53 (0.26)	A (A)	50 (26)
	WBL	30 (21)	C (C)	0.14 (0.27)	A (A)	8 (20)
	WBT	37 (34)	D (C)	0.50 (0.77)	A (C)	31 (81)
	WBR	10 (4)	B (A)	0.57 (0.42)	A (A)	16 (13)
	NBLT	8 (18)	A (B)	0.04 (0.09)	A (A)	6 (13)
	NBR	1 (1)	A (A)	0.05 (0.06)	A (A)	2 (1)
	SBL	14 (57)	B (E)	0.52 (0.95)	A (E)	57 (#137)
	SBT	8 (17)	A (B)	0.01 (0.06)	A (A)	3 (11)
	SBR	2 (4)	A (A)	0.11 (0.25)	A (A)	6 (12)

Figure 4 – Existing Signal Phasing, March Road at Campeau Drive



The results of the analysis indicate that the intersections of Campeau Drive at Teron Road and March Road at Corkstown Road operate with an acceptable LOS in the existing conditions. The intersection of March Road at Campeau Drive operates with an acceptable LOS in the AM peak hour, but is over capacity in the PM peak hour, with a v/c ratio of 1.09. Individual movements at this intersection that are over capacity include the westbound right turn in the AM peak hour and the southbound through and eastbound right turn in the PM peak hour.

It should be noted that while the analysis indicates the westbound right turn movement is over capacity in the AM peak hour, this movement is actually a channelized right turn lane, that transitions into its own northbound lane on March Road. The configuration of this lane allows the movement to generally be a free-flow movement, and therefore doesn't have an impact on the overall intersection operations. The lane is coded as a channelized right-turn in Synchro, however the results are not included in the weighted v/c ratio calculation for the overall intersection.

Table 4 below indicates the existing intersection operations using the average peak period turning movement volumes, as indicated in the MMLOS Guidelines.

Table 4 – Existing Conditions Analysis – AM (PM) Average Peak Period

Intersections	Intersection Performance			Critical Movements			
	Delay (s)	v/c ratio	LOS	Mvmt	v/c ratio	LOS	95th Queue (m)
March at Campeau	33 (63)	0.67 (0.98)	B (E)	WBR (EBR)	1.20 (1.05)	F (F)	#198 (#130)
Campeau at Teron	18 (20)	0.47 (0.64)	A (B)	WBR (SBL)	0.54 (0.77)	A (C)	16 (#98)
March at Corkstown	1 (2)	-	A (A)	NBT (WBL)	0.61 (0.70)	B (B)	0 (12)

Intersections	Mvmt	Delay (s)	Delay LOS	v/c Ratio	v/c LOS	95th Queue (m)
March at Campeau	EBL	57 (76)	E (E)	0.48 (0.35)	A (A)	26 (19)
	EBR	50 (111)	D (F)	0.86 (1.05)	D (F)	#105 (#130)
	WBL	35 (64)	C (E)	0.43 (0.77)	A (C)	36 (85)
	WBT	51 (74)	D (E)	0.56 (0.75)	A (C)	32 (#68)
	WBR	106 (1)	F (A)	1.20 (0.49)	F (A)	#198 (0)
	NBL	31 (57)	C (E)	0.25 (0.45)	A (A)	28 (49)
	NBT	14 (8)	B (A)	0.56 (0.23)	A (A)	102 (34)
	SBT	39 (66)	D (E)	0.64 (1.03)	B (F)	74 (#273)
	SBR	0 (0)	A (A)	0.03 (0.09)	A (A)	0 (0)
Campeau at Teron	EBL	26 (15)	C (B)	0.43 (0.37)	A (A)	26 (18)
	EBTR	26 (12)	C (B)	0.48 (0.23)	A (A)	45 (22)
	WBL	30 (21)	C (C)	0.12 (0.22)	A (A)	7 (17)
	WBT	37 (28)	D (C)	0.47 (0.66)	A (B)	28 (65)
	WBR	10 (5)	B (A)	0.54 (0.37)	A (A)	16 (12)
	NBLT	8 (16)	A (B)	0.04 (0.07)	A (A)	6 (11)
	NBR	1 (0)	A (A)	0.05 (0.05)	A (A)	2 (0)
	SBL	13 (33)	B (C)	0.47 (0.77)	A (C)	47 (#98)
	SBT	8 (15)	A (B)	0.01 (0.05)	A (A)	3 (9)
	SBR	2 (4)	A (A)	0.10 (0.21)	A (A)	5 (10)

Using the average peak period analysis gives an acceptable LOS for all intersections in the study area. There are still individual movements at the intersection of March Road at Campeau Drive with a LOS 'F', including the westbound right turn (AM peak), eastbound right turn (PM peak) and southbound through (PM peak) movements.

2.1.2 FUTURE HORIZON (2031) SCENARIOS

EMME3 models from the City of Ottawa were received for various potential alternative alignments of the Kanata LRT, including models for the intersection of March Road at Campeau Drive, and for the entire study area. For the purpose of this analysis, three EMME models were compared: the 2011 EMME model, the base 2031 EMME model (i.e. including all road works associated with the City's Affordable Plan), and the 2031 EMME model for the preferred Kanata LRT alignment (Scenario 8). Both the base 2031 EMME model and the Kanata LRT 2031 EMME model also include the Kanata North BRT. The table below provides a comparison between traffic volumes on March Road and Campeau Drive near the intersection of March Road and Campeau Drive, from the 2011 and 2031 EMME models, as well as 2011 and 2017 turning movement counts from the City of Ottawa.

Table 5 – Volume Comparison, EMME vs Turning Movement Counts (AM Peak Hour)

Intersections	March Road		Campeau Drive	
	Northbound	Southbound	Eastbound	Westbound
2011 EMME	2225	1650	770	470
2011 Turning Movement Count	4315	1285	750	525
2015 Turning Movement Count	3040	830	740	510
2017 Turning Movement Count	3370	975	775	515
Base 2031 EMME	2285	1650	710	280
Kanata LRT 2031 EMME	2280	1615	680	275

The traffic volumes in the 2011 EMME were generally the largest of the three EMME model scenarios, with Kanata LRT 2031 scenario being the smallest. It should be noted that for both the 2011 turning movement count and the 2011 EMME model, the extension of Terry Fox Drive from Kanata Avenue to Second Line Road was not in place. This would provide reasoning for why traffic volumes are generally larger in the 2011 scenarios than all other scenarios.

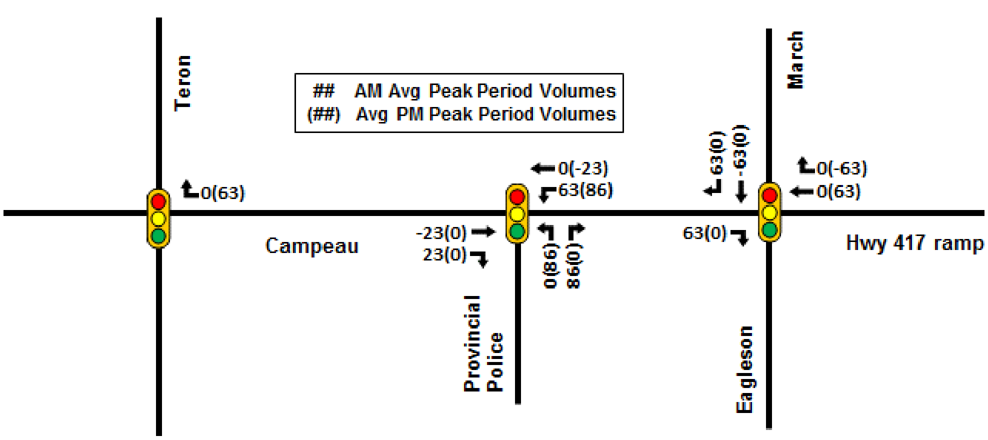
Given that the EMME model volumes for the 2031 model are similar to those in the 2011 model, it is assumed that there is zero growth expected from 2011 to 2031, therefore the 2017 turning movement counts from the existing conditions scenario will also be used for all future scenario analyses. This will provide the most conservative analysis for all scenarios.

PARK AND RIDE AND KISS AND RIDE

There are existing park and ride and kiss and ride facilities located at the Eagleson Park and Ride on the south side of Highway 417. However, in order to provide a more direct connection to the Kanata LRT, pedestrian pick-up and drop-off (PPUDO) spaces will be provided directly at the March LRT Station. The provision of these spaces allows for kiss and ride transit users, who get dropped off at the station by someone driving a vehicle. This will attract additional traffic to March LRT station, and therefore additional traffic to the intersection of Campeau Drive at Provincial Police Lane

Kiss and ride trips were generated using the City's EMME model and were split between the kiss and ride lots north and south of Highway 417 according to population distribution north and south of the highway. The kiss and ride trips were then assigned to the road network according to existing traffic patterns. Figure 5 below indicates the new kiss and ride trips generated by the March Station Kiss and Ride.

Figure 5 – March Station Kiss and Ride Trips



FUTURE INTERSECTION ALTERNATIVES

In the 2031 horizon scenario, two alternatives for an at-grade connection between the Kanata North BRT and the March LRT Station were developed:

- **Alternative 1A / 1B:** Median BRT on March Road. The eastbound left turn lane at March Road and Campeau Drive intersection is converted to a bus-only lane. This lane would extend west to the intersection of Campeau Drive at Provincial Police Lane, requiring a six-lane cross section on Campeau Drive;
- **Alternative 2:** Median BRT on March Road. The eastbound left turn lane at March Road and Campeau Drive intersection is extended west to the intersection of Campeau Drive at Provincial Police Lane. In order to maintain a five-lane cross section on Campeau Drive (i.e. no widening), the removal of one westbound through lane on Campeau Drive and one northbound left turn at March Road and Campeau Drive intersection is required;

General assumptions for the above scenarios, as well as the background 2031 scenario, are listed below:

- The intersections of March Road at Corkstown Road and Campeau Drive at Provincial Police Lane are signalized;
- The main access to any BRT facilities at March Station are via the intersection of Campeau Drive at Provincial Police Lane;
  - This intersection is unsignalized in the existing conditions, but is anticipated to be signalized as part of the Kanata North BRT project;
- As indicated above, due to the EMME model showing no growth from 2017 to 2031, the existing turning movement volumes were used for the future scenario, with the addition of bus volumes for the Kanata North BRT;
  - The bus volumes in the future scenario are as per the *West Transitway Connection: March Road – Preliminary Transportation Assessment* memo from 2010 (25 buses per hour in the AM peak) which meets the City of Ottawa's Transportation Master Plan planning guidelines for this type of facility (> 12 buses/hour)[3];
- The southbound right turn lane at the intersection of March Road and Campeau Drive was removed, with the curbside southbound through lane now shared with southbound right turn movements;
  - No diversion of traffic was assumed for March Road southbound due to the lane conversion;
- Kiss and ride volumes are applicable only to Alternatives 1 and 2;
- Average peak period volumes were used in the analysis, as per the MMLOS guidelines.
  - Peak hour vs average peak period ratio at the intersection of March Road and Campeau Drive is 1.16 in the AM peak and 1.07 in the PM peak.

FUTURE (2031) BACKGROUND CONDITIONS

The future (2031) background intersection performance within the study area is shown in Table 6. The same signal phasing was used as the existing conditions scenario, with adjustments to individual timings. The intersections of Campeau Drive at Provincial Police Lane and March Road at Corkstown Road are assumed to be signalized, as noted above.

[3] OC Transpo's projected volumes for the Kanata North BRT are 10 buses per hour in the peak direction, which do not meet the City of Ottawa's Transportation Master Plan planning guidelines for this type of facility.

Table 6 – Future Background Conditions Analysis – AM (PM) Average Peak Period

Intersections	Intersection Performance			Critical Movements			
	Delay (s)	v/c ratio	LOS	Mvmt	v/c ratio	LOS	95th Queue (m)
March at Campeau	33 (71)	0.68 (1.00)	B (E)	WBR (SBTR)	1.20 (1.05)	F (F)	#198 (#285)
Campeau at Provincial Police	7 (8)	0.30 (0.35)	A (A)	NBLR (WBT)	0.34 (0.35)	A (A)	9 (34)
Campeau at Teron	17 (18)	0.49 (0.56)	A (A)	WBR (SBL)	0.59 (0.75)	A (C)	17 (72)
March at Corkstown	4 (6)	0.71 (0.80)	C (C)	NBTR (SBT)	0.72 (0.81)	C (D)	111 (173)

Intersections	Mvmt	Delay (s)	Delay LOS	v/c Ratio	v/c LOS	95th Queue (m)
March at Campeau	EBL	74 (156)	E (F)	0.66 (0.88)	B (D)	#34 (#38)
	EBR	51 (107)	D (F)	0.88 (1.04)	D (F)	#92 (#126)
	WBL	39 (78)	D (E)	0.49 (0.89)	A (D)	42 (#98)
	WBT	59 (115)	E (F)	0.68 (0.99)	B (E)	#36 (#74)
	WBR	106 (1)	F (A)	1.20 (0.49)	F (A)	#198 (0)
	NBL	29 (55)	C (E)	0.28 (0.50)	A (A)	28 (53)
	NBT	11 (7)	B (A)	0.53 (0.22)	A (A)	79 (28)
	SBTR	38 (71)	D (E)	0.64 (1.05)	B (F)	75 (#285)
Campeau at Provincial Police	EBTR	7 (8)	A (A)	0.30 (0.31)	A (A)	30 (28)
	WBL	9 (11)	A (B)	0.16 (0.20)	A (A)	7 (8)
	WBT	6 (8)	A (A)	0.18 (0.35)	A (A)	17 (34)
	NBLR	17 (15)	B (B)	0.34 (0.29)	A (A)	9 (8)
Campeau at Teron	EBL	28 (17)	C (B)	0.44 (0.32)	A (A)	27 (23)
	EBTR	24 (13)	C (B)	0.28 (0.14)	A (A)	23 (14)
	WBL	34 (26)	C (C)	0.14 (0.29)	A (A)	8 (21)
	WBT	34 (25)	C (C)	0.29 (0.46)	A (A)	15 (37)
	WBR	12 (7)	B (A)	0.59 (0.44)	A (A)	17 (16)
	NBLT	7 (11)	A (B)	0.02 (0.04)	A (A)	3 (5)
	NBR	7 (11)	A (B)	0.02 (0.03)	A (A)	4 (5)
	SBL	1 (0)	A (A)	0.05 (0.05)	A (A)	2 (0)
	SBT	12 (26)	B (C)	0.46 (0.75)	A (C)	48 (72)
	SBR	7 (11)	A (B)	0.01 (0.05)	A (A)	3 (7)
March at Corkstown	WBL	37 (48)	D (D)	0.01 (0.07)	A (A)	2 (7)
	WBR	35 (19)	C (B)	0.07 (0.18)	A (A)	8 (9)
	NBTR	4 (2)	A (A)	0.72 (0.33)	C (A)	111 (25)
	SBL	8 (13)	A (B)	0.19 (0.56)	A (A)	3 (33)
	SBT	2 (8)	A (A)	0.37 (0.81)	A (D)	30 (173)

The results of the future background conditions indicate that all intersections within the vicinity of March Station operate with acceptable LOS in both average peak periods. The intersections of Campeau Drive at Provincial Police Lane and

March Road at Corkstown Road were unsignalized in the existing conditions analysis, and operate acceptably as signalized intersections.

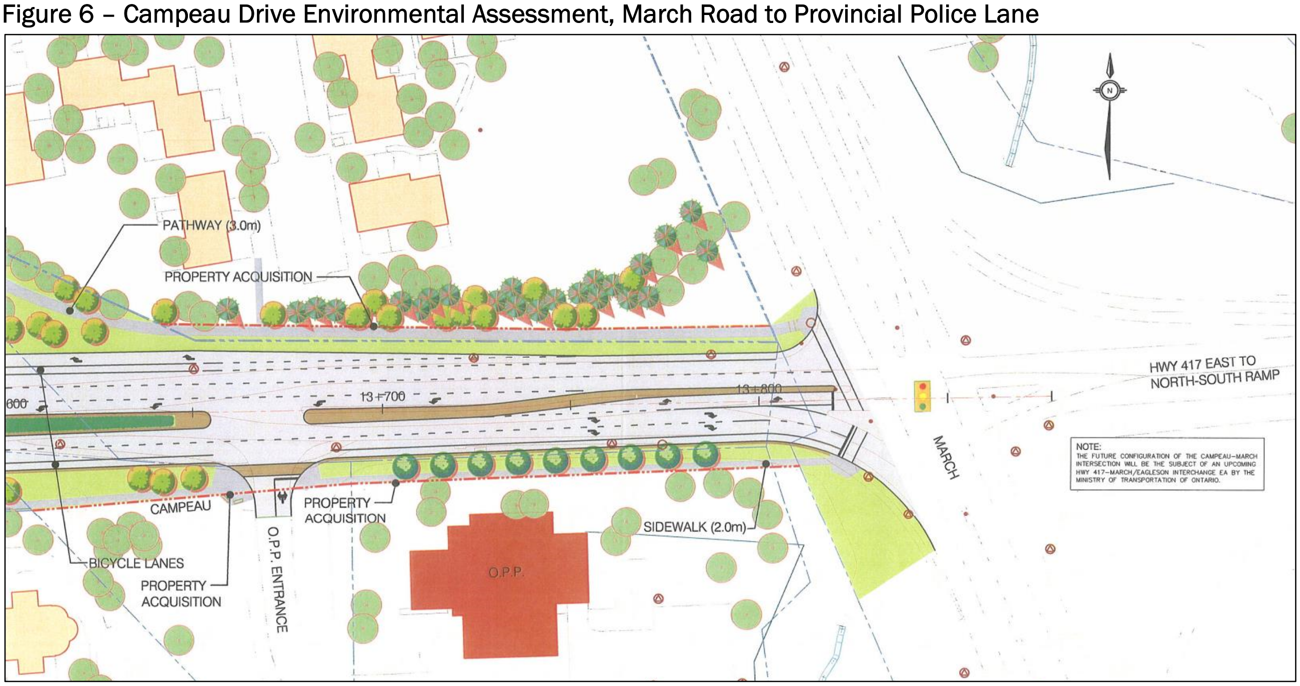
FUTURE CAMPEAU DRIVE WIDENING

For Alternative 1A and 1B, the eastbound left turn lane at March Road and Campeau Drive has been converted to a bus only lane. This lane would extend west to the intersection of Campeau Drive at Provincial Police Lane. Eastbound left turn general traffic at this location can be re-routed to Teron Road, which as a “Major Collector” classification and with less 450 northbound vehicles in both peak hours, can accommodate the additional 30-80 vehicles that currently make the eastbound left turn at March Road / Campeau Drive.

In order to accommodate the extended eastbound left turn lane, the section of Campeau Drive from March Road to Provincial Police Lane would have to be widened to six lanes. The *Campeau Drive Environmental Assessment Study* indicated additional property along Campeau Drive is required to accommodate bike lanes on Campeau Drive, as well as a multi-use pathway on the north side and a sidewalk on the south side of Campeau Drive. It should be noted that the portion of the Campeau Drive EA in this area is not a part of the City’s Affordable Network, and therefore it may not be completed prior to the construction of the Kanata North BRT or the Kanata LRT. However, for the purposes of this analysis, it will be assumed that it is completed.

It may be possible to widen Campeau Drive without acquiring additional property (than that identified in the Campeau Drive EA) by reducing the amount of landscaping shown in the functional design[4]. However, if it is preferable to maintain the landscaping from the EA (i.e. boulevards between the sidewalk and the multi-use pathway on Campeau Drive), then additional property in the order of 6m to 7m would be required. The functional design from the EA for this section is shown below in Figure 6.

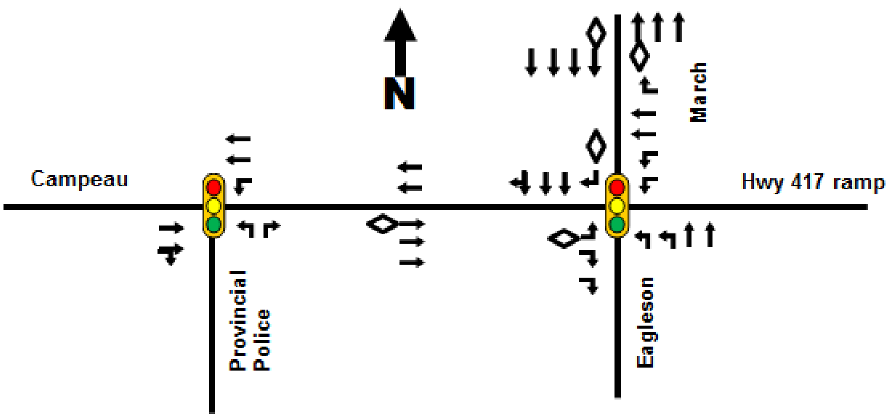
Figure 6 – Campeau Drive Environmental Assessment, March Road to Provincial Police Lane



[4] If the assumption is that the widening of Campeau Drive identified in the EA study will not be completed prior to the Kanata North BRT / Kanata LRT, then the property required to widen Campeau Drive to six lanes is similar to that identified in the EA study.

Alternative 1A and 1B assumes that the widening of Campeau Drive to six lanes is feasible. The proposed lane arrangement for Alternative 1A and 1B is shown below in Figure 7. The only difference between the two alternatives is a difference in signal phasing at the intersection of March Road and Campeau Drive.

Figure 7 – Alternative 1A / 1B Lane Arrangement



ALTERNATIVE 1A – MARCH ROAD AT CAMPEAU DRIVE

The proposed signal phasing for March Road at Campeau Drive in Alternative 1A is shown in Figure 8. This alternative uses a traditional signal phasing, with the eastbound and southbound BRT movements operating at the same time as the fully protected eastbound and westbound left turns. The intersection operations for March Road at Campeau Drive in Alternative 1A are shown below in Table 7. No operations were shown for other intersections, as it is assumed the lane arrangements / signal phasing at these locations is the same as in the Future Background Scenario provided in Table 4.

Figure 8 – Alternative 1A Signal Phasing

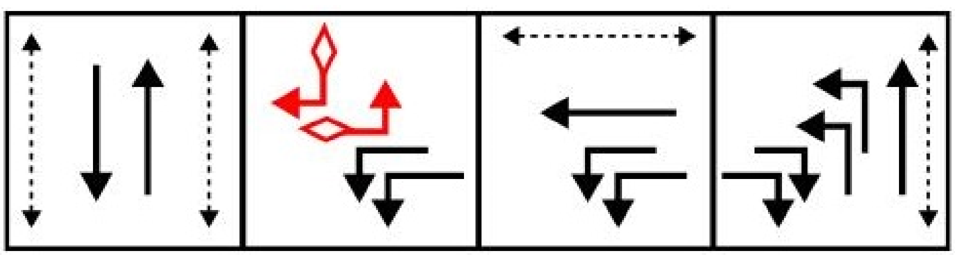


Table 7 – Alternative 1A Operational Analysis – AM (PM) Average Peak Period

Intersection	Mvmt	Delay (s)	Delay LOS	v/c Ratio	v/c LOS	95th Queue (m)
March at Campeau	EBL (BOL)	53 (102)	D (F)	0.23 (0.46)	A (A)	7 (#13)
	EBR	45 (180)	D (F)	0.92 (1.27)	E (F)	#115 (#132)
	WBL	41 (65)	D (E)	0.70 (0.90)	B (D)	43 (#89)
	WBT	41 (59)	D (E)	0.52 (0.77)	A (C)	#42 (#85)
	WBR	194 (1)	F (A)	1.39 (0.50)	F (A)	#271 (0)
	NBL	21 (50)	C (D)	0.26 (0.61)	A (B)	26 (49)
	NBT	10 (7)	A (A)	0.60 (0.26)	A (A)	81 (30)
	SBR (BOL)	67 (86)	E (F)	0.38 (0.35)	A (A)	#10 (#10)

Intersection	Mvmt	Delay (s)	Delay LOS	v/c Ratio	v/c LOS	95th Queue (m)
	SBTR	52 (138)	D (F)	0.95 (1.23)	E (F)	#85 (#289)
	Overall	33 (108)	-	0.85 (1.18)	D (F)	-

With the changes associated with Alternative 1A, the intersection of March Road at Campeau Drive is now failing in the PM period. The replacement of the general traffic eastbound left turn phase with a bus-only phase, as well as the kiss and ride traffic results in an increase in v/c ratio from 0.68 to 0.85 in the AM peak and 1.00 to 1.18 in the PM peak.

According to the City of Ottawa's Multi Modal Level of Service (MMLOS) Guidelines, a LOS E is acceptable at any intersection within 600m of a rapid transit station. The intersection of March Road at Campeau Street will be within 600m of the March LRT Station, therefore a LOS E is acceptable at this location. However, the MMLOS Guidelines indicate that the minimum acceptable LOS for transit movements on corridors identified for transit priority isolated measures (i.e. March Road) is LOS 'D'. Therefore the LOS for the southbound right and eastbound left bus only lanes technically does not meet City standards. Given the numerous failing movements at this intersection in the existing conditions and the future (2031) background conditions, it will be difficult to achieve acceptable LOS for transit and general traffic at this intersection.

ALTERNATIVE 1B – MARCH ROAD AT CAMPEAU DRIVE

The proposed signal phasing for March Road at Campeau Drive in Alternative 1B is shown in Figure 9. This alternative uses a split signal phasing, with the eastbound and southbound BRT movements operating at the same time as the fully protected eastbound left turn. The intersection operations for March Road at Campeau Drive Alternative 1B are shown below in Table 8. No operations were shown for other intersections, as it is assumed the lane arrangements / signal phasing at these locations is the same as in the Future Background Scenario provided in Table 4.

Figure 9 – Alternative 1B Signal Phasing

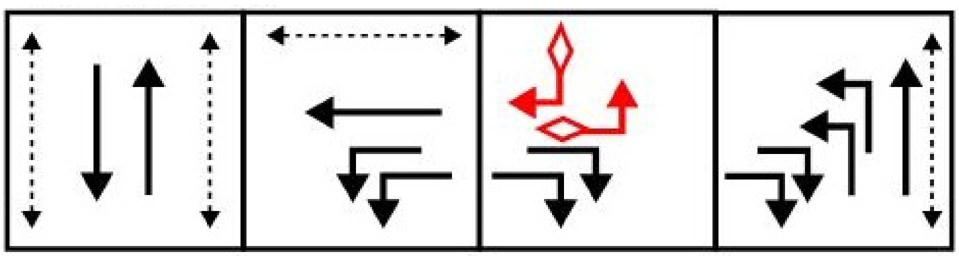


Table 8 – Alternative 1B Operational Analysis – AM (PM) Average Peak Period

Intersections	Mvmt	Delay (s)	Delay LOS	v/c Ratio	v/c LOS	95th Queue (m)
March at Campeau	EBL (BOL)	32 (57)	C (E)	0.07 (0.24)	A (A)	6 (10)
	EBR	43 (98)	D (F)	0.91 (1.04)	E (F)	#107 (#118)
	WBL	62 (161)	E (F)	0.89 (1.22)	D (F)	#55 (#109)
	WBT	42 (67)	D (E)	0.57 (0.85)	A (D)	31 (#69)
	WBR	194 (1)	F (A)	1.39 (0.50)	F (A)	#271 (0)
	NBL	61 (159)	E (F)	0.84 (1.18)	D (F)	#43 (#73)
	NBT	31 (11)	C (B)	0.89 (0.29)	D (A)	#143 (39)
	SBR (BOL)	33 (59)	C (E)	0.12 (0.18)	A (A)	7 (8)
	SBTR	37 (124)	D (F)	0.82 (1.20)	D (F)	70 (#284)
	Overall	40 (110)	-	0.90 (1.20)	D (F)	-

The overall intersection operation with this signal phasing is worse than that of Alternative 1A, however the delays to the transit movements are less than Alternative 1A. This is a trade-off that will be considered by the City when setting the future signal timing of this intersection. Given the relatively small difference between the future background conditions, Alternative 1A and Alternative 1B, both options would be acceptable solutions in providing transit priority service at the intersection of March Road and Campeau Drive.

ALTERNATIVE 2 – MARCH ROAD AT CAMPEAU DRIVE

Alternative 2 is similar to Alternative 1A and 1B, with the eastbound left turn lane at March Road and Campeau Drive converted to a bus only lane. This lane would extend west to the intersection of Campeau Drive at Provincial Police Lane. In this alternative in order to avoid a widening of Campeau Drive, one of the westbound through lanes on Campeau Drive is removed. This requires the removal of one northbound left turn lane and one westbound through lane at the intersection of March Road and Campeau Drive. The proposed intersection arrangement and signal timing for this alternative are shown below in Figure 10 and Figure 11, respectively. The intersection operations results for Alternative 2 are in Table 9.

Figure 10 - Alternative 2 Lane Arrangement

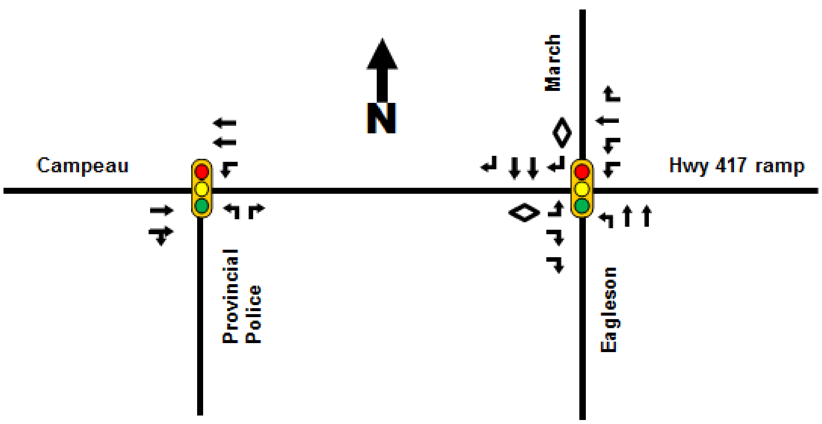


Figure 11 – Alternative 2 Signal Phasing

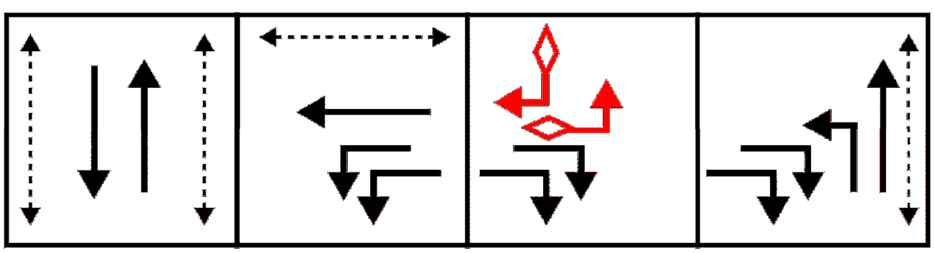


Table 9 – Alternative 2 Operational Analysis – AM (PM) Average Peak Period

Intersections	Mvmt	Delay (s)	Delay LOS	v/c Ratio	v/c LOS	95th Queue (m)
March at Campeau	EBL (BOL)	32 (82)	C (F)	0.07 (0.41)	A (A)	6 (#12)
	EBR	43 (67)	D (E)	0.91 (0.91)	E (E)	#107 (#107)
	WBL	62 (98)	E (F)	0.89 (1.04)	D (F)	#55 (#100)
	WBT	42 (227)	D (F)	0.57 (1.38)	A (F)	31 (#172)
	WBR	194 (1)	F (A)	1.39 (0.50)	F (A)	#271 (0)

Intersections	Mvmt	Delay (s)	Delay LOS	v/c Ratio	v/c LOS	95th Queue (m)
	NBL	61 (224)	E (F)	0.84 (1.36)	D (F)	#43 (#149)
	NBT	31 (11)	C (B)	0.89 (0.29)	D (A)	#143 (38)
	SBR (BOL)	33 (78)	D (E)	0.12 (0.31)	A (A)	7 (#9)
	SBTR	37 (200)	D (F)	0.82 (1.37)	D (F)	70 (#308)
	Overall	45 (155)	-	0.95 (1.37)	E (F)	-

The removal of one westbound through lane and one northbound left turn at this intersection has a negative impact on the capacity of the intersection. The v/c ratio in both peak periods is the highest of all alternatives, indicating that Alternative 2 is not the preferred alternative.

2.1.3 PREFERRED ALTERNATIVE

The table below summarizes the overall intersection LOS for each alternative at the intersection of March Road and Campeau Drive.

Table 10 – Comparison of March Road at Campeau Drive Intersection Operations – AM (PM) Average Peak Period

Intersections	Intersection Performance		
	Delay (s)	v/c ratio	LOS
Future Background	33 (71)	0.68 (1.00)	B (E)
Alternative 1A	33 (108)	0.85 (1.18)	D (F)
Alternative 1B	40 (110)	0.90 (1.20)	D (F)
Alternative 2	45 (155)	0.95 (1.37)	E (F)

The results of this preliminary analysis indicate that all alternatives to incorporate the Kanata North BRT at-grade through the intersection of March Road at Campeau Drive will result in a lower LOS for the intersection. All alternatives provide an acceptable LOS in the AM peak, however all alternatives provide a LOS ‘F’ in the PM peak. This is understandable given that the intersection is already at capacity (i.e. v/c ratio = 1.00) according to the future (2031) background scenario.

Alternative 1A and 1B provide better overall LOS than Alternative 2, making one of them the preferred alternative. Alternative 1A provides a better LOS for general traffic, whereas Alternative 1B provides a better LOS for transit. As this intersection is included as part of the Kanata North BRT corridor, Alternative 1B is preferred, as transit should be prioritized on transit priority corridors.

MARCH ROAD SOUTHBOUND LANE REDUCTION

The above analysis assumed that three southbound through lanes can be maintained on March Road in addition to the provision of median BRT lanes. Given that it may not be possible to maintain all three lanes as well as the median BRT lanes, an analysis of the preferred option (Alternative 1B) was undertaken that provides only two southbound through lanes at the intersection of March Road and Campeau Drive, with the southbound right turn lane shared with the curbside through lane. The results of this analysis are provided in Table 11.

Table 11 – Alternative 1B Operations with Two Southbound Through Lanes

Intersections	Intersection Performance			Critical Movements			
	Delay (s)	v/c ratio	LOS	Mvmt	v/c ratio	LOS	95th Queue (m)
March at Campeau	51 (210)	0.97 (1.51)	E (F)	EBR (SBTR)	0.99 (1.53)	E (F)	#124 (#468)

Intersections	Mvmt	Delay (s)	Delay LOS	v/c Ratio	v/c LOS	95th Queue (m)
March at Campeau	EBL (BOL)	36 (65)	D (E)	0.07 (0.30)	A (A)	6 (10)
	EBR	63 (159)	E (F)	0.99 (1.21)	E (F)	#124 (#129)
	WBL	82 (264)	F (F)	0.97 (1.47)	E (F)	#63 (#118)
	WBT	49 (102)	D (F)	0.62 (1.02)	B (F)	35 (#78)
	WBR	194 (1)	F (A)	1.39 (0.50)	F (A)	#294 (0)
	NBL	86 (257)	F (F)	0.95 (1.43)	E (F)	#50 (#78)
	NBT	26 (9)	C (A)	0.82 (0.27)	D (A)	132 (34)
	SBR (BOL)	37 (66)	D (E)	0.12 (0.23)	A (A)	8 (8)
	SBTR	53 (266)	D (F)	0.96 (1.53)	E (F)	#133 (#468)

As expected, the intersection of March Road at Campeau Drive deteriorates in LOS when one of the southbound through lanes is removed, with the v/c ratio for the intersection increasing from 0.90 to 0.97 in the AM period and 1.20 to 1.51 in the PM period. The delay and v/c ratio for the southbound through movement increases from 37s and 0.82 to 53s and 0.96 in the AM period and 124s and 1.20 to 266s and 1.53 in the PM period.

TRAFFIC VOLUMES FROM KANATA LRT EMME MODEL

Given that the preferred alternative for the intersection of March Road and Campeau Drive operates with a LOS 'F' in the PM peak period, an additional analysis was undertaken using the growth rate provided by the EMME mode, under the 2031 Kanata LRT Scenario. This EMME model generally has the smallest volumes of all EMME models (as noted in Table 5), likely due to a higher transit mode share, with more users on both the Kanata LRT and the Kanata North BRT. The ensuing analysis covers both Alternative 1A (Table 12) and Alternative 1B (Table 13), with traffic volumes used as shown in Figure 12.

Figure 12 – Kanata LRT 2031 EMME Volumes

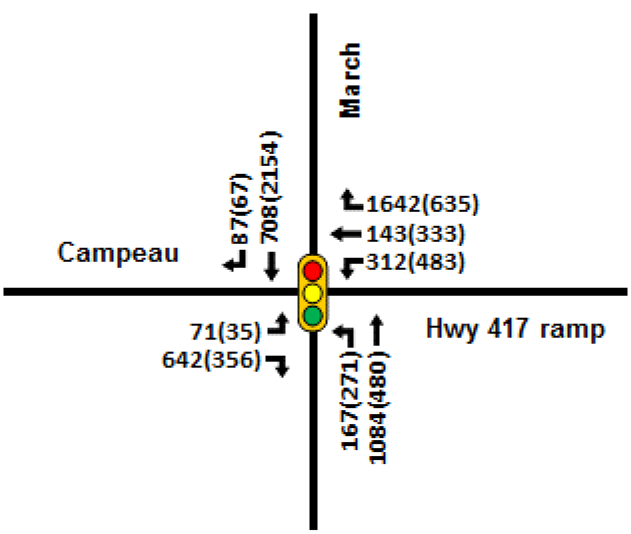


Table 12 – Alternative 1A Operations with Kanata LRT 2031 EMME Volumes

Intersections	Intersection Performance			Critical Movements			
	Delay (s)	v/c ratio	LOS	Mvmt	v/c ratio	LOS	95th Queue (m)
March at Campeau	26 (51)	0.67 (0.96)	B (E)	EBR (SBTR)	0.86 (1.01)	D (F)	#83 (#225)

Intersections	Mvmt	Delay (s)	Delay LOS	v/c Ratio	v/c LOS	95th Queue (m)
March at Campeau	EBL (BOL)	53 (92)	D (F)	0.23 (0.43)	A (A)	7 (#12)
	EBR	40 (80)	D (F)	0.86 (0.91)	D (E)	#83 (#79)
	WBL	41 (60)	D (E)	0.63 (0.84)	B (D)	35 (71)
	WBT	38 (57)	D (E)	0.35 (0.70)	A (B)	21 (#67)
	WBR	85 (1)	F (A)	1.15 (0.45)	F (A)	#149 (0)
	NBL	22 (52)	C (D)	0.19 (0.57)	A (A)	17 (43)
	NBT	8 (7)	A (A)	0.49 (0.22)	A (A)	60 (26)
	SBR (BOL)	67 (82)	E (F)	0.38 (0.33)	A (A)	#10 (#9)
	SBTR	30 (52)	C (D)	0.61 (1.01)	B (F)	58 (#225)

Table 13 – Alternative 1B Operations with Kanata LRT 2031 EMME Volumes

Intersections	Intersection Performance			Critical Movements			
	Delay (s)	v/c ratio	LOS	Mvmt	v/c ratio	LOS	95th Queue (m)
March at Campeau	32 (88)	0.77 (1.13)	C (F)	NBT (SBTR)	0.77 (1.15)	C (F)	102 (#246)

Intersections	Mvmt	Delay (s)	Delay LOS	v/c Ratio	v/c LOS	95th Queue (m)
March at Campeau	EBL (BOL)	31 (48)	C (D)	0.07 (0.16)	A (A)	6 (10)
	EBR	32 (46)	C (D)	0.76 (0.55)	C (A)	74 (63)
	WBL	47 (119)	D (F)	0.72 (1.10)	C (F)	38 (#95)
	WBT	37 (59)	D (E)	0.33 (0.73)	A (C)	20 (54)
	WBR	85 (1)	F (A)	1.15 (0.45)	F (A)	#149 (0)
	NBL	51 (105)	D (F)	0.65 (0.99)	B (E)	#24 (#58)
	NBT	26 (13)	C (B)	0.77 (0.26)	C (A)	102 (36)
	SBR (BOL)	32 (51)	C (D)	0.11 (0.12)	A (A)	7 (8)
	SBTR	31 (107)	C (F)	0.66 (1.15)	B (F)	55 (#246)

Intersection operations for both Alternative 1A and 1B improve due to fewer vehicles at the intersection. In this scenario, Alternative 1A operates with an acceptable level of service for general traffic, as the overall intersection is now LOS 'B' I the AM peak period and LOS 'E' in the PM peak period, as opposed to the LOS 'D' and LOS 'F' that it previously was. However this alternative continues to have failing level of service for transit in the average PM peak period for both the eastbound left and the southbound right.

Alternative 1B continues to operate with a LOS 'F' in the average PM peak period, however the v/c ratio of 1.13 is lower than the 1.20 that it was previously. The benefit in this scenario comes to the transit level of service, which operates with a LOS 'D', which is acceptable under the City's MMLOS guidelines. The reduced traffic at this intersection allows for the provision of adequate green time to the transit phases to meet the level of service criteria. Alternative 1B continues to the recommended solution at the intersection of March Road and Campeau Drive.

2.2 TERRY FOX STATION

Terry Fox Station is located one kilometre west from Kanata Town Centre Station, and is an existing Transitway station, located adjacent to the Kanata Centrum development. The existing station consists of a 200 metre long centre island bus platform, with a 550 space park and ride lot. The new LRT platforms will be located between the existing bus platforms and Highway 417, with new overhead walkways connecting the LRT platforms to the bus platforms, which will continue to be used for local transit services.

The station will be designed to protect for a potential MUP overpass located at the east end of the station area. This potential MUP crossing would connect to McGibbon Park, located on the south side of Highway 417. West of Terry Fox Station, the LRT tracks will descend below grade in an open cut, following the curve of the westbound Highway 417 Terry Fox off-ramp and then crossing under Terry Fox Drive at a point approximately 200 metres north of Highway 417.

Terry Fox Station is the proposed terminus for phase two of the Kanata LRT construction. This could result in a greater number of buses, park and ride users or kiss and ride activity at Terry Fox Station, in the interim period before phase three of the Kanata LRT (i.e. Terry Fox Station to Hazeldean Station) is operational.

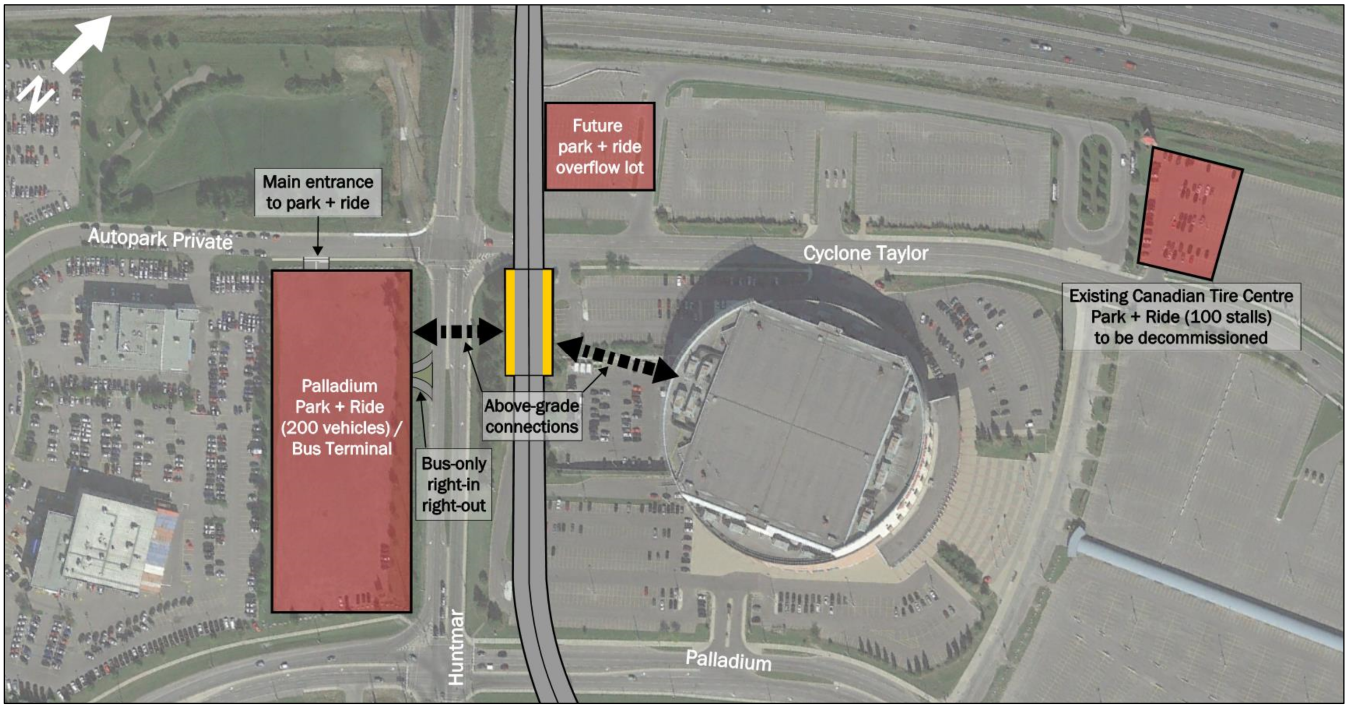
2.3 PALLADIUM STATION

Palladium Station is located one kilometre south of Campeau Station, on the west side of the existing Canadian Tire Centre, between Cyclone Taylor Drive and Palladium Drive. The station will be elevated, with sufficient clearance to provide for an elevated pedestrian walkway extending from the west side of the CTC at the 2nd floor elevation. This station location and configuration was previously developed as part of the BRT EA. Modifications required as part of the LRT project include a new local bus terminal and PPUDO located on the west side of Huntmar Drive (accessed via an overhead walkway over Huntmar Drive), with vehicular and bus access from Autopark Private[5]. A Park and Ride facility will also be required, likely located on the west side of Huntmar Drive, with a potential overflow lot provided at the northeast corner of Huntmar Drive and Cyclone Taylor Boulevard.

The figure below indicates a conceptual layout for the Palladium LRT Station and Park and Ride. Due to the potential for a larger Park and Ride facility, as well as the new bus facility on the west side of Huntmar Drive, a high level review of intersection operations in the area will be provided in the following section, including Huntmar Drive at Cyclone Taylor Boulevard, Huntmar Drive at Palladium Drive and Palladium Drive at Cyclone Taylor Boulevard.

[5] It is assumed that the section of Autopark Private between the park and ride entrance and Huntmar Drive will be converted to a street within the public right-of-way.

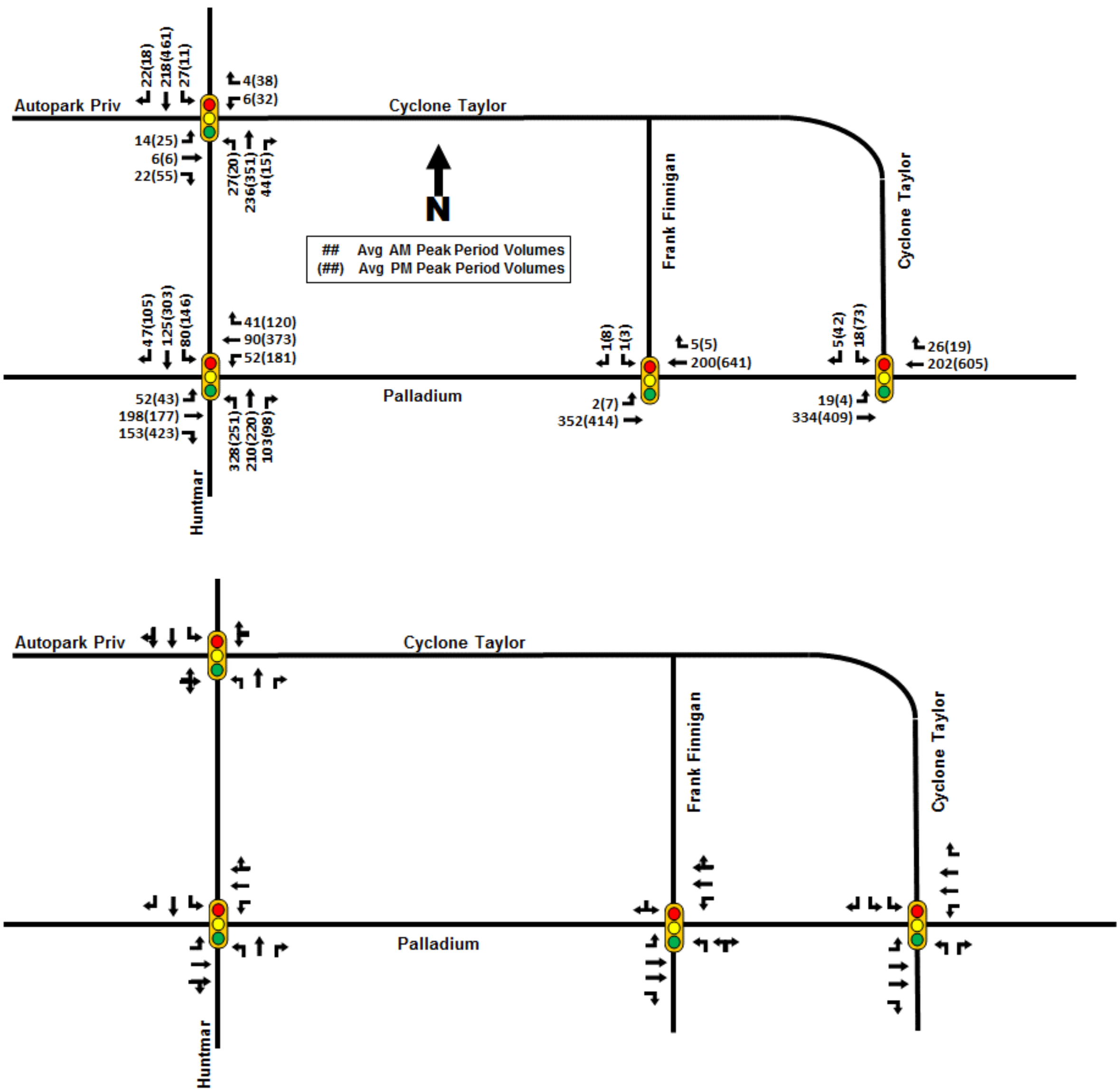
Figure 13 – Potential Palladium LRT Station Layout



2.3.1 EXISTING CONDITIONS

The existing conditions scenario for Palladium Station analyzed three intersections within the vicinity of Palladium Station: Huntmar Drive at Palladium Drive, Huntmar Drive at Cyclone Taylor Boulevard / Autopark Private and Palladium Drive at Cyclone Taylor Boulevard. The signalized intersection of Palladium Drive at Frank Finnigan Way was not analyzed, as large turning movements at this intersection only occur during events at the Canadian Tire Centre, which are usually outside the peak periods included in this analysis. Turning movement volumes and lane arrangements for the existing conditions analysis are indicated in Figure 14 below.

Figure 14 – Palladium Station, Existing (2017) Turning Movement Volumes and Lane Configuration



EXISTING INTERSECTION OPERATIONS

The analysis of intersection operations was completed using Trafficware Synchro software Version 9, following the methodology outlined in Sections 1.2 and 1.3 above. Existing intersection operations for the intersections near the future Palladium LRT Station are shown in Table 14.

Table 14 – Existing Conditions Analysis – AM (PM) Average Peak Period

Intersections	Intersection Performance			Critical Movements			
	Delay (s)	v/c ratio	LOS	Mvmt	v/c ratio	LOS	95th Queue (m)
Huntmar at Palladium	14 (17)	0.44 (0.59)	A (A)	EBTR (EBTR)	0.55 (0.72)	A (C)	27 (33)
Huntmar at Cyclone Taylor	4 (5)	0.15 (0.25)	A (A)	NBT (NBT)	0.17 (0.28)	A (A)	16 (24)
Palladium at Cyclone Taylor	2 (4)	0.12 (0.25)	A (A)	EBT (WBT)	0.12 (0.27)	A (A)	7 (15)

Intersections	Mvmt	Delay (s)	Delay LOS	v/c Ratio	v/c LOS	95th Queue (m)
Huntmar at Palladium	EBL	34 (38)	C (D)	0.28 (0.33)	A (A)	17 (15)
	EBTR	20 (17)	C (B)	0.55 (0.72)	A (C)	27 (33)
	WBL	21 (28)	C (C)	0.20 (0.61)	A (B)	13 (35)
	WBTR	14 (20)	B (B)	0.17 (0.43)	A (A)	10 (40)
	NBL	14 (21)	B (C)	0.47 (0.56)	A (A)	58 (57)
	NBT	9 (13)	A (B)	0.21 (0.24)	A (A)	30 (36)
	NBR	3 (3)	A (A)	0.12 (0.12)	A (A)	7 (7)
	SBL	10 (14)	A (B)	0.13 (0.28)	A (A)	14 (28)
	SBT	9 (14)	A (B)	0.12 (0.34)	A (A)	18 (50)
	SBR	0 (3)	A (A)	0.05 (0.13)	A (A)	1 (7)
Huntmar at Cyclone Taylor	EBLTR	10 (8)	B (A)	0.10 (0.19)	A (A)	6 (9)
	WBL	15 (14)	B (B)	0.02 (0.09)	A (A)	2 (6)
	WBR	0 (4)	A (A)	0.01 (0.10)	A (A)	0 (3)
	NBL	4 (5)	A (A)	0.03 (0.03)	A (A)	3 (2)
	NBT	3 (5)	A (A)	0.17 (0.28)	A (A)	16 (24)
	NBR	2 (0)	A (A)	0.04 (0.02)	A (A)	2 (0)
	SBL	4 (5)	A (A)	0.03 (0.02)	A (A)	3 (2)
	SBTR	3 (4)	A (A)	0.09 (0.21)	A (A)	7 (14)
Palladium at Cyclone Taylor	EBL	1 (4)	A (A)	0.02 (0.01)	A (A)	2 (1)
	EBT	1 (4)	A (A)	0.12 (0.18)	A (A)	7 (10)
	WBT	1 (4)	A (A)	0.07 (0.27)	A (A)	5 (15)
	WBR	0 (0)	A (A)	0.02 (0.02)	A (A)	0 (0)
	SBL	20 (18)	C (B)	0.04 (0.14)	A (A)	3 (6)
	SBR	0 (1)	A (A)	0.01 (0.12)	A (A)	0 (1)

The results of the analysis indicate that the intersections around the future Palladium LRT Station operate with an acceptable LOS in the existing conditions, as none of them are lower than a LOS ‘A’ in peak periods. The lowest individual turning movement LOS of all intersections is the eastbound through/right movement in the PM period at Huntmar Drive and Palladium Drive, which is a LOS ‘C’.

2.3.2 FUTURE HORIZON (2031) SCENARIOS

EMME3 models from the City of Ottawa were received for various potential alternative alignments of the Kanata LRT. For the purpose of this analysis, three EMME models were compared: the 2011 EMME model, the base 2031 EMME model (i.e. including all road works associated with the City's Affordable Plan), and the 2031 EMME model for the preferred Kanata LRT alignment (Scenario 8).

The results of the EMME models indicated that in general, more traffic growth is anticipated from the 2011 EMME model to the 2031 base EMME model, whereas traffic growth from the 2011 EMME model to the Kanata LRT 2031 model is smaller. This indicates that the Kanata LRT is expected to reduce vehicular volumes on the roadways by shifting users to other vehicular modes, such as transit. The growth rates taken from the EMME model for the 2031 base model and the 2031 Kanata LRT model are shown below in **Table 15**.

Table 15 – Palladium Station Growth Rates from EMME3 Model

Street	Direction	Compound Growth Rate (2011 to Base 2031)	Compound Growth Rate (2011 to Kanata LRT 2031)
Palladium Drive	EB	-1.8%	-1.7%
	WB	-2.7%	-5.8%
Huntmar Drive	NB	4.3%	4.2%
	SB	2.9%	2.7%
Cyclone Taylor Boulevard	EB/WB	1.2%	1.2%

BACKGROUND (2031) INTERSECTION OPERATIONS

Figure 15 shows the background traffic volumes for the 2031 horizon scenario, and **Table 16** below indicates the intersection operations for the background 2031 scenario. All signal timings in this scenario were optimized to accommodate any major changes in turning movement volumes.

Figure 15 – Palladium Station, Future (2031) Background Turning Movement Volumes

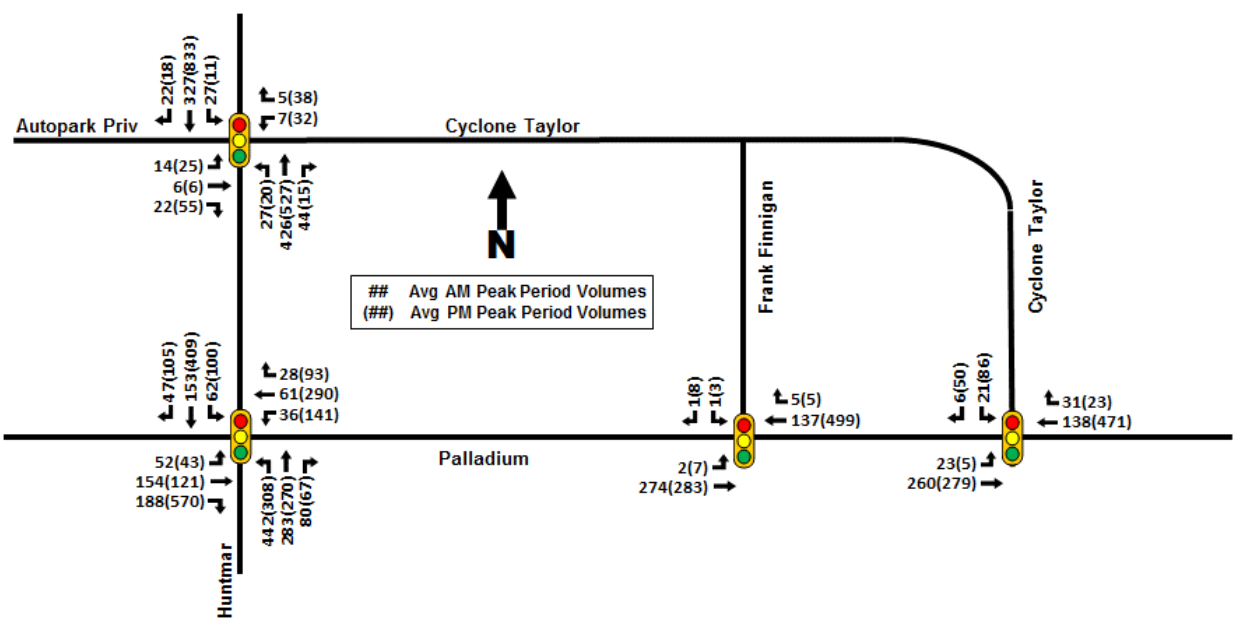


Table 16 – Background (2031) Conditions Analysis – AM (PM) Average Peak Period

Intersections	Intersection Performance			Critical Movements			
	Delay (s)	v/c ratio	LOS	Mvmt	v/c ratio	LOS	95th Queue (m)
Huntmar at Palladium	18 (26)	0.57 (0.78)	A (C)	NBL (EBR)	0.72 (0.90)	C (D)	#87 (65)
Huntmar at Cyclone Taylor	4 (7)	0.28 (0.39)	A (A)	NBT (NBT)	0.31 (0.44)	A (A)	35 (48)
Palladium at Cyclone Taylor	3 (6)	0.10 (0.21)	A (A)	EBT (SBL)	0.10 (0.23)	A (A)	7 (8)

Intersections	Mvmt	Delay (s)	Delay LOS	v/c Ratio	v/c LOS	95th Queue (m)
Huntmar at Palladium	EBL	34 (41)	C (D)	0.28 (0.31)	A (A)	17 (17)
	EBT	39 (42)	D (D)	0.57 (0.43)	A (A)	39 (36)
	EBR	9 (26)	A (C)	0.49 (0.90)	A (D)	15 (65)
	WBL	22 (35)	C (C)	0.16 (0.50)	A (A)	10 (36)
	WBTR	16 (28)	B (C)	0.13 (0.43)	A (A)	8 (40)
	NBL	21 (22)	C (C)	0.72 (0.71)	C (C)	#87 (57)
	NBT	11 (13)	B (B)	0.29 (0.27)	A (A)	42 (48)
	NBR	2 (2)	A (A)	0.09 (0.08)	A (A)	4 (4)
	SBL	20 (29)	B (C)	0.16 (0.27)	A (A)	16 (32)
	SBT	19 (36)	B (D)	0.23 (0.67)	A (B)	32 (#129)
	SBR	0 (3)	A (A)	0.07 (0.17)	A (A)	0 (5)
Huntmar at Cyclone Taylor	EBLTR	13 (11)	B (B)	0.13 (0.24)	A (A)	7 (10)
	WBL	17 (18)	B (B)	0.03 (0.15)	A (A)	3 (7)
	WBR	0 (5)	A (A)	0.02 (0.12)	A (A)	0 (4)
	NBL	4 (6)	A (A)	0.04 (0.05)	A (A)	3 (3)
	NBT	5 (8)	A (A)	0.31 (0.44)	A (A)	35 (48)
	NBR	2 (0)	A (A)	0.04 (0.02)	A (A)	3 (0)
	SBL	5 (6)	A (A)	0.04 (0.03)	A (A)	3 (2)
	SBTR	3 (6)	A (A)	0.13 (0.37)	A (A)	12 (32)
Palladium at Cyclone Taylor	EBL	2 (4)	A (A)	0.02 (0.01)	A (A)	2 (1)
	EBT	2 (4)	A (A)	0.10 (0.13)	A (A)	7 (8)
	WBT	2 (4)	A (A)	0.05 (0.21)	A (A)	4 (13)
	WBR	0 (0)	A (A)	0.03 (0.03)	A (A)	0 (0)
	SBL	27 (23)	C (C)	0.08 (0.23)	A (A)	4 (8)
	SBR	0 (2)	A (A)	0.02 (0.18)	A (A)	0 (2)

All three intersections continue to operate with an acceptable LOS, as all periods operate with a LOS ‘A’, with the exception of the PM period at the intersection of Huntmar Drive and Palladium Drive, which is a LOS ‘C’. The individual turning movement with the lowest LOS in this scenario is a LOS ‘D’ for the eastbound right turn[6] at Huntmar Drive and Palladium Drive in the PM peak period. This movement is approaching capacity with a v/c ratio of 0.90.

Given the above results, and that growth rates for the 2031 Kanata LRT scenario are smaller than the 2031 background scenario, all intersections in the vicinity of Palladium Station should continue to operate with acceptable LOS in the Kanata LRT scenario.

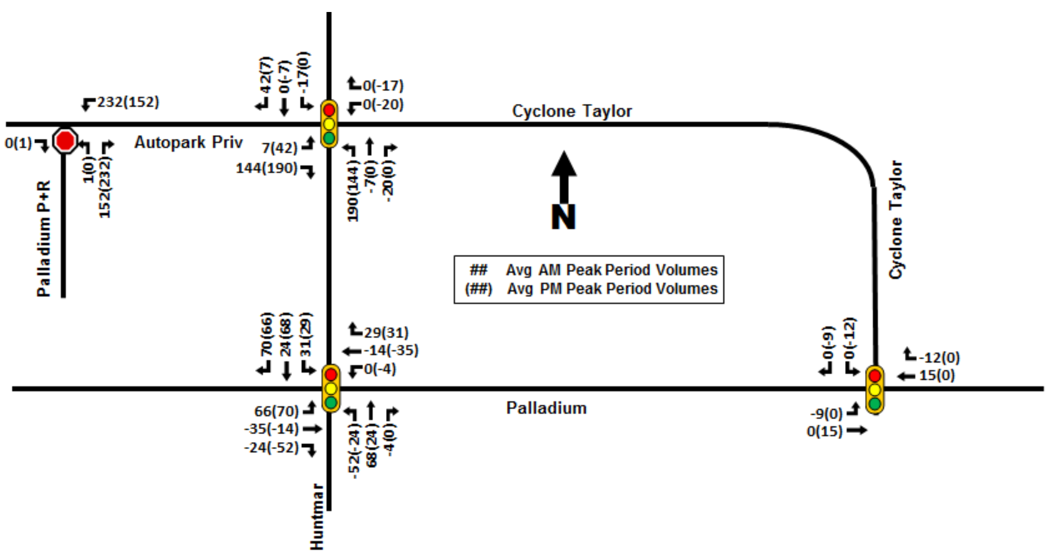
FUTURE (2031) INTERSECTION OPERATIONS WITH KANATA LRT

As indicated in Table 10, the implementation of the Kanata LRT is expected to generally reduce traffic volumes within the vicinity of the study area, due to the mode shift from general traffic to transit. However, the provision of a park and ride at Palladium Station will attract additional vehicles to the area, through users of both the park and ride and kiss and ride facilities.

The existing Canadian Tire Centre Park and Ride, located in the parking lot for the Canadian Tire Centre, accommodates 100 vehicles and averaged a 53% usage in 2016 and 2017. With the implementation of the Kanata LRT, this park and ride will be decommissioned shifting any existing park and ride trips to the location of the new Palladium Park and Ride on the west side of Huntmar Drive, south of Autopark Private. The remaining users of the new park and ride (total capacity of 200 vehicles) will be added to the road network.

Park and ride trips were generated using the City’s EMME model and were distributed to the road network according to the existing traffic patterns. **Figure 16** below indicates the redistributed trips from the Canadian Tire Centre Park and Ride, as well as the new trips for the Palladium Park and Ride.

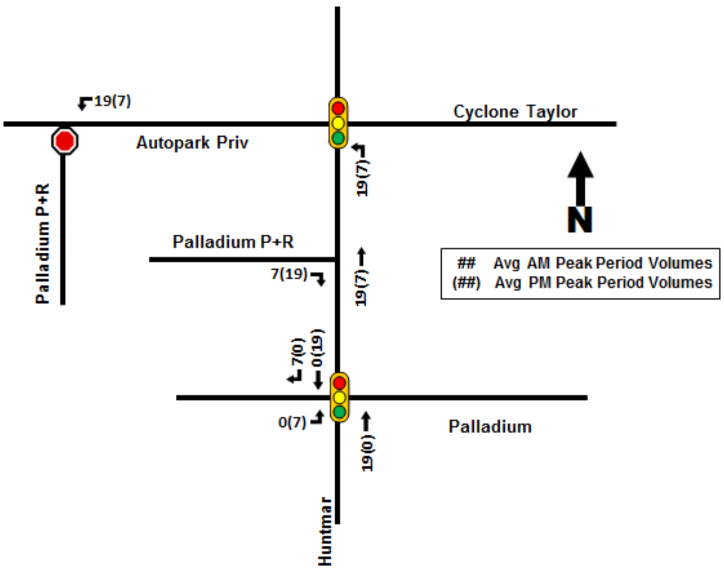
Figure 16 – Palladium Park and Ride / Kiss and Ride Trip Generation



[6] The Synchro model reported a “defacto” eastbound right turn lane during the PM peak period within the existing lane configuration (eastbound left, eastbound through, shared eastbound through/right). This is due to the eastbound right turn volume being significantly higher than the eastbound through volume (570 vph vs 120 vph), which indicates the lane is likely to be used as a right turn lane by all users. As a result, the eastbound approach was modelled with a single eastbound through lane and a single eastbound right turn lane in order to reflect the appropriate operating conditions during the PM peak period. It should be noted that the existing lane configuration at this intersection is likely due to the presence of the Canadian Tire Centre to the east, therefore double eastbound through lanes are required for when events are occurring at the Canadian Tire Centre.

In addition to park and ride traffic, the transit volumes around Palladium Station will change in order to provide more direct service to Kanata LRT stations. Bus-only access will be provided to Palladium Station via a right-in, right-out access on Huntmar Drive (shown in Figure 11 above). Projected transit routings and headways were developed, with Figure 17 showing the projected bus volumes at intersections in the vicinity of Palladium Station.

Figure 17 – Palladium Station Transit Volumes



All of the changes to background 2031 traffic volumes, including park and ride / kiss and ride trips as well as transit volumes were added to the road network for the Synchro analysis of the Kanata LRT 2031 scenario. Table 17 below shows the results of the intersection analysis for the Kanata LRT 2031 scenario.

Table 17 – Kanata LRT (2031) Conditions Analysis – AM (PM) Average Peak Period

Intersections	Intersection Performance			Critical Movements			
	Delay (s)	v/c ratio	LOS	Mvmt	v/c ratio	LOS	95th Queue (m)
Huntmar at Palladium	16 (29)	0.49 (0.83)	A (D)	NBL (EBR)	0.63 (0.88)	B (D)	#66 (69)
Huntmar at Cyclone Taylor	10 (17)	0.41 (0.68)	A (B)	NBL (SBTR)	0.51 (0.72)	A (C)	20 (71)
Palladium at Cyclone Taylor	3 (6)	0.10 (0.21)	A (A)	EBT (WBT)	0.10 (0.21)	A (A)	7 (14)

Intersections	Mvmt	Delay (s)	Delay LOS	v/c Ratio	v/c LOS	95th Queue (m)
Huntmar at Palladium	EBL	41 (69)	D (E)	0.57 (0.77)	A (C)	33 (42)
	EBT	34 (37)	C (D)	0.45 (0.22)	A (A)	32 (21)
	EBR	8 (27)	A (C)	0.43 (0.88)	A (D)	13 (69)
	WBL	22 (32)	C (C)	0.11 (0.44)	A (A)	7 (35)
	WBTR	10 (24)	B (C)	0.13 (0.41)	A (A)	6 (37)
	NBL	17 (30)	B (C)	0.63 (0.78)	B (C)	#66 (#69)
	NBT	11 (14)	B (B)	0.38 (0.30)	A (A)	60 (51)
	NBR	2 (0)	A (A)	0.09 (0.05)	A (A)	4 (1)
	SBL	21 (27)	C (C)	0.26 (0.25)	A (A)	24 (27)
	SBT	19 (42)	B (D)	0.26 (0.80)	A (C)	37 (#155)

Intersections	Mvmt	Delay (s)	Delay LOS	v/c Ratio	v/c LOS	95th Queue (m)
	SBR	2 (5)	A (A)	0.20 (0.27)	A (A)	6 (13)
Huntmar at Cyclone Taylor	EBLTR	10 (17)	B (B)	0.49 (0.70)	A (B)	16 (32)
	WBL	21 (24)	C (C)	0.05 (0.13)	A (A)	3 (5)
	WBR	0 (0)	A (A)	0.02 (0.06)	A (A)	0 (0)
	NBL	10 (11)	A (B)	0.51 (0.47)	A (A)	20 (20)
	NBT	8 (10)	A (A)	0.40 (0.50)	A (A)	35 (63)
	NBR	1 (1)	A (A)	0.03 (0.02)	A (A)	1 (1)
	SBL	12 (16)	B (B)	0.04 (0.05)	A (A)	3 (4)
	SBTR	12 (23)	B (C)	0.31 (0.72)	A (C)	21 (71)
Palladium at Cyclone Taylor	EBL	2 (4)	A (A)	0.01 (0.01)	A (A)	2 (1)
	EBT	2 (4)	A (A)	0.10 (0.09)	A (A)	7 (6)
	WBT	2 (4)	A (A)	0.04 (0.21)	A (A)	3 (14)
	WBR	0 (0)	A (A)	0.02 (0.02)	A (A)	0 (0)
	SBL	27 (23)	C (C)	0.08 (0.21)	A (A)	4 (8)
	SBR	0 (1)	A (A)	0.02 (0.15)	A (A)	0 (0)
Huntmar at Palladium Park and Ride	EBR	11 (10)	B (A)	0.01 (0.03)	A (A)	0 (1)
	NBT	0 (0)	A (A)	0.15 (0.16)	A (A)	0 (0)
	SBTR	0 (0)	A (A)	0.16 (0.30)	A (A)	0 (0)
Autopark at Palladium Park and Ride	EBTR	0 (0)	A (A)	0.03 (0.05)	A (A)	0 (0)
	WBLT	6 (6)	A (A)	0.17 (0.11)	A (A)	4 (3)
	NBLR	9 (10)	A (A)	0.16 (0.25)	A (A)	4 (7)

All signalized intersections within the vicinity of the Palladium LRT Station are expected to operate with an acceptable LOS in the Kanata LRT 2031 scenario. The lowest intersection LOS in this scenario is a LOS ‘D’ in the PM peak period for the intersection of Huntmar Drive at Palladium Drive.

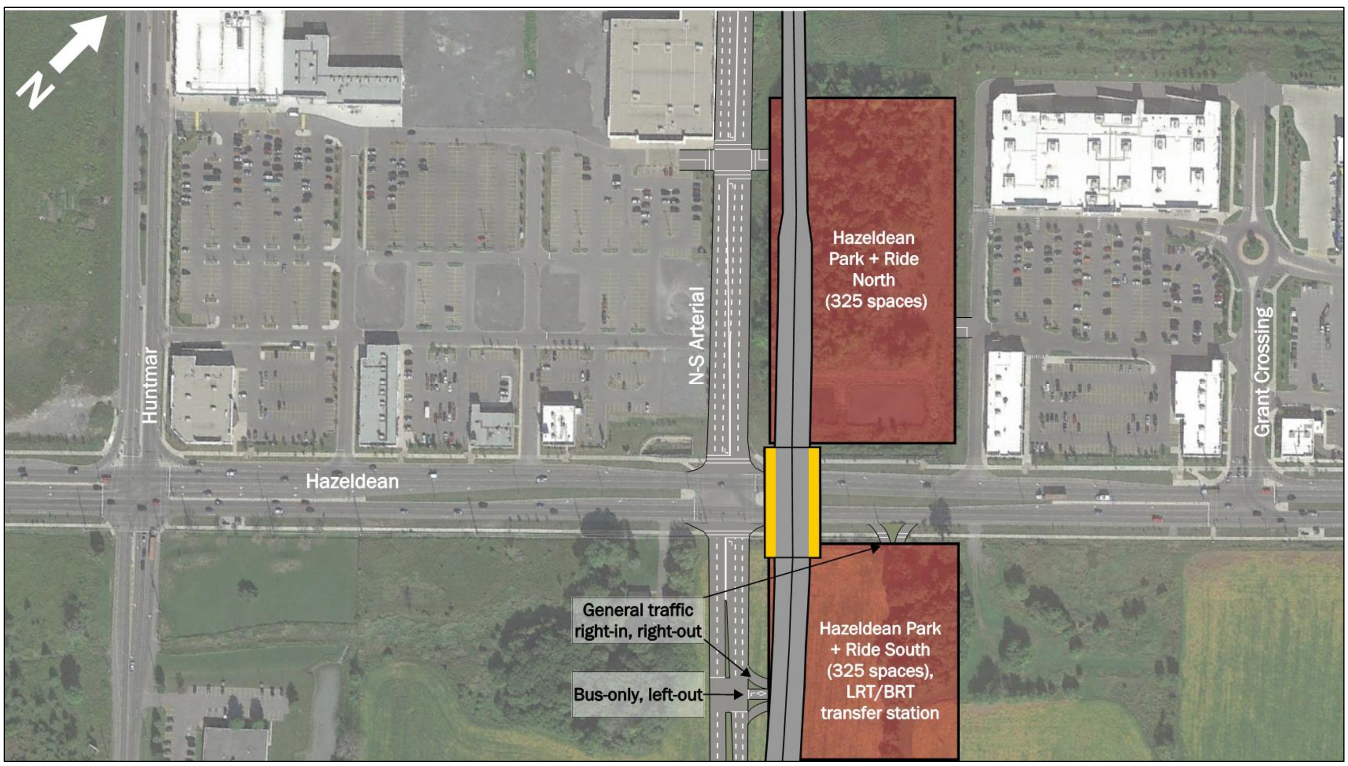
The additional traffic generated by the Palladium Park and Ride / Kiss and Ride and transit station is not expected to have a significant impact on the traffic operations within the vicinity of the Palladium LRT Station and no modifications to the future road network are recommended.

2.4 HAZELDEAN STATION

Hazeldean Station is located one kilometer south from Maple Grove Station and will be an elevated station spanning over Hazeldean Road, per the configuration proposed in the previous BRT EA. Two park and ride lots were identified as part of the BRT EA at this station location. Modifications proposed as part of the LRT EA include repurposing the south Park and Ride lot to accommodate a local bus terminal, which will serve buses connecting between the LRT terminus and Stittsville as well as the Fernbank community, via the proposed at-grade median busway which will continue south along the future North-South Arterial.

The figure below indicates a conceptual potential layout for the Hazeldean LRT Station and Park and Ride. Due to the new park and ride facility on the north side of Hazeldean Road (325 spaces), as well as the new bus facility / park and ride facility (325 spaces) on the south side of Hazeldean Road, a review of intersection operations is required for Huntmar Drive at Hazeldean Road, Hazeldean Road at North-South Arterial and Hazeldean Road at Grant Crossing. A review of potential new intersections will also be required, including a signalized intersection on the future North-South Arterial, 200m north of Hazeldean Drive into the Hazeldean Park and Ride, as well as a right-in, right-out access into the local bus facility / park and ride on the south side of Hazeldean Drive, from both Hazeldean Drive and the North-South Arterial.

Figure 18 – Potential Hazeldean LRT Station Layout



2.4.1 EXISTING CONDITIONS

The existing conditions scenario for Hazeldean Station analyzed three intersections within the vicinity of Hazeldean Station: Huntmar Drive at Hazeldean Road, Hazeldean Road at The Shoppes at Fairwind (Future N-S Arterial) and Hazeldean Road at Grant Crossing. Turning movement volumes and lane arrangements for the existing conditions analysis are indicated in Figure 19 below.

Figure 19 – Hazeldean Station, Existing (2017) Turning Movement Volumes and Lane Configuration

EXISTING INTERSECTION OPERATIONS

The analysis of intersection operations was completed using Trafficware Synchro software Version 9, following the methodology outlined in Sections 1.2 and 1.3 above. Existing intersection operations within the vicinity of Hazelden Station are shown in Table 18.

Table 18 – Existing Conditions Analysis – AM (PM) Average Peak Period

Intersections	Intersection Performance			Critical Movements			
	Delay (s)	v/c ratio	LOS	Mvmt	v/c ratio	LOS	95th Queue (m)
Huntmar at Hazeldean	34 (85)	0.76 (0.77)	C (C)	WBL (WBL)	0.94 (1.40)	E (F)	#44 (#71)
Hazeldean at N-S Arterial	2 (6)	0.40 (0.50)	A (A)	EBT (WBT)	0.40 (0.51)	A (A)	27 (62)
Hazeldean at Grant Crossing	2 (4)	0.38 (0.45)	A (A)	EBT (WBT)	0.38 (0.46)	A (A)	16 (42)

Intersections	Mvmt	Delay (s)	Delay LOS	v/c Ratio	v/c LOS	95th Queue (m)
Huntmar at Hazeldean	EBL	26 (26)	C (C)	0.50 (0.46)	A (A)	18 (17)
	EBTR	35 (29)	D (C)	0.80 (0.63)	C (B)	114 (84)
	WBL	102 (244)	F (F)	0.94 (1.40)	E (F)	#44 (#71)
	WBT	40 (182)	D (F)	0.50 (1.31)	A (F)	42 (#199)
	WBR	1 (10)	A (A)	0.11 (0.35)	A (A)	0 (19)
	NBL	20 (23)	B (C)	0.12 (0.36)	A (A)	12 (27)
	NBT	31 (33)	C (C)	0.34 (0.44)	A (A)	46 (59)
	NBR	9 (10)	A (B)	0.47 (0.51)	A (A)	26 (32)
	SBL	23 (26)	C (C)	0.36 (0.50)	A (A)	31 (39)
	SBT	30 (34)	C (C)	0.30 (0.50)	A (A)	43 (68)
	SBR	1 (8)	A (A)	0.23 (0.54)	A (A)	2 (29)
Hazeldean at N-S Arterial	EBL	2 (2)	A (A)	0.01 (0.06)	A (A)	m0 (m1)
	EBT	2 (3)	A (A)	0.40 (0.36)	A (A)	27 (23)
	WBT	2 (6)	A (A)	0.22 (0.51)	A (A)	28 (62)
	WBR	2 (2)	A (A)	0.02 (0.06)	A (A)	2 (4)
	SBL	45 (49)	D (D)	0.09 (0.38)	A (A)	9 (28)
	SBR	29 (19)	C (B)	0.02 (0.07)	A (A)	3 (5)
Hazeldean at Grant Crossing	EBL	2 (5)	A (A)	0.09 (0.38)	A (A)	3 (5)
	EBT	1 (1)	A (A)	0.38 (0.33)	A (A)	16 (13)
	WBT	1 (3)	A (A)	0.22 (0.46)	A (A)	13 (42)
	WBR	1 (1)	A (A)	0.01 (0.06)	A (A)	1 (2)
	SBL	47 (48)	D (D)	0.07 (0.27)	A (A)	5 (15)
	SBR	22 (16)	C (B)	0.13 (0.30)	A (A)	6 (11)

The results of the analysis indicate that the intersections around the future Hazeldean Station operate with an acceptable LOS in the existing conditions, as none of them operate with a LOS lower than LOS 'C' in the average peak periods. The lowest LOS at all intersections are the westbound left and westbound through movements in the PM period at Huntmar Drive and Hazeldean Road, which are both LOS 'F' and over capacity with a v/c ratio of 1.40 and 1.31, respectively.

2.4.2 FUTURE HORIZON (2031) SCENARIOS

EMME3 models from the City of Ottawa were received for various potential alternative alignments of the Kanata LRT. For the purpose of this analysis, three EMME models were compared: the 2011 EMME model, the base 2031 EMME model (i.e. including all road works associated with the City's Affordable Plan), and the 2031 EMME model for the preferred Kanata LRT alignment (Scenario 8).

The results of the EMME models indicated that in general, more traffic growth is anticipated from the 2011 EMME model to the base 2031 EMME model, whereas traffic growth from the 2011 EMME model to the Kanata LRT 2031 model is smaller. This indicates that the Kanata LRT is expected to reduce vehicular volumes on the roadways by shifting users to other vehicular modes, such as transit. The growth rates taken from the EMME model for the 2031 base model and the 2031 Kanata LRT model are shown below in Table 19.

Table 19 – Hazeldean Station Growth Rates from EMME3 Model

Street	Direction	Compound Growth (2011 to Base 2031)	Compound Growth (2011 to 2031 Kanata LRT)
Huntmar Drive	NB	4.3%	4.2%
	SB	2.9%	2.7%
Hazeldean Road	EB	-0.7%	-0.9%
	WB	-0.7%	-0.8%

It should be noted that the 2031 background scenario assumes that the new North-South Arterial street is completed, as per the 2012 EPR: *West Transitway Connection, Terry Fox Drive to Fernbank Road*. This results in the conversion of Hazeldean Road at N-S Arterial from a three-leg signalized intersection into a four-leg signalized intersection. The assumed lane configuration for this intersection is shown in Figure 16 above, and includes two through lanes and auxiliary left turn lanes in each direction, as well as auxiliary channelized right turn lanes in the southbound and westbound directions.

BACKGROUND (2031) INTERSECTION OPERATIONS

Figure 20 shows the background traffic volumes for the 2031 horizon scenario, and **Table 20** below indicates the intersection operations for the background 2031 scenario. All signal timings were optimized to accommodate major changes in turning movement volumes.

Figure 20 – Hazeldean Station, Future (2031) Background Turning Movement Volumes

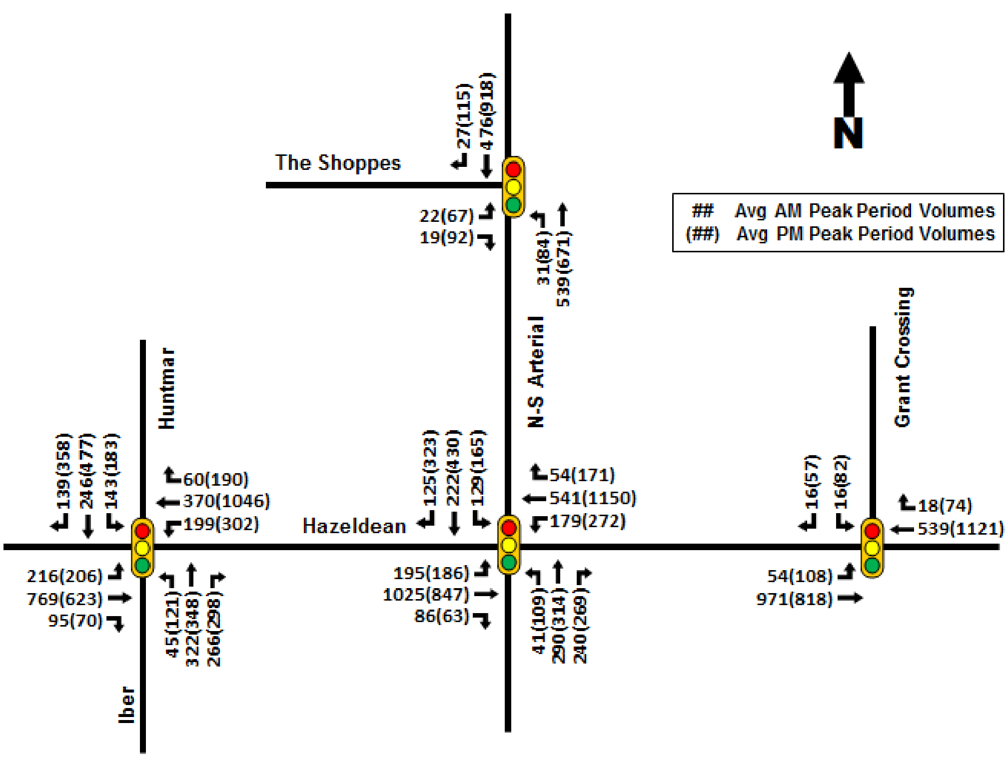


Table 20 – Background (2031) Conditions Analysis – AM (PM) Average Peak Period

Intersections	Intersection Performance			Critical Movements			
	Delay (s)	v/c ratio	LOS	Mvmt	v/c ratio	LOS	95th Queue (m)
Huntmar at Hazeldean	36 (55)	0.78 (1.00)	C (E)	EBTR (SBT)	0.86 (1.05)	D (F)	#118 (#178)
Hazeldean at N-S Arterial	33 (40)	0.83 (0.85)	D (D)	SBL (SBL)	0.95 (1.02)	E (F)	#41 (#56)
Hazeldean at Grant Crossing	3 (5)	0.35 (0.41)	A (A)	EBT (WBT)	0.35 (0.42)	A (A)	28 (40)
N-S Arterial at The Shoppes	4 (10)	0.20 (0.53)	A (A)	NBT (SBTR)	0.20 (0.57)	A (A)	15 (73)

Intersections	Mvmt	Delay (s)	Delay LOS	v/c Ratio	v/c LOS	95th Queue (m)
Huntmar at Hazeldean	EBL	36 (51)	D (D)	0.68 (0.80)	B (C)	19 (#25)
	EBTR	44 (37)	D (D)	0.86 (0.67)	D (B)	#118 (90)
	WBL	65 (67)	E (E)	0.74 (0.81)	C (D)	#36 (#53)
	WBT	37 (72)	D (E)	0.49 (1.02)	A (F)	48 (#171)
	WBR	1 (5)	A (A)	0.12 (0.33)	A (A)	0 (14)
	NBL	22 (95)	C (F)	0.16 (0.94)	A (E)	13 (#49)
	NBT	43 (55)	D (D)	0.68 (0.79)	B (C)	88 (#114)
	NBR	10 (10)	A (A)	0.50 (0.54)	A (A)	27 (29)
	SBL	33 (66)	C (E)	0.56 (0.87)	A (D)	33 (#62)
	SBT	35 (98)	D (F)	0.49 (1.05)	A (F)	66 (#178)
	SBR	1 (17)	A (B)	0.24 (0.64)	A (B)	2 (52)
Hazeldean at N-S Arterial	EBL	15 (49)	B (D)	0.46 (0.78)	A (C)	32 (#69)
	EBTR	41 (36)	D (D)	0.91 (0.78)	E (C)	#152 (114)
	WBL	30 (33)	C (C)	0.63 (0.78)	B (C)	#56 (#74)
	WBT	25 (49)	C (D)	0.45 (0.92)	A (E)	62 (#167)
	WBR	0 (10)	A (A)	0.08 (0.28)	A (A)	0 (19)
	NBL	23 (32)	C (C)	0.13 (0.47)	A (A)	11 (26)
	NBTR	28 (34)	C (C)	0.71 (0.76)	C (C)	44 (57)
	SBL	97 (108)	F (F)	0.95 (1.02)	E (F)	#41 (#56)
	SBT	32 (40)	C (D)	0.28 (0.59)	A (A)	27 (54)
	SBR	1 (21)	A (C)	0.26 (0.71)	A (C)	0 (44)
Hazeldean at Grant Crossing	EBL	2 (4)	A (A)	0.09 (0.33)	A (A)	4 (m2)
	EBT	2 (1)	A (A)	0.35 (0.31)	A (A)	28 (m4)
	WBT	2 (3)	A (A)	0.20 (0.42)	A (A)	14 (40)
	WBR	1 (1)	A (A)	0.01 (0.06)	A (A)	1 (2)
	SBL	50 (52)	D (D)	0.09 (0.35)	A (A)	5 (15)
	SBR	25 (19)	C (B)	0.18 (0.36)	A (A)	6 (11)
N-S Arterial at The Shoppes	EBLR	16 (14)	B (B)	0.13 (0.42)	A (A)	9 (19)
	NBL	3 (6)	A (A)	0.05 (0.23)	A (A)	3 (7)
	NBT	2 (5)	A (A)	0.20 (0.29)	A (A)	15 (24)
	SBTR	6 (14)	A (B)	0.20 (0.57)	A (A)	26 (73)

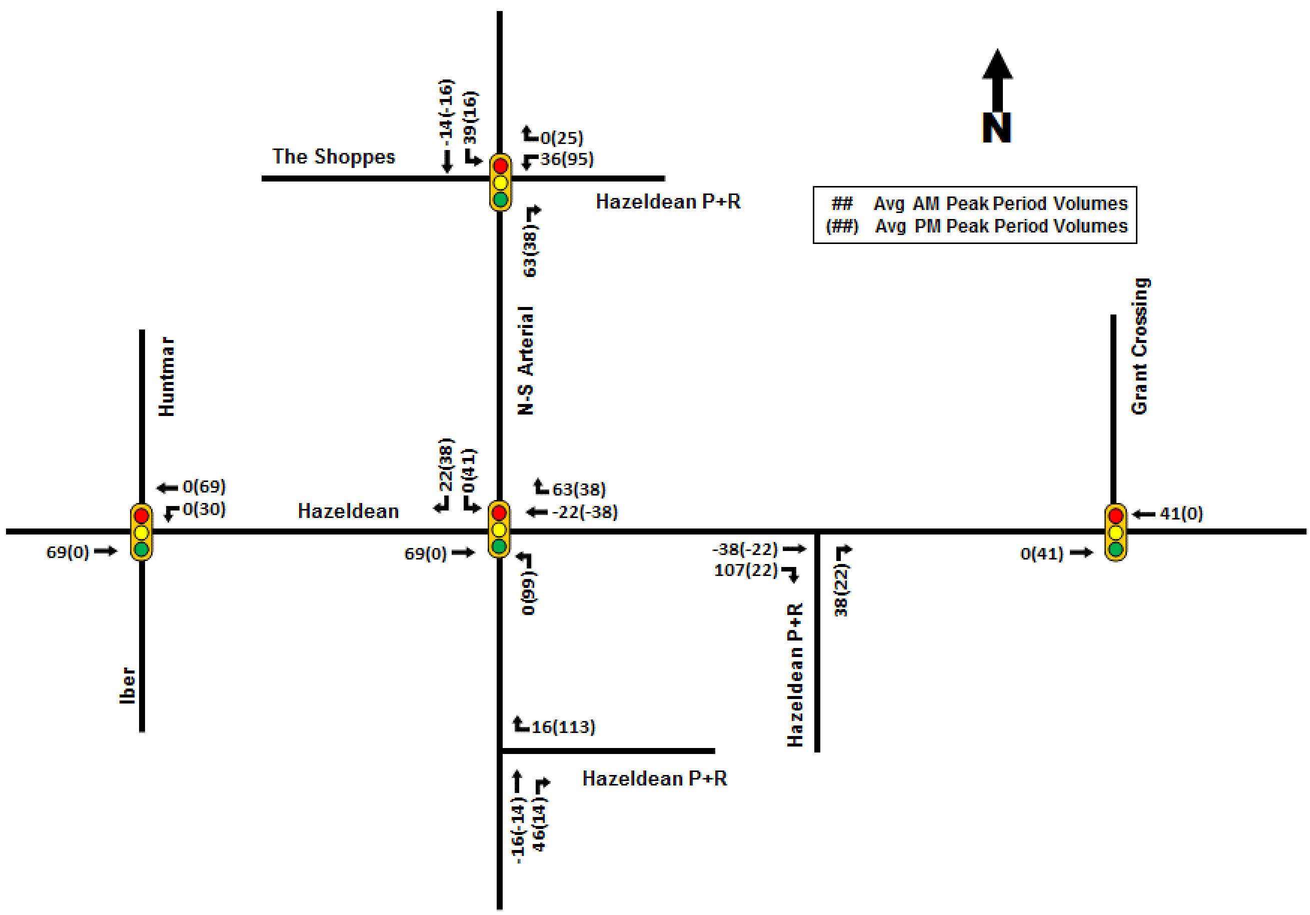
All intersections in the vicinity of Hazeldean Station operate with an acceptable LOS in the background 2031 scenario. The intersection of Huntmar Drive at Hazeldean Road operates with a LOS ‘E’ in the PM period, however that is an acceptable LOS according to the City’s MMLOS Guidelines, as this intersections is located within 600m of a rapid transit station. It should be noted that this intersection has a v/c ratio of 1.00, indicating that it is at capacity, and any further volumes at this intersection will result in a LOS ‘F’ for this intersection.

FUTURE (2031) INTERSECTION OPERATIONS WITH KANATA LRT

As indicated in Table 14, the implementation of the Kanata LRT is expected to generally reduce traffic volumes within the vicinity of the study area, due to the mode shift from general traffic to transit. However, the provision of a park and ride at Hazeldean Station will attract additional vehicles to the area, through trips generated by the park and ride and kiss and ride facilities.

Trips generated for the park and ride / kiss and ride were taken from the City’s EMME3 model and were distributed to the road network according to existing traffic patterns. It was assumed that the majority of the trips generated from the south and west would use the southern lot, while the majority of trips from the east and north would use the north lot. Figure 21 below indicates new trips generated by the Hazeldean Park and Ride / Kiss and Ride facility.

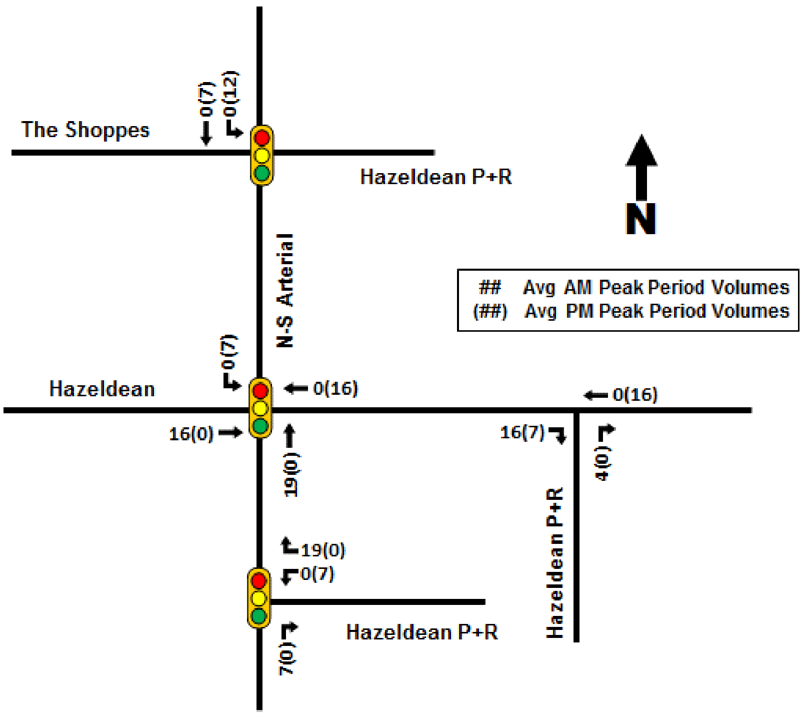
Figure 21 – Hazeldean Park and Ride / Kiss and Ride Trip Generation



In addition to park and ride traffic, the transit volumes around Hazeldean Station will change in order to provide more direct service to Kanata LRT stations. In addition, the implementation of the North-South Arterial will shift some transit routes from Huntmar Drive to the new North-South Arterial. It is assumed that at the southern park and ride access from

North-South Arterial a bus-only left turn lane will be provided for westbound to southbound buses. This access is assumed to be signalized, given the volume of north-south traffic that buses will be required to cross. Projected transit routings and headways were developed, with Figure 22 showing the projected bus volumes at intersections in the vicinity of Hazeldean Station.

Figure 22 – Hazeldean Station Transit Volumes



All of the changes to background 2031 traffic volumes, including park and ride / kiss and ride trips as well as transit volumes were added to the road network for the Synchro analysis of the Kanata LRT 2031 scenario. Table 21 below shows the results of the intersection analysis for the Kanata LRT 2031 scenario.

Table 21 – Kanata LRT (2031) Conditions Analysis – AM (PM) Average Peak Period

Intersections	Intersection Performance			Critical Movements			
	Delay (s)	v/c ratio	LOS	Mvmt	v/c ratio	LOS	95th Queue (m)
Huntmar at Hazeldean	40 (58)	0.80 (1.02)	C (F)	EBTR (WBT)	0.87 (1.05)	D (F)	#125 (#179)
Hazeldean at N-S Arterial	32 (45)	0.86 (0.85)	D (D)	EBTR (SBL)	0.91 (1.02)	E (F)	#166 (#75)
Hazeldean at Grant Crossing	2 (5)	0.34 (0.40)	A (A)	EBT (WBT)	0.34 (0.41)	A (A)	m12 (39)
N-S Arterial at The Shoppes	7 (10)	0.22 (0.50)	A (A)	NBTR (SBTR)	0.24 (0.55)	A (A)	34 (67)
N-S Arterial at Hazeldean P+R South	2 (5)	0.19 (0.32)	A (A)	NBTR (WBR)	0.20 (0.35)	A (A)	13 (8)

Intersections	Mvmt	Delay (s)	Delay LOS	v/c Ratio	v/c LOS	95th Queue (m)
Huntmar at Hazeldean	EBL	41 (51)	D (D)	0.74 (0.80)	C (C)	#22 (#25)
	EBTR	43 (38)	D (D)	0.87 (0.67)	D (B)	#125 (89)
	WBL	81 (62)	F (E)	0.85 (0.82)	D (D)	#41 (m47)
	WBT	55 (83)	D (F)	0.46 (1.05)	A (F)	56 (#179)
	WBR	4 (15)	A (B)	0.12 (0.32)	A (A)	7 (m16)
	NBL	22 (95)	C (F)	0.16 (0.94)	A (E)	13 (#49)
	NBT	42 (54)	D (D)	0.67 (0.78)	B (C)	87 (#110)
	NBR	11 (8)	B (A)	0.51 (0.53)	A (A)	30 (23)
	SBL	34 (68)	C (E)	0.57 (0.87)	A (D)	33 (#63)
	SBT	35 (98)	D (F)	0.48 (1.05)	A (F)	65 (#176)
	SBR	1 (17)	A (B)	0.24 (0.64)	A (B)	2 (52)
Hazeldean at N-S Arterial	EBL	15 (48)	B (D)	0.41 (0.75)	A (C)	m28 (m#65)
	EBTR	33 (42)	C (D)	0.90 (0.78)	D (C)	#166 (#108)
	WBL	43 (37)	D (D)	0.72 (0.78)	C (C)	#63 (#78)
	WBT	22 (40)	C (D)	0.38 (0.85)	A (D)	58 (#163)
	WBR	2 (4)	A (A)	0.17 (0.30)	A (A)	4 (14)
	NBL	29 (70)	C (E)	0.16 (0.88)	A (D)	13 (#63)
	NBTR	37 (41)	D (D)	0.79 (0.82)	C (D)	49 (55)
	SBL	85 (113)	F (F)	0.89 (1.06)	D (F)	#45 (#75)
	SBT	37 (53)	D (D)	0.27 (0.69)	A (B)	26 (55)
	SBR	7 (31)	A (C)	0.34 (0.81)	A (D)	13 (60)
Hazeldean at Grant Crossing	EBL	1 (6)	A (A)	0.09 (0.33)	A (A)	m1 (12)
	EBT	1 (3)	A (A)	0.34 (0.32)	A (A)	m12 (27)
	WBT	2 (3)	A (A)	0.21 (0.41)	A (A)	14 (39)
	WBR	1 (1)	A (A)	0.01 (0.06)	A (A)	1 (2)
	SBL	50 (52)	D (D)	0.09 (0.35)	A (A)	5 (15)
	SBR	25 (19)	C (B)	0.18 (0.36)	A (A)	6 (11)
N-S Arterial at The Shoppes / Hazeldean P+R	EBLTR	1 (9)	A (A)	0.12 (0.46)	A (A)	0 (12)
	WBLTR	25 (6)	C (A)	0.14 (0.38)	A (A)	10 (6)
	NBL	4 (7)	A (A)	0.05 (0.24)	A (A)	3 (8)
	NBTR	7 (9)	A (A)	0.23 (0.33)	A (A)	32 (40)
	SBL	4 (5)	A (A)	0.06 (0.06)	A (A)	4 (3)
	SBTR	7 (16)	A (B)	0.18 (0.57)	A (A)	25 (70)
Hazeldean at Hazeldean P+R	EBTR	0 (0)	A (A)	0.45 (0.41)	A (A)	0 (0)
	WBT	0 (0)	A (A)	0.19 (0.41)	A (A)	0 (0)
	NBR	10 (9)	A (A)	0.06 (0.03)	A (A)	1 (1)
N-S Arterial at Hazeldean P+R South	WBL	0 (14)	A (B)	0.00 (0.05)	A (A)	0 (2)
	WBR	0 (7)	A (A)	0.08 (0.35)	A (A)	0 (8)
	NBTR	2 (5)	A (A)	0.20 (0.28)	A (A)	13 (20)
	SBT	2 (5)	A (A)	0.15 (0.32)	A (A)	11 (23)

The signalized intersections of Hazeldean Road at North-South Arterial, Hazeldean Road at Grant Crossing, North-South Arterial at The Shoppes / Hazeldean Park and Ride and North-South Arterial at Hazeldean Park and Ride South operate with acceptable LOS in the Kanata LRT 2031 scenario. The addition of park and ride, kiss and ride and transit volumes to these intersections does not have a significant impact on their operations. The provision of a transit only signal at the intersection of North-South Arterial and Hazeldean Park and Ride South is not expected to have a major impact to north-south traffic on North-South Arterial.

The intersection of Huntmar Drive at Hazeldean Road is over capacity with a v/c ratio of 1.02 in the PM period which results in a LOS 'F'. This intersection operates worse than in the background 2031 conditions; however given the v/c ratio of this intersection in the background 2031 conditions (1.00), the decrease in intersection operations is not significant enough to warrant any major changes to the intersection.

2.5 CONCLUSIONS

Given that the Kanata LRT is grade separated in its entirety, direct impacts on the functioning of the road network in Kanata are not anticipated. In fact, the City's EMME model generally indicates that the construction of the Kanata LRT is expected to reduce traffic volumes during the AM and PM peak periods on major roadways in Kanata. Impacts to the transportation network are expected to arise from the addition of park and ride trips, kiss and ride trips and transit volumes.

The analysis in this report indicates that intersections within the vicinity of Palladium LRT Station and Hazeldean LRT Station are not expected to experience a significant deterioration in LOS due to implementation of the Kanata LRT. The same goes for most intersections around March LRT Station, with the exception of March Road at Campeau Drive. Given the implementation of the Kanata North BRT at this intersection, a lower LOS is projected at this intersection. This lower LOS is considered an acceptable trade off given the improved transit LOS for the March Road corridor as a whole.

VII. Geotechnical / Hydrogeological Overview

TECHNICAL MEMORANDUM

DATE February 12, 2018 **Project No.** 1668654

TO Paul Croft, MCIP, RPP
Parsons Corporation

CC Jack Ajrab, P.Eng.

FROM Bill Cavers, P.Eng. **EMAIL** wcavers@golder.com

DRAFT GEOTECHNICAL/HYDROGEOLOGICAL OVERVIEW AS INPUT TO PROFILE AND ALIGNMENT SELECTION KANATA LRT EA OTTAWA, ONTARIO

Golder Associates Ltd. (Golder) was retained by Parsons to provide geotechnical, hydrogeological, archaeological and built heritage input to the EA for the Kanata Light Rail Transit (LRT). This memorandum provides a geotechnical/hydrogeological overview of potential functional design and construction issues for the LRT track and structures along the alignment as input to profile and alignment selection, based on the anticipated subsurface conditions along the proposed alignment.

The input provided is based on a desktop review of published geological mapping, publicly available information (e.g., Ministry of Environment well records and reports available on City DevApp), and previous investigations along or near the alignment carried out by Golder or others and that are held within Golder's files or have been made available to Golder by Parsons. The available subsurface information is limited along some portions of the alignment and therefore assumptions have been made regarding the subsurface conditions.

The guidance provided in this memorandum is also based on the current conceptual design as indicated in preliminary general arrangement drawings prepared "for discussion only" by Parsons. The sections below have been organized along the proposed alignment section from east to west, with stationing decreasing to the west. Within each alignment section, a brief overview of the anticipated subsurface conditions is provided, along with an assessment of the associated potential geotechnical challenges and approaches to design and construction.

The reader is referred to the "Important Information and Limitations of This Report" which follows the text but forms an integral part of this document.

19+900 to 19+800 (CN Overpass)

The CN Rail crossing structure is planned to allow the LRT to pass over the CN rail line at this point, just north of the Highway 417 bridge structure. The designs for the Stage 2 LRT Maintenance and Storage Facility (MSF) are still very preliminary, but it is understood that those plans include a retaining wall between the MSF and the Highway 417 embankment that will provide a protected corridor for the future Kanata LRT extension. It is assumed the western limit of this retaining wall will extend close to the east end of the proposed CN Rail overpass at the required elevation to support the future Kanata LRT extension track. Along the west embankment for the CN overpass structure, the LRT alignment will again be parallel to and alongside Highway 417 but the land to the north of the alignment is currently undeveloped and it is assumed that retaining walls will not be required.

The subsurface conditions along this section of alignment consist of embankment fill extending to about 6 to 10 metres in depth (measured from the roadway surface of Highway 417) underlain by 3 to 4 metres of weathered silty clay and 8 to 13 metres of unweathered, firm to stiff, compressible grey silty clay. The clayey soils are in turn underlain by glacial till, less than about 1 metres in thickness, and sandstone bedrock. The groundwater level is indicated to be about 1 to 2 metres below the level of Corkstown Road.

The CN Rail overpass bridge structure will need to be supported on deep foundations, such as driven steel H-piles, since the clay soils do not have sufficient bearing resistance to support relatively highly loaded shallow foundations.

The approach embankment on the east side of the CN Rail overpass structure will need to tie-into the retained embankment planned to be constructed as part of Stage 2 LRT. It is anticipated that the retaining wall to be constructed as part of the current LRT project which will likely incorporate lightweight fill or structural support to reduce the settlements at the existing highway. It is assumed that the Stage 2 LRT retained embankment will extend to within a few metres of the rail corridor and that some transition treatment, potentially including lightweight fills and/or cast in place concrete retaining walls and/or possibly a lengthened CN Rail overpass structure will be required for the Kanata LRT construction.

The available subsurface information at the west approach embankment to the CN Rail crossing is limited, but it is anticipated that the embankment will also be underlain by compressible clay that will likely experience settlements greater than tolerable (i.e., greater than about 25 mm) if conventional fill is used to achieve the required grade raises. Those induced settlements will also have the potential to affect the highway surface. Depending on the separation distance between the highway and the LRT tracks, and the amount of proposed filling, lightweight fills or ground improvement may be required to limit the post-construction settlements of the LRT track and the existing Highway 417 embankment. Considering the proximity to the highway and the requirement to limit settlement of the adjoining roadway surface, ground improvement (such as preloading and surcharging) may not be practical and lightweight fills may be the preferred solution. If lightweight fills are used, 2 horizontal to 1 vertical side slopes may be achievable, but for planning purposes, 3 horizontal to 1 vertical side slopes should be assumed to avoid limiting the design options in the future.

19+800 to 18+480 (Trackway)

West of the CN overpass, the Kanata LRT alignment extends parallel to and just north of Highway 417, south of (and below) Corkstown Road. An exposed rock cut is present between about stations 19+400 and 18+480, which is mapped as sandstone of the Nepean formation. There is very little information, other than the published geology, for the remainder of this section (i.e., east of the rock cut). The subsurface conditions here likely consist of compressible silty clay, thinner and becoming less compressible moving westwards towards the rock cut.

Between the CN Rail overpass and Station 19+400, lightweight fills may be required at least along part of this alignment to reduce settlements, depending on the height of fill and separation distance between the track embankment and the roadway surface. If lightweight fills are used, 2 horizontal to 1 vertical side slopes may be achievable but for planning purposes, 3 horizontal to 1 vertical side slopes should be assumed to avoid limiting the design options.

From Station 19+400 to Station 18+480, the LRT alignment will likely extend through the existing rock cut and some widening/deepening of the rock cut will likely be required. OPSD 201.020 provides some guidance for unprotected rock cuts but indicates that there should be at least one metre separation between the toe of the near-vertical rock face and the toe of the roadway (or rail) embankment ditch. There is, in our experience, limited guidance to be found within most rail manuals (e.g., American Railway Engineering Association Manual for Railway Engineering) and the minimum separation distance is typically specified by the project's geotechnical engineer, based on the rock type and structure, but also on the ability to access and maintain (i.e., clean) the ditch. Conceptually, for planning purposes, the minimum separation distance between the face of a near-vertical rock cut in the expected sandstone bedrock should be at least equal to the height of the rock cut (measured from the ditch invert to the top of the cut) to reduce the potential for rock falls (such as the toppling of a jointed section of rock) to spill past the ditch.

18+480 to 17+680 (Trackway)

The track alignment continues west, parallel to Highway 417, until it reaches the March Road exit from the highway, where it then turns northward parallel to the westbound offramp. At the east end of this section, the existing ground surface drops steeply over an escarpment and significant filling, ranging from about 7 metres in maximum height to about 2 metres in height at the west end of the alignment section, will be required. At the west end of this portion of the alignment, the LRT track is in very close proximity to the existing Corkstown Road, which may require some realignment to accommodate the tracks.

The available subsurface information is again limited to the published geological mapping along this section, and indicates that the alignment is likely underlain by glacial till and/or shallow rock at the escarpment, transitioning to thicker compressible silty clay to the west. The bedrock surface is indicated to be at depths ranging from near surface at the escarpment to 10 to 15 metres depth at the western end of this alignment section before possibly rising in elevation again near the west end of this alignment section. The bedrock along this section is indicated to be sandstone in the east, possibly with Precambrian basement rock in the west.

There could be a requirement for lightweight fills or ground improvement (e.g., preloading and surcharging) along part of this embankment, but the information is too limited to reasonably assess the potential limits. For planning purposes, 3 horizontal to 1 vertical side slopes should be assumed to avoid limiting the design options in the future.

17+860 to 17+050 (Trench Structure and Station under March Road and Watt's Creek/ OPP Lane Crossings)

The LRT alignment along this section is proposed to cross under March Road within a box-shaped tunnel and in a U-shaped open trench structure outside of March Road. The alignment along the north side of the existing Highway 417 interchange with March Road crosses the ramps from the highway in their own box structures. The trench structure will also cross over Watt's Creek just west of March Road. The March/Eagleson Station will be within the box structure directly below March Road. At its deepest point, the cut will extend to about 5 metres below the surrounding ground surface and up to about 9 metres below the surface of the March Road embankment. It is also understood that an overpass will be required to carry OPP Lane (old Teron Road) over the LRT line and Watt's Creek. There is a large diameter watermain extending along OPP Lane within the clay overburden.

The available information indicates that the rock surface drops abruptly along this trenched section. The rock surface is indicated to be within about 3 metres of the ground surface at the eastern end of the trench and about 5 to 6 metres below the ground surface beyond the western limit of the trench. However, within the trench limits, deep boreholes advanced just east and west of March Road and along March Road north and south of the LRT alignment indicate the bedrock surface to be at depths of about 50 metres below the ground surface. The overburden is indicated to consist of 3 to 5 m of weathered silty clay overlying a deposit of firm to stiff compressible grey silty clay that may be up to about 30 metres in thickness underlain by glacial till and bedrock. Peat is also indicated to exist at surface at alongside Watt's Creek and below the March Road embankment fill. A deposit of silty sand, about 2 to 3 metres in thickness is also indicated to exist on the west side of Watt's Creek overlying the silty clay and just at or below the trench horizon. The near surface groundwater levels are indicated to be at or near the original (surrounding) ground surface. Within the glacial till, artesian groundwater conditions are indicated to exist.

Based on the information above, the below grade trench structure is expected to extend through the embankment fill (which may be composed of glacial till and/or rock fill), peat, weathered silty clay and into the grey compressible clay. At the eastern end, the trench may also extend into the shallow bedrock.

This portion of the alignment will require a complex series of structures since it will incorporate the U-shaped trench structures, underpasses below March Road and the ramps, a station below March Road and a crossing structure for Watt's Creek. Conceptually, the following should be considered from a geotechnical perspective:

- Considering the depth of the trench/box structures, it may be feasible to found the trench and box structures (and station) on the grey silty clay, provided the structures are designed as raft slabs.
- Shoring through the existing fill materials, peat and clay materials may be challenging. Secant pile walls or other deep shoring would be costly considering the depth to bedrock. Tie-backs for sheet piling or soldier pile and lagging would similarly be costly, and possibly impractical, considering the depth to bedrock. The shoring may therefore need to consist of internally braced steel sheet piling or steel soldier pile and timber lagging, although rock fill or other obstructions in the March Road embankment may make sheet piling impractical. Soldier piles would also need to extend through the clay deposit to the glacial till which could be at depths of 40 metres or more.
- Given the soft nature of the silty clay at this site, basal instability within the excavations may be an issue, particularly at the March Road embankment, where excavations will be about 9 metres deep. Deeper shoring may be required. At all locations, protection of the clay subgrade, which will be extremely sensitive to any disturbance, will be required.
- Trenchless installation of the box structures (such as jacked box sections) may be difficult and costly and potentially not feasible or practical to construct. The depth of cover over the box section appears to be about 2 metres, which is less than likely required for safe operations (without closing the overlying roads). Furthermore, the embankment fill material may contain cobbles, boulders or rockfill, which would be difficult to excavate, and high jacking forces would be required to advance through such materials.
- Given the potential shoring challenges outlined above, it may be more practical to install temporary bridges on piles along March Road and the ramps (noting the alignment of the LRT to the ramps is quite skewed), which would allow open excavation for construction of the trench and box structures. Temporary unsupported (i.e., open cut) side slopes for the excavation would probably need to be cut back to a flat angle, such as 3H:1V (horizontal to vertical), provided there is enough room to accommodate this type of excavation. Similar embankment slopes were required during the construction of the adjacent March Road/Highway 417 Underpass to maintain stability of the underlying weak clay soils.

- Groundwater inflows may be minimal (although a PTTW would likely still be required) and watertight shoring or other water control measures (e.g., grouting) may not be required for the construction period (provided it is reasonably short, i.e., less than one year). The exception may be at the eastern end of the trench where the excavations may extend through any permeable overburden and into the underlying bedrock.
- Settlement of the overlying roadways, particularly over short distances close to the trench/box structures, may occur due to disturbance, stress relief and temporary construction dewatering.
- The structure walls could likely be designed as drained structures. Given the net unloading effect of the tunnelled section, the low permeability of the clay soils, and the absence of structures within the anticipated radius of influence of permanent dewatering, it is unlikely that the 2-4 metres of groundwater level lowering in this area would result in significant impacts. This should, however, be confirmed during design.
- The finished floor and structure walls will likely require frost protection to reduce the potential for freezing/thawing of the unweathered clay soils and damage to the structures or heaving/settlement of the track and overlying roadways.
- A box culvert, as indicated on the preliminary drawings, is preferable for the crossing of Watt's Creek, rather than an open footing culvert, since that type of structure reduces the concentrated loads on the clay which limits the potential settlements.
- The grade separation structure for OPP Road will need to be supported on deep foundations. The 6 to 10 metre high approach embankments required would likely overstress the clay soils and result in significant settlements that would affect the embankments, and perhaps more importantly, the underlying large diameter watermain. The embankments will therefore likely need to be constructed using ultra-lightweight fills (i.e., EPS) to reduce the potential impacts to the existing watermain. Based on available subsurface information, this is expected to be more of a concern at the south approach, where the clays are expected to be very thick.

17+050 to 15+500 (Trackway and Kanata Town Station)

At the eastern end of this section of alignment (west of Watt's Creek), the track corridor extends north of an existing storm water management pond and is then bounded immediately to the north by residential housing before crossing under the existing pedestrian bridge over Highway 417 from Katimavik Road. Beyond that point, the alignment extends along the top of the slopes of another existing storm water management pond then past currently undeveloped lands. To the south of the alignment, Highway 417 extends parallel to and alongside the track corridor. The track will be placed on embankments with heights generally less than 2 metres above existing ground surface or will extend through cuts less than 2 m in depth, except between about Stations 16+570 to 16+330 (at a bedrock knob) where deeper cuts up to about a maximum depth of 6 metres will be required.

The subsurface conditions generally consist of shallow Precambrian rock with the rock surface generally undulating at depths ranging from about ground surface to 5 metres. The overburden, where present, is indicated to consist of stiff weathered clay, sand and glacial till overlying the shallow bedrock. The exceptions are at the eastern end of the alignment, where the bedrock is locally deeper as the alignment leaves the Watt's Creek crossing, and in the vicinity of the Kanata Town Station and westwards to about Station 15+550, where the surface of the bedrock is indicated to be at depths of up to about 16 metres below ground surface. Within these areas, compressible, unweathered, firm, grey clay underlies the surficial fill and weathered clay crust. The groundwater levels are generally indicated to be about 3 to 4 metres below the existing ground surface until west of the Kanata Town Station where the groundwater levels are indicated to be shallower, at about 1 to 2 metres below the existing ground surface.

The following conceptual geotechnical guidance may be considered along this section of the alignment:

- The cut between about Stations 16+570 to 16+330 will extend up to about 6 metres through Precambrian rock. The separation between the vertical face of the rock cut and the track embankment ditch should be at least equal to the height of the vertical rock face for planning purposes, unless the cut faces are suitably protected and reinforced to limit the potential for rockfall.

- The storm water management pond at the eastern end of this alignment section (i.e., at about Station 16+900), was excavated through relatively low strength unweathered silty clay, was likely not designed to accommodate 2 metres of additional filling immediately adjacent to the pond side slopes. The original slope stability analysis should be reviewed, and consideration should be given to lowering the alignment profile here, if feasible, to reduce the potential that other measures to stabilise the slopes might be required. It should be noted that shallow, near-surface bedrock is indicated to exist at about Station 16+750 (i.e., about 80 metres past the western edge of the pond) which may slightly increase other grade preparation (i.e., rock excavation) costs if the LRT grade is lowered.

- The storm water management pond north of Kanata Town Station, which is also located in an area of thicker clay, compressible soils, likely also did not account any additional loading from either filling or the station structure (if founded on shallow foundations). Nominal filling (i.e., less than 1 metre) is indicated for the track, which may be feasible, depending on the outcome of a slope stability analysis, but the station will likely need to be supported on deep foundations. Other grade raises for pathways or structure entrances should also be kept to less than 1 metre.

- A retaining wall up to 3 metres in height will be required on the north side of the corridor as it passes under the existing pedestrian bridge and approaches Kanata Town Station. This retaining wall will be about 3 metres from the existing pedestrian bridge abutment and will extend over the battered piles supporting that abutment. There is also an existing storm sewer, parallel to this retaining wall, and located about 2 to 3 metres south of the wall and the same distance below the track elevation. Given the limited room for foundations and the requirements to limit settlement that might impact the existing piles (by inducing downdrag loads) or storm sewer grades, lowering the grade and using a raft slab to support the tracks and the retaining wall might be feasible. If a sufficient depth of earth cover (i.e., 1.8 m) for frost protection purposes cannot be maintained over the existing bridge pile caps, insulation could be considered as an alternative.

15+500 to 15+450 (Kanata Avenue Underpass)

The LRT alignment is proposed to extend under Kanata Avenue, north of Highway 417, and will therefore extend through the existing highway overpass approach embankment fills.

The subsurface conditions at the underpass are indicated to consist of thin overburden over shallow sandstone and limestone (or possibly dolostone) bedrock, at depths below original ground surface of about 1 to 2 metres. The bedrock is expected to be overlain by approach embankment fill material, native sand, and glacial till. The groundwater levels are generally at or near the surface of the bedrock.

The proposed underpass structure and associated retaining walls can likely be supported on shallow foundations placed on the surface of the bedrock. The approaches can also likely be constructed with standard earth cuts with side slopes at 2 horizontal to 1 vertical.

15+450 to 14+700 (Trackway and Terry Fox Station)

This portion of the LRT extends alongside and north of Highway 417 from Kanata Avenue to the start of the trench structure crossing under Terry Fox Drive and includes Terry Fox Station. To the north, the alignment is bordered by parking areas for a commercial shopping area. In general, the profile indicates that nominal cuts and fills of less than about 1 metre are required. Immediately west of the station, slightly deeper, intermittent, cuts up to about 3 metres in depth will be needed.

The subsurface conditions consist of thin layers of existing fill and glacial till, generally less than 2 metres in thickness, overlying sandstone bedrock. The groundwater level along this section is generally indicated to be at depths ranging from about 2 to 4 metres below existing ground surface.

The proposed station structure can likely be supported on shallow foundations placed on the surface of the bedrock. Limited excavations may be required into the bedrock, particularly west of the station.

14+700 to 13+770 (Open Trench and Terry Fox Drive, Didsbury Roads East and West and Didsbury Station)

It is understood that the alignment through this section will be within a continuous trench that extends between the Kanata Centrum shopping mall and the Highway 417 Westbound to Terrry Fox off-ramp, beneath Terry Fox Drive and Didsbury Roads (East and West). The trench will be about 10 metres below existing ground surface at its deepest point. Terry Fox Drive is proposed to cross over the open trench on a bridge structure spanning the trench and the two Didsbury crossing structures will be box structures constructed under the existing roads. The lands surrounding the alignment are undeveloped except between the two Didsbury Roads where low height commercial structures are located to the north and south. The northern structure is about three stories in height and is located immediately adjacent to the alignment (i.e., within roughly 5 metres of the edge of the trench).

The subsurface conditions are indicated to consist of shallow sandstone bedrock, at or just below ground surface, until about Station 14+240 where the surface of the bedrock begins to drop off to unknown depths. The overburden is very thin (i.e., less than 1 metre in depth) or non-existent east of Station 14+240 after which the overburden transitions to a deposit of unweathered clay (generally stiff but becoming firm to soft and compressible towards the western end of this alignment) overlain by or containing relatively thick deposits (in the order of a few metres) of silty sand. The groundwater levels are indicated to be at depths ranging from about near original ground surface to about 2 metres depth.

The following geotechnical conceptual guidance should be considered along this section of the alignment:

- The eastern portion of the trench, between about 14+700 to Terry Fox Drive, will be excavated immediately alongside the highway off-ramp and up to about 6 metres below the ramp surface through the ramp fill and 1 to 2 metres into the underlying bedrock. A retaining wall will therefore be required, and the preliminary drawings currently indicate a cast in place concrete retaining wall supported on shallow footings placed on the rock outside the edges of the rock cut. Ideally, shallow footings should be placed outside the zone of influence of the rock cut and that zone is conservatively defined by a line drawn at 1H:1V slope from the cut wall at the invert. If this is not feasible, either permanent rock reinforcement below the footing (such as a reinforced concrete wall and/or rock bolts) may be required or other retaining wall solutions could be considered. Conceptually, an RSS wall could be constructed above the rock surface with the wall panels supported on a concrete wall within the rock cut (which would also retain the rock cut face and mitigate against rock fill, since it is unlikely that an adequate separation distance between the excavated rock face and the rails can be provided).

- The Terry Fox crossing bridge structure can be supported on shallow foundations placed on or within the bedrock.
- Excavation into the highly permeable sandstone bedrock, as will be required over the eastern portion of the trench, would require significant temporary construction dewatering that could extend over considerable distances. Limited groundwater lowering within the near surface bedrock (i.e., by up to about 1 or 2 metres) at the eastern limit may be relatively low risk, since that may not result in significant stress increases in the clay deposits and induced ground settlements, but more significant temporary dewatering will require measures (e.g., grouting of the rock) to limit the inflows.
- Considering the depth of the box structures under Didsbury Roads East and West, it may be feasible to found these structures on the grey silty clay or silty sand, provided those structures are designed as raft slabs. Temporary dewatering of the silty sand will be required to prevent disturbance of the subgrade and basal heaving. However, dewatering of the silty sand layers may result in significant groundwater level lowering that extends a considerable distance from the edge of the excavations, and could result in under drainage of the compressible clay soils. This increase in stress could result in settlement of the silty clay underlying structures and utilities. This is a particular risk for the commercial structures north and south of the trench and box structures, which are most likely founded on shallow spread footings.
- A ‘jacked’ box structure could be considered for the crossing under Didsbury Road West (which is entirely within overburden) but the silty sands below the water table would be susceptible to flowing into the jacked box from the face unless dewatered in advance of construction, which could lead to settlement impacts to surrounding structures and utilities as described above. Other measures to control groundwater inflows during construction, such as grouting from the face or pre-grouting, may be feasible but would likely be costly since synthetic grouts would be required to allow excavation at the face.
- The cut for the trench will be in highly permeable bedrock until about Station 14+300, after which it will extend into the silty clay and silty sand deposits. Temporary shoring could consist of internally braced steel sheet piles or soldier piles but given the groundwater concerns noted above and the limited separation between the commercial buildings and the proposed cuts, stiff watertight shoring will likely be required. This could consist of secant pile shoring or slurry walls that would extend to surface of the bedrock at depths of up to about 15 metres.
- The finished structure should be designed to be watertight to reduce the potential for long term groundwater lowering that could affect surrounding roadways, structures or utilities. Measures to counteract buoyancy and drainage for the finished structure will therefore also be required.
- The finished structure walls and floor will likely require frost protection to reduce the potential for freezing of the clay soils and damage to the structures or heaving/settlement of the track and overlying roadways.

13+770 to 11+700 (Carp River Crossing, Campeau Station, Feedmill Creek Crossing, Highway 417 and Cyclone Taylor Crossings, Palladium Station and Palladium Drive Crossing)

The alignment along this section is proposed to extend through the currently undeveloped lands between Didsbury Road (West) and the Carp River and then along the north side of Feedmill Creek, immediately adjacent to the creek’s 100 year floodplain. Feedmill Creek lies within a relatively shallow valley, about 1 to 3 metres deep, shallowest to the west and then becoming deeper towards the east. The LRT alignment will then turn southwards, just east of Huntmar Drive, before crossing Feedmill Creek again and then Highway 417, Cyclone Taylor Boulevard, and Palladium Drive, turning southeast through mostly undeveloped lands south of Palladium Drive.

The currently proposed profile indicates the trackway, Campeau Station and Palladium Station are to be constructed on an elevated platform about 8 to 10 metres above the surrounding ground surface along this entire section.

From about Station 13+770 to 12+650, just north of the Feedmill Creek crossing near Huntmar Drive, there is no existing subsurface information other than what is indicated on the published geology. The published information indicates that the subsurface conditions likely consist of a thick deposit of compressible unweathered clay, likely soft to firm, overlying bedrock at depths ranging from 10 metres (near Didsbury West) to 25 metres approaching Huntmar Drive. Highly compressible organic peat deposits are also anticipated within the Carp River valley. The groundwater level is expected to be relatively shallow and close to creek level.

From Station 12+650 (at Feedmill Creek) to 11+700 (south of Palladium Drive) the existing information indicates that the subsurface conditions consist of a deposit of silty clay overlying glacial till. The upper 2 to 5 metres of the clay is stiff and weathered and the underlying grey unweathered clay is firm to stiff, compressible, and extends to depths of about 8 to 14 metres below ground surface. The underlying glacial till is indicated to be about 4 to 7 metres in thickness and extends to the surface of the limestone bedrock at depths of about 16 to 25 metres below existing ground surface, generally becoming deeper south towards Palladium Drive. Deposits of peat are also indicated to exist and may still exist in isolated areas below roadway embankments or parking lots, if not removed during construction of those facilities.

Conceptually, the elevated structure, which is planned to be supported on piles, is a feasible solution for the multiple road and waterway crossings along this section of the alignment and for support of the track above the compressible clay deposits. The alignment is also constrained in terms of allowable footprint (width) along the section which parallels Feedmill Creek. However, construction of an elevated, structurally supported, trackway is costly.

Other alternatives may be feasible, such as the construction of steep embankments or embankments with retaining walls using light-weight fills (such as cellular concrete). Ground improvement such as deep soil mixing could also be considered, although this has not yet been used for a project with Champlain Sea clays in this region. However, those alternatives may not be able to achieve the full height required and may only be feasible in combination with a lowered grade along sections of the alignment (if feasible). Slope stability adjacent to Feedmill Creek would not be an issue based on the above options, provided that the final structure/embankment is constructed outside of the limit of hazard lands for the creek.

Preloading and surcharging, with or without wick drains, is likely not feasible since 3 horizontal to 1 vertical side slopes would be required to achieve stable embankment slopes.

11+700 to 10+000 (Maple Grove Station and Crossing, Poole Creek Crossing, Hazeldean Station and Crossing)

The LRT corridor along this section of alignment extends southeast through undeveloped lands (i.e., farm fields) before crossing Maple Grove Road. From Maple Grove Road, the alignment is bounded on both sides by existing or planned residential subdivisions, including two large storm water management ponds immediately adjacent to the alignment. The area past the subdivisions, near and beyond Hazeldean Road, are bordered to the southwest by parking areas for commercial shopping and the remaining areas are currently undeveloped. It is understood however, that the lands in this area will also be eventually developed with a mix of commercial and residential uses.

The current plans indicate the trackway will be at or near grade (i.e., grade raises of 1 m or less) from station 11+700 to 11+400. From 11+400 to 10+000, the trackway and associated structures will be supported on elevated structures about 9 metres above existing ground surface. Relatively short approach embankments, up to about 5 metres in existing height will lead up to the Maple Grove structure and connect the elevated structures between Maple Grove and Hazeldean stations. The connecting embankment is relatively short (~350 metres in length) in comparison to the elevated structures (~900 metres in total length).

There is very little information available, other than the published geology, regarding the ground conditions from about Station 11+700 to 10+850 but based on the geological trends and published mapping, this section of alignment is likely also underlain by compressible clay soils. From 10+850 to 10+000, the subsurface conditions are indicated to consist of stiff weathered silty clay, extending from ground surface to depths ranging from about 4 to 6 metres. The weathered clay is underlain by unweathered firm to stiff compressible clay soil that ranges in thickness from about 4 to 8 metres (i.e., to depths of about 8 to 13 metres below ground surface). In general, the compressible clay becomes thinner moving southwards along the alignment. The clays soils are underlain by glacial till and sands overlying limestone bedrock at depths ranging from about 28 to 10 metres below ground surface; the bedrock surface generally rises moving south along the alignment.

The structures for the crossings and stations will need to be supported on deep foundations (e.g., driven steel pile or caissons).

Elevated structures (contiguous with the crossing structures) are planned along the greater part of this section of alignment with the exception of the approach embankment at on the north side of Maple Grove Road and the approaches between about Station 10+680 and 10+280. These approaches will be up to about 5 metres in maximum height. These embankments, due to space constraints, would need to have retaining walls and, if constructed with conventional fills greater than 1.5 metres in height (as is planned), will likely exceed the load capacity of the compressible clay soils, resulting in excessive post-construction settlements of the track. These embankments would therefore need to be constructed with lightweight fill materials or be completely supported on deep foundation elements. RSS walls with cellular concrete would likely be a feasible lightweight alternative.

The Stittsville Diversion sewer will soon be constructed parallel to the LRT alignment between about Hazeldean and Maple Grove Roads. The sewer invert is indicated to be at about elevation 86 metres (i.e., about 15 metres below existing ground surface) and is about 15 m from the edge of the nearest track. Given the separation distance from the rail, depth of the sewer, planned pile supported structures and lightweight embankment construction discussed above, no impacts to the sewer are anticipated.

The structures and embankments are located sufficiently far from the storm water management ponds such that there should be no additional loading on the pond side slopes and no impacts to the ponds.

Closure

We trust the conceptual guidance provided above is acceptable and any questions may be directed to the undersigned.

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WC/ESO/mvrd
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Soil, Rock and Groundwater Conditions: Classification and identification of soils, rocks, and geologic units have been based on commonly accepted methods employed in the practice of geotechnical engineering and related disciplines. Classification and identification of the type and condition of these materials or units involves judgment, and boundaries between different soil, rock or geologic types or units may be transitional rather than abrupt. Accordingly, Golder does not warrant or guarantee the exactness of the descriptions.

IMPORTANT INFORMATION AND LIMITATIONS OF THIS REPORT (cont'd)

Special risks occur whenever engineering or related disciplines are applied to identify subsurface conditions and even a comprehensive investigation, sampling and testing program may fail to detect all or certain subsurface conditions. The environmental, geologic, geotechnical, geochemical and hydrogeologic conditions that Golder interprets to exist between and beyond sampling points may differ from those that actually exist. In addition to soil variability, fill of variable physical and chemical composition can be present over portions of the site or on adjacent properties. **The professional services retained for this project include only the geotechnical aspects of the subsurface conditions at the site, unless otherwise specifically stated and identified in the report.** The presence or implication(s) of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources are outside the terms of reference for this project and have not been investigated or addressed.

Soil and groundwater conditions shown in the factual data and described in the report are the observed conditions at the time of their determination or measurement. Unless otherwise noted, those conditions form the basis of the recommendations in the report. Groundwater conditions may vary between and beyond reported locations and can be affected by annual, seasonal and meteorological conditions. The condition of the soil, rock and groundwater may be significantly altered by construction activities (traffic, excavation, groundwater level lowering, pile driving, blasting, etc.) on the site or on adjacent sites. Excavation may expose the soils to changes due to wetting, drying or frost. Unless otherwise indicated the soil must be protected from these changes during construction.

Sample Disposal: Golder will dispose of all uncontaminated soil and/or rock samples 90 days following issue of this report or, upon written request of the Client, will store uncontaminated samples and materials at the Client's expense. In the event that actual contaminated soils, fills or groundwater are encountered or are inferred to be present, all contaminated samples shall remain the property and responsibility of the Client for proper disposal.

Follow-Up and Construction Services: All details of the design were not known at the time of submission of Golder's report. Golder should be retained to review the final design, project plans and documents prior to construction, to confirm that they are consistent with the intent of Golder's report.

During construction, Golder should be retained to perform sufficient and timely observations of encountered conditions to confirm and document that the subsurface conditions do not materially differ from those interpreted conditions considered in the preparation of Golder's report and to confirm and document that construction activities do not adversely affect the suggestions, recommendations and opinions contained in Golder's report. Adequate field review, observation and testing during construction are necessary for Golder to be able to provide letters of assurance, in accordance with the requirements of many regulatory authorities. In cases where this recommendation is not followed, Golder's responsibility is limited to interpreting accurately the information encountered at the borehole locations, at the time of their initial determination or measurement during the preparation of the Report.

Changed Conditions and Drainage: Where conditions encountered at the site differ significantly from those anticipated in this report, either due to natural variability of subsurface conditions or construction activities, it is a condition of this report that Golder be notified of any changes and be provided with an opportunity to review or revise the recommendations within this report. Recognition of changed soil and rock conditions requires experience and it is recommended that Golder be employed to visit the site with sufficient frequency to detect if conditions have changed significantly.

Drainage of subsurface water is commonly required either for temporary or permanent installations for the project. Improper design or construction of drainage or dewatering can have serious consequences. Golder takes no responsibility for the effects of drainage unless specifically involved in the detailed design and construction monitoring of the system.

VIII. Contamination Overview Study