Appendix F – Highway 401 and Power Dam Drive Air Quality Assessment

HIGHWAY 401 & POWER DAM DRIVE

SOUTH STORMONT, ONTARIO

AIR QUALITY ASSESSMENT
RWDI # 2104052
January 14, 2025

SUBMITTED TO

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EXECUTIVE SUMMARY

RWDI was retained by Morrison Hershfield to conduct an air quality impact assessment for the proposed redesign and replacement of an interchange that carries Power Dam Drive over Highway 401 near the City of Cornwall in the Township of South Stormont, Ontario. This air quality assessment was done in support of the environmental assessments described in the MTO Work Order 4017-E-0023 Large Value Retainer 18; GWP 4092-19-00. The study area includes the section of Highway 401 from 1.5 km east of Power Dam Drive to 1.5 km west of Power Dam Drive, and the section of Power Dam Drive north of Highway 401 to Headline Road and south of Highway 401 to Barlow Road.

The objective of the study is to predict air quality impacts as it relates to the project. The assessment was undertaken for five scenarios:

- An existing conditions No-Build scenario for the project year 2021;
- Future No-Build and Future Build scenarios for the project year 2031; and
- Future No-Build and Future Build scenarios for the project year 2041.

The No-Build scenarios represent Highway 401 and Power Dam Drive without the proposed redesign and replacement of the interchange for the project years 2021, 2031 and 2041. The 2031 Build scenario includes the proposed redesign and replacement of the interchange for the horizon year 2031, with two lanes in each direction along Highway 401. The 2041 Build scenario includes the widening and increase in the number of lanes along Highway 401, with three lanes in each direction, in addition to the interchange adjustment proposed to occur in 2031.

The emission modelling was based on the US EPA's roadway emissions model, MOVES3, and the dispersion modelling was based on the US EPA's dispersion model, AERMOD version 22112. The background concentrations were estimated using air quality monitoring data collected by the Ontario Ministry of Environment, Conservation and Parks (MECP) and Environment and Climate Change Canada (ECCC).

Representative discrete receptors within the study area were included with thirteen residential receptors in total, and these were chosen using the latest publicly available aerial imagery.

Air contaminants assessed as part of the study included $PM_{2.5}$, PM_{10}, CO, NO_2, acetaldehyde, acrolein, 1,3-butadiene, benzene, benzo(a)pyrene and formaldehyde. For the year 2041, MOVES3 estimated zero emissions of 1,3-butadiene due to US EPA updates of the toxic fractions of VOCs in vehicle exhaust; therefore, emissions results for 1,3-butadiene were not quantified for the 2041 Future No-Build and Future Build scenarios.

The proposed project is expected to have minor impact on local air contaminant levels at the receptors, with the maximum predicted cumulative concentrations for most contaminants and averaging periods less than current respective thresholds. For the 2021 No-Build Scenario, the 1-hour cumulative maximum predicted concentration for NO_2 exceeds the CAAQS (2025). Annual and 24-hour average benzo(a)pyrene concentrations exceed their respective AAQC thresholds for all five scenarios but are attributed to high ambient background concentrations. The average background benzo(a)pyrene concentration for the annual averaging period exceeds the AAQC on its own and the average background benzo(a)pyrene concentration for the 24-hour averaging period is over 80% of the AAQC threshold.

Overall, the Future Build scenarios are predicted to have minor air quality impacts and to be relatively comparable to the Future No-Build scenario; therefore, the project is not expected to have a significant impact on local air quality. No mitigation measures are recommended beyond those which are already in place through phased-in federal regulations for on-road vehicle and engine emissions, which are expected to reduce NO_2 and other tailpipe emissions beyond the horizon year used for emission factors in the present study.

The increase in greenhouse gas emissions from the project compared to the regional provincial emissions of greenhouse gas CO_2e is very low and therefore the project is not expected to have a significant impact on the regional air quality. Specifically, the increase is 0.005% from the 2031 No-Build to Build scenarios, and 0.006% from the 2041 No-Build to Build scenarios.

Construction phase impacts were addressed qualitatively in Section 4.3 of the report. It is recommended that in order to minimize potential air quality impacts during construction, the construction tendering process should include requirements for implementation of an Air Quality Management Plan.

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1 INTRODUCTION

RWDI was retained by Morrison Hershfield to conduct an air quality assessment for the proposed redesign and replacement of an interchange that carries Power Dam Drive over Highway 401 near the City of Cornwall in the Township of South Stormont, Ontario. This air quality assessment was done in support of the environmental assessments described in the MTO Work Order 4017-E-0023 Large Value Retainer 18; GWP 4092-19-00.

The scope of the study is itemized below:

- Use vehicle emissions modelling techniques to estimate tailpipe, brake wear, tire wear and road dust emissions associated with the traffic for existing conditions (2021) and horizon years 2031 and 2041.
- Use a computer simulation of atmospheric dispersion to predict maximum contaminant concentrations at representative sensitive receptors due to vehicle emissions from the future conditions without the project (No-Build scenario for 2021, 2031 and 2041), and future conditions with the project (Build scenario for 2031 and 2041).
- Use representative historical monitoring data to establish background concentrations for each contaminant of interest, due to various other sources in the surrounding area other than those associated with the proposed project.
- Combine the dispersion model results with the background concentrations and compare to applicable air quality thresholds for all scenarios.
- Conduct a semi-quantitative assessment to determine the incremental impact of greenhouse gases within the context of provincial emissions.
- Conduct a qualitative assessment of construction activities.

2 PROJECT DESCRIPTION

The project is described by the proposed redesign and replacement of an interchange that carries Power Dam Drive over Highway 401 near the City of Cornwall in the Township of South Stormont, Ontario. The study area includes the section of Highway 401 from 1.5 km east of Power Dam Drive to 1.5 km west of Power Dam Drive, and the section of Power Dam Drive north of Highway 401 to Headline Road and south of Highway 401 to Barlow Road.

Figure 1 shows the study area and its surrounding land use, modelled roadways and sensitive receptors for all three No-Build scenarios. **Figures 2 and 3** show the study area and its surrounding land use, modelled roadways and sensitive receptors for the 2031 and 2041 Build scenarios, respectively. The study area consists of residential, agricultural and forested land uses, and includes established residences.

Sensitive receptors representing established residences in closest proximity along different compass directions to the Power Dam Drive and Highway 401 interchange were identified based on the latest publicly available satellite imagery. Local air quality impacts are expected to be greatest at receptors closest to the modelled roadways.

3 ASSESSMENT METHODOLOGY

This assessment generally followed the methodology described in the MTO "Environmental Guide for Assessing and Mitigating the Air Quality Impacts and Greenhouse Gas Emissions of Provincial Transportation Projects" (May 2020) (the "MTO Air Quality Guide").

3.1 Modelled Scenarios

The assessment was undertaken for the following scenarios:

- **No-Build** of the proposed project for 2021 (existing conditions);
- **No-Build** of the proposed project for 2031;
- **No-Build** of the proposed project for 2041;
- **Build** of the proposed project for 2031; and,
- **Build** of the proposed project for 2041.

The assessment assumes that for the No-Build scenarios, no major roadway improvements have occurred to the existing road alignments, with traffic volumes based on traffic volumes on existing roadways in the study area as provided by Morrison Hershfield. The 2031 Build scenario includes the proposed redesign and replacement of the interchange for the horizon year 2031, with two lanes in each direction along Highway 401. The 2041 Build scenario includes the widening and increase in the number of lanes along Highway 401, with three lanes in each direction, in addition to the interchange adjustment proposed to occur in 2031. The traffic volumes used in both the No-Build and Build scenarios were based on AM and PM peak hour values. The No-Build and Build scenarios used roadway network speeds of 100kph for Highway 401 and 80kph for Power Dam Drive. Ramp traffic data were not provided; however ramp traffic is not expected to have a significant contribution to predicted concentrations relative to the contributions made by the main highway and arterial roads.

3.2 Modelled Roadways

The modelling included all of Highway 401 within the study area and Power Dam Drive between Barlow Road and Headline Road. The modelled roadway segments for the Future No-Build scenarios are shown in **Figure 1**, and the modelled segments for the 2031 and 2041 Future Build scenarios are shown in **Figures 2 and 3**, respectively.

3.3 Traffic Data

No-Build and Build road traffic data were provided for Highway 401 and Power Dam Drive by Morrison Hershfield. The No-Build data were provided for the year 2021 and the horizon years 2031 and 2041. The Build data were provided for the horizon years 2031 and 2041.

In order to assign the vehicle distribution percentages to appropriate vehicle classes, the MOVES vehicle classification by source type was used. (See Section 3.7 for discussion of MOVES emissions modelling.) Based on data provided by Morrison Hershfield, it was conservatively assumed that 37.5% of all vehicles using Highway 401 were trucks and 9% of all vehicles using Power Dam Drive were trucks. This was further broken down into Single Unit Short Haul Trucks (MOVES Source Type 51) and Single Unit Long Haul Trucks (MOVES Source Type 52). For both Highway 401 and Power Dam Drive, the percentage of trucks was split equally between Single Unit Short Haul and Single Unit Long Haul Trucks (19% each for Highway 401 and 4.5% each for Power Dam Drive). The remaining vehicles for each road were categorized as Passenger Car (MOVES Source Type 21) and Passenger Truck (MOVES Source Type 31). For Highway 401, the remaining 62.5% was split 38% for Passenger Cars and 25% for Passenger Trucks based on a split of passenger vehicles provided in MOVES technical guidance (US EPA, 2016). The same ratio of Passenger Cars to Passenger Trucks was applied for Power Dam Drive, and the remaining 91% was split 55% for Passenger cars and 36% for Passenger Trucks.

An hourly profile was developed to determine diurnal variation of traffic volumes. This profile was based on hourly profiles for eastbound and westbound traffic in this section of Highway 401 as extracted from iCorridor's estimated 2008 traffic data. The eastbound and westbound hourly percentage of peak traffic were averaged and normalized to the overall peak volume. A summary of the hourly profile is provided in **Appendix A.1**. Traffic composition on each roadway segment is provided in **Appendix A.2**. Modelled traffic volumes for each scenario are provided in **Tables 1, 2, and 3,** with additional detail in **Appendix A.3**.

3.4 Key Air Contaminants

Vehicular traffic produces a variety of air contaminants from fuel combustion inside the engine, evaporation of fuel from the tank, brake and tire wear, and re-suspension (also known as re-entrainment) of loose particles on the road surface (silt) as the vehicle travels over the road surface. The following key contaminants were assessed in accordance with the MTO Air Quality Guide:

- respirable particulate matter ($PM_{2.5}$)
- inhalable particulate matter (PM_{10})
- carbon monoxide (CO)
- nitrogen dioxide (NO_2)
- acetaldehyde
- acrolein
- benzene
- 1,3-butadiene
- benzo(a)pyrene
- formaldehyde

3.5 Air Quality Thresholds

The Ontario Ministry of Environment, Conservation and Parks (MECP) has Ontario Ambient Air Quality Criteria (AAQC) for airborne concentrations of PM_{10}, CO, NO_2, acetaldehyde, acrolein, benzene, benzo(a)pyrene, 1,3-butadiene, and formaldehyde. The Canadian Council of Ministers of the Environment (CCME) has established

Canadian Ambient Air Quality Standards (CAAQS) for $PM_{2.5}$ (CCME, 2022). CCME also has established standards for 1-hour and annual concentrations of NO_2 that will come into effect in 2025. The AAQCs and CAAQS are collectively referred to as air quality thresholds in this report. The thresholds are summarized in **Table 4** (in micrograms per cubic metre, µg/m³).

The CAAQS were developed for use by provinces and territories to guide air zone management actions. They are not project-level regulatory standards; measures mandated to achieve the CAAQS should consider technical achievability, practicality, and implementation costs (CCME, 2019).

3.6 Background Air Quality Data

AERMOD was used to predict the contribution of the modelled roadways to concentrations of contaminants at nearby sensitive receptors. The predicted maximum concentrations were combined with estimated background concentrations that are due to other emission sources in the surrounding area, thus providing a prediction of maximum cumulative concentrations.

The ambient background data for each key contaminant were taken from representative air quality monitoring stations within the ECCC National Air Pollution Surveillance (NAPS) Program and MECP ambient air monitoring station network. A review of representative stations with relevant data for the key contaminants was completed.

The Cornwall Memorial Park station (NAPS ID 61201) was used for background concentrations of $PM_{2.5}$, PM_{10}, and NO_2. This station is closest to the study area and is reasonably representative of local conditions.

Saint Anicet station (NAPS ID 54401) was used for carbon monoxide (CO). This station is the closest available with data for CO and it is located in an agricultural area of Québec, south of the St. Lawrence River, which is representative of the rural characteristics of the study area.

Data for volatile organic compounds (VOCs) are only available at select monitoring stations, and the nearest stations to the study area are Montréal Rivière-des-Prairies (50129) and Brossard Parc Sorbonne (50122). Station 50129 is located in close proximity to industrial facilities in east Montréal, including agri-food byproducts rendering and the Suncor Montreal oil refinery within 4 km. Station 50122 is located in a low- to medium-density residential area on the south shore of Montréal, and this is a closer match to the characteristics of the study area, which is essentially open space, forest, agricultural fields, and rural-residential. Therefore, NAPS station 50122 was selected for VOCs.

Data for benzo(a)pyrene and carbonyls are only available from a very limited number of monitoring stations. The nearest station is Montréal Rivière-des-Prairies (50129). As noted in the previous discussion for VOCs, this location is in close proximity to industrial facilities in east Montréal and is not representative of the rural characteristics of the study area. Highway 401 is a source of transportation related air pollution within the study area, but the emissions of contaminants from traffic on Highway 401 are already included in the emissions modelling; therefore, NAPS Station 60438 (Roadside 401W - Toronto) which is heavily impacted by immediate proximity to Highway 401 is not representative of the study area. Station 60512 (Hamilton Downtown) is located in an urban centre close to heavy industrial facilities and is not representative of the study area. Station 62601 (Experimental Farm) is located in a predominantly rural area and, although it is the furthest distance of the options considered, the location of this station is most representative of the study area; therefore Station 62601 was selected for benzo(a)pyrene and carbonyls.

The sources of background monitoring data used for this study are presented in **Table 5.**

In the case of NO_2 and ozone (O_3), hourly monitoring data were available for the local Cornwall Memorial Park monitoring station that allowed estimation of background concentration by hour of day. Project contribution of ozone was not assessed against air quality thresholds, but background ozone concentrations were used for converting nitrogen oxides (NO_X) to NO_2 using the Ozone Limiting Method (OLM). (See Section 3.8.2 for discussion of OLM.) As background concentrations vary widely from day to day, a 90th percentile concentration was calculated for each hour of the day using 5 years of hourly monitoring data from 2018 to 2022, as this represents the most recent data set available. The resulting background concentrations represented the highest background conditions likely to coincide with maximum predicted concentrations from the roadways. They were used when predicting maximum 1-hour and 24-hour cumulative concentrations of NO_2. The hourly background concentrations for NO_2 and O_3 are presented in **Table 6**. For the annual averaging period the annual mean values were used.

PM_{10} monitoring data were not available; therefore, PM_{10} background concentrations were estimated from the $PM_{2.5}$ values using a $PM_{2.5}/PM_{10}$ ratio of 0.54 (Lall et. Al., 2004).

For benzene and benzo(a)pyrene, the monitoring data consisted of 24-hour average concentrations. It was not possible to calculate background values by hour of the day, therefore, for these contaminants, the background concentrations for the 24-hour averaging period consisted of 90th percentile values. For 0.5-hour acetaldehyde and 1-hour acrolein, the background values were calculated from the corresponding 24-hour average background value following Section 4.4 of the Air Dispersion Modelling Guideline for Ontario. The summary of all background values used for the assessment is presented in **Table 7**.

3.7 Emissions Model

The standard approach for estimating vehicular emissions is to use computer simulation techniques that are based on extensive previous testing of a wide range of vehicles. Motor Vehicle Emission Simulator (MOVES3) is such a model that has been developed for this purpose by the U.S. Environmental Protection Agency (EPA). MOVES3 was used to generate vehicle emission factors for the years 2021, 2031 and 2041.

Exhaust emissions vary widely by vehicle type and speed, and MOVES3 was configured to generate emission factors based on the vehicle type and travel speed. These individual emission factors were aggregated to produce a composite emission factor for each key air contaminant, representing the average vehicle for each road segment assessed. MOVES emission factors by vehicle type and by roadway segment are provided in **Appendix A.4**.

For particulate matter, it is necessary to account for the re-suspension of dust as vehicles travel over a roadway surface, in addition to tailpipe emissions. The road dust emissions were calculated based on the revised version of U.S. EPA's AP-42, Chapter 13.2.1 (US EPA, 2011). The tailpipe emission factor for particulate matter, from MOVES3, was added to the road dust emission factor to account for both emission sources.

For the year 2041, MOVES3 estimated zero emissions of 1,3-butadiene due to US EPA updates of the toxic fractions of VOCs in vehicle exhaust (US EPA, 2020); therefore, tailpipe emissions of 1,3-butadiene were assumed to be zero and only the background values were quantified in **Tables 8d and 8e** for the 2041 Future No-Build and Future Build scenarios.

3.8 Dispersion Model

Air contaminants emitted from vehicles on a roadway will drift downwind and disperse as they travel. The degree to which the contaminants disperse depends on the weather-related factors, such as wind speed and amount of turbulence. The typical approach to determine potential future downwind concentrations from a proposed project is to use a computer simulation that predicts the dispersal of air pollutants as they drift away from the roads. These simulations are referred to as dispersion models.

Dispersion modelling is a common approach for assessing local air quality near an emission source such as vehicular traffic. The dispersion model used in this study is the US EPA's AERMOD version 22112. This is a widely used dispersion model and is an approved model for regulatory purposes in Ontario. The model predicts how emissions from the vehicles travelling within each segment disperse and contribute to air pollutant concentrations within the study area. The dispersion model requires information on emission rates for the air pollutants of interest, the layout of the project corridor, terrain elevation data, and hourly meteorological data.

Site-specific meteorological data were processed for input to the AERMOD model. Fully processed 5-year (2017-2021) site-specific meteorological data were prepared in-house at RWDI. Upper air weather data were obtained from the upper air monitoring station in Maniwaki, Quebec, and surface weather data were obtained from Massena, New York.

Terrain information for the study area was obtained from the Regional Meteorological and Terrain Data for Air Dispersion Modelling website of the MECP. The terrain data are based on the North American Datum 1983 (NAD83) horizontal reference datum. The rural dispersion coefficient was used in the dispersion modelling analysis.

3.8.1 Selection of Receptors

Sensitive receptors were identified within the study area based on the latest publicly available satellite imagery. The receptors were selected based on existing residences (R01 – R13) in closest proximity along different compass directions to the Power Ram Drive and Highway 401 interchange. Local air quality impacts are expected to be greatest at receptors closest to the modelled roadways. **Figures 1, 2 and 3** show the sensitive receptor locations within the study area.

3.8.2 Conversion of NO_x to NO_2, Ozone Limiting Method

Any chemical reactions among pollutants are not considered in the assessment of local air quality impacts, except for the conversion of nitric oxide (NO) to NO_2, through reaction with ambient ground-level ozone (O_3). Vehicle exhausts initially consist mainly of NO. However, NO can convert to NO_2 once in the outside air. The Ozone Limiting Method (OLM) was used to estimate this conversion for the credible worst-case NO concentration.

The OLM assumes that the conversion of NO to NO_2 is limited only by the amount of ozone (O_3) present in the outside air. If the concentration of available O_3 (parts per million or ppm) is less than that of the NO contributed by the modelled roadway emissions, then the portion of NO that is converted to NO_2 equals the available O_3. On the other hand, if the concentration of available O_3 exceeds that of the NO contributed by the modelled roadway, then all of the NO is converted to NO_2. The OLM calculation is conditional dependent on the ambient concentration of ozone compared to the concentration of NOx from combustion. These are shown below as (a) and (b).

(a) $If\ ambient\ O_3 > [0.9 \times NOx], then\ NO_2 = NOx$

(b) $If\ ambient\ O_3 < [0.9 \times NOx], then\ NO_2 = [0.1 \times NOx] +\ O_3$

For example, the concentration of ambient ozone at 12 p.m. is 43 ppb as shown in Table 6. Assuming the concentration of NOx at 12 p.m. is 100 ppb, equation (b) would apply as shown below.

$$43\ ppb < [0.9 \times 100\ ppb], so\ NO_2 = [0.1 \times 100\ ppb] +\ 43\ ppb$$

$$= 10\ ppb + 43\ ppb = 53\ ppb$$

For the credible worst-case analysis, a fixed hourly concentration of ozone was used in the OLM, shown in **Table 6**, corresponding to the 90^{th} percentile of measured values from historical monitoring data recorded at the Cornwall Memorial Park monitoring station operated by the MECP.

3.9 Climate Change Assessment

The potential for the project to impact climate change was assessed by calculating the total annual emissions for the No-Build and Build scenarios in 2031 and 2041. This analysis focused on the emissions of greenhouse gases, carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O), in terms of CO_2e (CO_2 equivalent).

This analysis included the emissions from modelled roadways within the study area.

In order to assess the effect of the project on regional air quality, annual project-related emissions were compared with the annual total Ontario-wide emissions of the same pollutants from transportation and other sources.

4 RESULTS

4.1 Assessment of Maximum Cumulative Concentrations

Tables 8a to 8e present a summary of the predicted maximum cumulative concentrations (maximum modelled project contribution plus the 90^{th} percentile 1-hour or 24-hour background concentration) at the thirteen modelled discrete receptors for the Existing No-Build, Future No-Build, and Future Build scenarios. The resultant concentrations are compared to the applicable thresholds.

The resultant concentrations for the Future Build scenarios were similar to the concentrations for the Future No-Build scenarios as a result of relatively small changes in traffic volumes from the project and associated traffic-related contaminant concentrations in relation to the ambient background concentrations.

For all Future No-Build and Future Build scenarios, the cumulative maximum predicted concentrations for 24-hour and annual average benzo(a)pyrene exceeded the AAQC. However, this is attributed to high ambient background concentrations. As shown in **Table 7**, the background levels of benzo(a)pyrene are 86% and 234% of the AAQC for 24-hour and annual averaging periods, respectively.

Frequency analyses were performed for modelled concentrations of 24-hour benzo(a)pyrene with and without background for the 2031 and 2041 Build scenarios, and with background for the previously mentioned scenarios in addition to the 2031 No-Build scenario. The results of the frequency analysis are shown in **Tables 12 to 16** for the 2031 Build scenario without background, 2041 Build scenario without background, 2031 No-Build scenario with background, 2031 Build scenario with background, and 2041 Build scenario with background, respectively.

The ambient background concentration of benzo(a)pyrene does not exceed the 24-hour AAQC for that contaminant. For the frequency analysis without background, the threshold for modelled concentrations of benzo(a)pyrene was set to the 24-hour AAQC of 5.0E-5 µg/m^3. As shown in **Table 12**, for the 2031 Build Scenario, modelled benzo(a)pyrene concentrations at receptor R6 exceeded the AAQC (5.0E-5 µg/m^3) 2 times over the five years modelled, representing 0.1% of the time. As shown in **Table 13**, for the 2041 Build Scenario, modelled benzo(a)pyrene concentrations did not exceed the AAQC at any receptors. For the frequency analysis with background, the threshold for modelled concentrations of benzo(a)pyrene was set to the difference between the benzo(a)pyrene 24-hour AAQC (5.0E-5 µg/m^3) and the benzo(a)pyrene background concentration (4.3E-05 µg/m^3), which is 6.6E-06 µg/m^3. This represents the portion of the AAQC that remains after background concentrations are considered, hence an exceedance of this threshold indicates that the modelled benzo(a)pyrene concentrations will exceed the 24-hour AAQC with background data included. As shown in **Table 14**, for the 2031 No-Build Scenario with background, modelled benzo(a)pyrene concentrations exceed the 6.6E-06 µg/m^3 value at all receptors, with the greatest number of exceedances occurring at receptor R7 (999 exceedances over the five years modelled, representing 56.8% of the time). As shown in **Table 15**, for the 2031 Build Scenario with background, modelled benzo(a)pyrene concentrations exceed the 6.6E-06 µg/m^3 value at all receptors, with the greatest number of exceedances occurring at receptor R7 (999 exceedances over the five years modelled, representing 56.8% of the time). Based on the values presented in **Tables 14** and **15**, the change in frequency of exceedance between the 2031 No-Build and Build scenarios with background is minimal, with change of less than 2% in the frequency of exceedance at 11 of 13 receptors. The greatest change was for R1 with frequency increasing from 30.4% to 39.8% due to realignment of Power Dam Drive which brought the road approximately 50 m closer, to within 20 m of R1. As shown in **Table 16**, for the 2041 Build Scenario with background, modelled benzo(a)pyrene concentrations exceed the 6.6E-06 µg/m^3 value at receptors R1, R2, R4, R6, R7, and R12, with the greatest number of exceedances occurring at receptor R6 (53 exceedances over the five years modelled, representing 3% of the time). Overall frequencies of exceedance for the 2041 Build Scenario are lower than those for the 2031 Build Scenario, therefore quantification of the changes between frequencies of exceedance for the No-Build and Build Scenarios was only considered for the 2031 analysis.

The cumulative maximum predicted concentrations for all other contaminants were below their respective criteria for all scenarios except the 2021 No-Build Scenario, where the 1-hour cumulative maximum predicted concentration for NO_2 exceeds the CAAQS (2025).

Tables 9a and 9b show the relative changes in cumulative maximum predicated concentrations for each contaminant, with the percent change from the Build versus the No-Build scenario for 2031 and 2041 respectively. The incremental change in predicted concentrations between the Future Build and Future No-Build scenarios for the 2031 and 2041 horizon years is less than 4% for all contaminants at all receptors except R1. The maximum incremental change in predicted concentration for R1 in 2031 and 2041 is 8% and 9%, respectively, for PM_{10}. This increase can be attributed to the very close in proximity of R1 to the proposed road realignment (specifically the portion of Power Dam Drive north of Highway 401) in the 2031 and 2041 Build scenarios; therefore, concentrations of PM_{10} are higher at R1 compared to all other receptors within the study area.

4.2 Assessment of Regional Air Quality and Greenhouse Gas Emissions

The impact of the project on greenhouse gas emissions was assessed by calculating the total annual emissions associated with the modelled roadways within the study area as shown in **Tables 10 and 11**. The annual regional greenhouse gas emissions are projected to increase between the No-Build and Build scenarios due to the increase in projected traffic volumes within the study area for the 2031 and 2041 horizon years. Overall, the emissions from this roadway network are small in relation to provincial totals, and there is little change in the regional emissions between the No-Build and Build scenarios for the 2031 and 2041 horizon years. Specifically, the increase is 0.005% from the 2031 No-Build to Build scenarios, and 0.006% from the 2041 No-Build to Build scenarios.

4.3 Emissions During the Construction Phase

Construction activities involve heavy equipment that generates air pollutants and dust; however, these impacts are temporary in nature. The emissions are highly variable, difficult to predict, and depend on the specific activities that are taking place and the effectiveness of the mitigation measures. The best manner to deal with these emissions is through diligent implementation of operating procedures such as application of dust suppressants, reduced travel speeds for heavy vehicles, efficient staging of activities and minimization of haul distances, covering up stockpiles, etc. It is recommended that in order to minimize potential air quality impacts during construction, the construction tendering process should include requirements for implementation of an Air Quality Management Plan. Such a Plan would set out established best management practices for dust and other emissions. Some of the best practices include the following:

- Use of reformulated fuels, emulsified fuels, exhaust catalyst and filtration technologies, cleaner engine repowers, and new alternative-fueled trucks to reduce emissions from construction equipment.
- Regular cleaning of construction sites and access roads to remove construction-caused debris and dust.

- Dust suppression on unpaved haul roads and other traffic areas susceptible to dust, subject to the area being free of sensitive plant, water or other ecosystems that may be affected by dust suppression chemicals.
- Covered loads when hauling fine-grained materials.
- Prompt cleaning of paved streets/roads where tracking of soil, mud or dust has occurred.
- Tire washes and other methods to prevent trucks and other vehicles from tracking soil, mud or dust onto paved streets or roads.
- Covered stockpiles of soil, sand, and aggregate, as necessary.
- Compliance with posted speed limits and, as appropriate, further reductions in speeds when travelling sites on unpaved surfaces.

5 CONCLUSIONS

The proposed project is expected to have low impacts on local air contaminant levels at the most-impacted receptors, with the maximum predicted cumulative concentrations for all contaminants and averaging periods less than current respective AAQC and CAAQS thresholds except benzo(a)pyrene for all scenarios and 1-hour NO_2 for the 2021 No-Build scenario. No mitigation measures are recommended, beyond those which are already in place through phased-in federal regulations for on-road vehicle and engine emissions, which are expected to reduce NO_2 and other tailpipe emissions beyond the 2031 and 2041 horizon years used for emission factors in this assessment.

The incremental emissions from the project compared to the regional provincial emissions of greenhouse gas CO_2e are low (less than 0.006%) for both the 2031 and 2041 horizon years, and therefore the project is not expected to have a significant impact on the regional air quality.

Construction phase impacts were addressed qualitatively. It is recommended that in order to minimize potential air quality impacts during construction, the construction tendering process should include requirements for implementation of an Air Quality Management Plan.

6 STATEMENT OF LIMITATIONS

This report entitled Air Quality Assessment – Highway 401 & Power Dam Drive EA, was prepared by RWDI AIR Inc. ("RWDI") for Morrison Hershfield ("Client"). The findings and conclusions presented in this report have been prepared for the Client and are specific to the project described herein ("Project"). The conclusions and recommendations contained in this report are based on the information available to RWDI when this report was prepared. Because the contents of this report may not reflect the final design of the Project or subsequent changes made after the date of this report, RWDI recommends that it be retained by Client during the final stages of the project to verify that the results and recommendations provided in this report have been correctly interpreted in the final design of the Project.

The conclusions and recommendations contained in this report have also been made for the specific purpose(s) set out herein. Should the Client or any other third party utilize the report and/or implement the conclusions and recommendations contained therein for any other purpose or project without the involvement of RWDI, the Client or such third party assumes any and all risk of any and all consequences arising from such use and RWDI accepts no responsibility for any liability, loss, or damage of any kind suffered by Client or any other third party arising therefrom.

Finally, it is imperative that the Client and/or any party relying on the conclusions and recommendations in this report carefully review the stated assumptions contained herein and to understand the different factors which may impact the conclusions and recommendations provided.

7 REFERENCES

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TABLES

Table 1: 2021 Traffic Volumes and Speeds for the Study Area

Road	Description	Direction	No-Build		Average Speed (km/hour)
			AM Peak Volume	PM Peak Volume	
Hwy 401	Highway 401 Westbound, East of Power Dam Drive	WB	580	1220	100
	Highway 401 Westbound, West of Power Dam Drive	WB	620	1280	
	Highway 401 Eastbound West of Power Dam Drive	EB	855	1055	
	Highway 401 Eastbound, East of Power Dam Drive	EB	820	1005	
Power Dam Drive	Power Dam Dr Northbound from Cornwall Centre Rd to South Intersection	NB	50	120	80
	Power Dam Dr Northbound from South to North Intersection	NB	50	120	
	Power Dam Dr Northbound from North Intersection to Headline Rd	NB	30	95	
	Power Dam Dr Southbound from Headline Rd to North Intersection	SB	65	100	
	Power Dam Dr Southbound from North to South Intersection	SB	50	75	
	Power Dam Dr Southbound from South Intersection to Cornwall Centre Rd	SB	80	120	

Table 2: 2031 Traffic Volumes and Speeds for the Study Area

Road	Description	Direction	No-Build		Build		Average Speed (km/hour)
			AM Peak Volume	PM Peak Volume	AM Peak Volume	PM Peak Volume	
Hwy 401	Highway 401 Westbound, East of Power Dam Drive	WB	705	1380	770	1470	100
	Highway 401 Westbound, West of Power Dam Drive	WB	735	1430	730	1425	
	Highway 401 Eastbound West of Power Dam Drive	EB	945	1205	950	1205	
	Highway 401 Eastbound, East of Power Dam Drive	EB	905	1165	1005	1245	
Power Dam Drive	Power Dam Dr Northbound from Cornwall Centre Rd to South Intersection	NB	65	135	30	40	80
	Power Dam Dr Northbound from South to North Intersection	NB	65	135	25	75	
	Power Dam Dr Northbound from North Intersection to Headline Rd	NB	45	105	75	135	
	Power Dam Dr Southbound from Headline Rd to North Intersection	SB	100	110	100	110	
	Power Dam Dr Southbound from North to South Intersection	SB	90	95	105	110	
	Power Dam Dr Southbound from South Intersection to Cornwall Centre Rd	SB	120	130	35	35	

Table 3: 2041 Traffic Volumes and Speeds for the Study Area

Road	Description	Direction	No-Build		Build		Average Speed (km/hour)
			AM Peak Volume	PM Peak Volume	AM Peak Volume	PM Peak Volume	
Hwy 401	Highway 401 Westbound, East of Power Dam Drive	WB	825	1535	900	1640	100
	Highway 401 Westbound, West of Power Dam Drive	WB	850	1580	845	1575	
	Highway 401 Eastbound West of Power Dam Drive	EB	1035	1360	1040	1360	
	Highway 401 Eastbound, East of Power Dam Drive	EB	995	1325	1100	1420	
Power Dam Drive	Power Dam Dr Northbound from Cornwall Centre Rd to South Intersection	NB	80	145	45	50	80
	Power Dam Dr Northbound from South to North Intersection	NB	75	145	40	90	
	Power Dam Dr Northbound from North Intersection to Headline Rd	NB	55	115	85	145	
	Power Dam Dr Southbound from Headline Rd to North Intersection	SB	140	120	140	120	
	Power Dam Dr Southbound from North to South Intersection	SB	125	110	145	130	
	Power Dam Dr Southbound from South Intersection to Cornwall Centre Rd	SB	155	145	75	50	

Table 4: Summary of Relevant Air Quality Thresholds (µg/m^3)

Pollutant	Criterion (µg/m³)	Averaging Period	Source of Threshold Value [5]
$PM_{2.5}$	27	24-hour	CAAQS 2020[1]
	8.8	Annual	CAAQS 2020[2]
PM_{10}	50	24-hour	AAQC
Carbon monoxide (CO)	36,200	1-hour	AAQC
	15,700	8-hour	AAQC
Nitrogen dioxide (NO_2)	400	1-hour	AAQC
	118.7	1-hour	CAAQS 2020 [3]
	83.1	1-hour	CAAQS 2025 [3]
	200	24-hour	AAQC
	33.6	Annual	CAAQS 2020 [4]
	23.7	Annual	CAAQS 2025 [4]
Benzo(a)pyrene	5.0E-05	24-hour	AAQC
	1.0E-05	Annual	AAQC
Acetaldehyde	500	0.5-hour	AAQC
	500	24-hour	AAQC
Acrolein	4.5	1-hour	AAQC
	0.4	24-hour	AAQC
Formaldehyde	65	24-hour	AAQC
Benzene	2.3	24-hour	AAQC
	0.45	Annual	AAQC
1,3-Butadiene	10	24-hour	AAQC
	2	Annual	AAQC

Note: [1] The 3-year average of the annual 98th percentile of the daily 24-hour average concentrations.

[2] The 3-year average of the annual average concentrations.

[3] The 3-year average of the annual 98th percentile daily maximum 1-hour average concentrations.

[4] The average over a single calendar year of all the 1-hour average concentrations.

[5] Ontario Ambient Air Quality Criteria (AAQC) from https://www.ontario.ca/page/ontarios-ambient-air-quality-criteria, accessed January 4, 2024.

Table 5: Source of Background Monitoring Data Used

Contaminant		NAPS ID and Location	Years Included
$PM_{2.5}$		61201 – MEMORIAL PARK _Cornwall_	2018, 2019, 2020, 2021, 2022
PM_{10}	[1]	61201 – MEMORIAL PARK _Cornwall_	2018, 2019, 2020, 2021, 2022
CO		54401 – SAINT-ANICET	2018, 2019, 2020, 2021, 2022
NO_2		61201 – MEMORIAL PARK _Cornwall_	2018, 2019, 2020, 2021, 2022
Benzo(a)pyrene	[2][3][4]	62601 – EXPERIMENTAL FARM _SIMCOE_	2016, 2017, 2018, 2019, 2020
Acetaldehyde	[5]	62601 – EXPERIMENTAL FARM _SIMCOE_	2015, 2016, 2017, 2018, 2019
Acrolein	[5]	62601 – EXPERIMENTAL FARM _SIMCOE_	2014, 2015, 2016, 2017
Formaldehyde	[5]	62601 – EXPERIMENTAL FARM _SIMCOE_	2015, 2016, 2017, 2018, 2019
Benzene	[2][3]	50122 – BROSSARD – PARC SORBONNE	2017, 2018, 2019, 2020, 2022
1,3-Butadiene	[2][3]	50122 – BROSSARD – PARC SORBONNE	2017, 2018, 2019, 2020, 2022

Notes:

[1] PM_{10} background data will be based on $PM_{2.5}$.

[2] Data availability from 2020 were insufficient for use in estimating a background value.

[3] No data for 2021 at this station.

[4] Data availability from 2022 were insufficient for use in estimating a background value.

[5] Most recent data available. Acrolein unavailable after 2017.

Table 6: 90th Percentile Background NO_2 and Ozone by Hour of Day

Hour of Day	NO_2 (ppb)	O_3 (ppb)
1	13.2	37.0
2	13.2	37.0
3	12.8	36.0
4	13.2	36.0
5	13.1	35.0
6	13.6	35.0
7	13.6	34.0
8	12.4	35.0
9	10.0	37.0
10	7.5	39.0
11	6.4	41.0
12	5.7	43.0
13	5.5	44.0
14	5.6	45.0
15	5.8	46.0
16	6.5	46.0
17	7.8	46.0
18	9.6	45.0
19	11.2	44.0
20	13.0	41.0
21	13.5	40.0
22	14.0	39.0
23	13.7	38.0
24	13.9	38.0

Table 7: Summary of Background Concentrations

Pollutant	Averaging Period	Adopted Background Value (µg/m³)	Description	Criterion (µg/m³)	% of Threshold
$PM_{2.5}$	24-hour	10.6	90th Percentile	27	39%
	Annual	6.2	Annual Average	8.8	70%
PM_{10}	24-hour	19.6	90th Percentile	50	39%
CO	1-hour	265	90th Percentile	36,200	1%
	8-hour	265	90th Percentile	15,700	2%
NO_2	1-hour	21.9	90th Percentile	400	5%
	1-hour	21.9	90th Percentile	118.7	18%
	1-hour	21.9	90th Percentile	83.1	26%
	24-hour	20.1	90th Percentile	200	10%
	Annual	9.7	Annual Average	33.6	29%
	Annual	9.7	Annual Average	23.7	41%
Benzo(a)pyrene	24-hour	4.3E-05	90th Percentile	5.0E-05	86%
	Annual	2.3E-05	Annual Average	1.0E-05	234%
Acetaldehyde	0.5-hour [1]	6.17	90th Percentile	500	1%
	24-hour	2.09	90th Percentile	500	0.4%
Acrolein	1-hour [2]	0.07	90th Percentile	4.5	1%
	24-hour	0.03	90th Percentile	0.4	7%
Formaldehyde	24-hour	1.32	90th Percentile	65	2%
Benzene	24-hour	0.60	90th Percentile	2.3	26%
	Annual	0.35	Annual Average	0.45	78%
1,3-Butadiene	24-hour	0.05	90th Percentile	10	0.5%
	Annual	0.02	Annual Average	2	1%

Notes:

[1] 0.5-hour average converted from 24-hour average background following Section 4.4 of the Air Dispersion Modelling Guideline for Ontario.

[2] 1-hour average converted from 24-hour average background value following Section 4.4 of the Air Dispersion Modelling Guideline for Ontario.

Table 8a: Year 2021 Maximum Predicted Concentrations (µg/m³) for No-Build Scenario With Background

	$PM_{2.5}$		PM_{10}	CO		NO_2 [1]				Benzo-a-pyrene		Acetaldehyde		Acrolein		Formaldehyde	Benzene		1,3-Butadiene	
Averaging Period	24-hour	Annual	24-hour	1-hour	8-hour	1-hour	1-hour	24-hour	Annual	24-hour	Annual	0.5-hour	24-hour	1-hour	24-hour	24-hour	24-hour	Annual	24-hour	Annual
Threshold	27	8.8	50.0	36200	15700	400	79.0	200	22.6	0.00005	0.00001	500.0	500.0	4.5	0.4	65	2.3	0.45	10	2
Source of Threshold Value	CAAQS 2020	CAAQS 2020	AAQC	AAQC	AAQC	AAQC	CAAQS 2025	AAQC	CAAQS 2025	AAQC	AAQC	AAQC	AAQC	AAQC	AAQC	AAQC	AAQC	AAQC	AAQC	AAQC
Ambient Background	10.6	6.20	19.6	328	337	21.9	21.9	20.1	9.7	4.15E-05	2.16E-05	6.17	2.09	0.067	0.028	1.32	0.44	0.31	0.025	0.016

Receptor	$PM_{2.5}$		PM_{10}	CO		NO_2 [1]				Benzo-a-pyrene		Acetaldehyde		Acrolein		Formaldehyde	Benzene		1,3-Butadiene	
R1	12.1	6.5	24.0	554	436	64.9	64.9	34.9	13.1	1.2E-04	3.7E-05	6.5	2.1	1.0E-01	3.6E-02	1.4	4.8E-01	3.2E-01	3.2E-02	1.7E-02
R2	12.5	6.4	25.0	576	431	72.7	72.7	44.1	12.9	1.5E-04	3.6E-05	6.5	2.2	1.1E-01	3.9E-02	1.5	4.9E-01	3.2E-01	3.4E-02	1.7E-02
R3	11.6	6.3	22.3	439	391	48.8	48.8	32.9	11.1	9.7E-05	2.8E-05	6.3	2.1	8.6E-02	3.4E-02	1.4	4.7E-01	3.1E-01	3.0E-02	1.6E-02
R4	12.4	6.5	24.6	588	438	79.0	79.0	45.3	13.2	1.5E-04	3.7E-05	6.5	2.2	1.1E-01	4.0E-02	1.5	4.9E-01	3.2E-01	3.4E-02	1.7E-02
R5	11.8	6.3	23.2	454	399	50.5	50.5	32.6	11.2	9.6E-05	2.8E-05	6.3	2.1	8.8E-02	3.4E-02	1.4	4.7E-01	3.1E-01	3.0E-02	1.6E-02
R6	12.5	6.5	24.8	683	459	88.5	88.5	45.6	14.0	1.6E-04	4.1E-05	6.6	2.2	1.3E-01	4.1E-02	1.5	5.0E-01	3.2E-01	3.5E-02	1.7E-02
R7	12.3	6.6	24.3	661	473	81.7	81.7	39.6	14.8	1.5E-04	4.5E-05	6.6	2.2	1.2E-01	3.9E-02	1.5	4.9E-01	3.2E-01	3.4E-02	1.8E-02
R8	11.4	6.4	21.8	480	402	50.1	50.1	28.8	12.0	9.1E-05	3.2E-05	6.4	2.1	9.3E-02	3.3E-02	1.4	4.6E-01	3.1E-01	2.9E-02	1.7E-02
R9	11.2	6.3	21.2	427	374	40.2	40.2	27.3	10.8	7.8E-05	2.6E-05	6.3	2.1	8.2E-02	3.2E-02	1.4	4.6E-01	3.1E-01	2.8E-02	1.6E-02
R10	11.1	6.3	21.2	399	368	37.2	37.2	26.3	10.7	7.0E-05	2.6E-05	6.3	2.1	8.0E-02	3.1E-02	1.4	4.6E-01	3.1E-01	2.8E-02	1.6E-02
R11	11.7	6.4	23.1	489	399	49.5	49.5	29.7	12.1	9.2E-05	3.2E-05	6.4	2.1	9.4E-02	3.3E-02	1.4	4.7E-01	3.2E-01	3.0E-02	1.7E-02
R12	11.9	6.4	23.4	492	405	57.0	57.0	36.2	11.7	1.1E-04	3.0E-05	6.4	2.1	9.6E-02	3.5E-02	1.4	4.7E-01	3.1E-01	3.1E-02	1.6E-02
R13	11.8	6.4	23.5	443	388	45.6	45.6	29.8	11.0	9.0E-05	2.7E-05	6.3	2.1	8.5E-02	3.3E-02	1.4	4.7E-01	3.1E-01	3.0E-02	1.6E-02
Maximum Predicted % of Threshold	**46%**	**75%**	**50%**	**2%**	**3%**	**22%**	**112%**	**23%**	**66%**	**324%**	**446%**	**1%**	**<1%**	**3%**	**10%**	**2%**	**22%**	**71%**	**<1%**	**<1%**

[1] Conversion of NO_x to NO_2 using the Ozone Limiting Method and hourly concentrations of NO_2 and ozone. The ambient background concentrations measured at local monitoring stations are not added directly to the modelled concentration without background.

Table 8b: Year 2031 Maximum Predicted Concentrations (μg/m³) for No-Build Scenario With Background

	$PM_{2.5}$		PM_{10}	CO		NO_2 [1]				Benzo-a-pyrene		Acetaldehyde		Acrolein		Formaldehyde	Benzene		1,3-Butadiene	
Averaging Period	24-hour	Annual	24-hour	1-hour	8-hour	1-hour	1-hour	24-hour	Annual	24-hour	Annual	0.5-hour	24-hour	1-hour	24-hour	24-hour	24-hour	Annual	24-hour	Annual
Threshold	27	8.8	50.0	36200	15700	400	79.0	200	22.6	0.00005	0.00001	500.0	500.0	4.5	0.4	65	2.3	0.45	10	2
Source of Threshold Value	CAAQS 2020	CAAQS 2020	AAQC	AAQC	AAQC	AAQC	CAAQS 2025	AAQC	CAAQS 2025	AAQC	AAQC	AAQC	AAQC	AAQC	AAQC	AAQC	AAQC	AAQC	AAQC	AAQC
Ambient Background	10.6	6.20	19.6	328	337	21.9	21.9	20.1	9.7	4.15E-05	2.16E-05	6.17	2.09	0.067	0.028	1.32	0.44	0.31	0.025	0.016

Receptor	$PM_{2.5}$		PM_{10}	CO		NO_2 [1]				Benzo-a-pyrene		Acetaldehyde		Acrolein		Formaldehyde	Benzene		1,3-Butadiene	
R1	11.8	6.5	24.3	466	398	37.4	37.4	26.4	11.0	7.2E-05	2.8E-05	6.3	2.1	8.2E-02	3.1E-02	1.4	4.5E-01	3.1E-01	2.7E-02	1.6E-02
R2	12.1	6.4	25.4	481	395	40.4	40.4	29.5	10.9	8.3E-05	2.7E-05	6.3	2.1	8.4E-02	3.2E-02	1.4	4.6E-01	3.1E-01	2.7E-02	1.6E-02
R3	11.4	6.3	22.5	396	371	32.5	32.5	25.3	10.3	6.3E-05	2.4E-05	6.2	2.1	7.5E-02	3.0E-02	1.4	4.5E-01	3.1E-01	2.6E-02	1.6E-02
R4	12.0	6.4	24.9	488	399	41.9	41.9	30.0	11.0	8.5E-05	2.8E-05	6.3	2.1	8.5E-02	3.3E-02	1.4	4.6E-01	3.1E-01	2.7E-02	1.6E-02
R5	11.6	6.3	23.6	406	376	32.7	32.7	25.1	10.3	6.3E-05	2.4E-05	6.2	2.1	7.6E-02	3.0E-02	1.4	4.5E-01	3.1E-01	2.6E-02	1.6E-02
R6	12.1	6.5	25.2	550	414	46.3	46.3	30.2	11.4	8.9E-05	2.9E-05	6.3	2.1	9.1E-02	3.3E-02	1.4	4.6E-01	3.1E-01	2.8E-02	1.6E-02
R7	11.9	6.5	24.5	534	421	43.8	43.8	27.7	11.7	8.3E-05	3.1E-05	6.3	2.1	8.9E-02	3.2E-02	1.4	4.6E-01	3.1E-01	2.7E-02	1.6E-02
R8	11.2	6.3	21.9	422	377	33.5	33.5	25.1	10.6	6.1E-05	2.6E-05	6.2	2.1	7.7E-02	3.0E-02	1.4	4.5E-01	3.1E-01	2.6E-02	1.6E-02
R9	11.1	6.3	21.3	389	360	30.2	30.2	23.8	10.1	5.6E-05	2.4E-05	6.2	2.1	7.3E-02	2.9E-02	1.3	4.5E-01	3.1E-01	2.6E-02	1.6E-02
R10	11.0	6.3	21.3	372	357	29.9	29.9	24.2	10.1	5.3E-05	2.3E-05	6.2	2.1	7.2E-02	2.9E-02	1.3	4.5E-01	3.1E-01	2.6E-02	1.6E-02
R11	11.6	6.4	23.4	426	375	32.8	32.8	25.3	10.6	6.2E-05	2.6E-05	6.2	2.1	7.7E-02	3.0E-02	1.4	4.5E-01	3.1E-01	2.6E-02	1.6E-02
R12	11.7	6.3	23.8	429	380	35.0	35.0	26.5	10.5	6.9E-05	2.5E-05	6.3	2.1	7.8E-02	3.1E-02	1.4	4.5E-01	3.1E-01	2.7E-02	1.6E-02
R13	11.7	6.3	23.9	399	369	31.6	31.6	24.2	10.2	6.1E-05	2.4E-05	6.2	2.1	7.4E-02	3.0E-02	1.3	4.5E-01	3.1E-01	2.6E-02	1.6E-02
Maximum Predicted % of Threshold	**45%**	**74%**	**51%**	**2%**	**3%**	**12%**	**59%**	**15%**	**52%**	**179%**	**306%**	**1%**	**<1%**	**2%**	**8%**	**2%**	**20%**	**70%**	**<1%**	**<1%**

[1] Conversion of NO_x to NO_2 using the Ozone Limiting Method and hourly concentrations of NO_2 and ozone. The ambient background concentrations measured at local monitoring stations are not added directly to the modelled concentration without background.

Table 8c: Year 2031 Maximum Predicted Concentrations (µg/m³) for Build Scenario With Background

	$PM_{2.5}$		PM_{10}	CO		NO_2 [1]				Benzo-a-pyrene		Acetaldehyde		Acrolein		Formaldehyde	Benzene		1,3-Butadiene	
Averaging Period	24-hour	Annual	24-hour	1-hour	8-hour	1-hour	1-hour	24-hour	Annual	24-hour	Annual	0.5-hour	24-hour	1-hour	24-hour	24-hour	24-hour	Annual	24-hour	Annual
Threshold	27	8.8	50.0	36200	15700	400	79.0	200	22.6	0.00005	0.00001	500.0	500.0	4.5	0.4	65	2.3	0.45	10	2
Source of Threshold Value	CAAQS 2020	CAAQS 2020	AAQC	AAQC	AAQC	AAQC	CAAQS 2025	AAQC	CAAQS 2025	AAQC	AAQC	AAQC	AAQC	AAQC	AAQC	AAQC	AAQC	AAQC	AAQC	AAQC
Ambient Background	10.6	6.20	19.6	328	337	21.9	21.9	20.1	9.7	4.15E-05	2.16E-05	6.17	2.09	0.067	0.028	1.32	0.44	0.31	0.025	0.016

Receptor	$PM_{2.5}$		PM_{10}	CO		NO_2 [1]				Benzo-a-pyrene		Acetaldehyde		Acrolein		Formaldehyde	Benzene		1,3-Butadiene	
R1	12.3	6.6	26.2	481	406	37.9	37.9	26.5	11.1	7.5E-05	2.8E-05	6.28	2.11	8.2E-02	3.1E-02	1.4	4.6E-01	3.1E-01	2.7E-02	1.6E-02
R2	12.1	6.4	25.3	480	396	41.0	41.0	29.7	10.9	8.4E-05	2.7E-05	6.29	2.12	8.4E-02	3.2E-02	1.4	4.6E-01	3.1E-01	2.7E-02	1.6E-02
R3	11.4	6.3	22.6	401	371	33.1	33.1	25.3	10.3	6.4E-05	2.4E-05	6.23	2.10	7.5E-02	3.0E-02	1.4	4.5E-01	3.1E-01	2.6E-02	1.6E-02
R4	12.0	6.4	24.9	488	399	42.0	42.0	30.1	11.0	8.6E-05	2.8E-05	6.30	2.12	8.5E-02	3.3E-02	1.4	4.6E-01	3.1E-01	2.7E-02	1.6E-02
R5	11.6	6.3	23.4	407	375	33.0	33.0	25.2	10.3	6.3E-05	2.4E-05	6.23	2.10	7.6E-02	3.0E-02	1.4	4.5E-01	3.1E-01	2.6E-02	1.6E-02
R6	12.2	6.5	25.5	559	419	47.7	47.7	30.9	11.5	9.3E-05	3.0E-05	6.35	2.12	9.3E-02	3.3E-02	1.4	4.6E-01	3.1E-01	2.8E-02	1.6E-02
R7	11.9	6.5	24.5	531	421	43.8	43.8	27.7	11.7	8.3E-05	3.1E-05	6.33	2.12	8.9E-02	3.2E-02	1.4	4.6E-01	3.1E-01	2.7E-02	1.6E-02
R8	11.3	6.3	22.0	426	379	34.0	34.0	25.3	10.7	6.2E-05	2.6E-05	6.25	2.10	7.8E-02	3.0E-02	1.4	4.5E-01	3.1E-01	2.6E-02	1.6E-02
R9	11.1	6.3	21.4	383	362	30.4	30.4	23.9	10.1	5.7E-05	2.3E-05	6.22	2.10	7.3E-02	2.9E-02	1.3	4.5E-01	3.1E-01	2.6E-02	1.6E-02
R10	11.0	6.3	21.3	372	356	30.0	30.0	24.2	10.1	5.3E-05	2.3E-05	6.21	2.10	7.2E-02	2.9E-02	1.3	4.5E-01	3.1E-01	2.6E-02	1.6E-02
R11	11.7	6.4	23.8	429	376	33.3	33.3	25.3	10.6	6.2E-05	2.6E-05	6.25	2.10	7.8E-02	3.0E-02	1.4	4.5E-01	3.1E-01	2.6E-02	1.6E-02
R12	11.8	6.3	24.1	429	381	35.4	35.4	26.8	10.5	7.1E-05	2.5E-05	6.25	2.11	7.8E-02	3.1E-02	1.4	4.5E-01	3.1E-01	2.7E-02	1.6E-02
R13	11.6	6.3	23.3	393	366	31.4	31.4	24.1	10.2	6.0E-05	2.4E-05	6.22	2.10	7.4E-02	3.0E-02	1.3	4.5E-01	3.1E-01	2.6E-02	1.6E-02
Maximum Predicted % of Threshold	**46%**	**75%**	**52%**	**2%**	**3%**	**12%**	**60%**	**15%**	**52%**	**185%**	**306%**	**1%**	**<1%**	**2%**	**8%**	**2%**	**20%**	**70%**	**<1%**	**<1%**

[1] Conversion of NO_x to NO_2 using the Ozone Limiting Method and hourly concentrations of NO_2 and ozone. The ambient background concentrations measured at local monitoring stations are not added directly to the modelled concentration without background.

Table 8d: Year 2041 Maximum Predicted Concentrations (µg/m³) for No-Build Scenario With Background

	$PM_{2.5}$		PM_{10}	CO		NO_2 [1]				Benzo-a-pyrene		Acetaldehyde		Acrolein		Formaldehyde	Benzene		1,3-Butadiene	
Averaging Period	24-hour	Annual	24-hour	1-hour	8-hour	1-hour	1-hour	24-hour	Annual	24-hour	Annual	0.5-hour	24-hour	1-hour	24-hour	24-hour	24-hour	Annual	24-hour	Annual
Threshold	27	8.8	50.0	36200	15700	400	79.0	200	22.6	0.00005	0.00001	500.0	500.0	4.5	0.4	65	2.3	0.45	10	2
Source of Threshold Value	CAAQS 2020	CAAQS 2020	AAQC	AAQC	AAQC	AAQC	CAAQS 2025	AAQC	CAAQS 2025	AAQC	AAQC	AAQC	AAQC	AAQC	AAQC	AAQC	AAQC	AAQC	AAQC	AAQC
Ambient Background	10.6	6.20	19.6	328	337	21.9	21.9	20.1	9.7	4.15E-05	2.16E-05	6.17	2.09	0.067	0.028	1.32	0.44	0.31	0.025	0.016

Receptor	$PM_{2.5}$		PM_{10}	CO		NO_2 [1]				Benzo-a-pyrene		Acetaldehyde		Acrolein		Formaldehyde	Benzene		1,3-Butadiene	
R1	11.8	6.4	24.5	438	386	29.9	29.9	24.3	10.3	5.0E-05	2.3E-05	6.2	2.1	6.8E-02	2.8E-02	1.3	4.5E-01	3.1E-01	2.5E-02	1.6E-02
R2	12.0	6.4	25.4	451	384	31.0	31.0	24.2	10.2	5.3E-05	2.3E-05	6.2	2.1	6.8E-02	2.8E-02	1.3	4.5E-01	3.1E-01	2.5E-02	1.6E-02
R3	11.3	6.3	22.5	383	364	28.7	28.7	23.4	10.0	4.8E-05	2.2E-05	6.2	2.1	6.8E-02	2.8E-02	1.3	4.5E-01	3.1E-01	2.5E-02	1.6E-02
R4	11.8	6.4	24.8	457	387	31.7	31.7	24.4	10.3	5.4E-05	2.3E-05	6.2	2.1	6.8E-02	2.8E-02	1.3	4.5E-01	3.1E-01	2.5E-02	1.6E-02
R5	11.6	6.3	23.9	391	368	28.8	28.8	23.5	10.0	4.8E-05	2.2E-05	6.2	2.1	6.8E-02	2.8E-02	1.3	4.5E-01	3.1E-01	2.5E-02	1.6E-02
R6	11.9	6.4	25.1	507	399	33.0	33.0	24.5	10.4	5.5E-05	2.4E-05	6.2	2.1	6.9E-02	2.8E-02	1.3	4.5E-01	3.1E-01	2.5E-02	1.6E-02
R7	11.7	6.5	24.4	492	404	31.7	31.7	24.8	10.5	5.3E-05	2.4E-05	6.2	2.1	6.9E-02	2.8E-02	1.3	4.5E-01	3.1E-01	2.5E-02	1.6E-02
R8	11.1	6.3	21.8	404	370	28.7	28.7	23.8	10.1	4.7E-05	2.3E-05	6.2	2.1	6.8E-02	2.8E-02	1.3	4.5E-01	3.1E-01	2.5E-02	1.6E-02
R9	11.0	6.3	21.4	376	356	27.8	27.8	23.2	9.9	4.6E-05	2.2E-05	6.2	2.1	6.8E-02	2.8E-02	1.3	4.5E-01	3.1E-01	2.5E-02	1.6E-02
R10	11.0	6.3	21.3	363	353	27.5	27.5	23.4	9.9	4.5E-05	2.2E-05	6.2	2.1	6.8E-02	2.8E-02	1.3	4.4E-01	3.1E-01	2.5E-02	1.6E-02
R11	11.6	6.4	23.7	406	367	28.5	28.5	23.9	10.1	4.7E-05	2.3E-05	6.2	2.1	6.8E-02	2.8E-02	1.3	4.5E-01	3.1E-01	2.5E-02	1.6E-02
R12	11.6	6.3	23.9	409	371	29.3	29.3	23.6	10.0	5.0E-05	2.3E-05	6.2	2.1	6.8E-02	2.8E-02	1.3	4.5E-01	3.1E-01	2.5E-02	1.6E-02
R13	11.7	6.4	24.2	384	362	28.2	28.2	23.4	9.9	4.7E-05	2.2E-05	6.2	2.1	6.8E-02	2.8E-02	1.3	4.5E-01	3.1E-01	2.5E-02	1.6E-02
Maximum Predicted % of Threshold	**44%**	**74%**	**51%**	**1%**	**3%**	**8%**	**42%**	**12%**	**47%**	**110%**	**241%**	**1%**	**<1%**	**2%**	**7%**	**2%**	**20%**	**69%**	**<1%**	**<1%**

[1] Conversion of NO_x to NO_2 using the Ozone Limiting Method and hourly concentrations of NO_2 and ozone. The ambient background concentrations measured at local monitoring stations are not added directly to the modelled concentration without background.

Table 8e: Year 2041 Maximum Predicted Concentrations (µg/m³) for Build Scenario With Background

	$PM_{2.5}$		PM_{10}	CO		NO_2 [1]				Benzo-a-pyrene		Acetaldehyde		Acrolein		Formaldehyde	Benzene		1,3-Butadiene	
Averaging Period	24-hour	Annual	24-hour	1-hour	8-hour	1-hour	1-hour	24-hour	Annual	24-hour	Annual	0.5-hour	24-hour	1-hour	24-hour	24-hour	24-hour	Annual	24-hour	Annual
Threshold	27	8.8	50.0	36200	15700	400	79.0	200	22.6	0.00005	0.00001	500.0	500.0	4.5	0.4	65	2.3	0.45	10	2
Source of Threshold Value	CAAQS 2020	CAAQS 2020	AAQC	AAQC	AAQC	AAQC	CAAQS 2025	AAQC	CAAQS 2025	AAQC	AAQC	AAQC	AAQC	AAQC	AAQC	AAQC	AAQC	AAQC	AAQC	AAQC
Ambient Background	10.6	6.20	19.6	328	337	21.9	21.9	20.1	9.7	4.15E-05	2.16E-05	6.17	2.09	0.067	0.028	1.32	0.44	0.31	0.025	0.016

Receptor	$PM_{2.5}$		PM_{10}	CO		NO_2 [1]				Benzo-a-pyrene		Acetaldehyde		Acrolein		Formaldehyde	Benzene		1,3-Butadiene	
R1	12.3	6.6	26.6	448	391	30.1	30.1	24.4	10.3	5.1E-05	2.4E-05	6.19	2.09	6.8E-02	2.8E-02	1.3	4.5E-01	3.1E-01	2.5E-02	1.6E-02
R2	12.0	6.4	25.4	451	385	31.4	31.4	24.3	10.2	5.4E-05	2.3E-05	6.19	2.09	6.8E-02	2.8E-02	1.3	4.5E-01	3.1E-01	2.5E-02	1.6E-02
R3	11.3	6.3	22.6	388	364	28.7	28.7	23.4	10.0	4.8E-05	2.2E-05	6.18	2.09	6.8E-02	2.8E-02	1.3	4.5E-01	3.1E-01	2.5E-02	1.6E-02
R4	11.8	6.4	24.8	457	387	31.7	31.7	24.4	10.3	5.4E-05	2.3E-05	6.19	2.09	6.9E-02	2.8E-02	1.3	4.5E-01	3.1E-01	2.5E-02	1.6E-02
R5	11.5	6.3	23.4	392	368	28.9	28.9	23.5	10.0	4.8E-05	2.2E-05	6.18	2.09	6.8E-02	2.8E-02	1.3	4.5E-01	3.1E-01	2.5E-02	1.6E-02
R6	12.0	6.4	25.4	516	404	33.5	33.5	24.8	10.5	5.6E-05	2.4E-05	6.20	2.09	6.9E-02	2.8E-02	1.3	4.5E-01	3.1E-01	2.5E-02	1.6E-02
R7	11.7	6.5	24.3	493	404	31.9	31.9	24.8	10.5	5.3E-05	2.4E-05	6.20	2.09	6.9E-02	2.8E-02	1.3	4.5E-01	3.1E-01	2.5E-02	1.6E-02
R8	11.2	6.3	22.0	407	371	28.7	28.7	23.9	10.1	4.7E-05	2.3E-05	6.18	2.09	6.8E-02	2.8E-02	1.3	4.5E-01	3.1E-01	2.5E-02	1.6E-02
R9	11.0	6.3	21.4	373	357	27.8	27.8	23.2	9.9	4.6E-05	2.2E-05	6.18	2.09	6.8E-02	2.8E-02	1.3	4.5E-01	3.1E-01	2.5E-02	1.6E-02
R10	11.0	6.3	21.3	363	353	27.5	27.5	23.4	9.9	4.5E-05	2.2E-05	6.18	2.09	6.8E-02	2.8E-02	1.3	4.4E-01	3.1E-01	2.5E-02	1.6E-02
R11	11.7	6.4	24.1	408	368	28.7	28.7	23.9	10.1	4.8E-05	2.3E-05	6.18	2.09	6.8E-02	2.8E-02	1.3	4.5E-01	3.1E-01	2.5E-02	1.6E-02
R12	11.7	6.3	24.3	409	373	29.4	29.4	23.7	10.1	5.0E-05	2.3E-05	6.18	2.09	6.8E-02	2.8E-02	1.3	4.5E-01	3.1E-01	2.5E-02	1.6E-02
R13	11.5	6.3	23.4	382	361	28.1	28.1	23.3	9.9	4.7E-05	2.2E-05	6.18	2.09	6.8E-02	2.8E-02	1.3	4.5E-01	3.1E-01	2.5E-02	1.6E-02
Maximum Predicted % of Threshold	**45%**	**75%**	**53%**	**1%**	**3%**	**8%**	**42%**	**12%**	**47%**	**112%**	**241%**	**1%**	**<1%**	**2%**	**7%**	**2%**	**20%**	**69%**	**<1%**	**<1%**

[1] Conversion of NO_x to NO_2 using the Ozone Limiting Method and hourly concentrations of NO_2 and ozone. The ambient background concentrations measured at local monitoring stations are not added directly to the modelled concentration without background.

Table 9a: Percent Change in Maximum Predicted Concentrations from 2031 NoBuild to Build Scenario With Background

	$PM_{2.5}$		PM_{10}	CO		NO_2 [1]				Benzo-a-pyrene		Acetaldehyde		Acrolein		Formaldehyde	Benzene		1,3-Butadiene	
Averaging Period	24-hour	Annual	24-hour	1-hour	8-hour	1-hour	1-hour	24-hour	Annual	24-hour	Annual	0.5-hour	24-hour	1-hour	24-hour	24-hour	24-hour	Annual	24-hour	Annual
Threshold	27	8.8	50.0	36200	15700	400	79.0	200	22.6	0.00005	0.00001	500.0	500.0	4.5	0.4	65	2.3	0.45	10	2
Source of Threshold Value	CAAQS 2020	CAAQS 2020	AAQC	AAQC	AAQC	AAQC	CAAQS 2025	AAQC	CAAQS 2025	AAQC	AAQC	AAQC	AAQC	AAQC	AAQC	AAQC	AAQC	AAQC	AAQC	AAQC
Ambient Background	10.6	6.2	19.6	328	337	21.9	21.9	20.1	9.7	4.15E-05	2.16E-05	6.2	2.1	0.07	0.03	1.3	0.44	0.31	0.03	0.02
Receptor	**$PM_{2.5}$**		**PM_{10}**	**CO**		**NO_2 [1]**				**Benzo-a-pyrene**		**Acetaldehyde**		**Acrolein**		**Formaldehyde**	**Benzene**		**1,3-Butadiene**	
R1	4%	2%	8%	3%	2%	1%	1%	<1%	1%	4%	3%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%
R2	<1%	<1%	<1%	<1%	<1%	2%	2%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%
R3	<1%	<1%	<1%	1%	<1%	2%	2%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%
R4	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%
R5	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%
R6	<1%	<1%	1%	2%	1%	3%	3%	2%	<1%	4%	1%	<1%	<1%	1%	1%	<1%	<1%	<1%	<1%	<1%
R7	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%
R8	<1%	<1%	<1%	<1%	<1%	2%	2%	<1%	<1%	2%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%
R9	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	2%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%
R10	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%
R11	<1%	<1%	2%	<1%	<1%	2%	2%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%
R12	<1%	<1%	1%	<1%	<1%	1%	1%	1%	<1%	2%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%
R13	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%

[1] Conversion of NO_x to NO_2 using the Ozone Limiting Method and hourly concentrations of NO_2 and ozone. The ambient background concentrations measured at local monitoring stations are not added directly to the modelled concentration without background.

Table 9b: Percent Change in Maximum Predicted Concentrations from 2041 NoBuild to Build Scenario With Background

	$PM_{2.5}$		PM_{10}	CO		NO_2 [1]				Benzo-a-pyrene		Acetaldehyde		Acrolein		Formaldehyde	Benzene		1,3-Butadiene	
Averaging Period	24-hour	Annual	24-hour	1-hour	8-hour	1-hour	1-hour	24-hour	Annual	24-hour	Annual	0.5-hour	24-hour	1-hour	24-hour	24-hour	24-hour	Annual	24-hour	Annual
Threshold	27	8.8	50.0	36200	15700	400	79.0	200	22.6	0.00005	0.00001	500.0	500.0	4.5	0.4	65	2.3	0.45	10	2
Source of Threshold Value	CAAQS 2020	CAAQS 2020	AAQC	AAQC	AAQC	AAQC	CAAQS 2025	AAQC	CAAQS 2025	AAQC	AAQC	AAQC	AAQC	AAQC	AAQC	AAQC	AAQC	AAQC	AAQC	AAQC
Ambient Background	10.6	6.2	19.6	328	337	21.9	21.9	20.1	9.7	4.15E-05	2.16E-05	6.2	2.1	0.07	0.03	1.3	0.44	0.31	0.03	0.02
Receptor	**$PM_{2.5}$**		**PM_{10}**	**CO**		**NO_2 [1]**				**Benzo-a-pyrene**		**Acetaldehyde**		**Acrolein**		**Formaldehyde**	**Benzene**		**1,3-Butadiene**	
R1	4%	3%	9%	2%	1%	<1%	<1%	<1%	<1%	2%	1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%
R2	<1%	<1%	<1%	<1%	<1%	1%	1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%
R3	<1%	<1%	<1%	1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%
R4	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%
R5	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%
R6	<1%	<1%	2%	2%	1%	2%	2%	1%	<1%	2%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%
R7	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%
R8	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%
R9	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%
R10	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%
R11	<1%	<1%	2%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%
R12	<1%	<1%	1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%
R13	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%	<1%

[1] Conversion of NO_x to NO_2 using the Ozone Limiting Method and hourly concentrations of NO_2 and ozone. The ambient background concentrations measured at local monitoring stations are not added directly to the modelled concentration without background.

Table 10: Total Annual Greenhouse Gas Emissions for Project Year 2031 Compared to Ontario's Total Annual Greenhouse Gas Emissions

Pollutant	Ontario Emissions (tonnes/year)	Ontario Emissions: Transportation Sector (tonnes/year)	Ontario Emissions: Road Transportation Sector (tonnes/year)	Emissions: 2031 Build (tonnes/year)	Change in Emissions due to the Project [2] (tonnes/year)
CO_2e [1]	151,000,000	52,400,000	38,800,000	6,910	0.005%

Notes:

[1] CO_2e emissions obtained from Environment and Climate Change Canada National Inventory Report – 2023 Edition, with data from 2021.

[2] Relative to total Ontario emissions.

Table 11: Total Annual Greenhouse Gas Emissions for Project Year 2041 Compared to Ontario's Total Annual Greenhouse Gas Emissions

Pollutant	Ontario Emissions (tonnes/year)	Ontario Emissions: Transportation Sector (tonnes/year)	Ontario Emissions: Road Transportation Sector (tonnes/year)	Emissions: 2041 Build (tonnes/year)	Change in Emissions due to the Project [2] (tonnes/year)
CO_2e [1]	151,000,000	52,400,000	38,800,000	8,238	0.006%

Notes:

[1] CO_2e emissions obtained from Environment and Climate Change Canada National Inventory Report – 2023 Edition, with data from 2021.

[2] Relative to total Ontario emissions.

Table 12: Benzo(a)pyrene Frequency Analysis - 2031 Build Scenario

RWDI# 2104052

Highway 401 & Power Dam Drive, South Stormont, Ontario

Receptor Information					Maximum Predicted 24-Hour Concentration ($\mu g/m^3$)	Predicted Excursions Above Specified 24-Hour Values [1]					
						Events > 0.00005 $\mu g/m^3$		Events > 0.00007 $\mu g/m^3$		Events > 0.00009 $\mu g/m^3$	
ID#	Description	X	Y	Z		Count	Frequency	Count	Frequency	Count	Frequency
R1	Residence	514907	4989770	1.5	3.32E-05	0	0.0%	0	0.0%	0	0.0%
R2	Residence	514798	4989534	1.5	4.25E-05	0	0.0%	0	0.0%	0	0.0%
R3	Residence	514499	4989514	1.5	2.22E-05	0	0.0%	0	0.0%	0	0.0%
R4	Residence	514452	4989743	1.5	4.41E-05	0	0.0%	0	0.0%	0	0.0%
R5	Residence	514956	4989264	1.5	2.20E-05	0	0.0%	0	0.0%	0	0.0%
R6	Residence	515652	4989109	1.5	5.11E-05	2	0.1%	0	0.0%	0	0.0%
R7	Residence	514680	4989826	1.5	4.10E-05	0	0.0%	0	0.0%	0	0.0%
R8	Residence	516211	4989152	1.5	2.06E-05	0	0.0%	0	0.0%	0	0.0%
R9	Residence	515401	4988783	1.5	1.54E-05	0	0.0%	0	0.0%	0	0.0%
R10	Residence	515361	4989983	1.5	1.15E-05	0	0.0%	0	0.0%	0	0.0%
R11	Residence	514788	4989903	1.5	2.05E-05	0	0.0%	0	0.0%	0	0.0%
R12	Residence	514915	4989371	1.5	2.92E-05	0	0.0%	0	0.0%	0	0.0%
R13	Residence	515143	4988998	1.5	1.86E-05	0	0.0%	0	0.0%	0	0.0%

42226 Hours of valid Meterological Data

1759 Days of valid Meteorological Data

Notes:

[1] Maximum predicted concentration with no background.

Table 13: Benzo(a)pyrene Frequency Analysis - 2041 Build Scenario

RWDI# 2104052

Highway 401 & Power Dam Drive, South Stormont, Ontario

Receptor Information					Maximum Predicted 24-Hour Concentration (µg/m³)	Predicted Excursions Above Specified 24-Hour Values [1]					
ID#	Description	X	Y	Z		Events > 0.00005 µg/m³		Events > 0.00007 µg/m³		Events > 0.00009 µg/m³	
						Count	Frequency	Count	Frequency	Count	Frequency
R1	Residence	514907	4989770	1.5	9.85E-06	0	0.0%	0	0.0%	0	0.0%
R2	Residence	514798	4989534	1.5	1.22E-05	0	0.0%	0	0.0%	0	0.0%
R3	Residence	514499	4989514	1.5	6.33E-06	0	0.0%	0	0.0%	0	0.0%
R4	Residence	514452	4989743	1.5	1.25E-05	0	0.0%	0	0.0%	0	0.0%
R5	Residence	514956	4989264	1.5	6.40E-06	0	0.0%	0	0.0%	0	0.0%
R6	Residence	515652	4989109	1.5	1.45E-05	0	0.0%	0	0.0%	0	0.0%
R7	Residence	514680	4989826	1.5	1.15E-05	0	0.0%	0	0.0%	0	0.0%
R8	Residence	516211	4989152	1.5	5.81E-06	0	0.0%	0	0.0%	0	0.0%
R9	Residence	515401	4988783	1.5	4.37E-06	0	0.0%	0	0.0%	0	0.0%
R10	Residence	515361	4989983	1.5	3.32E-06	0	0.0%	0	0.0%	0	0.0%
R11	Residence	514788	4989903	1.5	6.11E-06	0	0.0%	0	0.0%	0	0.0%
R12	Residence	514915	4989371	1.5	8.52E-06	0	0.0%	0	0.0%	0	0.0%
R13	Residence	515143	4988998	1.5	5.52E-06	0	0.0%	0	0.0%	0	0.0%

42226 Hours of valid Meterological Data
1759 Days of valid Meteorological Data

Notes:
[1] Maximum predicted concentration with no background.

Table 14: Benzo(a)pyrene Frequency Analysis - 2031 No-Build Scenario with Background

RWDI# 2104052

Highway 401 & Power Dam Drive, South Stormont, Ontario

Receptor Information					Maximum Predicted 24-Hour Concentration (µg/m³)	Predicted Excursions Above Specified 24-Hour Values [1]					
						Events > 6.76E-06 µg/m³		Events > 2.68E-05 µg/m³		Events > 4.68E-05 µg/m³	
ID#	Description	X	Y	Z		Count	Frequency	Count	Frequency	Count	Frequency
R1	Residence	514907	4989770	1.5	3.07E-05	534	30.4%	1	0.1%	0	0.0%
R2	Residence	514798	4989534	1.5	4.18E-05	539	30.6%	14	0.8%	0	0.0%
R3	Residence	514499	4989514	1.5	2.19E-05	111	6.3%	0	0.0%	0	0.0%
R4	Residence	514452	4989743	1.5	4.38E-05	596	33.9%	16	0.9%	0	0.0%
R5	Residence	514956	4989264	1.5	2.19E-05	131	7.4%	0	0.0%	0	0.0%
R6	Residence	515652	4989109	1.5	4.79E-05	736	41.8%	25	1.4%	2	0.1%
R7	Residence	514680	4989826	1.5	4.12E-05	999	56.8%	12	0.7%	0	0.0%
R8	Residence	516211	4989152	1.5	1.94E-05	188	10.7%	0	0.0%	0	0.0%
R9	Residence	515401	4988783	1.5	1.44E-05	28	1.6%	0	0.0%	0	0.0%
R10	Residence	515361	4989983	1.5	1.13E-05	12	0.7%	0	0.0%	0	0.0%
R11	Residence	514788	4989903	1.5	2.00E-05	214	12.2%	0	0.0%	0	0.0%
R12	Residence	514915	4989371	1.5	2.79E-05	215	12.2%	1	0.1%	0	0.0%
R13	Residence	515143	4988998	1.5	1.94E-05	88	5.0%	0	0.0%	0	0.0%

42226 Hours of valid Meterological Data

1759 Days of valid Meteorological Data

Notes:

[1] Maximum predicted concentration that exceeds the difference between the AAQC and the background value (represents concentration with background).

Table 15: Benzo(a)pyrene Frequency Analysis - 2031 Build Scenario with Background

RWDI# 2104052

Highway 401 & Power Dam Drive, South Stormont, Ontario

Receptor Information					Maximum Predicted 24-Hour Concentration (µg/m³)	Predicted Excursions Above Specified 24-Hour Values [1]					
ID#	Description	X	Y	Z		Events > 6.76E-06 µg/m³		Events > 2.68E-05 µg/m³		Events > 4.68E-05 µg/m³	
						Count	Frequency	Count	Frequency	Count	Frequency
R1	Residence	514907	4989770	1.5	3.32E-05	700	39.8%	3	0.2%	0	0.0%
R2	Residence	514798	4989534	1.5	4.25E-05	541	30.7%	14	0.8%	0	0.0%
R3	Residence	514499	4989514	1.5	2.22E-05	114	6.5%	0	0.0%	0	0.0%
R4	Residence	514452	4989743	1.5	4.41E-05	596	33.9%	16	0.9%	0	0.0%
R5	Residence	514956	4989264	1.5	2.20E-05	127	7.2%	0	0.0%	0	0.0%
R6	Residence	515652	4989109	1.5	5.11E-05	764	43.4%	31	1.8%	3	0.2%
R7	Residence	514680	4989826	1.5	4.10E-05	999	56.8%	12	0.7%	0	0.0%
R8	Residence	516211	4989152	1.5	2.06E-05	233	13.2%	0	0.0%	0	0.0%
R9	Residence	515401	4988783	1.5	1.54E-05	34	1.9%	0	0.0%	0	0.0%
R10	Residence	515361	4989983	1.5	1.15E-05	12	0.7%	0	0.0%	0	0.0%
R11	Residence	514788	4989903	1.5	2.05E-05	244	13.9%	0	0.0%	0	0.0%
R12	Residence	514915	4989371	1.5	2.92E-05	238	13.5%	2	0.1%	0	0.0%
R13	Residence	515143	4988998	1.5	1.86E-05	67	3.8%	0	0.0%	0	0.0%

42226 Hours of valid Meterological Data
1759 Days of valid Meteorological Data

Notes:
[1] Maximum predicted concentration that exceeds the difference between the AAQC and the background value (represents concentration with background).

Table 16: Benzo(a)pyrene Frequency Analysis - 2041 Build Scenario with Background

RWDI# 2104052

Highway 401 & Power Dam Drive, South Stormont, Ontario

Receptor Information					Maximum Predicted 24-Hour Concentration (µg/m³)	Predicted Excursions Above Specified 24-Hour Values [1]					
						Events > 6.76E-06 µg/m³		Events > 2.68E-05 µg/m³		Events > 4.68E-05 µg/m³	
ID#	Description	X	Y	Z		Count	Frequency	Count	Frequency	Count	Frequency
R1	Residence	514907	4989770	1.5	9.85E-06	7	0.4%	0	0.0%	0	0.0%
R2	Residence	514798	4989534	1.5	1.22E-05	18	1.0%	0	0.0%	0	0.0%
R3	Residence	514499	4989514	1.5	6.33E-06	0	0.0%	0	0.0%	0	0.0%
R4	Residence	514452	4989743	1.5	1.25E-05	22	1.3%	0	0.0%	0	0.0%
R5	Residence	514956	4989264	1.5	6.40E-06	0	0.0%	0	0.0%	0	0.0%
R6	Residence	515652	4989109	1.5	1.45E-05	53	3.0%	0	0.0%	0	0.0%
R7	Residence	514680	4989826	1.5	1.15E-05	20	1.1%	0	0.0%	0	0.0%
R8	Residence	516211	4989152	1.5	5.81E-06	0	0.0%	0	0.0%	0	0.0%
R9	Residence	515401	4988783	1.5	4.37E-06	0	0.0%	0	0.0%	0	0.0%
R10	Residence	515361	4989983	1.5	3.32E-06	0	0.0%	0	0.0%	0	0.0%
R11	Residence	514788	4989903	1.5	6.11E-06	0	0.0%	0	0.0%	0	0.0%
R12	Residence	514915	4989371	1.5	8.52E-06	5	0.3%	0	0.0%	0	0.0%
R13	Residence	515143	4988998	1.5	5.52E-06	0	0.0%	0	0.0%	0	0.0%

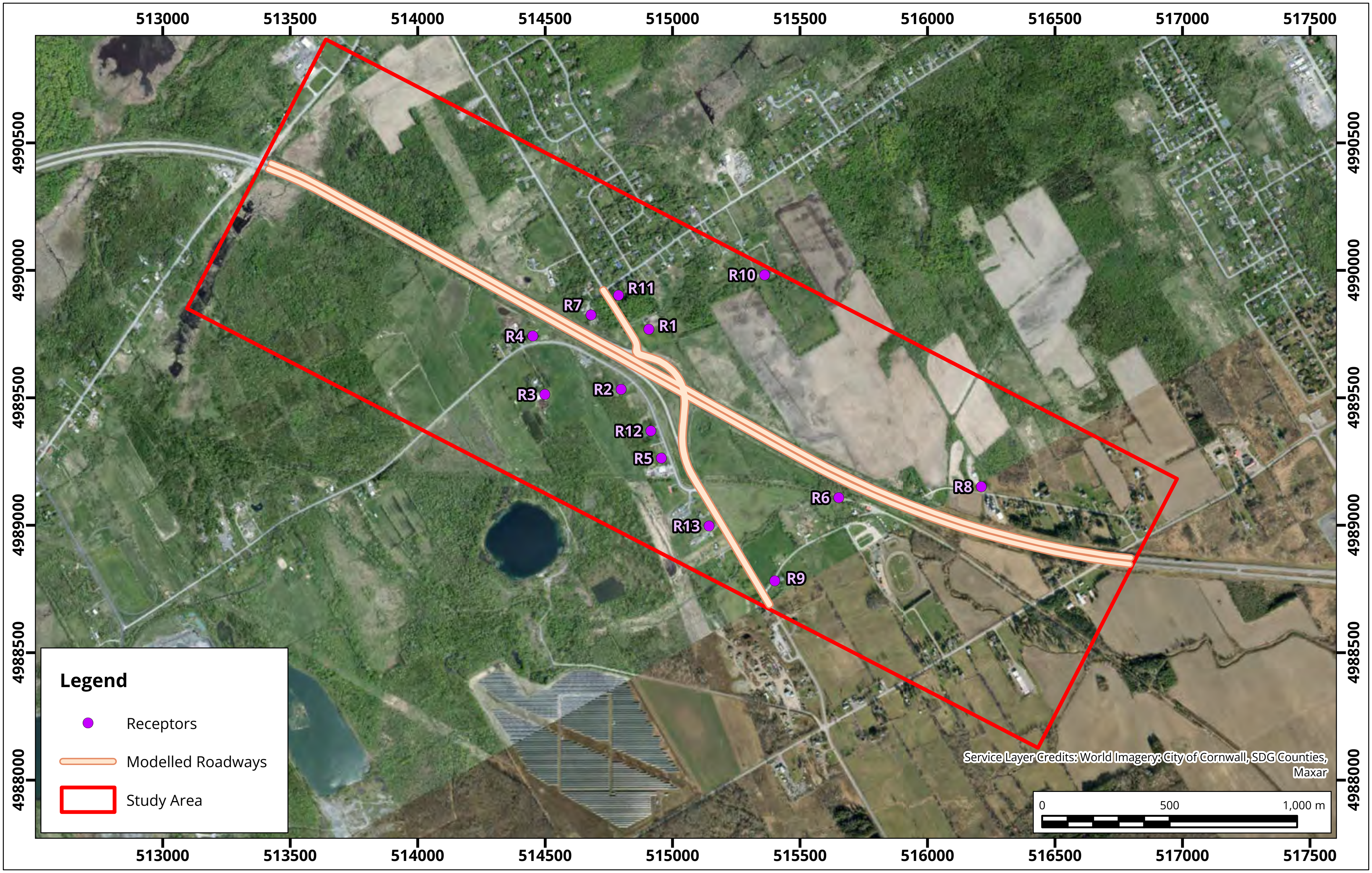
42226 Hours of valid Meterological Data

1759 Days of valid Meteorological Data

Notes:

[1] Maximum predicted concentration that exceeds the difference between the AAQC and the background value (represents concentration with background).

FIGURES



No-Build Scenario Area Plan Showing Study Area, Modelled Roadways, and Sensitive Receptors

Map Projection: NAD 1983 UTM Zone 18N

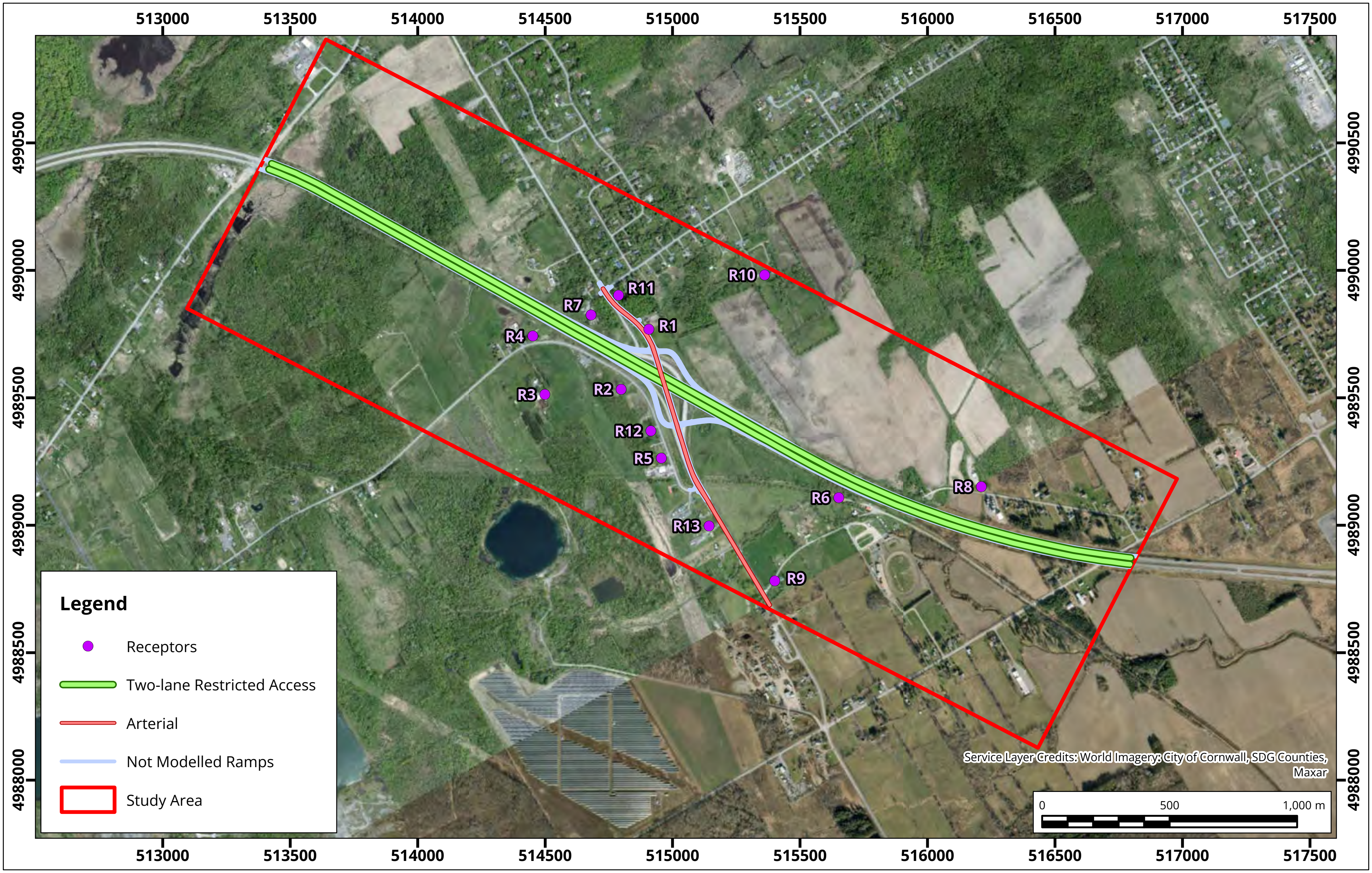
Highway 401 & Power Dam Drive - South Stormont, Ontario

True North

Project #: 2104052

Drawn by: PIP	Figure: 1
Approx. Scale:	1:21,000
Date Revised:	Jun 26, 2024

Map Document: C:\WorkingFolder\Jobs_Americas\P2104052\P2104052.aprx



2031 Build Scenario Area Plan Showing Study Area, Modelled Roadways, and Sensitive Receptors

Map Projection: NAD 1983 UTM Zone 18N

Highway 401 & Power Dam Drive - South Stormont, Ontario

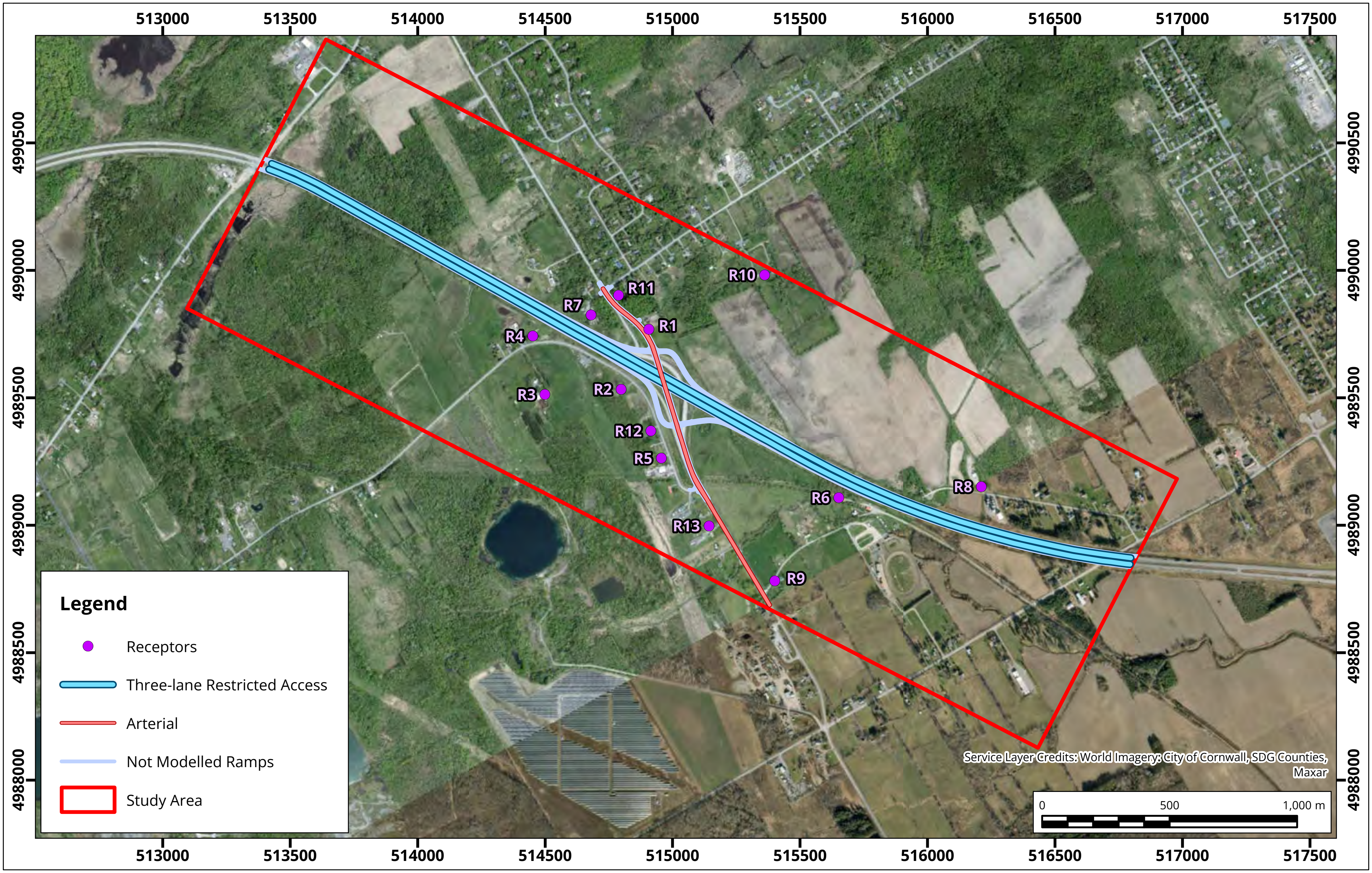
True North

Project #: 2104052

Drawn by: PIP	Figure: 2
Approx. Scale:	1:21,000
Date Revised:	Jul 4, 2024

RWDI

Map Document: C:\WorkingFolder\Jobs_Americas\P2104052\P2104052.aprx



2041 Build Scenario Area Plan Showing Study Area, Modelled Roadways, and Sensitive Receptors

Map Projection: NAD 1983 UTM Zone 18N

Highway 401 & Power Dam Drive - South Stormont, Ontario

True North

Project #: 2104052

Drawn by: PIP	Figure: 3
Approx. Scale:	1:21,000
Date Revised:	Jul 4, 2024

Map Document: C:\WorkingFolder\Jobs_Americas\P2104052\P2104052.aprx

APPENDIX A

Appendix A.1: Traffic Data Hourly Profile

Highway 401 and Power Dam Drive
South Stormont, Ontario

RWDI Project#: 2104052

Hwy 401

	0-1	*1-2*	*2-3*	*3-4*	*4-5*	*5-6*	*6-7*	*7-8*	*8-9*	*9-10*	*10-11*	*11-12*	*12-13*	*13-14*	*14-15*	*15-16*	*16-17*	*17-18*	*18-19*	*19-20*	*20-21*	*21-22*	*22-23*	*23-24*
Time (Hour Ending)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Hourly Eastbound Traffic Volume	200	179	167	155	149	167	259	400	454	472	434	437	505	599	649	704	732	670	505	419	398	402	356	278
Hourly ratio of traffic to peak hour	27%	24%	23%	21%	20%	23%	35%	55%	62%	64%	59%	60%	69%	82%	89%	96%	100%	92%	69%	57%	54%	55%	49%	38%
Hourly Westbound Traffic Volume	174	140	102	74	69	98	217	400	445	480	533	585	588	593	626	685	753	698	594	503	430	368	299	235
Hourly ratio of traffic to peak hour	23%	19%	14%	10%	9%	13%	29%	53%	59%	64%	71%	78%	78%	79%	83%	91%	100%	93%	79%	67%	57%	49%	40%	31%
Average Hourly ratio of traffic	25%	22%	18%	16%	15%	18%	32%	54%	61%	64%	65%	69%	74%	80%	86%	94%	100%	92%	74%	62%	56%	52%	44%	35%
Average Hourly ratio of traffic normalized to peak	25%	22%	18%	16%	15%	18%	32%	54%	61%	64%	65%	69%	74%	80%	86%	94%	100%	92%	74%	62%	56%	52%	44%	35%

[1] Traffic volume is from iCorridor, for the eastbound and westbound segments of Highway 401 between Headline Road and Cornwall Centre Road.
https://www.arcgis.com/apps/mapviewer/index.html?url=https://services.arcgis.com/6iGx1Dq91oKtcE7x/ArcGIS/rest/services/HighwayExpansionPrioritization/FeatureServer&source=sd

Appendix A.2: Traffic Composition by Source | **RWDI Project#: 2104052**

Highway 401 and Power Dam Drive
South Stormont, Ontario

Road	Description	Average Speed (km/h)	Direction	Model Source ID	Vehicle Composition						Weighted Average Vehicle Height (m)	AERMOD Initial Vertical Dimension (m)	AERMOD Initial Vertical Dispersion Coefficient (Szinit) (m)	AERMOD Source Release Height (Relhgt) (m)
					MOVES Vehicle Type >>	Passenger Car	Passenger Truck	Single Unit Short Haul Truck	Single Unit Long Haul Truck	Total %				
					MOVES SourceTypeID >>	21	31	52	53					
					Average Vehicle Height (m) >>	1.53	1.90	4.00	4.00					
Hwy 401	Highway 401 Westbound, East of Power Dam Drive	100	WB	L1		38%	25%	19%	19%	100%	2.55	4.33	2.02	2.17
Hwy 401	Highway 401 Westbound, West of Power Dam Drive	100	WB	L2		38%	25%	19%	19%	100%	2.55	4.33	2.02	2.17
Hwy 401	Highway 401 Eastbound West of Power Dam Drive	100	EB	L3		38%	25%	19%	19%	100%	2.55	4.33	2.02	2.17
Hwy 401	Highway 401 Eastbound, East of Power Dam Drive	100	EB	L4		38%	25%	19%	19%	100%	2.55	4.33	2.02	2.17
Power Dam Drive	Power Dam Dr Northbound from Cornwall Centre Rd to South Intersection	80	NB	L5		55%	36%	5%	5%	100%	1.89	3.21	1.49	1.60
Power Dam Drive	Power Dam Dr Northbound from South to North Intersection	80	NB	L6		55%	36%	5%	5%	100%	1.89	3.21	1.49	1.60
Power Dam Drive	Power Dam Dr Northbound from North Intersection to Headline Rd	80	NB	L7		55%	36%	5%	5%	100%	1.89	3.21	1.49	1.60
Power Dam Drive	Power Dam Dr Southbound from Headline Rd to North Intersection	80	SB	L8		55%	36%	5%	5%	100%	1.89	3.21	1.49	1.60
Power Dam Drive	Power Dam Dr Southbound from North to South Intersection	80	SB	L9		55%	36%	5%	5%	100%	1.89	3.21	1.49	1.60
Power Dam Drive	Power Dam Dr Southbound from South Intersection to Cornwall Centre Rd	80	SB	L10		55%	36%	5%	5%	100%	1.89	3.21	1.49	1.60

Appendix A.3: Year 2021 Detailed Traffic Data and Fugitive Particulate Matter Emissions, No-Build

Highway 401 and Power Dam Drive

South Stormont, Ontario

Road	Description	Model Source ID	Direction	AM Peak Volume	PM Peak Volume		AM Peak Volume by Vehicle					PM Peak Volume by Vehicle					Peak Hour Network Speed (km/hour)	Weighted Average Vehicle Weight (US short tons)		Silt Loading (g/m2)	AM Peak				PM Peak			
						MOVES Vehicle Type >>	Passenger Car	Passenger Truck	Single Unit Short Haul Truck	Single Unit Long Haul Truck	Total	Passenger Car	Passenger Truck	Single Unit Short Haul Truck	Single Unit Long Haul Truck	Total					AP-42 Emission Factor		Base Emission Rate		AP-42 Emission Factor		Base Emission Rate	
						MOVES SourceTypeID >>	21	31	52	53		21	31	52	53			AM Peak	PM Peak		PM_{10} (g/VKT)	$PM_{2.5}$ (g/VKT)	PM_{10} (g/s-mile)	$PM_{2.5}$ (g/s-mile)	PM_{10} (g/VKT)	$PM_{2.5}$ (g/VKT)	PM_{10} (g/s-mile)	$PM_{2.5}$ (g/s-mile)
						Average Vehicle Weight (US short tons) >>	1.36	1.99	15.51	15.35		1.36	1.99	15.51	15.35													
Hwy 401	Highway 401 Westbound, East of Power Dam Drive	L1	WB	580	1,220		218	145	109	109	580	458	305	229	229	1220	100	6.8	6.8	0.015	0.096	0.023	0.025	0.006	0.096	0.023	0.052	0.013
Hwy 401	Highway 401 Westbound, West of Power Dam Drive	L2	WB	620	1,280		233	155	116	116	620	480	320	240	240	1280	100	6.8	6.8	0.015	0.096	0.023	0.027	0.006	0.096	0.023	0.055	0.013
Hwy 401	Highway 401 Eastbound West of Power Dam Drive	L3	EB	855	1,055		321	214	160	160	855	396	264	198	198	1055	100	6.8	6.8	0.015	0.096	0.023	0.037	0.009	0.096	0.023	0.045	0.011
Hwy 401	Highway 401 Eastbound, East of Power Dam Drive	L4	EB	820	1,005		308	205	154	154	820	377	251	188	188	1005	100	6.8	6.8	0.015	0.096	0.023	0.035	0.008	0.096	0.023	0.043	0.010
Power Dam Drive	Power Dam Dr Northbound from Cornwall Centre Rd to South Intersection	L5	NB	50	120		27	18	2	2	50	66	44	5	5	120	80	2.9	2.9	0.200	0.418	0.101	0.009	0.002	0.418	0.101	0.022	0.005
Power Dam Drive	Power Dam Dr Northbound from South to North Intersection	L6	NB	50	120		27	18	2	2	50	66	44	5	5	120	80	2.9	2.9	0.200	0.418	0.101	0.009	0.002	0.418	0.101	0.022	0.005
Power Dam Drive	Power Dam Dr Northbound from North Intersection to Headline Rd	L7	NB	30	95		16	11	1	1	30	52	35	4	4	95	80	2.9	2.9	0.200	0.418	0.101	0.006	0.001	0.418	0.101	0.018	0.004
Power Dam Drive	Power Dam Dr Southbound from Headline Rd to North Intersection	L8	SB	65	100		35	24	3	3	65	55	36	5	5	100	80	2.9	2.9	0.200	0.418	0.101	0.012	0.003	0.418	0.101	0.019	0.005
Power Dam Drive	Power Dam Dr Southbound from North to South Intersection	L9	SB	50	75		27	18	2	2	50	41	27	3	3	75	80	2.9	2.9	0.200	0.418	0.101	0.009	0.002	0.418	0.101	0.014	0.003
Power Dam Drive	Power Dam Dr Southbound from South Intersection to Cornwall Centre Rd	L10	SB	80	120		44	29	4	4	80	66	44	5	5	120	80	2.9	2.9	0.200	0.418	0.101	0.015	0.004	0.418	0.101	0.022	0.005

Appendix A.3: Year 2031 Detailed Traffic Data and Fugitive Particulate Matter Emissions, Build
Highway 401 and Power Dam Drive
South Stormont, Ontario

Road	Description	Model Source ID	Direction	AM Peak Volume	PM Peak Volume		AM Peak Volume by Vehicle					PM Peak Volume by Vehicle									AM Peak				PM Peak			
						MOVES Vehicle Type >>	Passenger Car	Passenger Truck	Single Unit Short Haul Truck	Single Unit Long Haul Truck	Total	Passenger Car	Passenger Truck	Single Unit Short Haul Truck	Single Unit Long Haul Truck	Total	Peak Hour Network Speed (km/hour)	Weighted Average Vehicle Weight (US short tons)		Silt Loading (g/m^2)	AP-42 Emission Factor		Base Emission Rate		AP-42 Emission Factor		Base Emission Rate	
						MOVES SourceTypeID >>	21	31	52	53		21	31	52	53			AM Peak	PM Peak		PM_{10} (g/VKT)	$PM_{2.5}$ (g/VKT)	PM_{10} (g/s-mile)	$PM_{2.5}$ (g/s-mile)	PM_{10} (g/VKT)	$PM_{2.5}$ (g/VKT)	PM_{10} (g/s-mile)	$PM_{2.5}$ (g/s-mile)
						Average Vehicle Weight (US short tons) >>	1.36	1.99	15.51	15.35		1.36	1.99	15.51	15.35													
Hwy 401	Highway 401 Westbound, East of Power Dam Drive	L1	WB	770	1,470		289	193	144	144	770	551	368	276	276	1470	100	6.8	6.8	0.015	0.096	0.023	0.033	0.008	0.096	0.023	0.063	0.015
Hwy 401	Highway 401 Westbound, West of Power Dam Drive	L2	WB	730	1,425		274	183	137	137	730	534	356	267	267	1425	100	6.8	6.8	0.015	0.096	0.023	0.031	0.008	0.096	0.023	0.061	0.015
Hwy 401	Highway 401 Eastbound, West of Power Dam Drive	L3	EB	950	1,205		356	238	178	178	950	452	301	226	226	1205	100	6.8	6.8	0.015	0.096	0.023	0.041	0.010	0.096	0.023	0.052	0.012
Hwy 401	Highway 401 Eastbound, East of Power Dam Drive	L4	EB	1,005	1,245		377	251	188	188	1005	467	311	233	233	1245	100	6.8	6.8	0.015	0.096	0.023	0.043	0.010	0.096	0.023	0.053	0.013
Power Dam Drive	Power Dam Drive Northbound from Cornwall Rd to South Intersection	L5	NB	30	40		16	11	1	1	30	22	15	2	2	40	80	2.9	2.9	0.600	1.136	0.275	0.015	0.004	1.136	0.275	0.020	0.005
Power Dam Drive	Power Dam Drive Northbound from South to North Intersection	L6	NB	25	75		14	9	1	1	25	41	27	3	3	75	80	2.9	2.9	0.200	0.418	0.101	0.005	0.001	0.418	0.101	0.014	0.003
Power Dam Drive	Power Dam Drive Northbound from North Intersection to Headline Rd	L7	NB	75	135		41	27	3	3	75	74	49	6	6	135	80	2.9	2.9	0.200	0.418	0.101	0.014	0.003	0.418	0.101	0.025	0.006
Power Dam Drive	Power Dam Drive Southbound from Headline Rd to North Intersection	L8	SB	100	110		55	36	5	5	100	60	40	5	5	110	80	2.9	2.9	0.200	0.418	0.101	0.019	0.005	0.418	0.101	0.021	0.005
Power Dam Drive	Power Dam Drive Southbound from North to South Intersection	L9	SB	105	110		57	38	5	5	105	60	40	5	5	110	80	2.9	2.9	0.200	0.418	0.101	0.020	0.005	0.418	0.101	0.021	0.005
Power Dam Drive	Power Dam Drive Southbound from South Intersection to Cornwall Rd	L10	SB	35	35		19	13	2	2	35	19	13	2	2	35	80	2.9	2.9	0.600	1.136	0.275	0.018	0.004	1.136	0.275	0.018	0.004

Appendix A.3: Year 2031 Detailed Traffic Data and Fugitive Particulate Matter Emissions, No-Build

Highway 401 and Power Dam Drive

South Stormont, Ontario

Road	Description	Model Source ID	Direction	AM Peak Volume	PM Peak Volume		AM Peak Volume by Vehicle					PM Peak Volume by Vehicle										AM Peak				PM Peak			
						MOVES Vehicle Type >>	Passenger Car	Passenger Truck	Single Unit Short Haul Truck	Single Unit Long Haul Truck	Total	Passenger Car	Passenger Truck	Single Unit Short Haul Truck	Single Unit Long Haul Truck	Total	Peak Hour Network Speed (km/hour)	Weighted Average Vehicle Weight (US short tons)		Silt Loading (g/m2)	AP-42 Emission Factor		Base Emission Rate		AP-42 Emission Factor		Base Emission Rate	
						MOVES SourceTypeID >>	21	31	52	53		21	31	52	53			AM Peak	PM Peak		PM_{10} (g/VKT)	$PM_{2.5}$ (g/VKT)	PM_{10} (g/s-mile)	$PM_{2.5}$ (g/s-mile)	PM_{10} (g/VKT)	$PM_{2.5}$ (g/VKT)	PM_{10} (g/s-mile)	$PM_{2.5}$ (g/s-mile)
						Average Vehicle Weight (US short tons) >>	1.36	1.99	15.51	15.35		1.36	1.99	15.51	15.35													
Hwy 401	Highway 401 Westbound, East of Power Dam Drive	L1	WB	705	1,380		264	176	132	132	705	518	345	259	259	1380	100	6.8	6.8	0.015	0.096	0.023	0.030	0.007	0.096	0.023	0.059	0.014
Hwy 401	Highway 401 Westbound, West of Power Dam Drive	L2	WB	735	1,430		276	184	138	138	735	536	358	268	268	1430	100	6.8	6.8	0.015	0.096	0.023	0.031	0.008	0.096	0.023	0.061	0.015
Hwy 401	Highway 401 Eastbound West of Power Dam Drive	L3	EB	945	1,205		354	236	177	177	945	452	301	226	226	1205	100	6.8	6.8	0.015	0.096	0.023	0.040	0.010	0.096	0.023	0.052	0.012
Hwy 401	Highway 401 Eastbound, East of Power Dam Drive	L4	EB	905	1,165		339	226	170	170	905	437	291	218	218	1165	100	6.8	6.8	0.015	0.096	0.023	0.039	0.009	0.096	0.023	0.050	0.012
Power Dam Drive	Power Dam Dr Northbound from Cornwall Centre Rd to South Intersection	L5	NB	65	135		35	24	3	3	65	74	49	6	6	135	80	2.9	2.9	0.200	0.418	0.101	0.012	0.003	0.418	0.101	0.025	0.006
Power Dam Drive	Power Dam Dr Northbound from South to North Intersection	L6	NB	65	135		35	24	3	3	65	74	49	6	6	135	80	2.9	2.9	0.200	0.418	0.101	0.012	0.003	0.418	0.101	0.025	0.006
Power Dam Drive	Power Dam Dr Northbound from North Intersection to Headline Rd	L7	NB	45	105		25	16	2	2	45	57	38	5	5	105	80	2.9	2.9	0.200	0.418	0.101	0.008	0.002	0.418	0.101	0.020	0.005
Power Dam Drive	Power Dam Dr Southbound from Headline Rd to North Intersection	L8	SB	100	110		55	36	5	5	100	60	40	5	5	110	80	2.9	2.9	0.200	0.418	0.101	0.019	0.005	0.418	0.101	0.021	0.005
Power Dam Drive	Power Dam Dr Southbound from North to South Intersection	L9	SB	90	95		49	33	4	4	90	52	35	4	4	95	80	2.9	2.9	0.200	0.418	0.101	0.017	0.004	0.418	0.101	0.018	0.004
Power Dam Drive	Power Dam Dr Southbound from South Intersection to Cornwall Centre Rd	L10	SB	120	130		66	44	5	5	120	71	47	6	6	130	80	2.9	2.9	0.200	0.418	0.101	0.022	0.005	0.418	0.101	0.024	0.006

Appendix A.3: Year 2041 Detailed Traffic Data and Fugitive Particulate Matter Emissions, Build
Highway 401 and Power Dam Drive
South Stormont, Ontario

Road	Description	Model Source ID	Direction	AM Peak Volume	PM Peak Volume		AM Peak Volume by Vehicle						PM Peak Volume by Vehicle									AM Peak				PM Peak			
						MOVES Vehicle Type >>	Motorcycle	Passenger Car	Passenger Truck	Single Unit Short Haul Truck	Single Unit Long Haul Truck	Total	Passenger Car	Passenger Truck	Single Unit Short Haul Truck	Single Unit Long Haul Truck	Total	Peak Hour Network Speed (km/hour)	Weighted Average Vehicle Weight (US short tons)		Silt Loading (g/m^2)	AP-42 Emission Factor		Base Emission Rate		AP-42 Emission Factor		Base Emission Rate	
						MOVES SourceTypeID >>	11	21	31	52	53		21	31	52	53			AM Peak	PM Peak		PM_{10} (g/VKT)	$PM_{2.5}$ (g/VKT)	PM_{10} (g/s-mile)	$PM_{2.5}$ (g/s-mile)	PM_{10} (g/VKT)	$PM_{2.5}$ (g/VKT)	PM_{10} (g/s-mile)	$PM_{2.5}$ (g/s-mile)
						Average Vehicle Weight (US short tons) >>	0.23	1.36	1.99	15.51	15.35		1.36	1.99	15.51	15.35													
Hwy 401	Highway 401 Westbound, East of Power Dam Drive	L1	WB	900	1,640		0	338	225	169	169	900	615	410	308	308	1640	100	6.8	6.8	0.015	0.096	0.023	0.039	0.009	0.096	0.023	0.070	0.017
Hwy 401	Highway 401 Westbound, West of Power Dam Drive	L2	WB	845	1,575		0	317	211	158	158	845	591	394	295	295	1575	100	6.8	6.8	0.015	0.096	0.023	0.036	0.009	0.096	0.023	0.067	0.016
Hwy 401	Highway 401 Eastbound, West of Power Dam Drive	L3	EB	1,040	1,360		0	390	260	195	195	1040	510	340	255	255	1360	100	6.8	6.8	0.015	0.096	0.023	0.045	0.011	0.096	0.023	0.058	0.014
Hwy 401	Highway 401 Eastbound, East of Power Dam Drive	L4	EB	1,100	1,420		0	413	275	206	206	1100	533	355	266	266	1420	100	6.8	6.8	0.015	0.096	0.023	0.047	0.011	0.096	0.023	0.061	0.015
Power Dam Drive	Power Dam Drive Northbound from Cornwall Rd to South Intersection	L5	NB	45	50		0	25	16	2	2	45	27	18	2	2	50	80	2.9	2.9	0.600	1.136	0.275	0.023	0.006	1.136	0.275	0.025	0.006
Power Dam Drive	Power Dam Drive Northbound from South to North Intersection	L6	NB	40	90		0	22	15	2	2	40	49	33	4	4	90	80	2.9	2.9	0.200	0.418	0.101	0.007	0.002	0.418	0.101	0.017	0.004
Power Dam Drive	Power Dam Drive Northbound from North Intersection to Headline Rd	L7	NB	85	145		0	46	31	4	4	85	79	53	7	7	145	80	2.9	2.9	0.200	0.418	0.101	0.016	0.004	0.418	0.101	0.027	0.007
Power Dam Drive	Power Dam Drive Southbound from Headline Rd to South Intersection	L8	SB	140	120		0	76	51	6	6	140	66	44	5	5	120	80	2.9	2.9	0.200	0.418	0.101	0.026	0.006	0.418	0.101	0.022	0.005
Power Dam Drive	Power Dam Drive Southbound from North to South Intersection	L9	SB	145	130		0	79	53	7	7	145	71	47	6	6	130	80	2.9	2.9	0.200	0.418	0.101	0.027	0.007	0.418	0.101	0.024	0.006
Power Dam Drive	Power Dam Drive Southbound from South Intersection to Cornwall Rd	L10	SB	75	50		0	41	27	3	3	75	27	18	2	2	50	80	2.9	2.9	0.200	0.418	0.101	0.014	0.003	0.418	0.101	0.009	0.002

Appendix A.3: Year 2041 Detailed Traffic Data and Fugitive Particulate Matter Emissions, No-Build

Highway 401 and Power Dam Drive

South Stormont, Ontario

Road	Description	Model Source ID	Direction	AM Peak Volume	PM Peak Volume		AM Peak Volume by Vehicle					PM Peak Volume by Vehicle									AM Peak				PM Peak			
						MOVES Vehicle Type >>	Passenger Car	Passenger Truck	Single Unit Short Haul Truck	Single Unit Long Haul Truck	Total	Passenger Car	Passenger Truck	Single Unit Short Haul Truck	Single Unit Long Haul Truck	Total	Peak Hour Network Speed (km/hour)	Weighted Average Vehicle Weight (US short tons)		Silt Loading (g/m^2)	AP-42 Emission Factor		Base Emission Rate		AP-42 Emission Factor		Base Emission Rate	
						MOVES SourceTypeID >>	21	31	52	53		21	31	52	53			AM Peak	PM Peak		PM_{10} (g/VKT)	$PM_{2.5}$ (g/VKT)	PM_{10} (g/s-mile)	$PM_{2.5}$ (g/s-mile)	PM_{10} (g/VKT)	$PM_{2.5}$ (g/VKT)	PM_{10} (g/s-mile)	$PM_{2.5}$ (g/s-mile)
						Average Vehicle Weight (US short tons) >>	1.36	1.99	15.51	15.35		1.36	1.99	15.51	15.35													
Hwy 401	Highway 401 Westbound, East of Power Dam Drive	L1	WB	825	1,535		309	206	155	155	825	576	384	288	288	1535	100	6.8	6.8	0.015	0.096	0.023	0.035	0.009	0.096	0.023	0.066	0.016
Hwy 401	Highway 401 Westbound, West of Power Dam Drive	L2	WB	850	1,580		319	213	159	159	850	593	395	296	296	1580	100	6.8	6.8	0.015	0.096	0.023	0.036	0.009	0.096	0.023	0.068	0.016
Hwy 401	Highway 401 Eastbound West of Power Dam Drive	L3	EB	1,035	1,360		388	259	194	194	1035	510	340	255	255	1360	100	6.8	6.8	0.015	0.096	0.023	0.044	0.011	0.096	0.023	0.058	0.014
Hwy 401	Highway 401 Eastbound, East of Power Dam Drive	L4	EB	995	1,325		373	249	187	187	995	497	331	248	248	1325	100	6.8	6.8	0.015	0.096	0.023	0.043	0.010	0.096	0.023	0.057	0.014
Power Dam Drive	Power Dam Dr Northbound from Cornwall Centre Rd to South Intersection	L5	NB	80	145		44	29	4	4	80	79	53	7	7	145	80	2.9	2.9	0.200	0.418	0.101	0.015	0.004	0.418	0.101	0.027	0.007
Power Dam Drive	Power Dam Dr Northbound from South to North Intersection	L6	NB	75	145		41	27	3	3	75	79	53	7	7	145	80	2.9	2.9	0.200	0.418	0.101	0.014	0.003	0.418	0.101	0.027	0.007
Power Dam Drive	Power Dam Dr Northbound from North Intersection to Headline Rd	L7	NB	55	115		30	20	2	2	55	63	42	5	5	115	80	2.9	2.9	0.200	0.418	0.101	0.010	0.002	0.418	0.101	0.021	0.005
Power Dam Drive	Power Dam Dr Southbound from Headline Rd to North Intersection	L8	SB	140	120		76	51	6	6	140	66	44	5	5	120	80	2.9	2.9	0.200	0.418	0.101	0.026	0.006	0.418	0.101	0.022	0.005
Power Dam Drive	Power Dam Dr Southbound from North to South Intersection	L9	SB	125	110		68	46	6	6	125	60	40	5	5	110	80	2.9	2.9	0.200	0.418	0.101	0.023	0.006	0.418	0.101	0.021	0.005
Power Dam Drive	Power Dam Dr Southbound from South Intersection to Cornwall Centre Rd	L10	SB	155	145		85	56	7	7	155	79	53	7	7	145	80	2.9	2.9	0.200	0.418	0.101	0.029	0.007	0.418	0.101	0.027	0.007

Appendix A.4: MOVES Emission Factors for PM Peak Traffic by Roadway Segment

Modelled Year	Modelled Scenario	Model Source ID	Aggregate Emission Factor (g/s-mile)												
			Acrolein	Acetaldehyde	Benzo(a)pyrene	Benzene	CO	1,3-butadiene	Formaldehyde	NOx	PM_{10}	$PM_{2.5}$	CO_2	CH_4	N_2O
2021	No-Build	L1	1.98E-04	1.22E-03	1.76E-06	7.76E-04	1.14E+00	1.41E-04	2.48E-03	4.33E-01	2.36E-02	1.57E-02	1.70E+02	4.09E-03	6.92E-04
		L2	2.08E-04	1.28E-03	1.84E-06	8.14E-04	1.20E+00	1.48E-04	2.61E-03	4.55E-01	2.47E-02	1.65E-02	1.78E+02	4.29E-03	7.26E-04
		L3	1.72E-04	1.05E-03	1.52E-06	6.71E-04	9.88E-01	1.22E-04	2.15E-03	3.75E-01	2.04E-02	1.36E-02	1.47E+02	3.53E-03	5.99E-04
		L4	1.63E-04	1.00E-03	1.45E-06	6.39E-04	9.41E-01	1.16E-04	2.05E-03	3.57E-01	1.94E-02	1.30E-02	1.40E+02	3.37E-03	5.70E-04
		L5	7.56E-06	5.85E-05	8.81E-08	7.89E-05	1.09E-01	1.10E-05	1.02E-04	2.15E-02	1.42E-03	6.36E-04	1.26E+01	4.73E-04	7.54E-05
		L6	7.08E-06	5.42E-05	8.39E-08	7.23E-05	1.04E-01	9.99E-06	9.53E-05	1.98E-02	1.39E-03	6.12E-04	1.20E+01	4.39E-04	6.76E-05
		L7	5.61E-06	4.29E-05	6.64E-08	5.72E-05	8.20E-02	7.91E-06	7.55E-05	1.56E-02	1.10E-03	4.85E-04	9.48E+00	3.48E-04	5.35E-05
		L8	5.90E-06	4.52E-05	6.99E-08	6.02E-05	8.63E-02	8.33E-06	7.94E-05	1.65E-02	1.16E-03	5.10E-04	9.98E+00	3.66E-04	5.63E-05
		L9	4.43E-06	3.39E-05	5.25E-08	4.52E-05	6.47E-02	6.24E-06	5.96E-05	1.23E-02	8.68E-04	3.83E-04	7.48E+00	2.75E-04	4.23E-05
		L10	7.08E-06	5.42E-05	8.39E-08	7.23E-05	1.04E-01	9.99E-06	9.53E-05	1.98E-02	1.39E-03	6.12E-04	1.20E+01	4.39E-04	6.76E-05
2031	No-Build	L1	7.81E-05	4.55E-04	6.89E-07	2.65E-04	7.06E-01	3.09E-05	9.69E-04	1.66E-01	2.05E-02	7.52E-03	1.68E+02	1.89E-03	5.25E-04
		L2	8.10E-05	4.71E-04	7.14E-07	2.75E-04	7.32E-01	3.20E-05	1.00E-03	1.72E-01	2.13E-02	7.79E-03	1.74E+02	1.95E-03	5.44E-04
		L3	6.82E-05	3.97E-04	6.02E-07	2.31E-04	6.17E-01	2.69E-05	8.46E-04	1.45E-01	1.79E-02	6.56E-03	1.47E+02	1.65E-03	4.58E-04
		L4	6.60E-05	3.84E-04	5.82E-07	2.24E-04	5.96E-01	2.61E-05	8.18E-04	1.40E-01	1.73E-02	6.35E-03	1.42E+02	1.59E-03	4.43E-04
		L5	2.57E-06	1.60E-05	3.44E-08	1.99E-05	6.18E-02	9.26E-07	3.33E-05	5.84E-03	1.53E-03	3.73E-04	1.12E+01	1.82E-04	4.02E-05
		L6	2.57E-06	1.60E-05	3.44E-08	1.99E-05	6.18E-02	9.26E-07	3.33E-05	5.84E-03	1.53E-03	3.73E-04	1.12E+01	1.82E-04	4.02E-05
		L7	2.00E-06	1.24E-05	2.68E-08	1.55E-05	4.80E-02	7.20E-07	2.59E-05	4.54E-03	1.19E-03	2.90E-04	8.74E+00	1.42E-04	3.12E-05
		L8	2.09E-06	1.30E-05	2.80E-08	1.62E-05	5.03E-02	7.54E-07	2.72E-05	4.75E-03	1.25E-03	3.04E-04	9.16E+00	1.49E-04	3.27E-05
		L9	1.81E-06	1.12E-05	2.42E-08	1.40E-05	4.35E-02	6.51E-07	2.35E-05	4.11E-03	1.08E-03	2.62E-04	7.91E+00	1.28E-04	2.83E-05
		L10	2.47E-06	1.54E-05	3.31E-08	1.91E-05	5.95E-02	8.91E-07	3.21E-05	5.62E-03	1.47E-03	3.59E-04	1.08E+01	1.76E-04	3.87E-05
	Build	L1	8.32E-05	4.84E-04	7.34E-07	2.82E-04	7.52E-01	3.29E-05	1.03E-03	1.77E-01	2.19E-02	8.01E-03	1.79E+02	2.01E-03	5.59E-04
		L2	8.07E-05	4.70E-04	7.12E-07	2.74E-04	7.29E-01	3.19E-05	1.00E-03	1.71E-01	2.12E-02	7.76E-03	1.74E+02	1.95E-03	5.42E-04
		L3	6.82E-05	3.97E-04	6.02E-07	2.31E-04	6.17E-01	2.69E-05	8.46E-04	1.45E-01	1.79E-02	6.56E-03	1.47E+02	1.65E-03	4.58E-04
		L4	7.05E-05	4.10E-04	6.22E-07	2.39E-04	6.37E-01	2.78E-05	8.74E-04	1.50E-01	1.85E-02	6.78E-03	1.52E+02	1.70E-03	4.73E-04
		L5	7.61E-07	4.73E-06	1.02E-08	5.89E-06	1.83E-02	2.74E-07	9.88E-06	1.73E-03	4.53E-04	1.10E-04	3.33E+00	5.40E-05	1.19E-05
		L6	1.43E-06	8.87E-06	1.91E-08	1.10E-05	3.43E-02	5.14E-07	1.85E-05	3.24E-03	8.50E-04	2.07E-04	6.25E+00	1.01E-04	2.23E-05
		L7	2.57E-06	1.60E-05	3.44E-08	1.99E-05	6.18E-02	9.26E-07	3.33E-05	5.84E-03	1.53E-03	3.73E-04	1.12E+01	1.82E-04	4.02E-05
		L8	2.09E-06	1.30E-05	2.80E-08	1.62E-05	5.03E-02	7.54E-07	2.72E-05	4.75E-03	1.25E-03	3.04E-04	9.16E+00	1.49E-04	3.27E-05
		L9	2.09E-06	1.30E-05	2.80E-08	1.62E-05	5.03E-02	7.54E-07	2.72E-05	4.75E-03	1.25E-03	3.04E-04	9.16E+00	1.49E-04	3.27E-05
		L10	6.66E-07	4.14E-06	8.92E-09	5.15E-06	1.60E-02	2.40E-07	8.64E-06	1.51E-03	3.97E-04	9.67E-05	2.91E+00	4.73E-05	1.04E-05
2041	No-Build	L1	5.91E-06	6.50E-05	1.93E-07	1.41E-04	5.66E-01	0.00E+00	7.50E-05	6.65E-02	1.16E-02	2.38E-03	1.70E+02	1.45E-03	4.40E-04
		L2	6.08E-06	6.69E-05	1.99E-07	1.45E-04	5.83E-01	0.00E+00	7.72E-05	6.84E-02	1.19E-02	2.45E-03	1.75E+02	1.49E-03	4.53E-04
		L3	5.23E-06	5.76E-05	1.71E-07	1.25E-04	5.02E-01	0.00E+00	6.65E-05	5.89E-02	1.03E-02	2.11E-03	1.51E+02	1.28E-03	3.90E-04
		L4	5.10E-06	5.61E-05	1.67E-07	1.22E-04	4.89E-01	0.00E+00	6.48E-05	5.74E-02	1.00E-02	2.05E-03	1.47E+02	1.25E-03	3.80E-04
		L5	3.40E-07	3.66E-06	1.26E-08	1.18E-05	4.21E-02	0.00E+00	5.14E-06	2.57E-03	1.16E-03	2.05E-04	1.08E+01	1.29E-04	3.82E-05
		L6	3.40E-07	3.66E-06	1.26E-08	1.18E-05	4.21E-02	0.00E+00	5.14E-06	2.57E-03	1.16E-03	2.05E-04	1.08E+01	1.29E-04	3.82E-05
		L7	2.70E-07	2.91E-06	1.00E-08	9.37E-06	3.34E-02	0.00E+00	4.08E-06	2.04E-03	9.21E-04	1.62E-04	8.59E+00	1.02E-04	3.03E-05
		L8	2.82E-07	3.03E-06	1.04E-08	9.77E-06	3.48E-02	0.00E+00	4.26E-06	2.12E-03	9.62E-04	1.69E-04	8.97E+00	1.06E-04	3.16E-05
		L9	2.58E-07	2.78E-06	9.57E-09	8.96E-06	3.19E-02	0.00E+00	3.90E-06	1.95E-03	8.81E-04	1.55E-04	8.22E+00	9.76E-05	2.90E-05
		L10	3.40E-07	3.66E-06	1.26E-08	1.18E-05	4.21E-02	0.00E+00	5.14E-06	2.57E-03	1.16E-03	2.05E-04	1.08E+01	1.29E-04	3.82E-05
	Build	L1	6.31E-06	6.94E-05	2.07E-07	1.51E-04	6.05E-01	0.00E+00	8.01E-05	7.10E-02	1.24E-02	2.54E-03	1.82E+02	1.55E-03	4.70E-04
		L2	6.06E-06	6.67E-05	1.98E-07	1.45E-04	5.81E-01	0.00E+00	7.70E-05	6.82E-02	1.19E-02	2.44E-03	1.74E+02	1.49E-03	4.52E-04
		L3	5.23E-06	5.76E-05	1.71E-07	1.25E-04	5.02E-01	0.00E+00	6.65E-05	5.89E-02	1.03E-02	2.11E-03	1.51E+02	1.28E-03	3.90E-04
		L4	5.46E-06	6.01E-05	1.79E-07	1.31E-04	5.24E-01	0.00E+00	6.94E-05	6.15E-02	1.07E-02	2.20E-03	1.57E+02	1.34E-03	4.07E-04
		L5	1.17E-07	1.26E-06	4.35E-09	4.07E-06	1.45E-02	0.00E+00	1.77E-06	8.85E-04	4.01E-04	7.06E-05	3.74E+00	4.44E-05	1.32E-05
		L6	2.11E-07	2.27E-06	7.83E-09	7.33E-06	2.61E-02	0.00E+00	3.19E-06	1.59E-03	7.21E-04	1.27E-04	6.73E+00	7.99E-05	2.37E-05
		L7	3.40E-07	3.66E-06	1.26E-08	1.18E-05	4.21E-02	0.00E+00	5.14E-06	2.57E-03	1.16E-03	2.05E-04	1.08E+01	1.29E-04	3.82E-05
		L8	2.82E-07	3.03E-06	1.04E-08	9.77E-06	3.48E-02	0.00E+00	4.26E-06	2.12E-03	9.62E-04	1.69E-04	8.97E+00	1.06E-04	3.16E-05
		L9	3.05E-07	3.28E-06	1.13E-08	1.06E-05	3.77E-02	0.00E+00	4.61E-06	2.30E-03	1.04E-03	1.84E-04	9.72E+00	1.15E-04	3.42E-05
		L10	1.17E-07	1.26E-06	4.35E-09	4.07E-06	1.45E-02	0.00E+00	1.77E-06	8.85E-04	4.01E-04	7.06E-05	3.74E+00	4.44E-05	1.32E-05

Appendix A.4: MOVES Emission Factors by Vehicle Type and Average Speed

Modelled Year	MOVES Link ID	Road Name	Road Type	Link Average Speed (km/h)	MOVES Source ID	Vehicle Type	MOVES Emission Factor (g/mile)												
							Acrolein	Acetaldehyde	Benzo(a)pyrene	Benzene	CO	1,3-butadiene	Formaldehyde	NOx	PM_{10}	$PM_{2.5}$	CO_2	CH_4	N_2O
2021	1	Highway 401	Rural Restricted	100	21	PassengerCar	2.46E-05	4.26E-04	1.02E-06	1.29E-03	2.43E+00	1.40E-04	4.90E-04	2.31E-01	1.31E-02	3.65E-03	2.58E+02	8.96E-03	1.08E-03
	1	Highway 401	Rural Restricted	100	31	PassengerTruck	9.37E-05	1.04E-03	1.61E-06	2.25E-03	3.49E+00	2.89E-04	1.45E-03	5.13E-01	1.72E-02	6.95E-03	3.57E+02	1.40E-02	2.10E-03
	1	Highway 401	Rural Restricted	100	52	SingleUnitShortHaulTruck	1.43E-03	8.30E-03	1.22E-05	3.57E-03	4.79E+00	8.02E-04	1.76E-02	2.93E+00	1.47E-01	1.14E-01	8.61E+02	1.55E-02	2.87E-03
	1	Highway 401	Rural Restricted	100	53	SingleUnitLongHaulTruck	1.52E-03	8.60E-03	1.13E-05	3.05E-03	3.67E+00	7.52E-04	1.86E-02	2.74E+00	1.75E-01	1.17E-01	8.22E+02	1.23E-02	3.06E-03
	2	Power Dam Drive	Rural Unrestricted	80	21	PassengerCar	2.89E-05	5.04E-04	1.16E-06	1.52E-03	2.59E+00	1.68E-04	5.76E-04	2.32E-01	2.16E-02	4.99E-03	2.68E+02	1.04E-02	1.35E-03
	2	Power Dam Drive	Rural Unrestricted	80	31	PassengerTruck	1.08E-04	1.21E-03	1.85E-06	2.61E-03	3.54E+00	3.38E-04	1.68E-03	5.11E-01	2.70E-02	8.88E-03	3.67E+02	1.60E-02	2.63E-03
	2	Power Dam Drive	Rural Unrestricted	80	52	SingleUnitShortHaulTruck	1.69E-03	9.93E-03	1.41E-05	4.62E-03	5.03E+00	9.80E-04	2.09E-02	3.23E+00	1.89E-01	1.35E-01	8.99E+02	2.07E-02	3.59E-03
	2	Power Dam Drive	Rural Unrestricted	80	53	SingleUnitLongHaulTruck	1.80E-03	1.03E-02	1.28E-05	3.97E-03	3.95E+00	9.13E-04	2.20E-02	3.00E+00	2.58E-01	1.41E-01	8.58E+02	1.67E-02	3.83E-03
2031	1	Highway 401	Rural Restricted	100	21	PassengerCar	5.93E-06	5.97E-05	4.13E-07	3.46E-04	1.43E+00	3.93E-08	1.21E-04	2.80E-02	1.21E-02	2.77E-03	2.08E+02	3.68E-03	6.25E-04
	1	Highway 401	Rural Restricted	100	31	PassengerTruck	2.04E-05	1.49E-04	6.25E-07	4.40E-04	1.81E+00	5.43E-06	3.04E-04	6.52E-02	1.37E-02	3.81E-03	2.95E+02	4.48E-03	8.00E-04
	1	Highway 401	Rural Restricted	100	52	SingleUnitShortHaulTruck	5.24E-04	3.01E-03	4.05E-06	1.22E-03	2.35E+00	2.11E-04	6.41E-03	1.11E+00	1.25E-01	4.79E-02	7.83E+02	6.56E-03	2.50E-03
	1	Highway 401	Rural Restricted	100	53	SingleUnitLongHaulTruck	5.24E-04	3.00E-03	3.88E-06	1.18E-03	2.21E+00	2.11E-04	6.41E-03	1.05E+00	1.19E-01	4.61E-02	7.48E+02	6.35E-03	2.48E-03
	2	Power Dam Drive	Rural Unrestricted	80	21	PassengerCar	6.68E-06	6.72E-05	4.54E-07	3.89E-04	1.49E+00	4.43E-08	1.36E-04	2.78E-02	2.04E-02	3.94E-03	2.16E+02	4.15E-03	7.82E-04
	2	Power Dam Drive	Rural Unrestricted	80	31	PassengerTruck	2.33E-05	1.70E-04	7.24E-07	4.90E-04	1.74E+00	6.24E-06	3.45E-04	6.68E-02	2.30E-02	5.26E-03	3.02E+02	4.92E-03	1.00E-03
	2	Power Dam Drive	Rural Unrestricted	80	52	SingleUnitShortHaulTruck	6.26E-04	3.64E-03	4.61E-06	1.56E-03	2.27E+00	2.49E-04	7.65E-03	1.31E+00	2.44E-01	6.68E-02	8.15E+02	9.04E-03	3.13E-03
	2	Power Dam Drive	Rural Unrestricted	80	53	SingleUnitLongHaulTruck	6.26E-04	3.63E-03	4.41E-06	1.53E-03	2.18E+00	2.49E-04	7.65E-03	1.27E+00	2.29E-01	6.39E-02	7.84E+02	8.87E-03	3.10E-03
2041	1	Highway 401	Rural Restricted	100	21	PassengerCar	3.95E-06	4.04E-05	2.11E-07	2.19E-04	8.80E-01	0.00E+00	7.78E-05	7.02E-03	1.18E-02	2.47E-03	1.86E+02	2.33E-03	6.34E-04
	1	Highway 401	Rural Restricted	100	31	PassengerTruck	5.40E-06	5.66E-05	2.89E-07	2.66E-04	1.12E+00	0.00E+00	9.92E-05	1.56E-02	1.26E-02	2.75E-03	2.62E+02	2.88E-03	7.28E-04
	1	Highway 401	Rural Restricted	100	52	SingleUnitShortHaulTruck	2.99E-05	3.34E-04	8.34E-07	5.02E-04	1.98E+00	0.00E+00	3.33E-04	4.07E-01	4.57E-02	9.85E-03	7.18E+02	4.90E-03	1.51E-03
	1	Highway 401	Rural Restricted	100	53	SingleUnitLongHaulTruck	2.88E-05	3.22E-04	7.76E-07	4.72E-04	1.85E+00	0.00E+00	3.18E-04	3.90E-01	5.90E-02	1.13E-02	6.87E+02	4.71E-03	1.76E-03
	2	Power Dam Drive	Rural Unrestricted	80	21	PassengerCar	4.45E-06	4.56E-05	2.29E-07	2.47E-04	9.14E-01	0.00E+00	8.77E-05	6.96E-03	2.00E-02	3.60E-03	1.93E+02	2.63E-03	7.92E-04
	2	Power Dam Drive	Rural Unrestricted	80	31	PassengerTruck	6.09E-06	6.40E-05	3.17E-07	2.90E-04	1.07E+00	0.00E+00	1.10E-04	1.65E-02	2.16E-02	4.01E-03	2.68E+02	3.16E-03	9.10E-04
	2	Power Dam Drive	Rural Unrestricted	80	52	SingleUnitShortHaulTruck	4.28E-05	4.81E-04	8.30E-07	5.99E-04	1.78E+00	0.00E+00	4.49E-04	6.07E-01	9.57E-02	1.65E-02	7.46E+02	6.85E-03	1.88E-03
	2	Power Dam Drive	Rural Unrestricted	80	53	SingleUnitLongHaulTruck	4.18E-05	4.70E-04	7.85E-07	5.78E-04	1.69E+00	0.00E+00	4.37E-04	5.91E-01	1.28E-01	2.03E-02	7.19E+02	6.69E-03	2.20E-03

Appendix G – Stage 1 Archaeological Assessment for the Highway 401 Power Dam Drive Bridge and Interchange Study

THE STAGE 1 ARCHAEOLOGICAL ASSESSMENT FOR THE HIGHWAY 401 POWER DAM DRIVE BRIDGE AND INTERCHANGE STUDY (GWP 4092-19-00), MUNICIPALITIES OF SOUTH STORMONT, UNITED COUNTIES OF STORMONT, DUNDAS AND GLENGARRY

(PART LOTS 15-16, CON. 3, PART LOTS 15-19, CON. 4 AND LOTS 19-21, CON. 5, GEO. TWP. OF CORNWALL)

Prepared for

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PIF # P035-0363-2021
09-Nov-2022

EXECUTIVE SUMMARY

This report discusses the rationale, methods and results of the Stage 1 archaeological assessment for the Highway 401 Power Dam Drive Bridge and Interchange, Township of South Stormont, within the United Counties of Stormont, Dundas and Glengarry (Part Lots 15-16, Con. 3, Part Lots 15-19, Con. 4 and Lots 19-21, Con. 5, Geo. Twp. of Cornwall). This assessment was undertaken under the *Environmental Assessment Act* and triggered by the *Class Environmental Assessment for Provincial Transportation Facilities* (2000). The field assessment was conducted on lands owned by the Ministry of Transportation, for which permission to enter was arranged by Morrison Hershfield Limited. A Stage 1 site visit was made to the property on November 6, 2021, under partially overcast conditions and temperatures around +8ºC.

All archaeological assessment activities were performed according to the *Standards and Guidelines for Consultant Archaeologists* (MHSTCI 2011). All work was done under the archaeological consulting license, P035, issued to Andrew Murray of A. M. Archaeological Associates under the *Ontario Heritage Act*. All records pertaining to this project will be curated at the offices of A. M. Archaeological Associates.

The Highway 401 Power Dam Bridge and Interchange Study includes the replacement of Bridge Site 013X-180/BO that carries Power Dam Drive over Highway 401 west of the City of Cornwall (Maps 1 and 14). The study will also develop the long-term plan for the interchange and establish the footprint for the future widening of Highway 401 to six lanes, so the potential evaluation includes 1.5-km of Highway 401 to the east and west of the current bridge for a 250-metre radius. The study also provides for 750-metres to the north and south of Highway 401 along Power Dam Drive (Maps 11 and 12). This section of Highway 401 travels through primarily rural forested and agricultural lands with a few rural residences.

The background research identified that most of the overall study area is close to archaeological potential features such as historic roads, farmsteads, and water sources (Table 5; Maps 11 and 13). However, the background research also indicates that most of the archaeological potential within the current Highway 401 and Power Dam Drive right-of-way has been removed from intensive and extensive disturbance. As a result, only 16,000-m^2 of the Highway 401 right-of-way has archaeological potential. This area is towards the western end of the study area 900-metres from the bridge and will require Stage 2 property assessment via the test pit survey method before any impacts (Map 12). The assessment should follow the standards laid out in *Section 2.1.2 Test Pit Survey* in the *Standards and Guidelines for Consultant Archaeologists, 2011* (MHSTCI 2011: 30-32).

The potential for archaeological remains is much greater outside the right-of-way within the 250-metre study area buffer. The only areas not requiring further assessment, approximately 6 percent, are the disturbances from the rural roads and ditching, the low and wet area near the west end and the previously assessed area at the east end. Approximately 71.7 percent should be subject to a Stage 2 property survey using professional judgement at the time of the assessment (Maps 12 and 13). The method for agricultural areas is pedestrian survey at five-metre intervals as per *Section 2.1.1 Pedestrian Survey* in the *Standards and Guidelines for Consultant Archaeologists, 2011* (MHSTCI 2011: 30-32). An exception can be made for any linear corridors less than 10-metres wide, which can be assessed using the test pit method. These areas and any forested or built-up areas should be assessed following *Section 2.1.2 Test Pit Survey* in the *Standards and Guidelines for Consultant Archaeologists, 2011* (MHSTCI 2011: 30-32).

Based on the above information, the following recommendation can be made:

1. The study area within the current Highway 401 and Power Dam Road right-of-way is mainly disturbed by previous construction. No further work is required for the remaining area within the right-of-way. Should any future impacts be proposed for the areas shown in Map 12, they should be assessed through a test pit survey according to *Section 2.1.2 Test Pit Survey* in the *Standards and Guidelines for Consultant Archaeologists, 2011*.
2. Most of the area within the 250-metre buffer around the highway right-of-way has archaeological potential due to the proximity to water or nineteenth-century features. As shown on Maps 12 and 13, these areas should be subject to Stage 2 property assessment before any impacts using the appropriate method described in *Section 2.1.2 Test Pit Survey* or *Section 2.1.1 Pedestrian Survey*.

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PROJECT PERSONNEL

Project/ Field Director/ Report Graphics/ Preparation	Andrew Murray, P035
Field Technician	Jackie Dolling, P158

1.0 PROJECT CONTEXT

1.1 Development Context

This report discusses the rationale, methods and results of the Stage 1 archaeological assessment for the Highway 401 Power Dam Drive Bridge and Interchange, Township of South Stormont, within the United Counties of Stormont, Dundas and Glengarry (Part Lots 15-16, Con. 3, Part Lots 15-19, Con. 4 and Lots 19-21, Con. 5, Geo. Twp. of Cornwall). This assessment was undertaken under the *Environmental Assessment Act* and triggered by the *Class Environmental Assessment for Provincial Transportation Facilities* (2000). The field assessment was conducted on lands owned by the Ministry of Transportation, for which permission to enter was arranged by Morrison Hershfield Limited. A Stage 1 site visit was made to the property on November 6, 2021, under partially overcast conditions and temperatures around +8ºC.

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1.2 Historic Context

1.2.1 General Area

1.2.1.1 Precontact era

The archaeological research that has been conducted in eastern Ontario is not as extensive as in other parts of south and southwestern Ontario, where thousands of archaeological sites have been discovered and excavated. Archaeologists divide eastern Ontario’s precontact history into the following temporal/cultural sequences (Table 1):

Table 1: General cultural synthesis for south-central Ontario.

PERIOD	GROUP	TIME RANGE	COMMENT
Paleo-Indian	Big game hunters; small nomadic groups		
Early	Fluted Point	9500–8500 BC.	Distinctive lanceolate and fluted points
Late	Hi-Lo	8500–8000 BC.	Side-notched points
Archaic	Nomadic hunters and gatherers. Territories are exploited on a yearly round.		
Early	Nettling Bifurcate Based	7800–6900 BC. 6900–6000 BC.	More varied toolkit.
Middle	Stanly/Neville Otter Creek Brewerton	6000–5000 BC. 5000–3000 BC. 3000-2500 BC.	Ground and polished stone tool industry; subsistence fishing.
Late	Narrow Point Broad Point Small Point	2500–1800 BC. 1800–1500 BC. 1500–800 BC.	Bipolar lithic reduction as evidence of more extensive woodworking Net fishing, nut harvesting, dog burials Evidence of mortuary practices; bow and arrow technology.
Woodland	Introduction of pottery and agriculture.		
Early	Meadowood	900–400 BC.	Earliest pottery; pop-eyed birdstones
Middle	Point Peninsula Princess Point	400 BC –500 AD. 500–900 AD.	Long-distance trade networks. Incipient horticulture.
Late *Early*	Pickering/ Glen Meyer	900–1280 AD.	Transition to village life and maize agriculture.
Middle	Uren Middleport	1280–1330 AD. 1330–1400 AD.	Large village sites. Rapid population growth.
Late	Wendat (Huron) Neutral Petun St. Lawrence Haudenosaunee (Iroquois)	1400–1650 A.D.	Well-made ceramic pots Tribal differentiation and warfare.
Historic	European colonization		
Early	Odawa, Ojibwa, Mississauga, Six Nations	1700–1875 AD.	Fur trade; social displacement.
Late	Odawa, Ojibwa, Mississauga, Six Nations Euro-Canadian	1790 AD –present	Consolidation of Indigenous people on reserves; continued presence throughout urban and rural areas European urban & rural settlement

1.2.1.2 Early contact era

The Indigenous people of the region probably had indirect knowledge of the contact with Jacque Cartier, who made it as far west as Montreal during his expeditions from 1534 to 1542. The accounts of Cartier’s encounters with the St. Lawrence Iroquois at the settlements of Stadacona and Hochelaga are the primary written records of their occupation of the region. Algonquian speakers had replaced the Iroquoians by the time of Samuel de Champlain’s first visit in 1603. The first contact between French explorers and the Indigenous population of Ontario began in the early 1600s with the subsequent visits by Etienne Brulé in 1610 and Samuel de Champlain in 1613. Champlain’s next visit of 1615-1616 would have brought him near the study area as he travelled from Huronia to attack the Five Nations Iroquois in New York State.

Champlain spent the winter of 1615-1616 in Huronia and would have met Iroquoian-speaking peoples such as the Wendat (Huron), Petun (Tobacco) and 'la nation neutre' (the Neutrals), and a variety of Algonkian-speaking Anishinabeg bands.

French explorers and missionaries had extensive contact with the Huron-Wendat, and the Jesuits established the first permanent European settlement in central Ontario in 1639, known as the mission at Sainte-Marie among the Hurons on the Wye River near Midland. The increased contact between Europeans and First Nations through the seventeenth century resulted in widespread epidemics that caused significant depopulation and destabilization of the communities of the region (Warrick 2008). Competition between the British and the French also exacerbated tensions between the First Nations allied with the French like the Huron, Petun and Anishinabeg, and those allied with the British; the League of the Haudenosaunee (Five Nations Iroquois: Cayuga, Mohawk, Oneida, Onondaga, Seneca, and Tuscarora). However, the Haudenosaunee continued to utilize southern Ontario as a hunting ground for furs to trade with the English and Dutch and maintained villages at the mouth of the Humber and Rouge Rivers. Five Nations Iroquois, including Mohawk, Cayuga and other nations, were utilizing the area of Eastern Ontario as hunting grounds as early as 1665, when European missionaries first appeared in the area. The early focus of French settlement was in Quebec, and the British colony was focused in the eastern parts of the modern-day U.S.

Fort Cataraqui, later renamed Fort Frontenac, was established by Louis de Buade, Compte de Frontenac, in 1673. The fort site was strategically located on the west bank of the Cataraqui River. Although there was a military garrison at the fort, it primarily functioned as a trading post. Several Iroquois longhouses accompanied the French settlement around the exterior of the fort. The post was rebuilt in 1675 and again in 1695. On May 13, 1675, explorer Rene-Robert Cavelier La Salle was granted ownership of Grand Ile (Wolfe Island) by King Louis XIV of France, and the islands of Simcoe, Amherst, Howe, Horseshoe and Garden, and 10 miles inland from the shoreline of the St. Lawrence River became La Salle's seigneury. The French maintained a garrison stationed at the fort until 1745, but in 1758 the fort fell into British hands when it was claimed by Colonel John Bradstreet. The fort was ransacked and abandoned until 1783, when the fort was re-established as a Brish military base. It remained under British military control until the end of the War of 1812.

By 1700, the Ojibwa had replaced the Iroquois from the North Shore of Lake Ontario. The Treaty of Paris at the end of the Seven Years' War in 1763 signalled a change in the administration of a vast section of North America from Hudson Bay to the Gulf of Mexico. The Royal Proclamation of 1763 established a framework for the administration of the territory so that only land deals between the Crown and First Nations were legal. In 1783-84, Captain W. R. Crawford was entrusted to conduct negotiations with the Mississauga's for a tract of land along most of the north shore of the St. Lawrence River. The limits of the land deal were vague, and these land surrenders were poorly documented.

1.2.1.3 Historic Euro-Canadian Colonization

The French did not encourage permanent Euro-Canadian settlement in eastern Ontario, so the settlement of Loyalists didn't begin until 1784, after the American Revolutionary War. The first range of Royal Townships was laid out between Longueuil and Kingston. The study area is within eight numbered townships within the district initially known as the District of Lancaster. The district name was changed to Lunenburg by 1788 (Belden 1879). Township Number 2, which became Cornwall Township, was first surveyed by Patrick McNiff in 1784 (Pringle 1890). The separate counties of Stormont, Dundas and Glengarry, were proclaimed in 1792 in the Eastern District (Armstrong 1984). A community called Cornwall Centre grew around the intersection of Cornwall Centre Road and Power Dam Drive south of the study area. The Township Hall was erected on the front of the east half of Lot 18, Concession 4, on land purchased from John Milroy on June 13, 1855 (Map 3).

In 1849, the Eastern District was abolished and succeeded by the United Counties of Stormont, Dundas and Glengarry. In 1998, Cornwall Township was amalgamated with the former Township of Osnabruck to form the Township of South Stormont, a regional municipality (excluding the City of Cornwall).

1.2.2 Property History

The land grants for the study area's lots were awarded primarily between 1797 and 1803, but the lots in the 5th Concession along Post Road were awarded a bit later between 1809 and 1820 (Table 2). The eastern end of the study area extends southward into the north of two lots in the 3rd Concession. One of these lots was awarded to King's College in 1835, which was part of thousands of acres of land granted to the institution that would become the University of Toronto for future income.

Table 2: Summary of original land grants.

Owner	Lot	Concession	Date	Acres
John & Adam Hartle	15	3	27-May-1797	200
King's College (John Groves)	16	3	16-May-1835 (20-Dec-1853)	200
John Bradshaw	15	4	17-May-1802	200
James Johnson	16	4	27-May-1797	200
Benjamin Eastman	17	4	27-May-1797	200
John Milroy	18	4	27-May-1797	200
Effron Pulman/ Daniel Robertson	19	4	27-May-1797	200
John McDonell	19W	5	19-Sep-1803	100
John McIntosh	19E	5	03-Oct-1803	100
Donald McMillan	20W	5	01-Oct-1803	100
John McDonell	20E	5	24-Sep-1803	100
William Branan	20S	5	23-Jun-1809	100
Harmanus Hawn	21W	5	28-Mar-1820	100
William Branan	21E	5	23-Jun-1809	100

The 1862 Walling map and 1879 Belden map indicate that the lands within and surrounding the study area were well settled by the mid-nineteenth century (Table 3; Maps 2 and 3).

Table 3: Summary of buildings from 1862 Walling map and 1879 Belden map.

Owner	Lot	Concession	Building	Reference
O. Groves/ D. Hartle	16	3	House	1862/ 1879
Wm. Mattice/ Wm. Mattice	15	4	House	1862/ 1879
J. Alguire/ J. Alguire	16	4	House	1862/ 1879
Miss Johnston/ N. Johnston	16	4	House	1862/ 1879
J. Barlow/ J. Barlow	17	4	House	1862/ 1879
E. Tilton	17	4	House	1879
Wm. Alguire/ W. Alguire	18	4	House	1862/ 1879
Township Hall	18	4	Building	1879
W. Johnston	18	4	House	1879
Tannery	18	4	Building	1879
J. Alguire/ J. Alguire	18	4	House	1862/ 1879
R. Alguire/ Orange Hall	19	4	House	1862/ 1879
R. K. Milroy	19	4	House	1879
N. Eastman/ N. Eastman	19	5	House	1862/ 1879
O. Ault	20	5	House	1879
M. Corken/ Runnions	21	5	House	1862/ 1879
P. Wheeler/ P. Wheeler	21	5	House	1862/ 1879

The Ottawa and New York Railway was built immediately south of the section of Highway 401 east of Power Dam Drive in 1897 and remained in operation until 1957 (Maps 4, 5, 6 and 7). The former railway right-of-way is now an unnamed drain.

Highway 401 construction began in the early 1950s, and an official opening took place in November 1964 despite some remaining two-lane sections in eastern Ontario (Shragge 2007). Highway 401 was different from the QEW and Highway 400 since it was conceived as a completely controlled-access highway on a separate 300-foot alignment that bypassed all the cities and towns along its length. In general, much of the length of the highway has low historic archaeological potential because of this design plan, which intentionally avoided historic settlement roads. The study area section was one of the last to be completed as a series of maps from 1961 to 1964 illustrates (Map 9).

1.3 Archaeological Context

The Highway 401 Power Dam Bridge and Interchange Study includes the replacement of Bridge Site 013X-180/BO that carries Power Dam Drive over Highway 401 west of the City of Cornwall (Maps 1 and 14). The study will also develop the long-term plan for the interchange and establish the footprint for the future widening of Highway 401 to six lanes, so the potential evaluation includes 1.5-km of Highway 401 to the east and west of the current bridge for a 250-metre radius. The study also provides for 750-metres to the north and south of Highway 401 along Power Dam Drive (Maps 11 and 12). This section of Highway 401 travels through primarily rural forested and agricultural lands with a few rural residences.

1.3.1 Environmental Setting

The existing intersection is located in the Glengarry Till Plain physiographic region (Chapman and Putnam 2007). The Glengarry Till Plain is characterized by its stony soils and low undulating to rolling relief (Chapman and Putnam 1984). The elevation is around 70 metres.

The soils of the Highway 138 roundabout study area are Eamer Loam and North Gower Clay Loam (Department of Agriculture 1954) (Map 8). The Eamer Loam soil is moderately stony and well adapted to farm crops (Matthews and Richards 1954). Eamer Loam has good drainage and is strongly undulating to rolling. North Gower Clay Loam is poorly drained, level to slightly undulating and stone free. Open ditches or tile draining is necessary for growing crops (Matthews and Richards 1954).

Several streams and artificial drains flow into the South Raisin River. Archaeological potential buffers of 300-metres were extended around these sources.

1.3.2 Registered Archaeological Sites

A search of the Ministry of Heritage, Sport, Tourism and Culture Industries' archaeological sites database revealed two archaeological sites within a four-kilometre radius of the study area (MHSTCI 2021) (Table 2). The two sites were recorded in the 1950s during an archaeological survey before the expansion of the St. Lawrence Seaway. There are 17 registered sites in South Stormont Township and seven more in Cornwall.

Table 4: Summary of registered archaeological sites within a 4-km radius (MHSTCI 2021).

Borden #	Site Name	Time Period	Affinity	Site Type	Proximity
BgFr-6	Mille Roche	Pre-Contact	Indigenous	Camp	3.7-km
BgFq-5	Hartle	Pre-Contact	Indigenous	Camp/ burial	3.8-km

1.3.3 Past Projects

A search of the archaeological report database at the Ministry of Heritage, Sport, Tourism and Culture Industries using the keywords "Highway 401" and "Power Dam" and the lots and concessions within the study area retrieved the titles of two archaeological reports near the eastern end of the study area and another 1-km to the east. A 2004 report by Archaeological Services Inc. included two of the interchanges in Cornwall that was beyond 50-metres (ASI 2004). The lands beyond the Highway 401 interchange right-of-way at Brookdale Avenue (IC789) were deemed to have the potential for archaeological remains, but the lands within the interchange were determined to be disturbed. ASI also completed a Stage 1 assessment for the lands around the bridge at Highway 401 over Cornwall Centre Road in 2010 (ASI 2010). The report determined there was archaeological potential beyond the right-of-way, and Golder Associates completed the Stage 2 assessment of the lands that would be impacted by a proposed snowplow turnaround and construction staging areas (Golder 2011). No archaeological remains were discovered.

2.0 METHODOLOGY

2.1 GIS Methods

The existing survey plan was overlaid with nineteenth and twentieth-century mapping using the best available landmarks. The maps were rotated and stretched in east-west and north-south directions to provide the best fit. The locations of the buildings from the 1862 and 1879 maps were refined using twentieth-century topographic mapping, aerial photos, and ground-based observations.

2.2 Field Assessment

A Stage 1 site visit was made to the property on November 6, 2021, under partially overcast conditions and temperatures around +8ºC. The current property conditions were visually assessed and photo-documented from directly within the study area under excellent viewing conditions. Photograph locations were logged by GPS (Images 1 - 50; Maps 11 and 12).

2.2.1 Highway 401

A close comparison of the highway landscape before and after construction using aerial photography was combined with the walking visual survey to determine the extent of disturbances that may have removed archaeological potential (Maps 6, 7 and 10: Images 1 - 36). Overall, there is very little of the highway right-of-way that has not been intensively and extensively disturbed. The disturbance includes deep and wide ditching, berms and hillside cuts. There is also a low and wet area near the western end of the study area.

The forested sections along the eastbound and westbound lanes were the only areas within the right-of-way where the disturbance could not be confirmed. The 1946 aerial photography indicates that these areas were once cleared, but the available aerial photography from 1977 does not cover these areas. There were also no visual indications such as berms or ditches inside the tree line. These areas should be subject to Stage 2 test pits as described in *Section 2.1.2 Test Pit Survey* in the *Standards and Guidelines for Consultant Archaeologists, 2011* (MHSTCI 2011: 30-32). The test pit survey method involves systematically walking the property along regularly spaced transects, excavating small pits by hand at regular five-metre intervals and examining their contents before backfilling.

The areas beyond the right-of-way but within the 250-m study area buffer are a mix of agricultural, forested, and rural residential lands. Since the buffer is part of the long-range planning study, the future conditions of these lands can not be determined, and specific assessment methods are not provided. However, pedestrian survey is the preferred method of Stage 2 property assessment. Any actively or recently cultivated agricultural land will require Stage 2 assessment following *Section 2.1.1 Pedestrian Survey* in the *Standards and Guidelines for Consultant Archaeologists, 2011* (MHSTCI 2011: 30-32). The Stage 2 pedestrian survey method involves walking ploughed and weathered fields systematically at five metres intervals to map and collect artifacts found on the ground surface. Since the fields need to be ploughed and weather two rainfalls, it is best to conduct this work in spring or fall to avoid crop damage.

2.2.2 Power Dam Drive North

The first section of Power Dam Drive north of the highway to Headline Road was built only 50 years ago as the original alignment was 60-metres to the west (Map 6). However, it is a similar rural road to the section north of Headline Road with gravel shoulders and ditching (Images 37 - 42). The ditches and roadway are intensively and extensively disturbed, but lands beyond the ditches have archaeological potential. These areas are primarily forested, rural residential, or have not been subject to ploughing recently. The presumptive method for assessing these adjacent lands is test pit survey, but pedestrian survey may be possible in isolated areas.

2.2.3 Power Dam Drive South

Part of the section of Power Dam Drive south of Highway 401 has been subject to extensive disturbance from the construction of the bridge, realignment of Power Dam Drive and Atchison Drive, a gas pipeline, artificial drainage and a former railway (Images 43 - 50). The appropriate survey method will depend on the conditions at the time of the survey. There is rural residential property to the west, which may be partially disturbed from house construction, driveways and septic beds, but Stage 2 will be necessary to determine the extent of any disturbances. It is most likely that these lands will not be ploughable and will require assessment using the test pit survey method. There is agricultural pasture to the east, which may be ploughable to allow for assessment using the pedestrian survey method. However, piles of boulders near the east side of the Power Dam Drive and Highway 401 bridge may indicate that parts of this area remain as pasture due to rocky conditions.

2.3 Inventory of the Documentary Record

No archaeological remains were discovered during the Stage 1 visual assessment. The documentary record of the project consists of one GPS track and 185 geo-tagged digital photographs, and this report. The documentary record will be stored at the office of A. M.

Archaeological Associates until it can be deposited at a long-term storage facility with the approval of the Ministry of Heritage, Sport, Tourism and Culture Industries.

3.0 ANALYSIS AND CONCLUSIONS

The background research identified that most of the overall study area is close to archaeological potential features such as historic roads, farmsteads, and water sources (Table 5; Maps 11 and 13). However, the background research also indicates that most of the archaeological potential within the current Highway 401 and Power Dam Drive right-of-way has been removed from intensive and extensive disturbance. As a result, only 16,000-m^2 of the Highway 401 right-of-way has archaeological potential. This area is towards the western end of the study area 900-metres from the bridge and will require Stage 2 property assessment via the test pit survey method before any impacts (Map 12). The assessment should follow the standards laid out in *Section 2.1.2 Test Pit Survey* in the *Standards and Guidelines for Consultant Archaeologists, 2011* (MHSTCI 2011: 30-32).

The potential for archaeological remains is much greater outside the right-of-way within the 250-metre study area buffer. The only areas not requiring further assessment, approximately 6 percent, are the disturbances from the rural roads and ditching, the low and wet area near the west end and the previously assessed area at the east end. Approximately 71.7 percent should be subject to a Stage 2 property survey using professional judgement at the time of the assessment (Maps 12 and 13). The method for agricultural areas is pedestrian survey at five-metre intervals as per *Section 2.1.1 Pedestrian Survey* in the *Standards and Guidelines for Consultant Archaeologists, 2011* (MHSTCI 2011: 30-32). An exception can be made for any linear corridors less than 10-metres wide, which can be assessed using the test pit method. These areas and any forested or built-up areas should be assessed following *Section 2.1.2 Test Pit Survey* in the *Standards and Guidelines for Consultant Archaeologists, 2011* (MHSTCI 2011: 30-32).

Table 5: Summary of archaeological potential.

Conditions	**Inside (m^2)**	**%**	**Outside (m^2)**	**%**
Potential - 100-m to historic feature		0.0%	838400	30.3%
Potential - 300-m to water source	16000	3.9%	1777640	64.2%
Potential- Combined (overlapping)	*16000*	*3.9%*	*1984700*	*71.7%*
No Potential- Disturbed	388650	95.9%	52215	1.9%
No Potential- Low-wet	2730	0.7%	88015	3.2%
Previously Assessed			2100	0.1%
Total Area	**405150**		**2767655**	

4.0 RECOMMENDATIONS

Based on the above information, the following recommendation can be made:

1. The study area within the current Highway 401 and Power Dam Road right-of-way is mainly disturbed by previous construction. No further work is required for the remaining area within the right-of-way. Should any future impacts be proposed for the areas shown in Map 12, they should be assessed through a test pit survey according to *Section 2.1.2 Test Pit Survey* in the *Standards and Guidelines for Consultant Archaeologists, 2011*.
2. Most of the area within the 250-metre buffer around the highway right-of-way has archaeological potential due to the proximity to water or nineteenth-century features. As shown on Maps 12 and 13, these areas should be subject to Stage 2 property assessment before any impacts using the appropriate method described in *Section 2.1.2 Test Pit Survey* or *Section 2.1.1 Pedestrian Survey*.

5.0 ADVICE ON COMPLIANCE WITH LEGISLATION

1. Advice on compliance with legislation is not part of the archaeological record. However, for the benefit of the proponent and approval authority in the land use planning and development process, the report must include the following standard statements:

a. This report is submitted to the Minister of Heritage, Sport, Tourism and Culture Industries as a condition of licensing in accordance with Part VI of the *Ontario Heritage Act*, RSO. 1990, c 0.18. The report is reviewed to ensure 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 Heritage, Sport, Tourism and Culture Industries, a letter will be issued by the ministry stating that there are no further concerns with regard to alterations to archaeological sites by the proposed development.

b. 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 remove any artifact or other physical evidence of past human use or activity from the site, until such time as a licensed archaeologist has completed archaeological 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 Archaeological Reports referred to in Section 65.1 of the *Ontario Heritage Act.*

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

d. The Cemeteries Act, RSO. 1990 c. C.4 and the Funeral, Burial and Cremation Services Act, 2002, SO. 2002, C.33 (when proclaimed in force) requires that any person discovering human remains must notify the police or coroner and the Registrar of Cemeteries at the Ministry of Government and Consumer Services.

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7.0 IMAGES

Image 1: West view of the eastbound 401 with a large wetland.

Image 2: West view of the westbound 401 with a large wetland.

Image 3: East view of the eastbound 401 showing wide ditch and cut slope.

Image 4: East view of the westbound 401 showing wide ditch and cut slope.

Image 5: East view of the eastbound 401 showing wide ditch and cut slope.

Image 6: West view of westbound 401 showing forested lands beyond the ditch.

Image 7: East view of the eastbound 401 with a broad slope to the edge of the right-of-way.

Image 8: North view of the westbound 401 with the wetland beyond the right-of-way.

Image 9: West view of the eastbound 401 with a broad slope to the edge of the right-of-way.

Image 10: East view of the westbound 401 showing wide ditch and cut slope.

Image 11: East view of the eastbound 401 showing wide ditch and cut slope.

Image 12: East view of westbound 401 showing ditching at the top of the cut slope.

Image 13: East view of the eastbound 401 showing wide ditch and cut slope.

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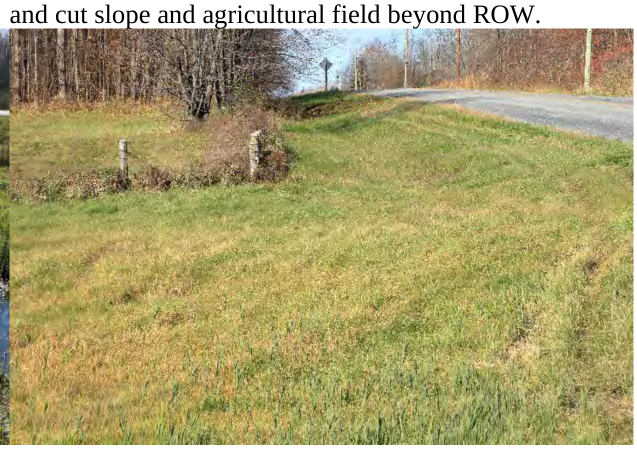
Image 17: East view of the eastbound 401 exit at Power Dam Drive showing wide ditch.



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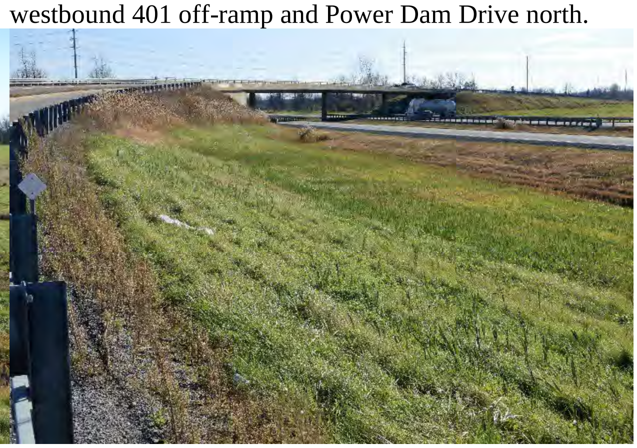

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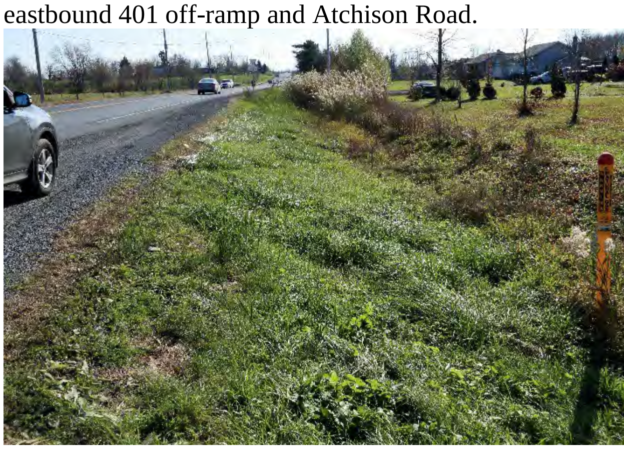


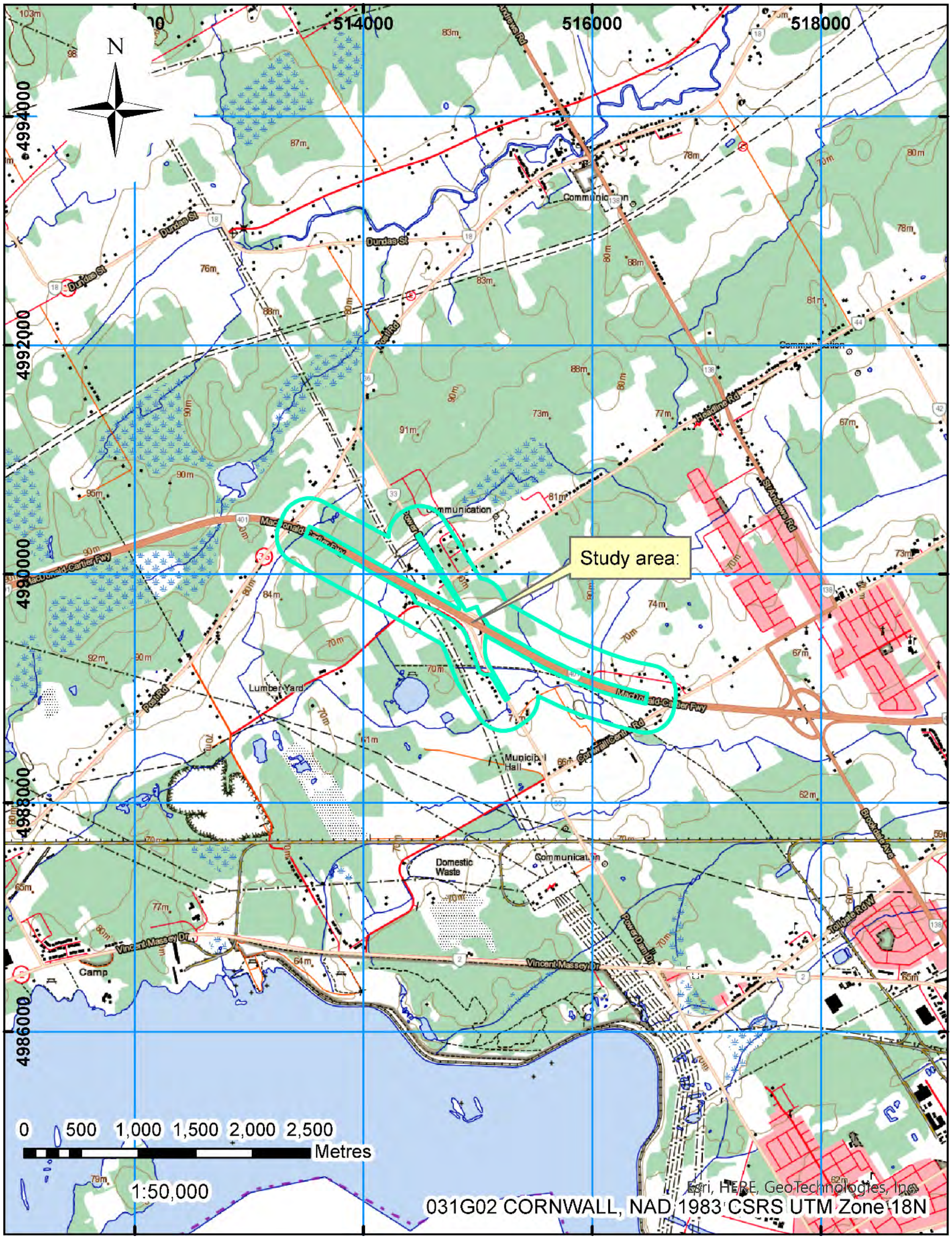
Image 47: South view along the west side of Power Dam Drive with a deep ditch.


Image 48: North view along the east side of Power Dam Drive showing deep ditch.

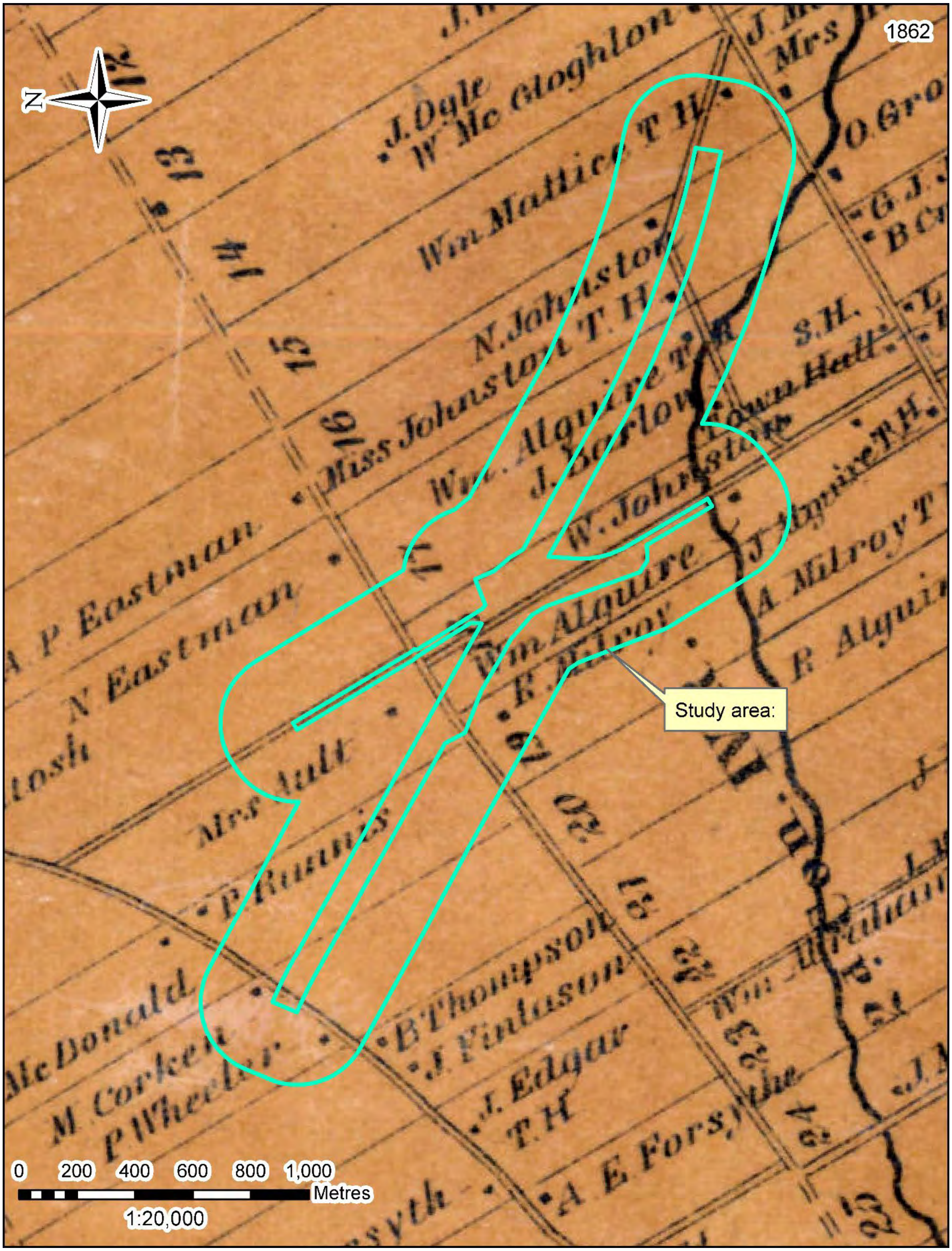
Image 49: South view along the west side of Power Dam Drive with a deep ditch.

Image 50: South view along the east side of Power Dam Drive showing deep ditch.

8.0 MAPS

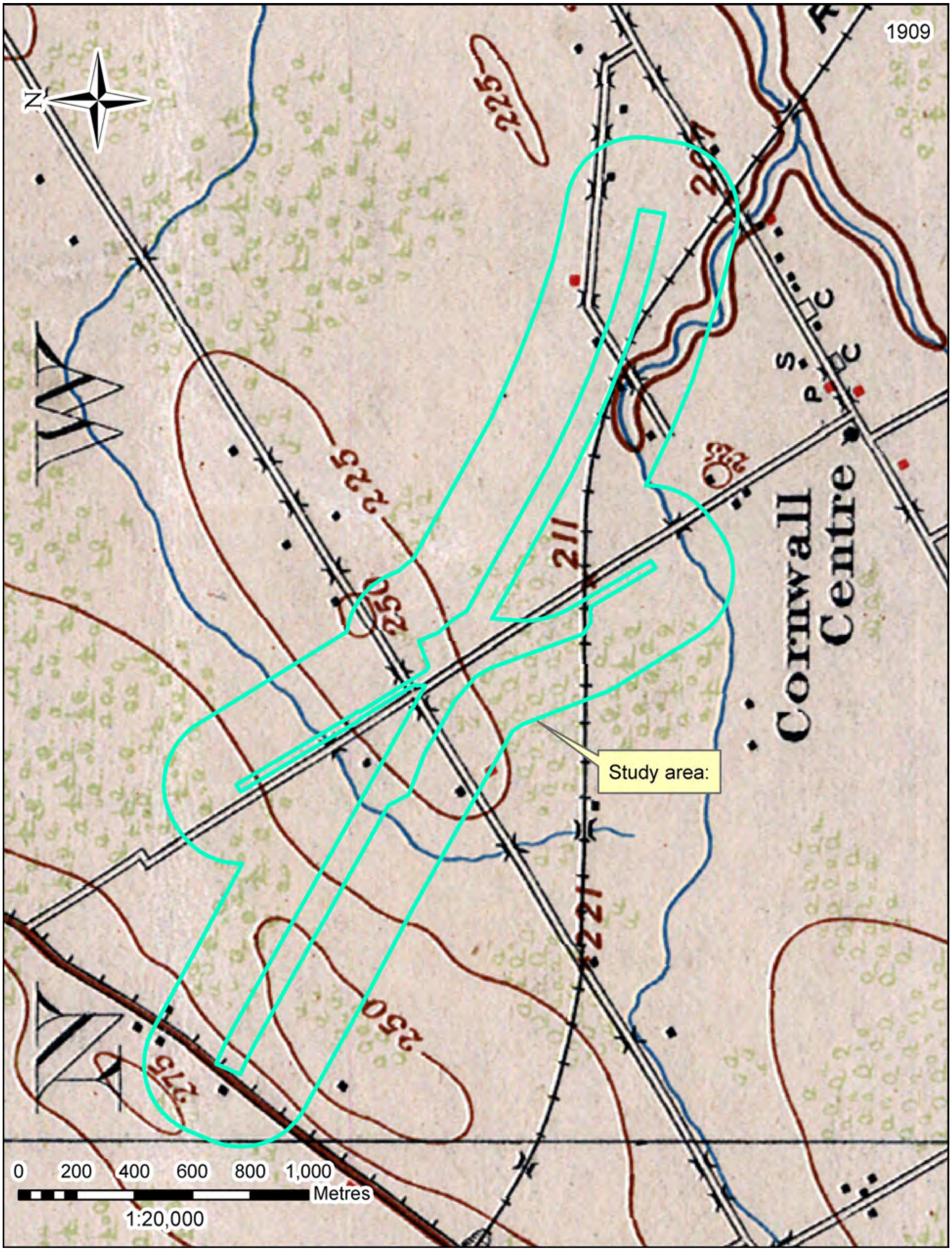


Map 1: Location of Highway 401 Power Dam Drive Bridge and Interchange study area (NRC 2000).

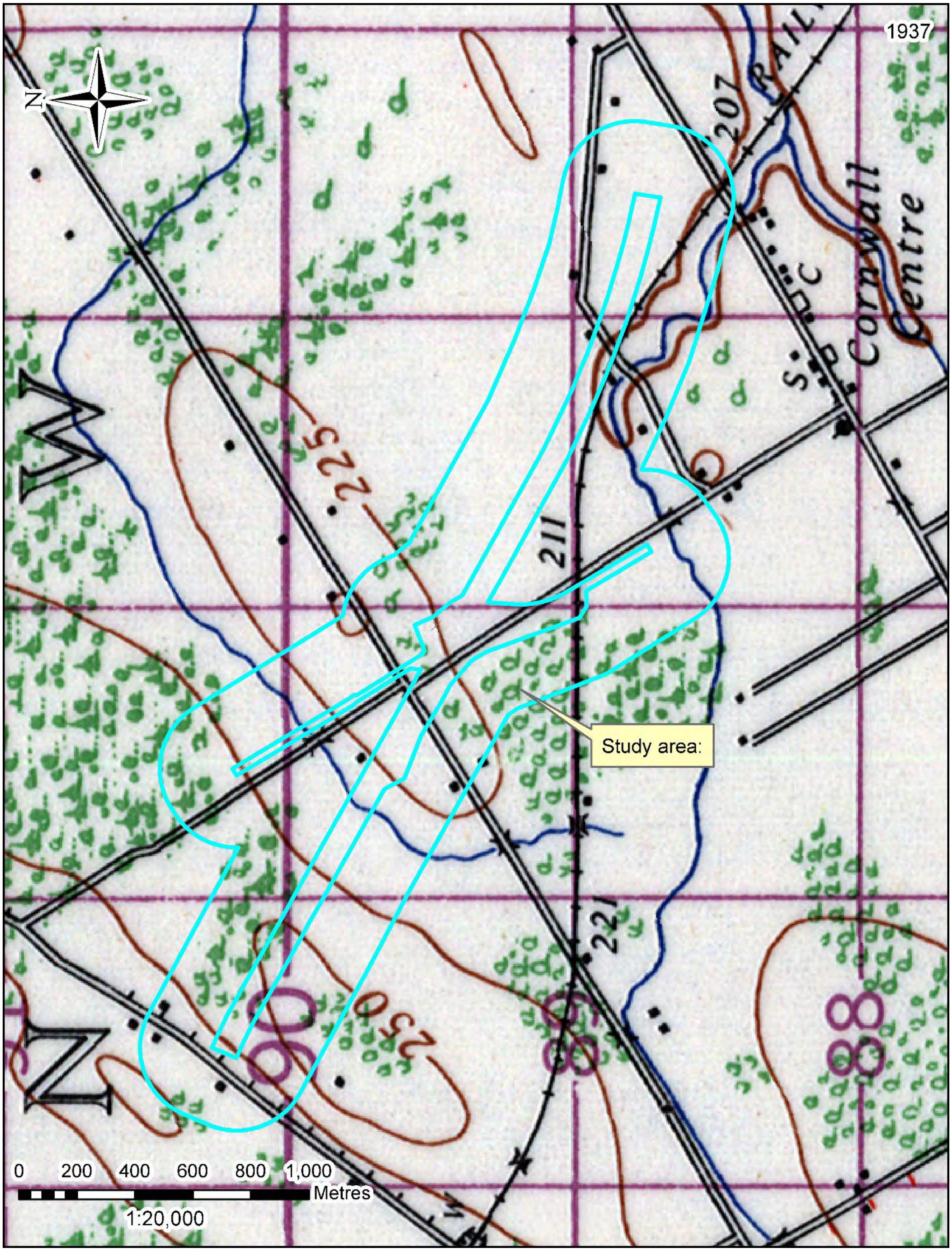


Map 2: 1862 map showing the landowners and buildings near the study area (Walling 1862).

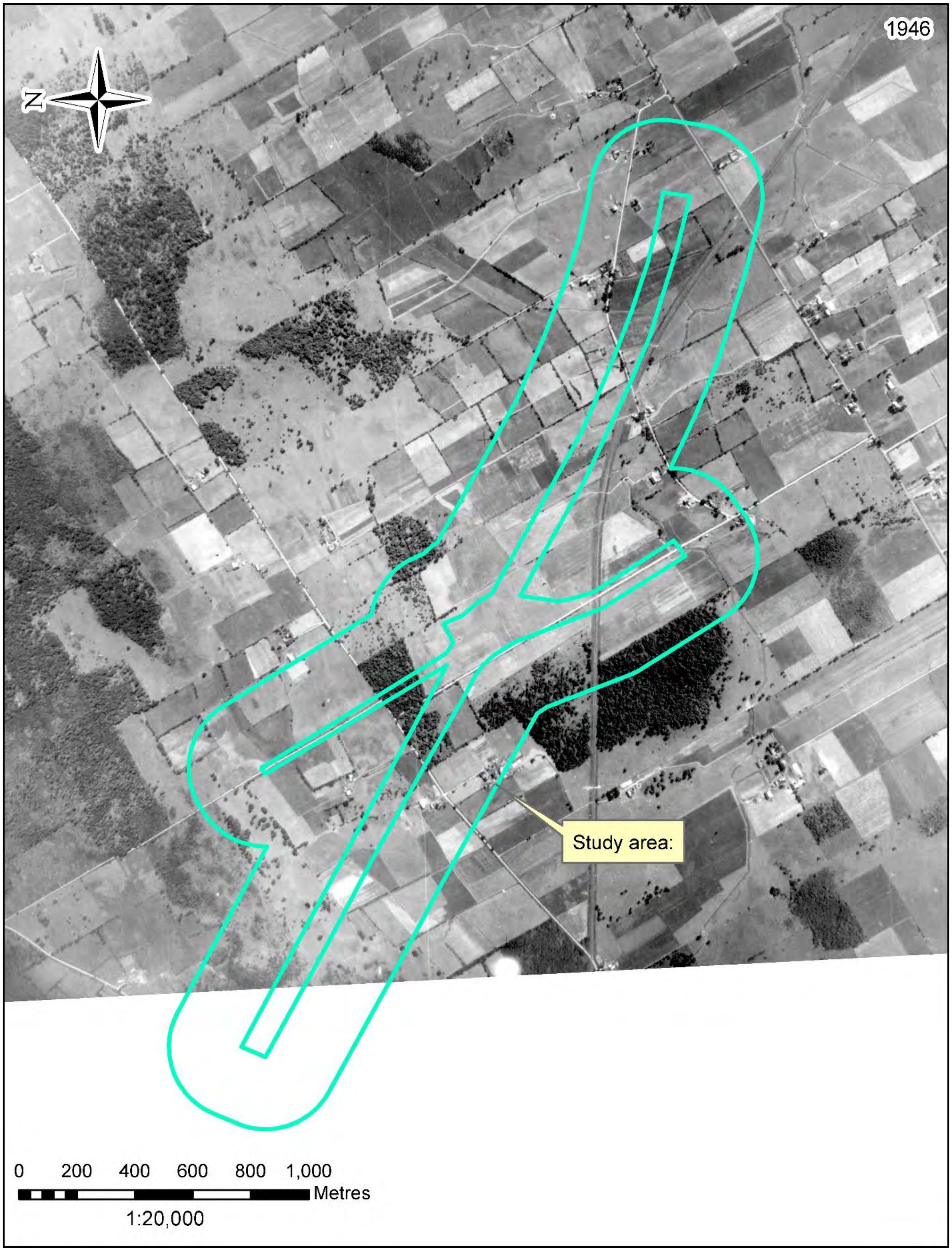
Map 3: 1879 map showing the landowners and buildings near the study area (Belden 1879).



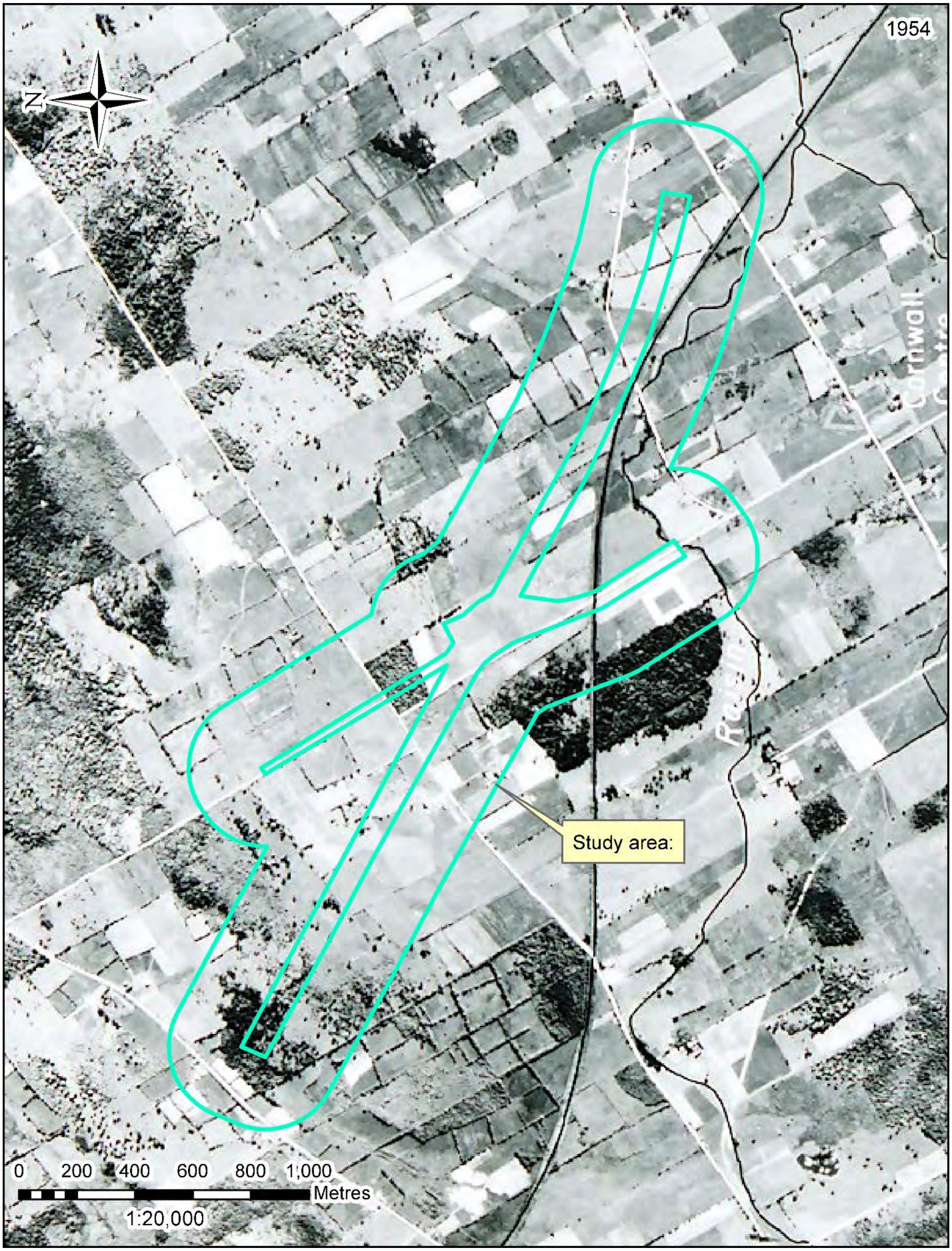
Map 4: 1909 topographic map showing buildings, railway, and water sources before constructing Highway 401 (DMD 1909).



Map 5: 1937 location of the study area's location with a similar view to the 1909 map (DND 1937).



Map 6: 1946 aerial view of the study area before the highway (City of Cornwall 2022).



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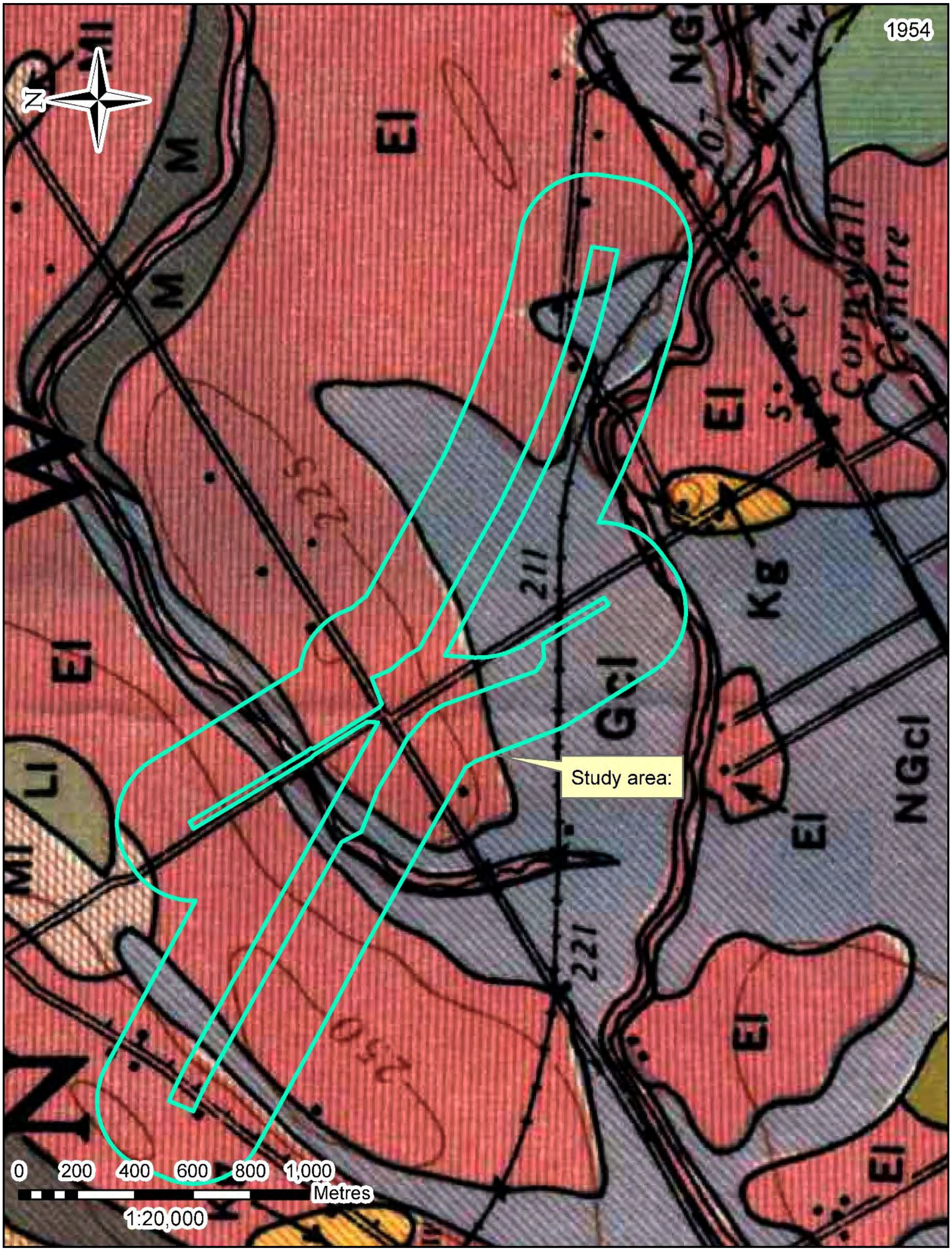

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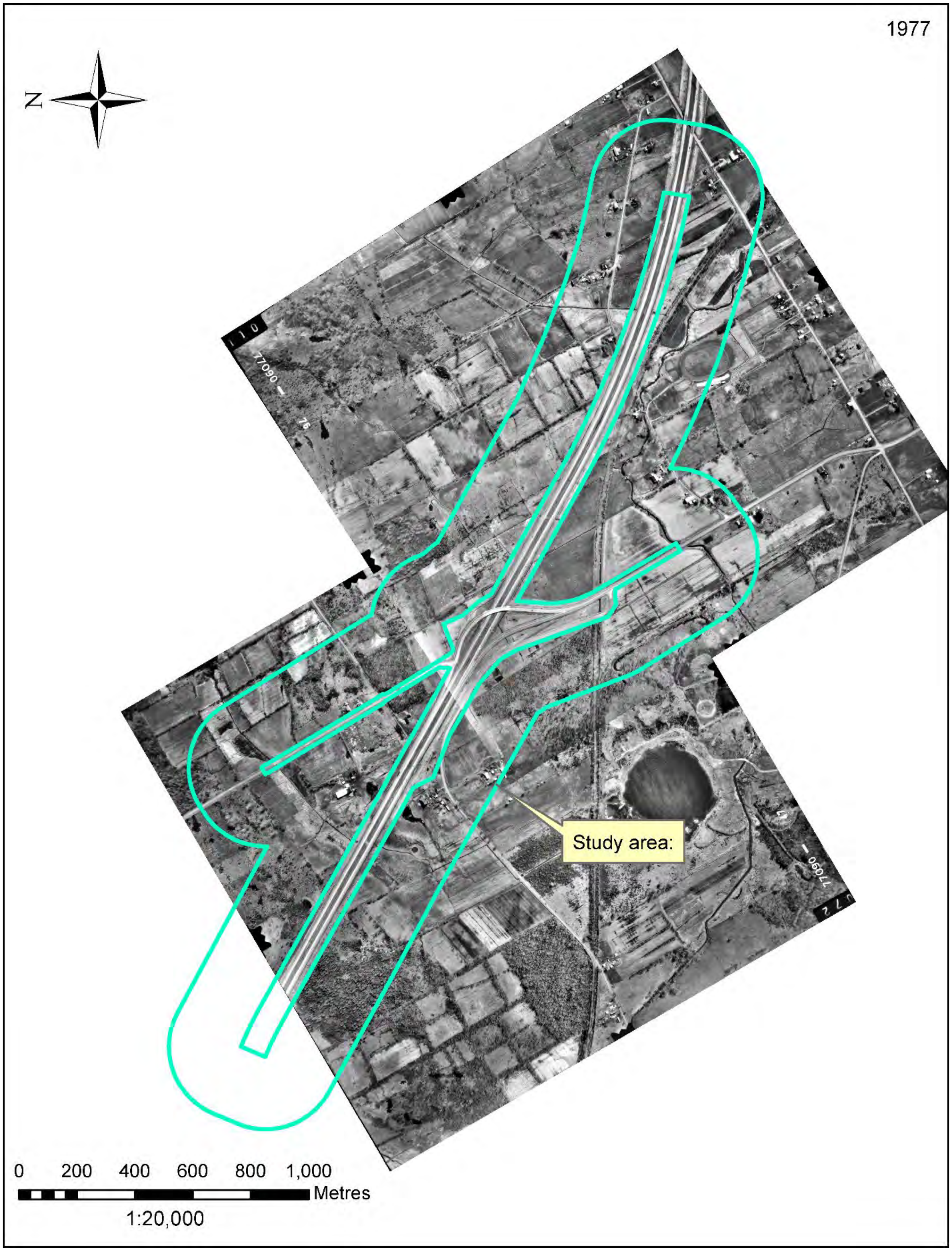
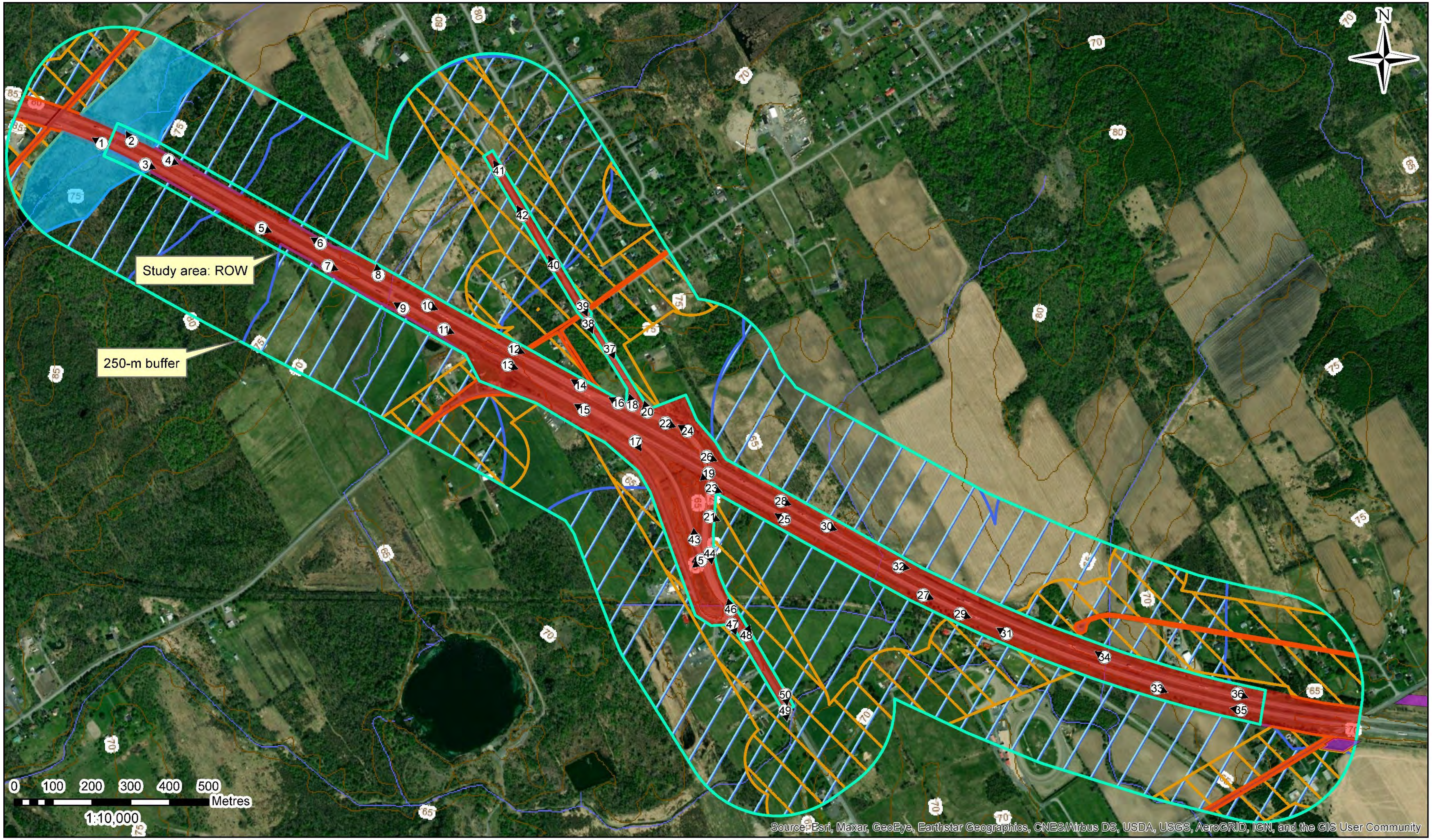


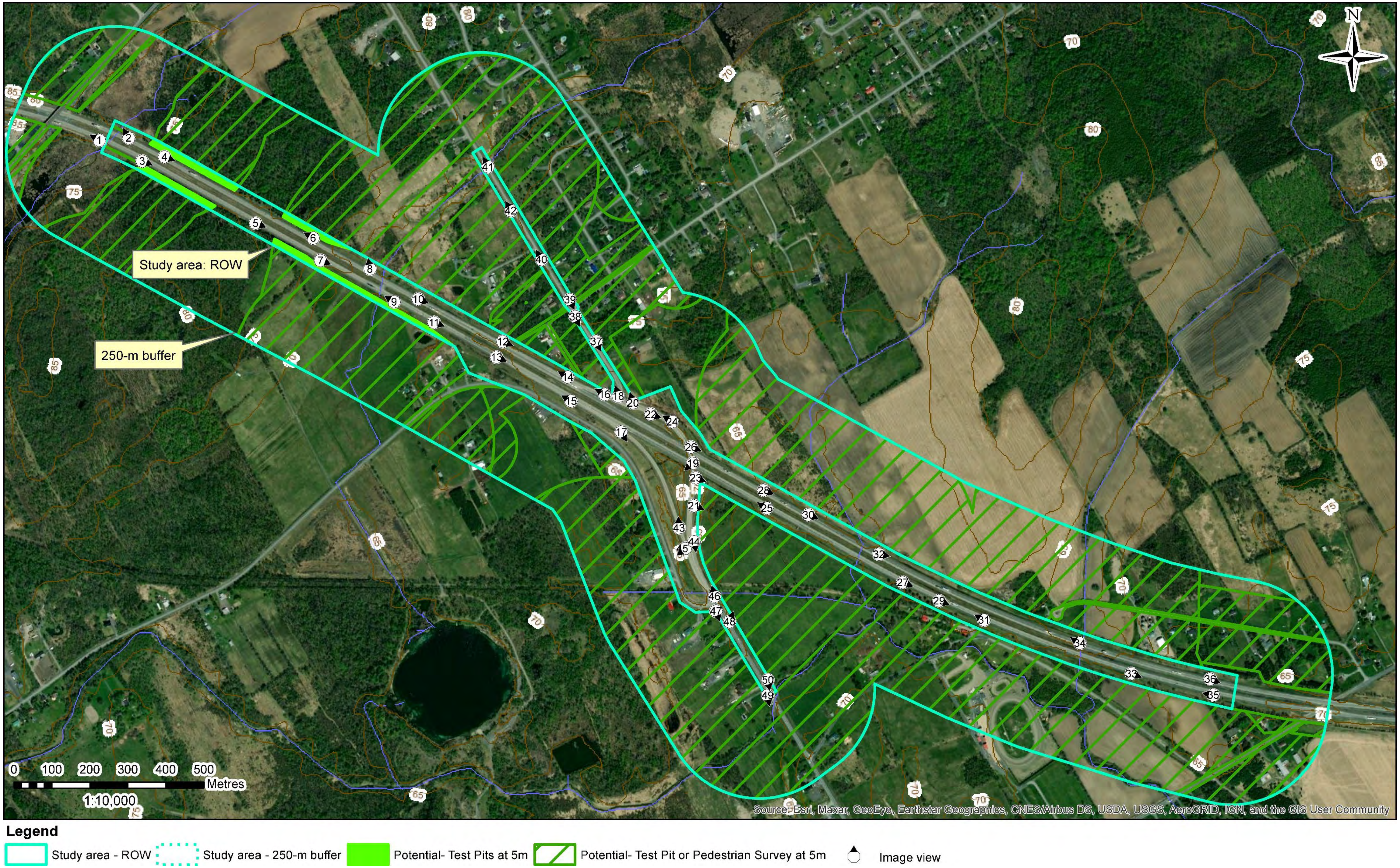
Map 10: 1977 aerial view of the study area showing new highway and bridge (City of Cornwall 2022).



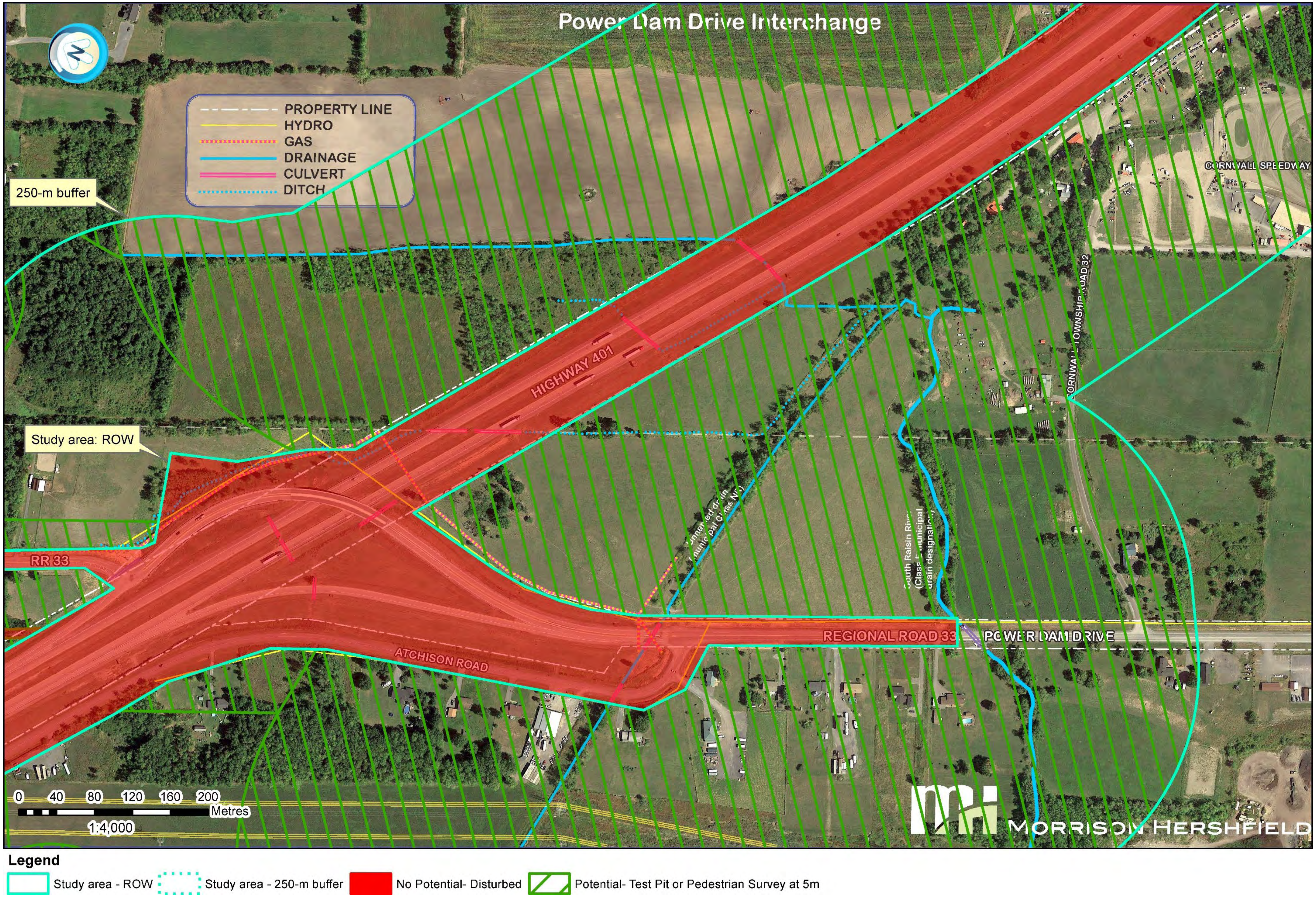
Legend

Study area - ROW | Study area - 250-m buffer | Potential- 100m to 19th C. feature | Potential- 300m to water | No Potential- Low and wet | No Potential- Disturbed | Previous Assessment | Image view

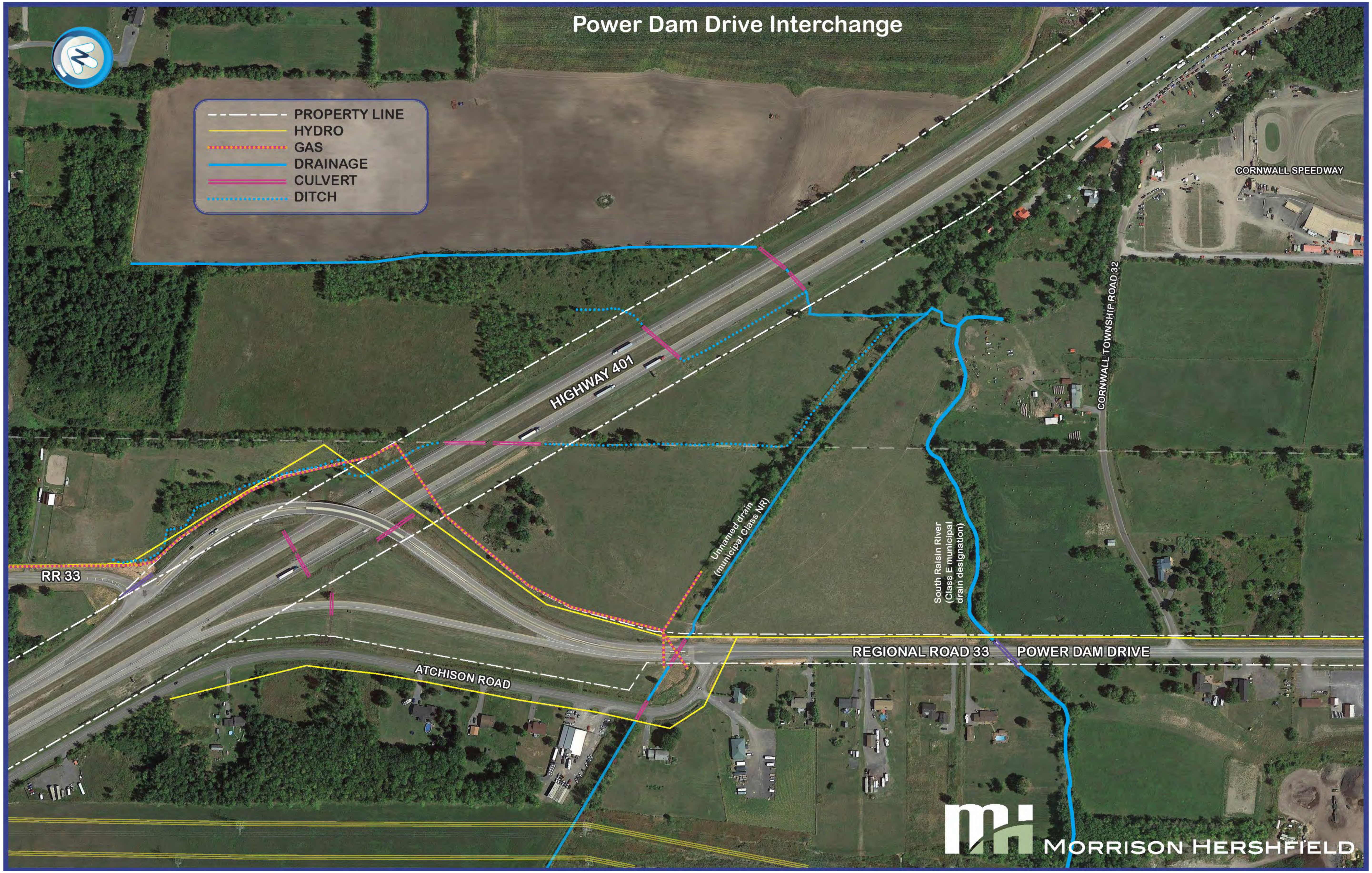
Map 11: Highway 401 Power Dam Drive Bridge and Interchange study area with archaeological potential zones and photo locations (ESRI 2022; MNR 2004).



Map 12: Highway 401 Power Dam Drive Bridge and Interchange study area with recommended Stage 2 archaeological assessment areas and photo locations (ESRI 2022; MNR 2004).



Map 13: Detail of the Highway 401 Power Dam Drive Bridge and Interchange study area with recommended Stage 2 archaeological assessment areas.



Map 14: Current plan of Highway 401 Power Dam Drive Bridge and Interchange study area (as provided by Morrison Hershfield).

Appendix H – Cultural Heritage Resource Assessment Report for the Replacement of Bridge Site 013X-180 /B.O. Highway 401 at Power Dam Drive Interchange (I.C. 789) Class Environmental Assessment

Cultural Heritage Resource Assessment Report

Replacement of Bridge Site 013X-180 /B.O. Highway 401 at Power Dam Drive Interchange (I.C. 786) Class Environmental Assessment

Township of South Stormont United Counties of Stormont, Dundas and Glengarry, Ontario

Prepared for:

Morrison Hershfield
1005 Skyview Drive, Suite
175 Burlington, ON L7P 5B1

Archaeological Services Inc. File: 21CH-075

February 2022 (Updated February and September 2024 and January 2025)

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Executive Summary

Archaeological Services Inc. was contracted by Morrison Hershfield, on behalf of the Ministry of Transportation (M.T.O.) to conduct a Cultural Heritage Resource Assessment Report (C.H.R.A.R.) as part of the Replacement of Bridge Site 013X-180 /B.O. Highway 401 at Power Dam Drive Interchange (I.C. 786) (G.W.P. 4092-19-00) Preliminary Design and Environmental Assessment (hereafter referred to as "The Project") under the Class Environmental Assessment for Provincial Transportation Facilities process. The Project involves the replacement of Bridge Site 013X-180/B.O. that carries Power Dam Drive over Highway 401. The Project will also develop the long-term plan for the interchange, including future interchange improvements. The project limits are approximately 1.5 kilometres northwest to 1.5 kilometres southeast of the Highway 401 and Power Dam Drive interchange, and approximately 500 metres northeast to 500 metres southwest of the interchange. The study area is generally bounded by agricultural and residential properties.

The study will follow the approved environmental planning process for Group "B" projects under the Class Environmental Assessment for Provincial Transportation Facilities (2024). The study will identify and evaluate options to improve the operational and geometric conditions of this interchange as part of M.T.O.'s ongoing review of safety and operational needs for the provincial highway network.

The purpose of the C.H.R.A.R. is to document the existing conditions of the study area and identify known and potential built heritage resources (B.H.R.s) and cultural heritage landscapes (C.H.L.s) within the study area, provide a preliminary impact assessment relating to the proposed project, and propose appropriate mitigation measures.

The Bridge Site 013X-180 /B.O. was screened by the Ministry of Transportation, and it was determined not to have potential for cultural heritage value or interest. A review of federal, provincial, and municipal registers, inventories, and databases revealed that there are no previously identified features of cultural heritage value within the study area. Seven features were identified during fieldwork, including four potential B.H.R.s and three potential C.H.L.s.

Based on a review of the short-listed alternatives, and as presented in Table 2 in the body of the report, Alternatives Three, Five, Six, and Eight may result in indirect impacts to B.H.R. 1 due to construction-related vibration. Alternatives Three, Five, Six, and Eight will not result in any other direct or indirect impacts to the other identified B.H.R.s or C.H.L.s in the study area. Alternative One will not result in any direct or indirect impacts to the identified B.H.R.s or C.H.L.s.

Next steps, as well as general recommendations, are presented as follows:

1. Alternatives Three, Five, Six, and Eight may result in indirect impacts from construction-related vibration to B.H.R. 1 as the structure is within 50-metres of the proposed infrastructure improvements. To address the potential for indirect impacts due to construction-related vibration, undertake a baseline vibration assessment during Detail Design to determine potential for vibration impacts and monitor where required.

2. A copy of this C.H.R.A.R. and other heritage reports for this Project, should be provided to the Ministry of Citizenship and Multiculturalism, and other interested parties for review and comment.

3. All technical cultural heritage studies are to be completed in accordance with the Standards and Guidelines (2010) and M.T.O.'s cultural heritage conservation policy and process by a Qualified Person as defined in the Standards and Guidelines.

4. Should future work require an expansion or alteration of the study area, the additional area or change should be studied by a qualified heritage professional to confirm the impacts of the proposed work on potential B.H.R.s and C.H.L.s.

Report Accessibility Features

This report has been formatted to meet the Information and Communications Standards under the *Accessibility for Ontarians with Disabilities Act*, 2005 (A.O.D.A.). Features of this report which enhance accessibility include: headings, font size and colour, alternative text provided for images, and the use of periods within acronyms. Given this is a technical report, there may be instances where additional accommodation is required in order for readers to access the report's information. If additional accommodation is required, please contact Annie Veilleux, Manager of the Cultural Heritage Division at Archaeological Services Inc., by email at aveilleux@asiheritage.ca or by phone 416-966-1069 ext. 255.

Project Personnel

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- **Project Coordinator:** Jessica Bisson, B.F.A. (Hon.), Cultural Heritage Technician, Division Coordinator – Cultural Heritage Division
- **Project Manager**: Lindsay Graves
- **Field Review**: Johanna Kelly, M.S.c., Cultural Heritage Analyst, Project Manager – Cultural Heritage Division
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- Alanna Martini, B.A., Associate Archaeologist, Field Director – Environmental Assessment Division
- Leora Bebko, M.M.St., Cultural Heritage Technician, Technical Writer and Researcher – Cultural Heritage Division
- **Graphics Production**: Carolyn Nettleton, B.A., Archaeologist, Geomatics Technician – Operations Division
- **Report Reviewer(s)**: Lindsay Graves
- John Sleath, M.A., Cultural Heritage Specialist, Project Manager – Cultural Heritage Division

For further information on the qualified persons involved in this project, see Appendix A.

Glossary

Built Heritage Resource (B.H.R.)

Definition: "…one or more significant buildings (including fixtures or equipment location in or forming part of a building), structures, monuments, installations, or remains associated with architectural, cultural, social, political, economic, or military history and identified as being important to a community. For the purposes of these Standards and Guidelines, "structures" does not include roadways in the provincial highway network an in-use electrical or telecommunications transmission towers" (Standards and Guidelines for Conservation of Provincial Heritage Properties, 2010).

Cultural Heritage Landscape (C.H.L.)

Definition: "…a defined geographical area of heritage significance that human activity has modified and that a community values. Such an area involves a grouping(s) of individual heritage features, such as structures, spaces, archaeological sites, and natural elements, which together form a significant type of heritage form distinct from its constituent elements or parts. Heritage conservation districts designated under the *Ontario Heritage Act*, villages, parks, gardens, battlefields, mainstreets and neighbourhoods, cemeteries, trails, and industrial complexes of cultural heritage value are some examples." (Standards and Guidelines for Conservation of Provincial Heritage Properties, 2010).

Known Built Heritage Resource or Cultural Heritage Landscape

Definition: A known built heritage resource or cultural heritage landscape is a property that has recognized cultural heritage value or interest. This can include a property listed on a Municipal Heritage Register, designated under Part IV or V of the *Ontario Heritage Act*, or protected by a heritage agreement, covenant or easement, protected by the *Heritage Railway Stations Protection Act or the Heritage Lighthouse Protection Act*, identified as a Federal Heritage Building, or located within a U.N.E.S.C.O. World Heritage Site (Ministry of Citizenship and Multiculturalism, 2016).

Impact
Definition: Includes negative and positive, direct and indirect effects to an identified built heritage resource and cultural heritage landscape. Direct impacts include destruction of any, or part of any, significant heritage attributes or features and/or unsympathetic or incompatible alterations to an identified resource. Indirect impacts include, but are not limited to, creation of shadows, isolation of heritage attributes, direct or indirect obstruction of significant views, change in land use, land disturbances (Ministry of Citizenship and Multiculturalism, 2006). Indirect impacts also include potential vibration impacts.

Mitigation
Definition: Mitigation is the process of lessening or negating anticipated adverse impacts to built heritage resources or cultural heritage landscapes and may include, but are not limited to, such actions as avoidance, monitoring, protection, relocation, remedial landscaping, and documentation of the cultural heritage landscape and/or built heritage resource if to be demolished or relocated (Ministry of Citizenship and Multiculturalism, 2006).

Potential Built Heritage Resource or Cultural Heritage Landscape
Definition: A potential built heritage resource or cultural heritage landscape is a
Definition: A potential built heritage resource or cultural heritage landscape is a
property that has the potential for cultural heritage value or interest. This can include properties/project area that contain a parcel of land that is the subject of a commemorative or interpretive plaque, is adjacent to a known burial site and/or cemetery, is in a Canadian Heritage River Watershed, or contains buildings or structures that are 40 or more years old (Ministry of Citizenship and Multiculturalism, 2016).

Significant
Definition: With regard to cultural heritage and archaeology resources, significant means “resources that have been determined to have cultural heritage value or interest. Processes and criteria for determining cultural heritage value or interest are established by the Province under the authority of the *Ontario Heritage Act.* While some significant resources may already be identified and inventoried by

official sources, the significance of others can only be determined after evaluation” (Ministry of Municipal Affairs and Housing, 2024, p. 51).

Vibration Zone of Influence

Definition: Area within a 50-metre buffer of construction-related activities in which there is potential to affect an identified built heritage resource or cultural heritage landscape. A 50-metre buffer is applied in the absence of a project-specific defined vibration zone of influence based on existing secondary source literature (Carman et al., 2012; Crispino & D’Apuzzo, 2001; P. Ellis, 1987; Rainer, 1982; Wiss, 1981). This buffer accommodates the additional threat from collisions with heavy machinery or subsidence (Randl, 2001).

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Before the Common Era – B.C.E.

Built Heritage Resource – B.H.R. Common Era – C.E.

Cultural Heritage Landscape – C.H.L.

Cultural Heritage Resource Assessment Report – C.H.R.A.R.

Environmental Assessment – E.A.

Group Work Project – G.W.P. Interchange – I.C.

Ministry of Citizenship and Multiculturalism – M.C.M.

Ministry of Transportation, Ontario – M.T.O.

Ontario Heritage Act – O.H.A.

Ontario Heritage Bridge Guide – O.H.B.G.

Ottawa and New York Railway – O. and N.Y.R.

Right-of-way – R.O.W.

United Nations Educational, Scientific and Cultural Organization – U.N.E.S.C.O.

1.0 Introduction

Archaeological Services Inc. was contracted by Morrison Hershfield, on behalf of the Ministry of Transportation (M.T.O.) to conduct a Cultural Heritage Resource Assessment Report (C.H.R.A.R.) as part of the Replacement of Bridge Site 013X-180 /B.O. Highway 401 at Power Dam Drive Interchange (I.C. 786) (G.W.P. 4092-19-00) Preliminary Design and Environmental Assessment (hereafter referred to as "The Project") under the Class Environmental Assessment (E.A.) for Provincial Transportation Facilities process.

The study is following the approved planning process for Group B projects under the M.T.O. Class E.A. for Provincial Transportation Facilities with opportunity for public input throughout the process. Group B projects involve major improvements to provincial transportation facilities. A Transportation Environmental Study Report will be prepared to document the development of the Preliminary Design, including the evaluation of alternatives, the Recommended Plan, environmental effects, proposed mitigation measures and consultation undertaken throughout the process.

The purpose of the Class E.A. Study is to identify a Recommended Plan for the Highway 401 Power Dam Bridge and Interchange Study as part of M.T.O.'s ongoing review of safety and operational needs for the provincial highway network. The Class E.A. Study will also determine the bridge replacement needs associated with the ultimate widening of Highway 401 with consideration for the ultimate interchange configuration.

1.1 Purpose of the Report

The purpose of the C.H.R.A.R. is to inform project planning and design by providing recommendations for conserving built heritage resources (B.H.R.s) and cultural heritage landscapes (C.H.L.s). The C.H.R.A.R. will establish existing baseline conditions by identifying all potential B.H.R.s and C.H.L.s located within the study area. It also includes a preliminary impact assessment of potential impacts from proposed project activities and provides recommendations on alternatives and mitigations to conserve the identified potential B.H.R.s and C.H.L.s. The assessment evaluates project alternatives and informs the selection of the Recommended Plan.

This C.H.R.A.R. has been prepared in accordance with the following:

- Ontario Heritage Act (Ministry of Citizenship and Multiculturalism, 1990);
- Standards and Guidelines for Conservation of Provincial Heritage Properties (2010) (hereafter the Standards and Guidelines) issued under Section 25.2 of the Ontario Heritage Act (O.H.A.);
- Class Environmental Assessment for Provincial Transportation Facilities (Ministry of Transportation, 2000 amended 2024) including M.T.O. technical standards and guidance documents;
- Environmental Guide for Built Heritage and Cultural Heritage Landscapes (MTO 2007); and
- Ontario Heritage Bridge Guidelines for Provincially Owned Bridges (interim) MTO January 11, 2008 (OHBG) (Ministry of Transportation, 2008).

1.2 Project Overview

The Project involves the replacement of Bridge Site 013X-180 /B.O. that carries Power Dam Drive over Highway 401 in the Township of South Stormont, within the United Counties of Stormont, Dundas and Glengarry. The Project will also develop the long-term plan for the interchange, including future interchange improvements, and establish the footprint for the future widening of Highway 401 to six lanes. The bridge design will consider the future widening of Highway 401, but the E.A. for the future widening will not be completed as part of this Study.

The Project limits are approximately 1.5 kilometres northwest to 1.5 kilometres southeast of the Highway 401 and Power Dam Drive interchange, and approximately from 500 metres northeast to 500 metres southwest of the interchange. The Project study area is generally bounded by agricultural and rural residential properties. Highway 401 is a four-lane divided rural freeway at the Power Dam Road interchange. The interchange's current configuration does not allow for all traffic movements on to and off Highway 401. Currently traffic can exit eastbound and enter westbound at this partial interchange. Reasonable alternatives to address the required improvements will be developed and evaluated leading to the selection of the preferred alternative(s) and a Recommended Plan. The proposed bridge replacement will proceed first and interchange improvements will follow at a later date.

2.0 Study Area

The study area for this Cultural Heritage Resource Assessment Report (C.H.R.A.R.) has been developed as per the *Environmental Guide for Built Heritage and Cultural Heritage Landscapes* (2007), which defines a study area as "all lands to be affected adversely either through displacement and/or disruption by the proposed highway design and construction within the existing and proposed highway right-of-way (R.O.W.) and the off-route zones adjacent or abutting the existing R.O.W. (Ministry of Transportation, 2007, p. 13). It further describes the study area as having three zones, as follows:

1. A R.O.W. study zone comprises lands to be cleared and developed for the proposed highway R.O.W.
2. A 25-metre study zone is located immediately beside the R.O.W. and has potential for associated land clearance.
3. A 25 to 250-metre study zone further off the R.O.W. comprising an area where land clearance is unlike to occur, however, where impacts to B.H.R.s and C.H.L.s may be experienced.

At project start-up in late 2021, Archaeological Services Inc. was provided with a large preliminary study area (C.H.R.A.R. Study Area) and completed data collection and a field review for the lands contained therein (Figure 1). The three zones identified above are shown in Section 5.0 mapping of the project alternatives.

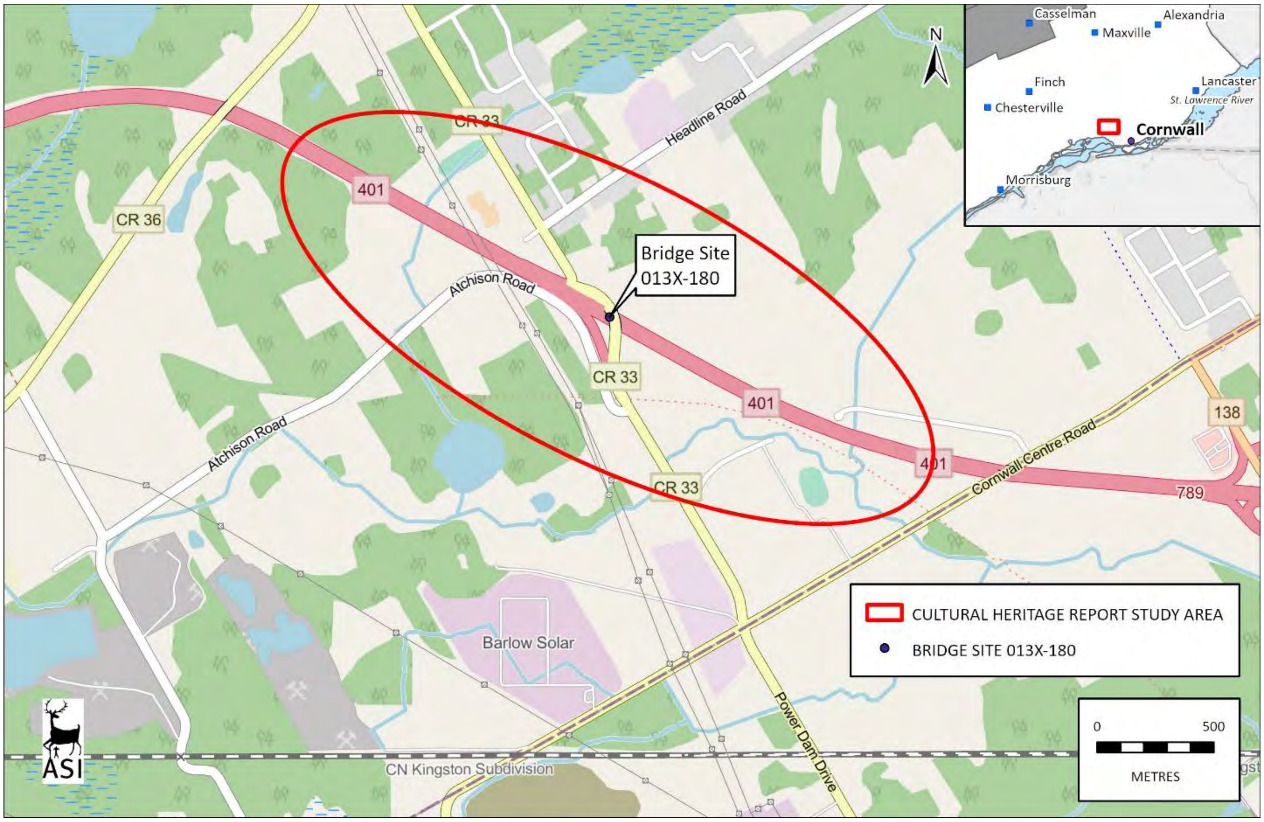

Figure 1: Location of the project study area. Base Map: ©OpenStreetMap and contributors, Creative Commons-Share Alike License (C.C.-By-S.A.)

3.0 Summary of Historical Development Within the Study Area

This section provides a brief summary of historical research. A review of available primary and secondary source material was undertaken to produce a contextual overview of the study area, including a general description of physiography, Indigenous land use, and Euro-Canadian settlement.

3.1 Physiography

The study area is within the Glengarry Till Plain physiographic region of Southern Ontario, which is a region of low relief and forms the drainage divide between the international section of the St. Lawrence and the Ottawa River basin, from Prescott to the Quebec boundary. This region covers an area of approximately

2500 square kilometres, with a terrain that is undulating to rolling, and consists of long moraine ridges and a few well-formed drumlins together with intervening clay flats and swamps. A large number of small streams arise within the till plain (Chapman & Putnam, 1984). The study area's physiography, soil type, and location in the vicinity of the St. Lawrence River influenced early settlement and its transformation into agricultural lands.

3.2 Indigenous Land Use and Settlement

Southern Ontario has been occupied by human populations since the retreat of the Laurentide glacier approximately 13,000 years ago, or 11,000 Before the Common Era (B.C.E.) (Ferris, 2013).[1] During the Paleo period (c. 11,000 B.C.E. to 9,000 B.C.E.), groups tended to be small, nomadic, and non-stratified. The population relied on hunting, fishing, and gathering for sustenance, though their lives went far beyond subsistence strategies to include cultural practices including but not limited to art and astronomy. Fluted points, beaked scrapers, and gravers are among the most important artifacts to have been found at various sites throughout southern Ontario, and particularly along the shorelines of former glacial lakes. Given the low regional population levels at this time, evidence concerning Paleo period groups is very limited (C. J. Ellis & Deller, 1990).

Moving into the Archaic period (c. 9,000 B.C.E. to 1,000 B.C.E.), many of the same roles and responsibilities continued as they had for millennia, with groups generally remaining small, nomadic, and non-hierarchical. The seasons dictated the size of groups (with a general tendency to congregate in the spring/summer and disperse in the fall/winter), as well as their various sustenance activities, including fishing, foraging, trapping, and food storage and preparation. There were extensive trade networks which involved the exchange of both raw materials and finished objects such as polished or ground stone tools, beads, and

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

notched or stemmed projectile points. Furthermore, mortuary ceremonialism was evident, meaning that there were burial practices and traditions associated with a group member's death (C. J. Ellis et al., 2009; C. J. Ellis & Deller, 1990).

The Woodland period (c. 1,000 B.C.E. to 1600 C.E.) saw several trends and aspects of life remain consistent with previous generations. Among the more notable changes, however, was the introduction of pottery, the establishment of larger occupations and territorial settlements, incipient horticulture, more stratified societies, and more elaborate burials. Later in this period, settlement patterns, foods, and the socio-political system continued to change. A major shift to agriculture occurred in some regions, and the ability to grow vegetables and legumes such as corn, beans, and squash ensured long-term settlement occupation and less dependence upon hunting and fishing. This development contributed to population growth as well as the emergence of permanent villages and special purpose sites supporting those villages. Furthermore, the socio-political system shifted from one which was strongly kinship based to one that involved tribal differentiation as well as political alliances across and between regions (Birch et al., 2021; Dodd et al., 1990; C. J. Ellis & Deller, 1990; Williamson, 1990).

The arrival of European trade goods in the sixteenth century, Europeans themselves in the seventeenth century, and increasing settlement efforts in the eighteenth century all significantly impacted traditional ways of life in Southern Ontario. Over time, war and disease contributed to death, dispersion, and displacement of many Indigenous peoples across the region. The Euro-Canadian population grew in both numbers and power through the eighteenth and nineteenth centuries and treaties between colonial administrators and First Nations representatives began to be negotiated. The study area is within the Crawford Purchase. In August 1783 Sir John Johnson, Superintendent General of Indian Affairs convinced the Mississaugas of the Quinte region to a land cession. Johnson turned the task over to Captain William Crawford.

3.2.1 Treaties and Traditional Territories

The study area is within the Crawford Purchase. In August 1783 Sir John Johnson, Superintendent General of Indian Affairs convinced the Mississaugas of the Quinte region to a land cession. Johnson turned the task over to Captain William Crawford. Crawford's Purchases were made on behalf of the Crown, and the Six Nations in October 1783, and involved the land along the north shore of eastern Lake Ontario and the St. Lawrence River. It is reported that the cost paid to the Mississauga chiefs was clothing "for all their families", guns "for those who did not have any", powder and ball for winter hunting, 12 laced hats and red cloth sufficient for 12 coats. Chief Mynass, who assisted Crawford with the deal, also sold his own lands (Surtees, 1984). A second deal likely occurred with the Mississaugas over "the land at the bottom of the Bay".

These purchases were designed to provide land to Loyalists who fought on behalf of the British during the American Revolution, including Indigenous allies, namely Six Nations, and United Empire Loyalists (Ministry of Indigenous Affairs, 2020).

3.3 Historical Euro-Canadian Township Survey and Settlement

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

Historically, the study area is located in the former Township of Cornwall, County of Stormont in part of Lots 15-20, Concession 4 and Lots 19-21, Concession 5.

3.3.1 Former Township of Cornwall

The former Township of Cornwall, County of Stormont, was first settled in 1784 by United Empire Loyalists, led by Superintendent General of Indian Affairs Sir John Johnson. By the mid 1800s, about one fifth of the township was under cultivation, a total of four grist mills and four sawmills were in operation, and the population was recorded at 3,907. The main settlement center to develop in the township was the town of Cornwall, situated in the south-east corner on the St. Laurence River. The settlement first served as a garrison town and as a communications and supply post during the War of 1812. During the mid 1800s, Cornwall had evolved into a centre of learning and political influence. By the late 1800s, Cornwall had established itself as an important industrial centre in Eastern Ontario (City of Cornwall, 2017; Smith, 1846). The study area remained an agricultural area in the late nineteenth century.

The area maintained its agricultural base throughout the twentieth century, even as tourism began to grow in importance in the latter half of the twentieth century especially to the south of the study area, particularly following the construction of the St. Lawrence Seaway (Mika & Mika, 1983).

3.3.2 Ottawa and New York Railway – New York Central Railroad

Transecting the study area is the former alignment of the Ottawa and New York Railway (O. and N.Y.R.) which was part of the New York Central Railroad. The O. and N.Y.R. was located in eastern Ontario, entering Ontario at Cornwall and traveling northeast to Ottawa. The portion of the line between Cornwall and Ottawa was constructed in 1899 and was the only all-American owned track in eastern Ontario (Andreae, 1997).

During the nineteenth century, American railway investors were looking for new opportunities for broadening their influence and new avenues of commerce. One such opportunity was a possible connection between the New York State markets and the capital of Canada, Ottawa. This led to the charter of the Ontario Pacific Railway in 1882, which included the construction of a line from Cornwall to Ottawa, with extensions further west and branch lines to communities outside of Ottawa. The goal of this rail line would be to connect to British Columbia. Work was also included for the bridge works needed to cross the St. Lawrence River into the United States. However, the money was not readily available for such an undertaking and the charter sat for a long period of time (*Southern Ontario Railway Map*, 2009).

In the mid-1890s, with additional American financiers, the name was changed from the Ontario Pacific Railway to the O. and N.Y.R. Construction began shortly thereafter and the line between Ottawa and Cornwall was complete and operational by 1898. The O. and N.Y.R. also needed to connect to the existing New York rail lines so the rail lines were charted to build southeast to Tupper Lake. As work along the rail line progressed, construction began on the bridge across the St. Lawrence River. This work was completed by 1900; however, during the construction of the bridge, an accident occurred where there was a large loss of life where a portion of the bridge collapsed. As a result of this and continual cost overruns, the company fell into receivership the same year. By 1904, the New York Central and Hudson Railway took over control of the line and merged it with its own system by 1913 (*Southern Ontario Railway Map*, 2009).

Throughout the early twentieth century, traffic along the line remained busy, however, with the growing use of cars and trucks after World War II passenger service was suspended in 1954. The line was abandoned by the New York Central in 1957. After the line was abandoned, the infrastructure was sold to the Canadian National Railway, who dismantled the line. Parts of the former route were leased for infrastructure needs as well as recreational trails (*Southern Ontario Railway Map*, 2009)

3.3.3 Highway 401

Construction of Highway 401, a controlled access highway spanning Southern Ontario from Windsor to the Ontario/Quebec boundary, began after World War II and reached completion by 1968 (Bevers, 2012; Ministry of Transportation and Communications, 1972). Plans to build Highway 401, originally known as the MacDonald-Cartier Highway, were realized in the late 1930s, however, construction was delayed due to the outbreak of World War II (Bevers, 2012). The highway was built to relieve heavy traffic congestion on Highway 2, the main east-west transportation corridor in southern Ontario during the first half of the twentieth century. Certain areas of Highway 2 were of particular concern, and therefore the highway was built in sections to relieve traffic congestion where it was needed the most. The first section to be completed was the Toronto-Oshawa Highway in 1947. Construction began on the Toronto Bypass in the 1950s, reaching completion by 1956 (Bevers, 2012).

The next phase in the construction of Highway 401 took place in the late 1950s and early 1960s (Bevers, 2012). This phase included the following sections: Windsor to Tilbury; London to Woodstock; Milton to Toronto; Oshawa to Port Hope; Trenton to Belleville; and Kingston to Gananoque. The remaining phases were completed in the mid- to late 1960s. The final section of Highway 401 was completed between Gananoque and Brockville by 1968 (Bevers, 2012).

The significance of Highway 401 as a transportation corridor across southern Ontario is best summarized by Professor E. G. Preva of the University of Western Ontario, as quoted in the document *'401' The MacDonald-Cartier Freeway*: "Highway 401 is the most important single development changing the social and economic pattern of Ontario. It is still transforming the province's economy and the social, work and spending habits of its people" (Ministry of Transportation and Communications 1972:1).

3.4 Review of Historical Mapping

The 1862 *Map of the Counties of Stormont, Dundas, Glengarry, Prescott & Russell* (Walling & Gray, 1862) and the 1879 *Illustrated Historical Atlas of the Counties of Stormont, Dundas and Glengarry* (H. Belden & Co., 1879) were examined to determine the presence of historical features within the study area during the nineteenth century (Figure 2 and Figure 3). Historically, the study area is located in in part of Lots 15-20, Concession 4 and Lots 19 - 21, Concession 5 in the former Township of Cornwall, County of Stormont

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

Nineteenth-century mapping depicts the study area in a rural agricultural context (Figure 2 and **Error! Reference source not found.**). The 1862 *Map of the Counties of Stormont, Dundas, Glengarry, Prescott & Russell* (Figure 2) depicts Power Dam Drive, Headline Road, and Cornwall Centre Road as historically surveyed roads all following similar alignments to their present orientation. Power Dam Drive would later be re-routed with the introduction of Highway 401 and Headline Road would terminate east of the Highway 401 with the road to the west being re-named Atchison Road. Also depicted are Speer Road and Barlow Road; however, the map is torn in part of the location of the alignment of the route. A lot/concession system is evident, and several names are identified as property owners of what may be called large homesteads. The South Raisin River is illustrated meandering through the southern portion of the study area. The 1879 *Illustrated Historical Atlas of the Counties of Stormont, Dundas and Glengarry* (Figure 3) depicts the study area in a similar context as the earlier mapping. Speer Road and Barlow Road are illustrated as a continuous singular roadway at the time. A Grange Hall is located south of Atchison Road and west of Power Dam Drive. A small community at the intersection of Cornwall Centre Road and Power Dam Drive is depicted with a township hall and post office.

In addition to nineteenth-century mapping, historical topographic mapping and aerial photographs from the twentieth century were examined. This report presents maps and aerial photographs from 1909, 1954, 1966. and 1982 (Figure 4 to Figure 7).

Twentieth-century mapping continues to depict the study area in an agricultural context with the most notable change coming from the introduction of Highway 401 during the latter-half of the twentieth century. The 1909 topographic map (Figure 4) illustrates some change within the study area. The Ottawa and New York Railway (O. and N.Y.R.) has been constructed through the southern portion of the study area. The map shows the location of frame and brick farmhouses (black squares represent frame houses, red squares represent brick/masonry houses) and all the roads within the study area are unmetalled roads. There are several bridges illustrated along the roadways; however, no construction material is identified for the structures. Few changes to the area occur through the middle of the twentieth century and the study area remains largely agricultural and rural as captured in the 1954 aerial photography (Figure 5). The 1966 topographic map (Figure 6) illustrates the change that occurred in the study area following the construction of Highway 401. Power Dam Drive (labelled as Nine Mile Road on the mapping), Headline Road, and Speer Road and Barlow Road were all re-routed after the highway's construction. A crossing at the location of the Power Dam Drive interchange is depicted on the mapping. The O. and N.Y.R. is labelled as abandoned. A hydro corridor is illustrated to the west of Power Dam Road traveling north-south. Overall, the study area remains sparsely settled and remains as such into the late-twentieth century as illustrated in the 1982 topographic map (Figure 7). The bridge carrying Power Dam Drive is illustrated with a curved approach from the north and from the south. Some additional houses have been constructed as has a racetrack, which may be associated with the Cornwall Motor Speedway that is located there presently.

Figure 2: The study area overlaid on the 1862 *Map of the Counties of Stormont, Dundas, Glengarry, Prescott & Russell.* Base Map: (Walling & Gray, 1862).

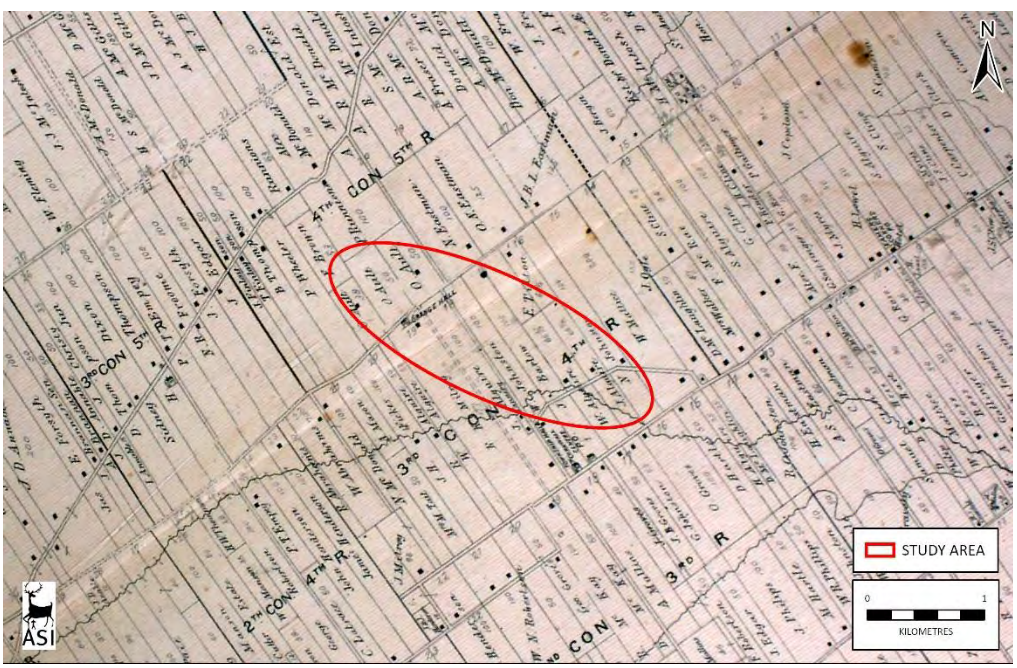

Figure 3: The study area overlaid on the 1879 *Illustrated Historical Atlas of the Counties of Stormont, Dundas and Glengarry*. Base Map: (H. Belden & Co., 1879).

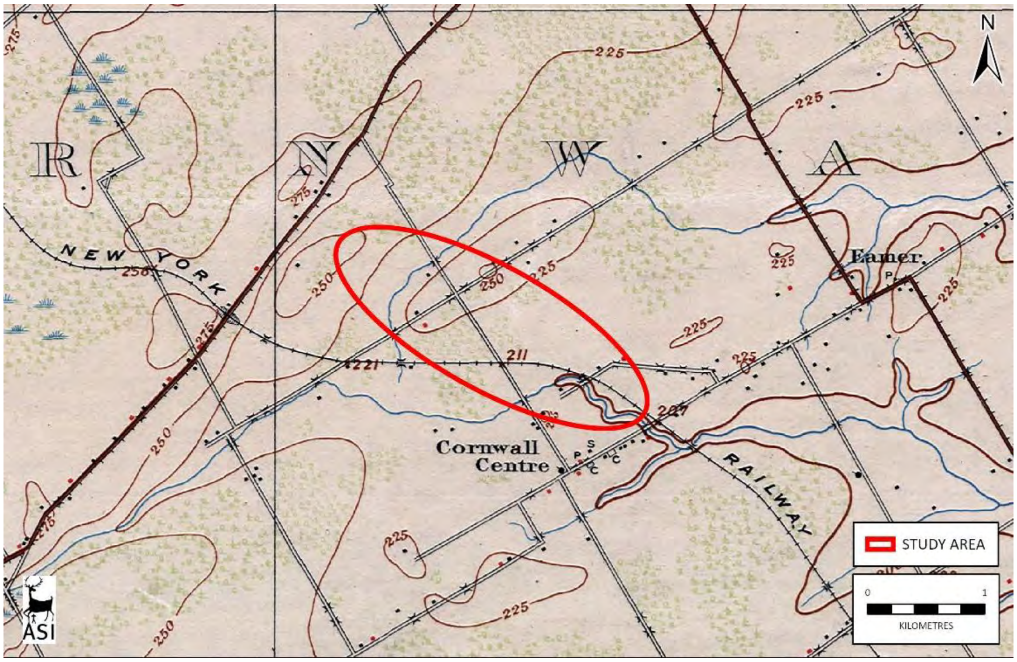

Figure 4: The study area overlaid on the 1909 topographic map. Base Map: Cornwall Sheet No. 17 (Department of Militia and Defence, 1909)

Figure 5: The study area overlaid on the 1954 aerial photograph of the Township of South Stormont. Base Plate: 451.744 (Hunting Survey Corporation Limited, 1954)

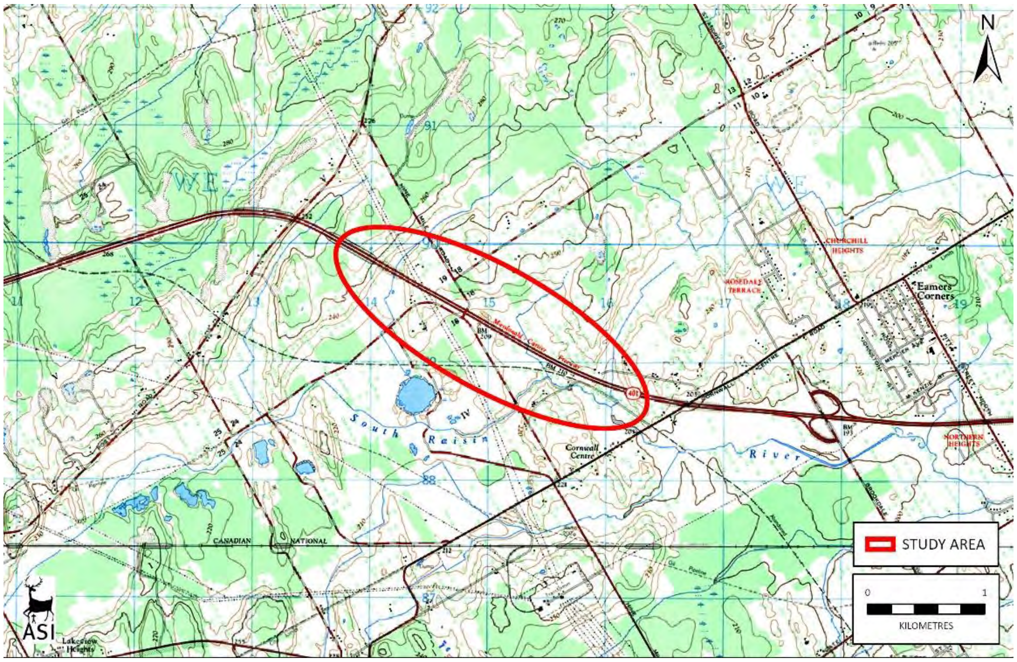

Figure 6: The study area overlaid on the 1966 topographic map. Base Map: Cornwall Sheet 31G/2c (Department of Militia and Defence, 1909)

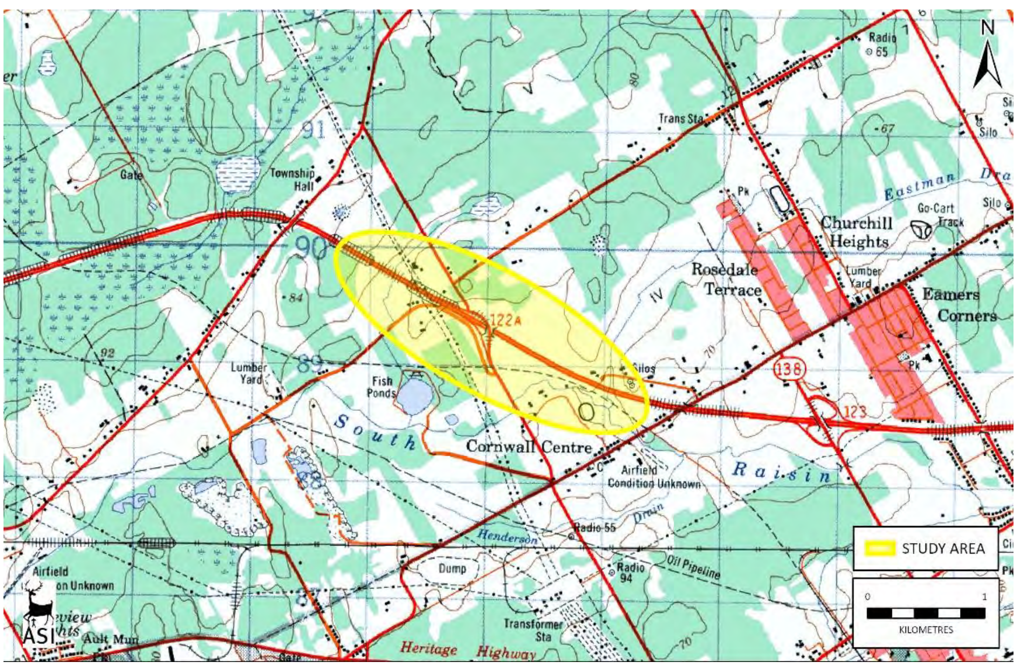

Figure 7: The study area overlaid on the 1982 topographic map. Base Map: Cornwall Sheet 31G/2 and 31B/15 (Department of Energy, Mines and Resources, 1982)

4.0 Known and Potential Built Heritage Resources and Cultural Heritage Landscapes within the Study Area

The following sections present the results of desktop data collection, community engagement, and field review.

4.1 Review of Existing Heritage Inventories

A number of resources were consulted in order to identify previously identified built heritage resources and cultural heritage landscapes within the study area. These resources, reviewed on 25 January, 2022, include:

- *Historical Sites and Points of Interest in South Stormont* on the *History and Heritage* webpage for the Township of South Stormont (2020);
- The *Ontario Heritage Act Register* (Ontario Heritage Trust, n.d.b);
- The *Places of Worship Inventory* (Ontario Heritage Trust, n.d.c);
- The inventory of Ontario Heritage Trust easements (Ontario Heritage Trust, n.d.a);
- The Ontario Heritage Trust's *An Inventory of Provincial Plaques Across Ontario*: a PDF of Ontario Heritage Trust Plaques and their locations (Ontario Heritage Trust, 2023);
- Inventory of known cemeteries/burial sites in the Ontario Genealogical Society's online databases (Ontario Genealogical Society, n.d.);
- Canada's Historic Places website: available online, the searchable register provides information on historic places recognized for their heritage value at the local, provincial, territorial, and national levels (Parks Canada, n.d.a);
- Directory of Federal Heritage Designations: a searchable on-line database that identifies National Historic Sites, National Historic Events, National Historic People, Heritage Railway Stations, Federal Heritage Buildings, and Heritage Lighthouses (Parks Canada, n.d.b);
- Canadian Heritage River System: a national river conservation program that promotes, protects and enhances the best examples of Canada's river

heritage (Canadian Heritage Rivers Board and Technical Planning Committee, n.d.); and,

- United Nations Educational, Scientific and Cultural Organization (U.N.E.S.C.O.) World Heritage Sites (U.N.E.S.C.O. World Heritage Centre, n.d.).

4.2 Review of Previous Heritage Reporting

No additional cultural heritage studies are known to have been undertaken within the study area and so none were reviewed as part of this assessment.

4.3 Community Engagement

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

- Samuel Burrell, Administrative Assistant, Township of South Stormont (email communication 4 and 7 February 2022). Email correspondence confirmed that there are no previously identified built heritage resources and cultural heritage landscapes within the study area.
- The Ministry (email communication 4 and 14 February 2022). Email correspondence confirmed that there are no properties designated by the Minister and no known Provincial Heritage Properties within the study area.
- The Ontario Heritage Trust (email communication 4 February 2022). A response indicated that there are no conservation easements or Trust-owned properties within the study area.

The Ministry of Transportation distributed the Environmental Assessment notifications (Notice of Study Commencement, Notice of Public Information Centre) directly to the following communities:

- Mohawks of Akwesasne
- Métis Nation of Ontario

The Mohawks of Akwesasne requested a meeting with the Ministry of Transportation and Morrison Hershfield to further discuss the project, which took place on October 19, 2022. A review of the meeting minutes[2] confirmed that no areas of potential or known built heritage resources or cultural heritage landscapes in the study area were identified.

The communities will continue to be notified of future project milestones. Should any additional information be received related to cultural heritage assessment, this report will be updated, as appropriate

4.4 Description of Field Review

A field review of the study area was undertaken by Johanna Kelly of Archaeological Services Inc., on 4 November 2021 to document the existing conditions of the study area from existing rights-of-way. The existing conditions of the study area are described below and captured in Plate 1 to Plate 11. A map depicting the location of photographic plates is included in **Error! Reference source not found.**.

The study area is located in the Township of South Stormont and is centred on the bridge that carries Power Dam Drive over Highway 401 and the interchange on the highway. The project limits are from 1.5 kilometres northwest to 1.5 kilometres southeast of the Highway 401 and Power Dam Drive interchange, and approximately from 500 metres northeast to 500 metres southwest of the

[2] Ministry of Transportation recorded the meeting minutes, which are on file with Archaeological Services Inc.

interchange. The study area is generally bounded by agricultural and residential properties.

Within the study area, Highway 401 is a divided freeway with two lanes of northwest-bound and two lanes of southeast-bound vehicular traffic. There is an eastbound exit for traffic and westbound traffic from Power Dam Drive can enter at the partial interchange. Power Dam Drive is an undivided two lane north-south roadway. The road curves to the east before it is carried over Highway 401 by a four-span circular voided slab post-tensioned cast-in-place concrete bridge (Plate 3: View of the four-span bridge carrying Power Dam Drive over Highway 401 from Atchison Road, looking east.) that was constructed in 1961 (Ministry of Transportation, n.d.). The bridge carries two lanes of Power Dam Drive vehicular traffic over the Highway 401. The bridge was screened by the Ministry of Transportation, and it was determined not to have potential for cultural heritage value or interest. For the completed Criteria for Evaluating Potential Heritage Bridges Screening Form see Appendix B.

To the north of the interchange is a residential neighbourhood that is northeast of the intersection of Power Dam Drive and Headline Road. The streets within this neighbourhood are lined with late-twentieth century and twenty-first century homes.

Located west of Highway 401 is Atchison Road, a rural paved two-lane roadway lined with rural and agricultural properties. The road generally travels in a north-south alignment from south of the interchange to south of Highway 401. It begins to curve northwestwards to run parallel to the highway before curving again to a more westwards alignment.

Located within the southern portion of the study area to the east of Highway 401 is Speer Road, which is a rural paved two-lane roadway. The road travels in a general northwest-southeast orientation and is lined with rural and agricultural properties. To the west of Highway 401 is Barlow Road, a rural gravel two lane roadway and is oriented in a general east-west alignment. The road is also lined with rural and agricultural properties. To the south of Barlow Road is the Cornwall

Motor Speedway, with a racetrack, parking, and buildings associated with the racetrack. The Speedway has an entrance driveway and secondary laneway from Cornwall Centre Road. The secondary laneway provides additional parking and follows the alignment of the former Ottawa and New York Railway from Cornwall Centre Road to Barlow Road.

The South Raisin River meanders through the southern portion of the study area in a general northwest-southeast orientation from north of Cornwall Centre Road to just north of Barlow Road where it curves westwards to Power Dam Drive. A timber beam bridge carries Barlow Road over the South Raisin River and a concrete box culvert carries the river under Power Dam Drive. Through application of the 2016 Checklist, the bridge was determined to have potential for cultural heritage value or interest, while the culvert does not.

Plate 1: View of the exit to Power Dam Drive and the bridge carrying Power Dam Drive over Highway 401, looking north.

Plate 2: Looking south-southeast along Power Dam Drive from south of the Highway 401 interchange.

Plate 3: View of the four-span bridge carrying Power Dam Drive over Highway 401 from Atchison Road, looking east.

Plate 4: Looking south-southeast along Power Dam Drive from north of the Highway 401 interchange.

Plate 5: View north-northwest from Barlow Road to Power Dam Drive with rural residential properties.

Plate 6: Speer Road with agricultural fields on both sides, looking west-northwest. Highway 401 is on the left side of the photograph.

Plate 7: View north from Atchison Road to agricultural properties and Highway 401 in the far left.

Plate 8: Looking northeast along Beaver Dam Drive in the residential neighbourhood north of the Power Dam Drive and Highway 401 interchange.

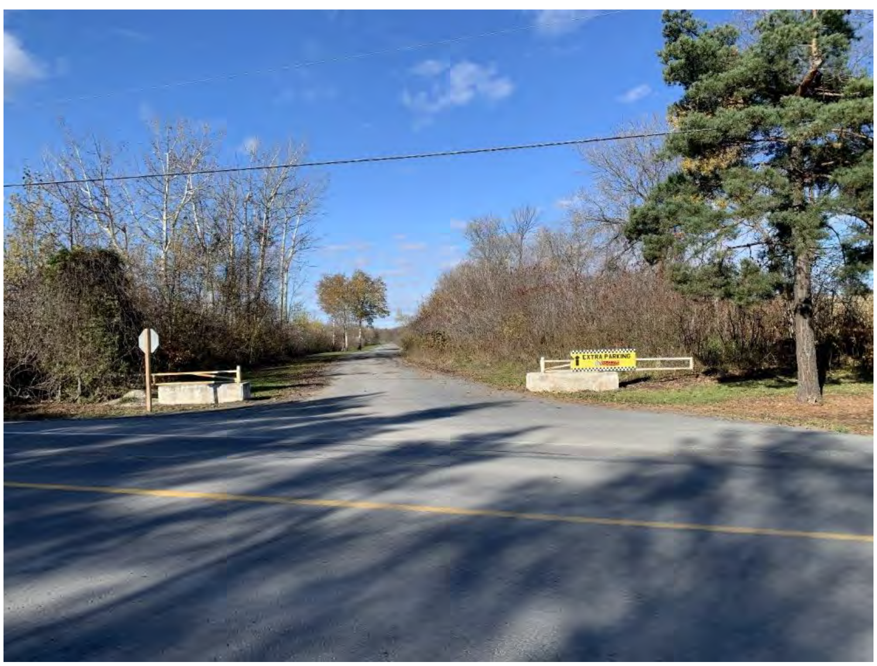

Plate 9: View northwest from Cornwall Centre Road to the secondary laneway for the Cornwall Motor Speedway that follows the former alignment of the O. and N.Y.R.

Plate 10: View south to the Cornwall Motor Speedway from Barlow Road.

Plate 11: View of the timber beam bridge along Barlow Road over the South Raisin River, looking northwest.

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

This Cultural Heritage Resource Assessment Report (C.H.R.A.R.) is prepared in accordance with the legislation and guidelines stated above in Section 1.0. The objective of this report is to identify known and potential built heritage resources (B.H.R.) and cultural heritage landscapes (C.H.L.) within the study area, identify potential impacts to known and potential B.H.R.s and C.H.L.s as a result of the proposed project, and recommend mitigation measures.

4.5.1 Screening for Built Heritage Resources and Cultural Heritage Landscapes

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

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

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

Properties were screened using the application of the criteria as set out in the following screening checklists, where applicable:

- Minister of Citizenship and Multiculturalism's (M.C.M.) screening form, Criteria for Evaluating Potential for Built Heritage Resources and Cultural Heritage Landscapes (Ministry of Citizenship and Multiculturalism, 2016);
- Ministry of Transportation Bridge Screening Forms; and
- Ministry of Transportation Structural Culvert Screening Forms.

The screening forms are used in conjunction with the professional judgement of the qualified person to determine if a more technical Cultural Heritage Evaluation is required. In addition, use of a 40-year-old benchmark is a guiding principle when conducting a preliminary identification of B.H.R.s and C.H.L.s. While identification of a resource that is 40 years old or older does not confer outright cultural heritage value or interest significance, this benchmark provides a means to collect information about resources that may retain cultural heritage value.

This section will describe the results of background research, field review, professional judgement, and application of the criteria as set out in the above-mentioned screening checklists.

The Bridge Site 013X-180 /B.O. was screened by the Ministry of Transportation, and it was determined not to have potential for cultural heritage value or interest. For the completed Criteria for Evaluating Potential Heritage Bridges Screening Form see Appendix B.

4.5.2 Summary of Identified Built Heritage Resources and Cultural Heritage Landscapes

A review of federal, provincial, and municipal registers, inventories, and databases revealed that there are no previously identified features of cultural heritage value within the study area. Seven features were identified during fieldwork, including four potential B.H.R.s and three potential C.H.L.s.

The following provides a brief description of the B.H.R.s and C.H.L.s in Table 1 and mapping showing their locations (Figure 8).

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

Feature I.D.	Type of Property	Address or Location	Heritage Status and Recognition	Description of Property and Known or Potential C.H.V.I.	Photographs/ Digital Image
B.H.R. 1	Residence	17025 Speer Road	Potential B.H.R. – Identified during background research and field review	The residence is located on the northern side of Speer Road to the east of Highway 401. The potential heritage attributes include the one-and-a-half storey residence with a gable roof, a rectangular footprint, and a rear addition. The house features a covered verandah along the front (southern) façade and a chimney along the eastern elevation. The 1879 map (Figure 3) depicts a residence in the vicinity of the existing structure.	 Plate 12: View of the residence at 17025 Speer Road.
B.H.R. 2	Residence	16981 Barlow Road	Potential B.H.R. – Identified during background research and field review	The residence is located on the northern side of Barlow Road to the west of Highway 401. The potential heritage attributes include the one-and-a-half storey residence with a T-shaped footprint, and cross gable roof with a central gable along the eastern portion of the residence. The house also has a western addition and a rear addition. The 1909 topographic map (Figure 4) depicts a wooden house in the vicinity of the extant structure.	 Plate 13: View of the residence at 16981 Barlow Road.

Feature I.D.	Type of Property	Address or Location	Heritage Status and Recognition	Description of Property and Known or Potential C.H.V.I.	Photographs/ Digital Image
B.H.R. 3	Bridge	Barlow Road over South Raisin River	Potential B.H.R. – Identified during background research and field review	The bridge is located along Barlow Road over the South Raisin River. The potential heritage attributes are the single span timber beam bridge resting on concrete abutments. The 1909 topographic map (Figure 4) depicts a bridge crossing the river in the location of the extant structure, though the construction material is not identified.	 Plate 14: View of the timber beam bridge over the South Raisin River.
B.H.R. 4	Residence	16936 Barlow Road	Potential B.H.R. – Identified during background research and field review	The residence is located on the southern side of Barlow Road to the east of Power Dam Drive. The potential heritage attributes include the one-and-a-half storey residence with a gable roof. The western portion of the house features a fieldstone foundation and potentially is the original residence. The eastern portion features a concrete foundation, three dormer windows, and a rear addition. The 1879 map (Figure 3) depicts a residence in the vicinity of the existing structure.	 Plate 15: View of the residence at 16936 Barlow Road.

Feature I.D.	Type of Property	Address or Location	Heritage Status and Recognition	Description of Property and Known or Potential C.H.V.I.	Photographs/ Digital Image
C.H.L. 1	Farmscape	17055 Speer Road	Potential C.H.L. – Identified during background research and field review	The farmscape is located on the northern side of Speer Road to the east of Highway 401. The potential heritage attributes include the one-and-a-half storey residence with gable roof and rear addition, mature trees, and agricultural fields. The 1879 map (**Error! Reference source not found.**) depicts a residence in the vicinity of the existing structure.	 Plate 16: View of the residence at 17055 Speer Road.
C.H.L. 2	Farmscape	16955 Barlow Road	Potential C.H.L. – Identified during background research and field review	The farmscape is located on the northern side of Barlow Road, roughly equidistant from Power Dam Drive and Highway 401. The potential heritage attributes include the one-and-a-half storey residence with gable roof and centre gable, and a western addition. The property also features a small bridge crossing the South Raisin River, mature trees, and pastures. The 1879 map (**Error! Reference source not found.**) depicts a residence in the vicinity of the existing structure.	 Plate 17: View of the residence at 16955 Barlow Road.

Feature I.D.	Type of Property	Address or Location	Heritage Status and Recognition	Description of Property and Known or Potential C.H.V.I.	Photographs/ Digital Image
C.H.L. 3	Farmscape	16826 Atchison Road	Potential C.H.L. – Identified during background research and field review	The farmscape is located on the southern side of Atchison Road to the west of Highway 401. The potential heritage attributes include the one-and-a-half storey residence with L-shaped footprint. The property also features a barn and outbuildings, mature trees surrounding the house, a long driveway and circulation route, and agricultural fields. The 1879 map (**Error! Reference source not found.**) depicts a residence in the vicinity of the existing structure and a Grange Hall immediately north of the residence.	 Plate 18: View of the property at 16826 Atchison Road.

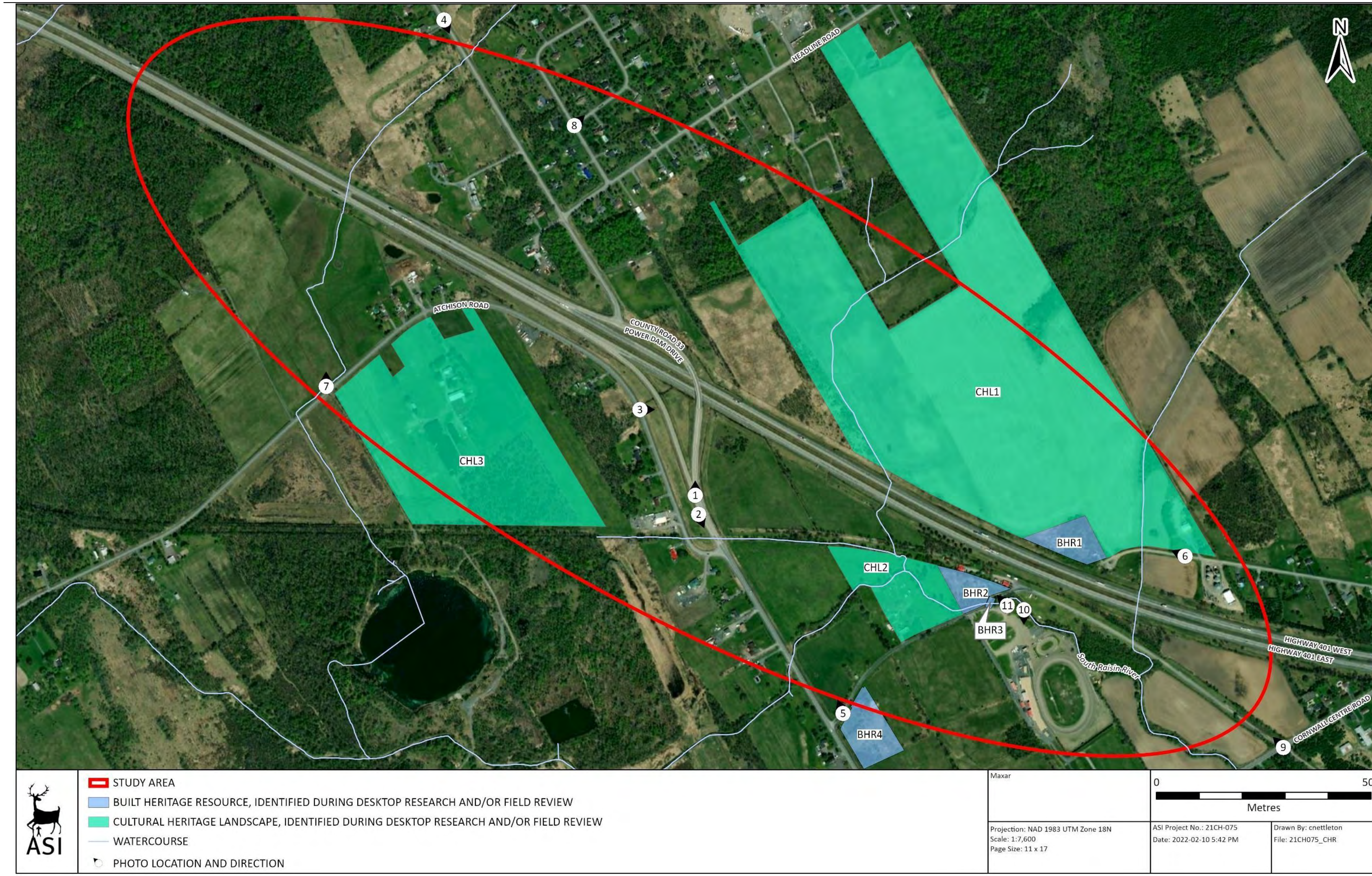

Figure 8: Location of Identified Built Heritage Resources (B.H.R.s) and Cultural Heritage Landscapes (C.H.L.s) in the Project study area

5.0 Preliminary Impact Assessment

The following sections provide more detailed information regarding the proposed project undertaking and analysis of potential impacts on identified built heritage resources (B.H.R.s) and cultural heritage landscapes (C.H.L.s).

5.1 Preliminary Impact Assessment Methodology

The development of transportation facilities has the potential to impact B.H.R.s and C.H.L.s through various methods. These impacts are outlined in *Information Bulletin 3: Heritage Impact Assessments for Provincial Heritage Properties* (Ministry of Citizenship and Multiculturalism, 2017):

- removal or demolition of all or part of any heritage attribute;
- removal or demolition of any building or structure on the provincial heritage property whether or not it contributes to the cultural heritage value or interest of the property (i.e. non-contributing buildings);
- any land disturbance, such as a change in grade and/or drainage patterns that may adversely affect a provincial heritage property, including archaeological resources;
- alterations to the property in a manner that is not sympathetic, or is incompatible, with cultural heritage value or interest of the property. This may include necessary alterations, such as new systems or materials to address health and safety requirements, energy-saving upgrades, building performance upgrades, security upgrades or servicing needs;
- alterations for access requirements or limitations to address such factors as accessibility, emergency egress, public access, security;
- introduction of new elements that diminish the integrity of the property, such as a new building, structure or addition, parking expansion or addition, access or circulation roads, landscape features;
- changing the character of the property through removal or planting of trees or other natural features, such as a garden, or that may result in the obstruction of significant views or vistas within, from, or of built and natural features;

- change in use for the provincial heritage property that could result in permanent, irreversible damage or negates the property's cultural heritage value or interest;
- continuation or intensification of a use of the provincial heritage property without conservation of heritage attributes;
- shadows that alter the appearance of a heritage attribute or change the visibility of an associated natural feature or plantings, such as a tree row, hedge or garden;
- isolation of a heritage attribute from its surrounding environment, context or a significant relationship;
- vibration damage to a structure due to construction or activities on or adjacent to the property;[3] and
- alteration or obstruction of a significant view of or from the provincial heritage property from a key vantage point.

In accordance with this document, direct adverse impacts are identified where the following resulting conditions are anticipated:

- a permanent and irreversible negative affect on the cultural heritage value or interest of a property; and
- loss of a heritage attribute on all or part of the provincial heritage property.

[3] The potential for a heritage attribute to be impacted by vibration is determined by its location within the Vibration Zone of Influence. Vibration Zone of Influence is the area within a 50-metre buffer of construction-related activities in which there is potential to affect an identified built heritage resource or cultural heritage landscape. A 50-metre buffer is applied in the absence of a project-specific defined vibration zone of influence based on existing secondary source literature (Carman et al., 2012; Crispino & D'Apuzzo, 2001; P. Ellis, 1987; Rainer, 1982; Wiss, 1981). This buffer accommodates the additional threat from collisions with heavy machinery or subsidence (Randl, 2001).

Indirect adverse impacts are identified where activities on or near the property may adversely affect its cultural heritage value or interest and/or heritage attributes. Positive impacts may also result where a property's cultural heritage value or interest and/or heritage attributes is conserved or enhanced.

The proposed undertaking should endeavor to avoid adversely affecting known and potential B.H.R.s and C.H.L.s and interventions should be managed in such a way that identified cultural heritage resources are conserved. When the nature of the undertaking is such that adverse impacts are unavoidable, it may be necessary to implement alternative approaches or mitigation strategies that alleviate the negative effects on identified B.H.R.s and C.H.L.s. Mitigation is the process of lessening or negating anticipated adverse impacts to B.H.R.s and

C.H.L.s and may include, but are not limited to, such actions as avoidance, monitoring, protection, relocation, remedial landscaping, and documentation of the B.H.R.s and C.H.L.s if to be demolished or relocated.

Various works associated with infrastructure improvements have the potential to affect B.H.R.s and C.H.L.s in a variety of ways, and as such, appropriate mitigation measures for the undertaking need to be considered.

5.2 Description of Proposed Undertaking

The Replacement of Bridge Site 013X-180 /B.O. project consists of the replacement of Bridge Site 013X-180 /B.O. that carries Power Dam Drive over Highway 401 and the development of a long-term plan establishing the footprint of the interchange to accommodate the future widening of Highway 401 to six lanes (Morrison Hershfield, 2022).

A long list of eight alternatives was initially developed for a coarse evaluation which was then narrowed down to a short list of five alternatives (Alternatives One, Three, Five, Six, and Eight) for detailed evaluation.

The short-listed alternatives are discussed below:

- Alternative One ("Do Nothing") consists no changes to the existing bridge structure or the configuration of the interchange.
- Alternative Three consists of a new 35 degree skewed straight bridge west of the existing bridge location, a partial cloverleaf (Parclo) A.B. Interchange with two direct ramps to/from the east and two loop ramps to/from the west connecting Power Dam Drive to Highway 401 with T- intersections to the north and south of the bridge.
- Alternative Five consists of a new 60 degree skewed tangent bridge in the location of the current bridge, a Button Hook/Parclo B connection to Highway 401's west-bound lanes in the northwest quadrant with a controlled intersection on Power Dam Drive and a Single Diamond with a controlled intersection located south of the bridge.
- Alternative Six consists of a new 60 degree skewed curved bridge located west of the existing bridge location, a Parclo B2 Interchange with full movement, and intersections to the north and south of the bridge.
- Alternative Eight consists of a new 41 degree skewed tangent bridge west of the existing bridge location, and a Single Diamond Interchange with four ramps connected through two controlled intersections on Power Dam Drive.

See Section 5.3 below for an analysis of potential impacts of each short-listed alternative on the identified B.H.R.s and C.H.L.s.

5.3 Analysis of Potential Impacts

The potential impacts of the proposed undertaking were evaluated according to Ministry of Citizenship and Multiculturalism's (M.C.M.'s) *Information Bulletin 3: Heritage Impact Assessments for Provincial Heritage Properties* (2017). Table 2 outlines the potential impacts from each short-listed alternative on the identified B.H.R.s and C.H.L.s within the study area and are illustrated in Figure 9Figure 16.

Table 2: Impacts from the Five short listed alternatives to the Potential B.H.R.s and C.H.L. and Proposed Mitigations

Feature I.D.	Address or Location	Heritage Status and Recognition	Description of Impacts	Proposed Mitigations and Next Steps
B.H.R. 1	17025 Speer Road	Potential B.H.R. – Identified during background research and field review	<u>Alternative One:</u> This alternative proposes no changes to the existing bridge structure or interchange configuration. No direct or indirect impacts to this B.H.R. have been identified.	<u>Alternative One:</u> No mitigation is required.
			<u>Alternatives Three, Five, Six, and Eight:</u> For each of these alternatives, B.H.R. 1 is located within the 250-metre buffer of the proposed works and just outside of the 25-metre buffer along Highway 401. The proposed work includes the construction of an off-ramp south of the property within the existing Ministry of Transportation (M.T.O.) right of way (R.O.W.). As it is understood that the work will be limited to the Highway 401 R.O.W., no direct impacts from grading or property encroachment are anticipated to B.H.R. 1. The proposed work may result in construction-related vibration impacts given identified heritage attributes are located within the Vibration Zone of Influence, the area within a 50-metre buffer of construction related activities.	<u>Alternatives Three, Five, Six, and Eight:</u> For each of these alternatives, recommend continued avoidance of this property. Mitigation: To address the potential for indirect impacts due to construction-related vibration, undertake a baseline vibration assessment during detail design to determine potential vibration impacts. Should this advance assessment conclude that the structure will be subject to vibrations, a vibration monitoring plan should be prepared and implemented as part of the detailed design phase of the project to lessen vibration impacts related to construction.
B.H.R. 2	16981 Barlow Road	Potential B.H.R. – Identified during background research and field review	<u>Alternative One:</u> This alternative proposes no changes to the existing bridge structure or interchange configuration. No direct or indirect impacts to this B.H.R. have been identified.	<u>Alternative One:</u> No mitigation is required.

Feature I.D.	Address or Location	Heritage Status and Recognition	Description of Impacts	Proposed Mitigations and Next Steps
			Alternatives Three, Five, Six, and Eight For each of these alternatives, B.H.R. 2 is located within the 250-metre buffer of the proposed works, however no direct or indirect adverse impacts to the potential heritage attributes of this property are anticipated. Indirect impacts due to construction-related vibration are not anticipated given that the structure on this property is not within the Vibration Zone of Influence, the area within a 50-metre buffer of construction-related activities.	Alternatives Three, Five, Six, and Eight: For each of these alternatives, recommend continued avoidance of this property. No specific mitigations or next steps are required.
B.H.R. 3	Barlow Road over South Raisin River	Potential B.H.R. – Identified during background research and field review	Alternative One: This alternative proposes no changes to the existing bridge structure or interchange configuration. No direct or indirect impacts to this B.H.R. have been identified.	Alternative One: No mitigation is required.
			Alternatives Three, Five, Six, and Eight: For each of these alternatives, B.H.R. 3 is located within the 250-metre buffer of the proposed works, however no direct or indirect adverse impacts to the potential heritage attributes of this structure are anticipated. Indirect impacts due to construction-related vibration are not anticipated given that the structure is not within the Vibration Zone of Influence, the area within a 50-metre buffer of construction-related activities.	Alternatives Three, Five, Six, and Eight: For each of these alternatives, recommend continued avoidance of this structure. No specific mitigations or next steps are required.

Feature I.D.	Address or Location	Heritage Status and Recognition	Description of Impacts	Proposed Mitigations and Next Steps
B.H.R. 4	16936 Barlow Road	Potential B.H.R. – Identified during background research and field review	Alternative One: This alternative proposes no changes to the existing bridge structure or interchange configuration. No direct or indirect impacts to this B.H.R. have been identified.	Alternative One: No mitigation is required.
			Alternatives Three, Five, Six, and Eight: For each of these alternatives, B.H.R. 4 is not located within the 250-metre buffer of the proposed works therefore no direct or indirect adverse impacts to the potential heritage attributes of this property are anticipated. Indirect impacts due to construction-related vibration are not anticipated given that the structure on this property is not within the Vibration Zone of Influence, the area within a 50-metre buffer of construction-related activities.	Alternatives Three, Five, Six, and Eight: For each of these alternatives, recommend continued avoidance of this property. No specific mitigations or next steps are required.
C.H.L. 1	17055 Speer Road	Potential C.H.L. – Identified during background research and field review	Alternative One: This alternative proposes no changes to the existing bridge structure or interchange configuration. No direct or indirect impacts to this C.H.L. have been identified.	Alternative One: No mitigation is required.

Feature I.D.	Address or Location	Heritage Status and Recognition	Description of Impacts	Proposed Mitigations and Next Steps
			Alternatives Three, Five, Six, and Eight: For each of these alternatives, the southern half of C.H.L. 1 is located within the 250-metre buffer of the proposed works and almost entirely outside of the 25-metre buffer along Highway 401 with the exception of a small sliver of property at the southwestern corner which falls within the 25-metre buffer. The proposed work includes the construction of an off-ramp south of the property within the existing M.T.O. R.O.W. As it is understood that the work will be limited to the Highway 401 R.O.W., no direct impacts from grading or property encroachment are anticipated to C.H.L. 1. Indirect impacts due to construction-related vibration are not anticipated given that the structures on this property are not within the Vibration Zone of Influence, the area within a 50-metre buffer of construction-related activities.	Alternatives Three, Five, Six, and Eight: For each of these alternatives, recommend continued avoidance of this property. No specific mitigations or next steps are required.
C.H.L. 2	16955 Barlow Road	Potential C.H.L. – Identified during background research and field review	Alternative One: This alternative proposes no changes to the existing bridge structure or interchange configuration. No direct or indirect impacts to this C.H.L. have been identified.	Alternative One: No mitigation is required.

Feature I.D.	Address or Location	Heritage Status and Recognition	Description of Impacts	Proposed Mitigations and Next Steps
			Alternatives Three, Five, Six, and Eight: For each of these alternatives, C.H.L. 2 is generally located within the 250-metre buffer of the proposed works, however no direct or indirect adverse impacts to the potential heritage attributes of this property are anticipated. Indirect impacts due to construction-related vibration are not anticipated given that the structure on this property is not within the Vibration Zone of Influence, the area within a 50-metre buffer of construction-related activities.	Alternatives Three, Five, Six, and Eight: For each of these alternatives, recommend continued avoidance of this property. No specific mitigations or next steps are required.
C.H.L. 3	16826 Atchison Road	Potential C.H.L. – Identified during background research and field review	Alternative One: This alternative proposes no changes to the existing bridge structure or interchange configuration. No direct or indirect impacts to this C.H.L. have been identified.	Alternative One: No mitigation is required.
			Alternatives Three, Five, Six, and Eight: For each of these alternatives, part of this property is located within the 250-metre buffer of the proposed works, however no direct or indirect adverse impacts to the potential heritage attributes of this property are anticipated. Indirect impacts due to construction-related vibration are not anticipated given that the structure on this property is not within the Vibration Zone of Influence, the area within a 50-metre buffer of construction-related activities.	Alternatives Three, Five, Six, and Eight: For each of these alternatives, recommend continued avoidance of this property. No specific mitigations or next steps are required.

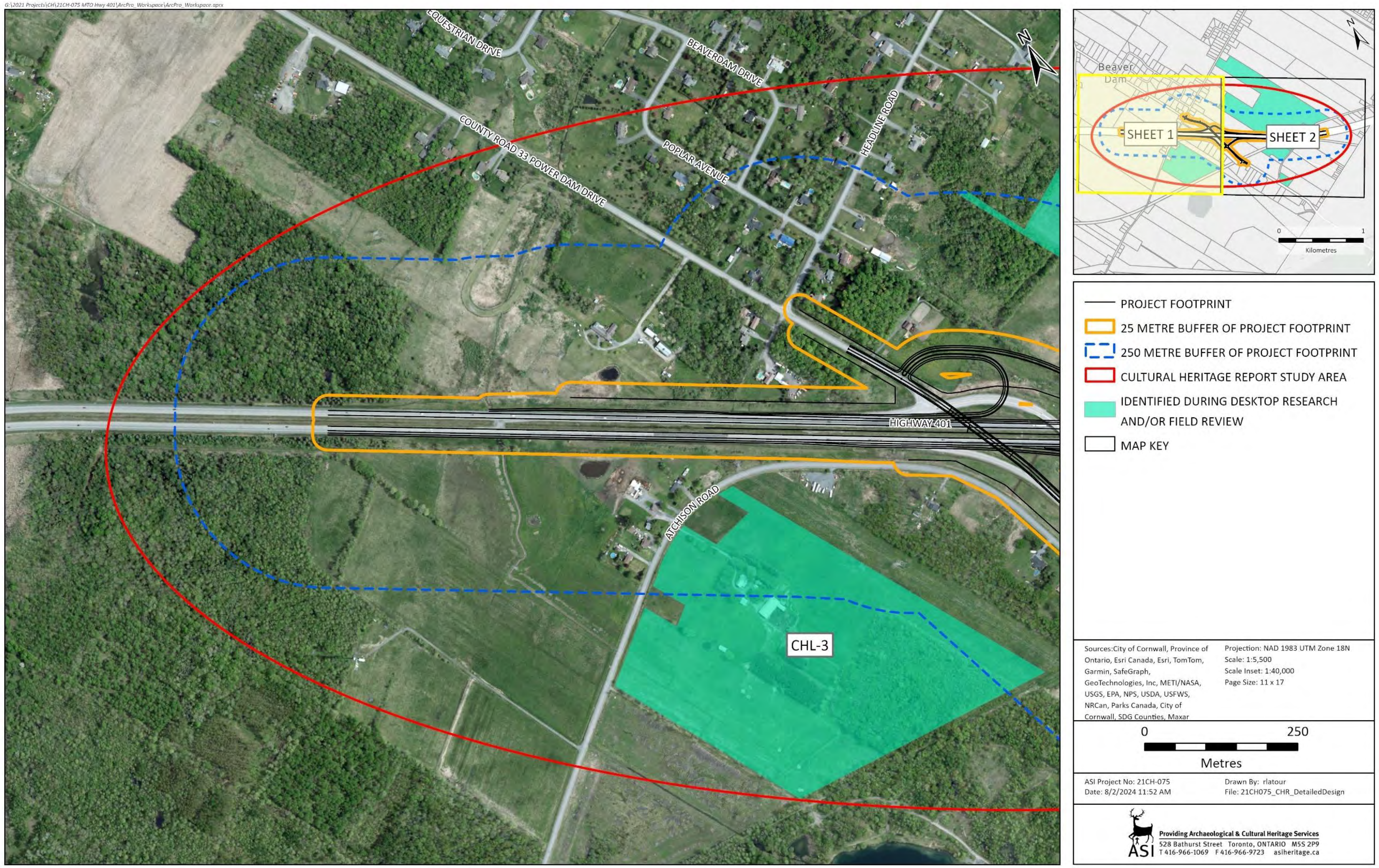

Figure 9: Location of identified B.H.R.s and C.H.L.s within the study area showing the Alternative Three (western half) (Sheet 1).

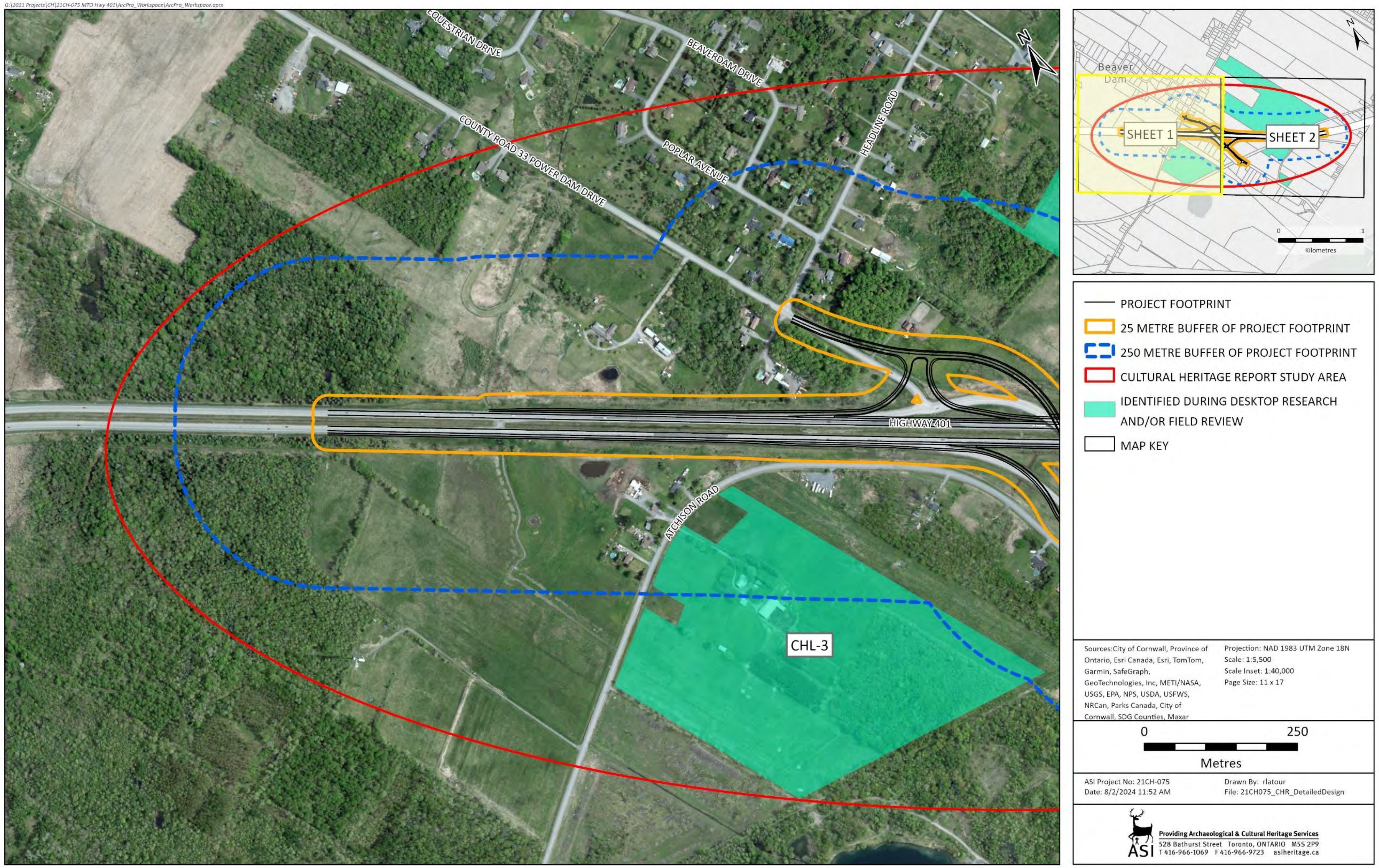

Figure 10: Location of identified B.H.R.s and C.H.L.s within the study area showing the Alternative Five (western half) (Sheet 1).

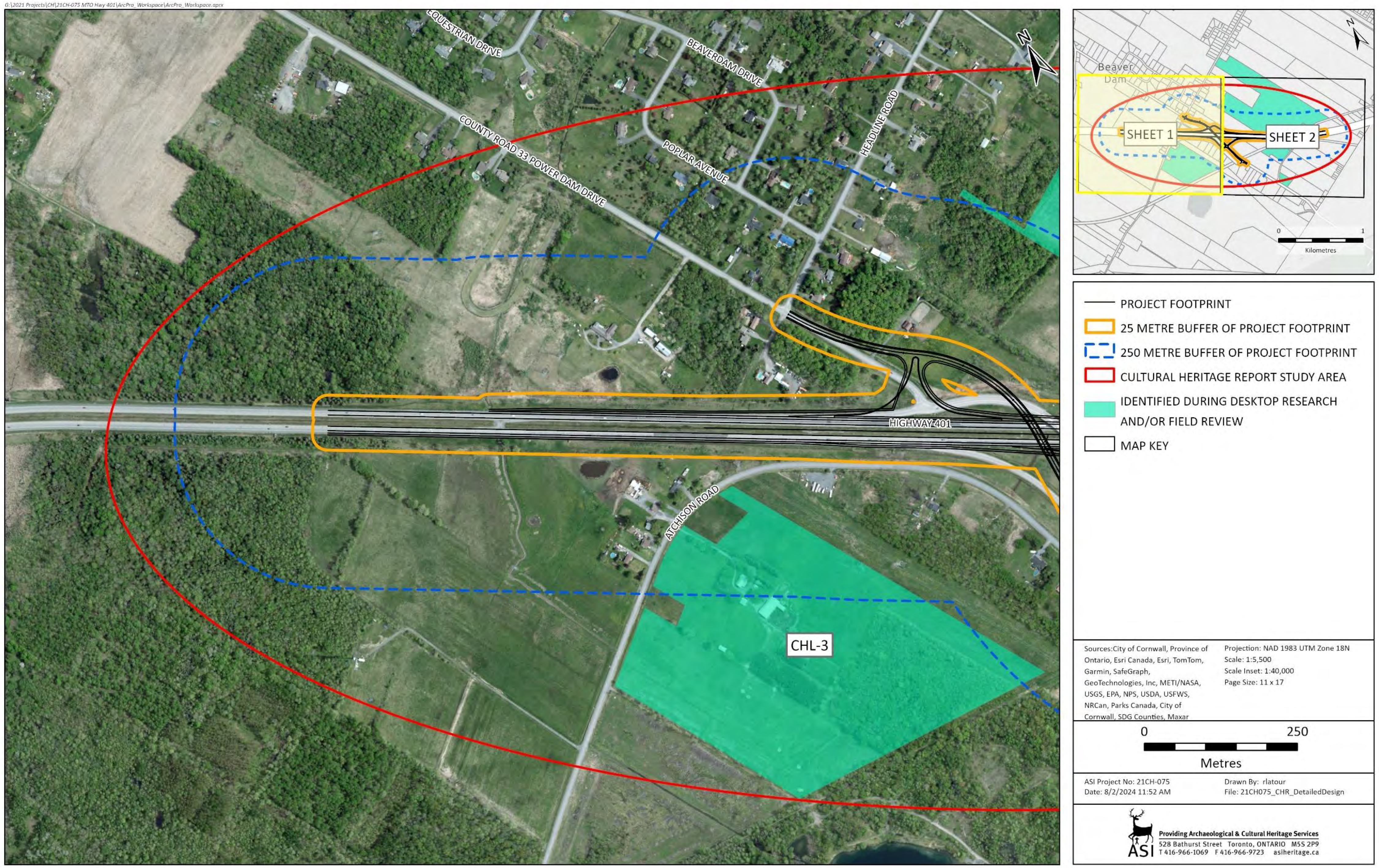

Figure 11: Location of identified B.H.R.s and C.H.L.s within the study area showing the Alternative Six (western half) (Sheet 1).

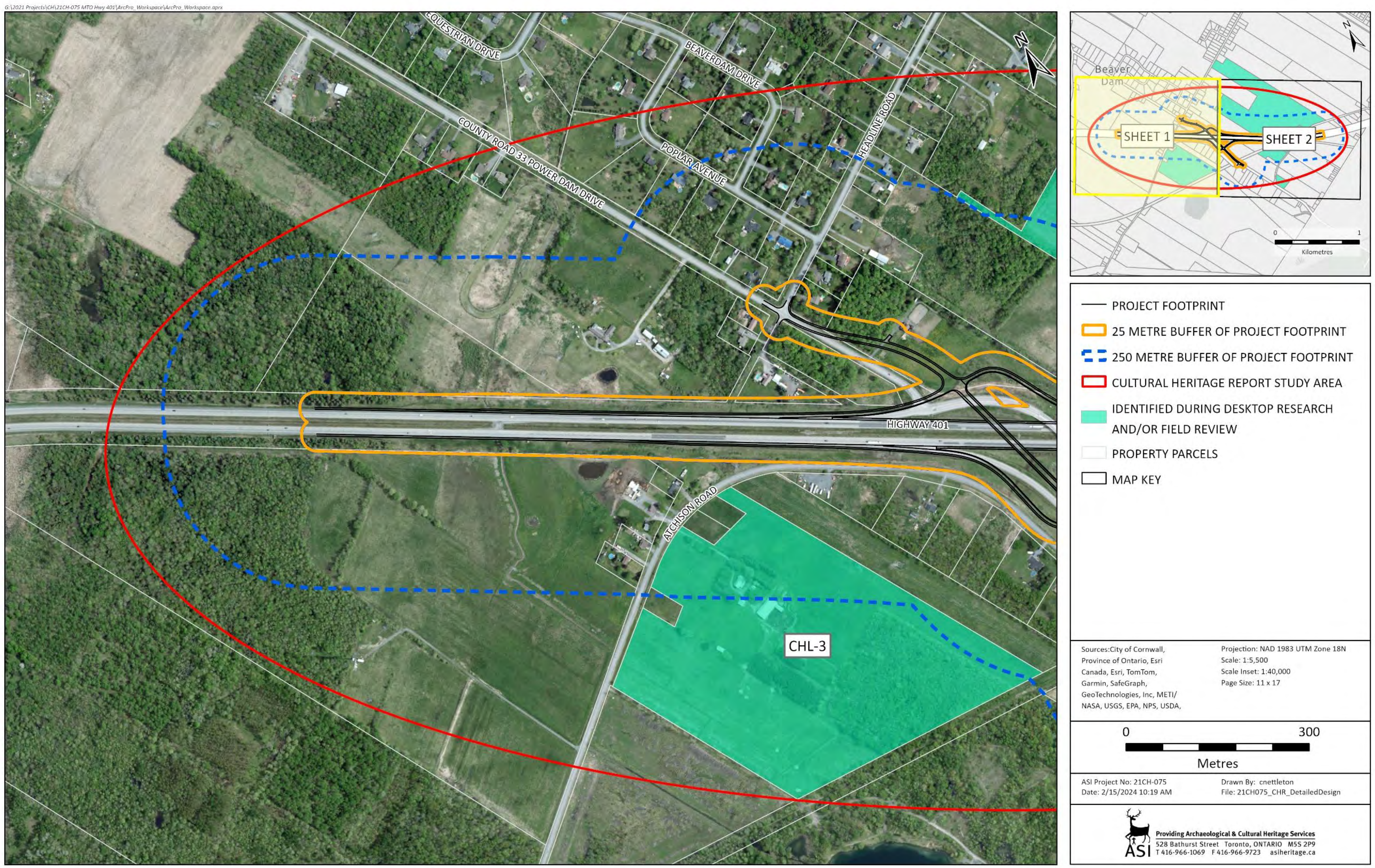

Figure 12: Location of identified B.H.R.s and C.H.L.s within the study area showing Alternative Eight (western half) (Sheet 1).

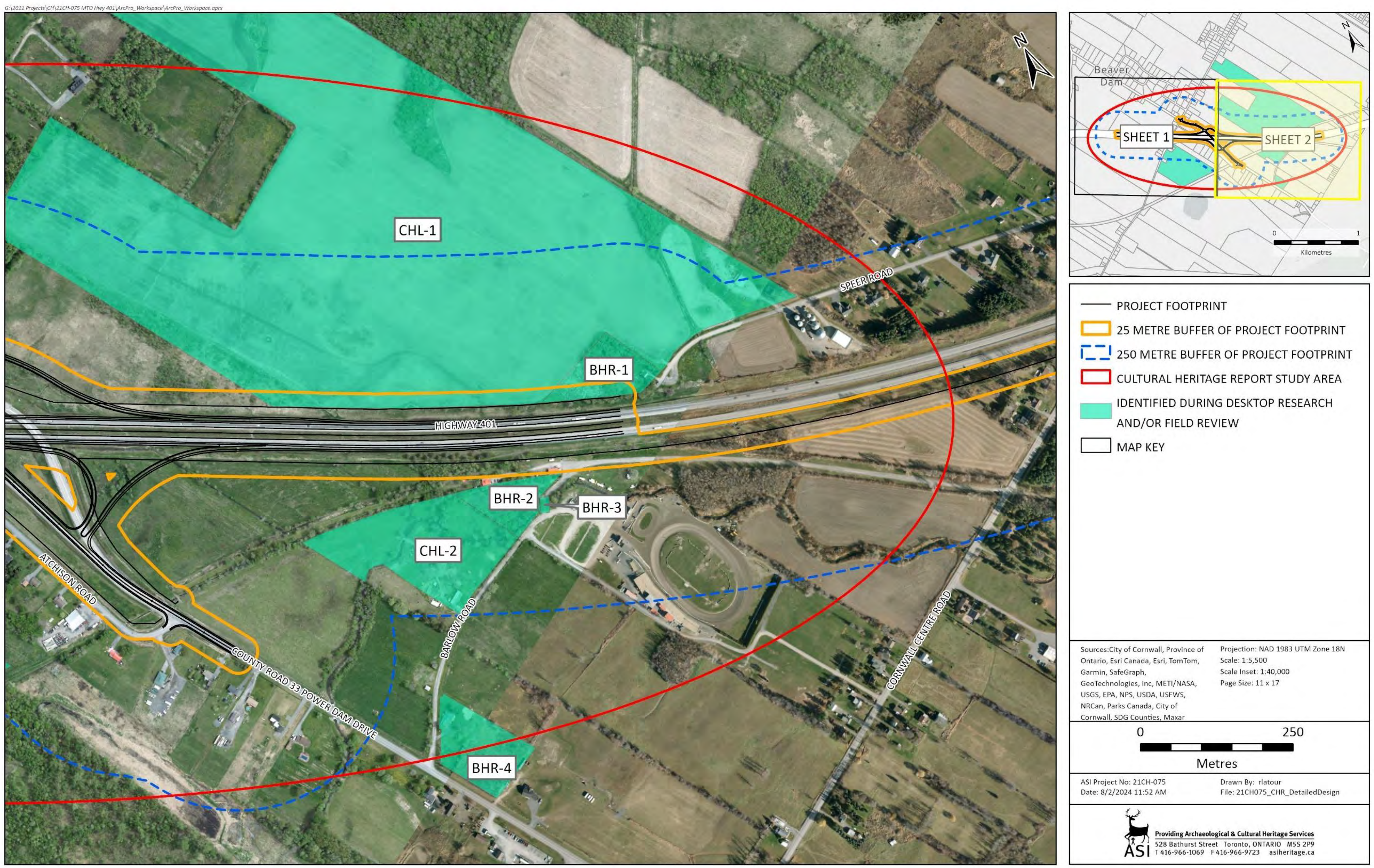

Figure 13: Location of identified B.H.R.s and C.H.L.s within the study area showing the Alternative Three (eastern half) (Sheet 2).

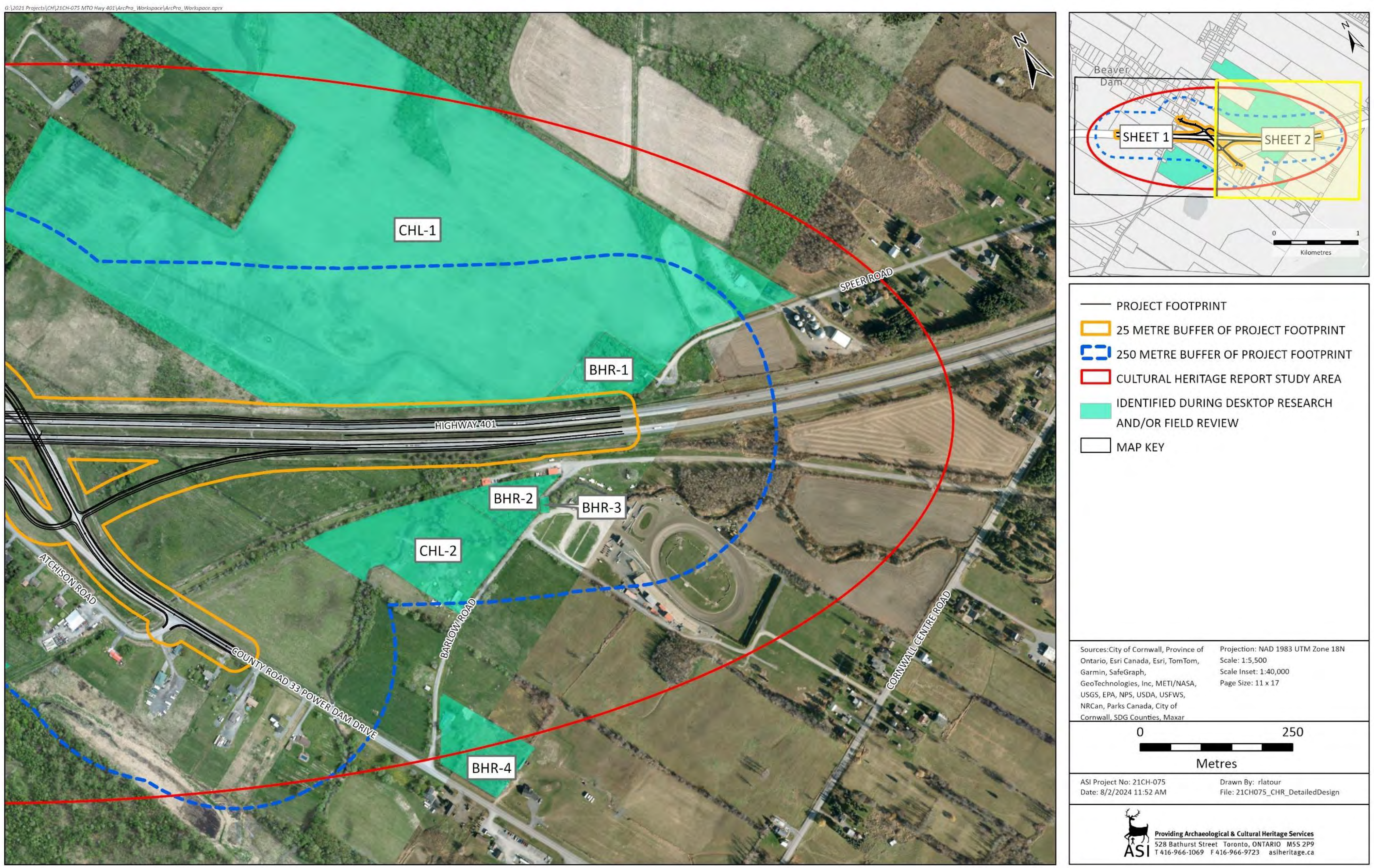

Figure 14: Location of identified B.H.R.s and C.H.L.s within the study area showing the Alternative Five (eastern half) (Sheet 2).

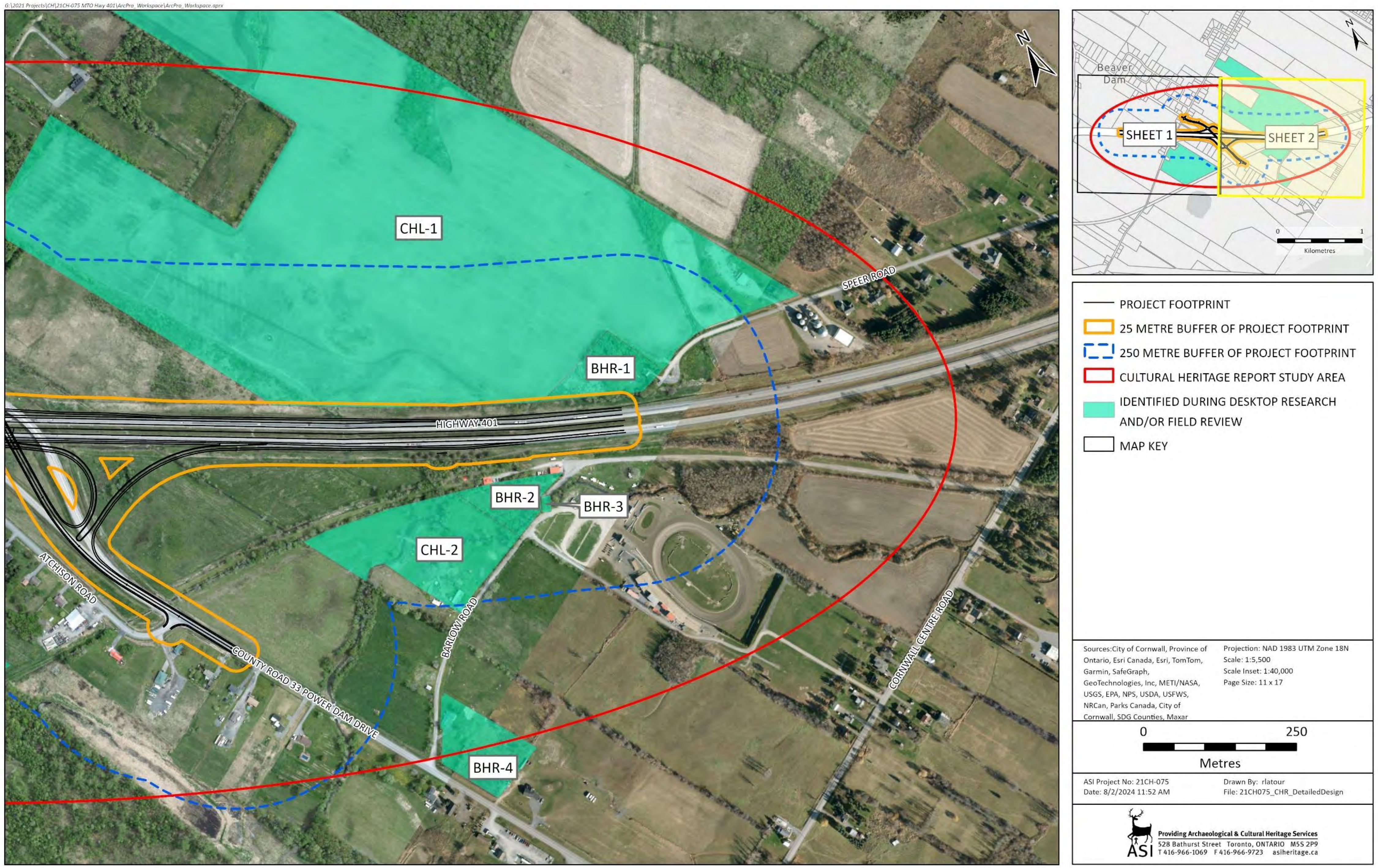

Figure 15: Location of identified B.H.R.s and C.H.L.s within the study area showing the Alternative Six (eastern half) (Sheet 2).

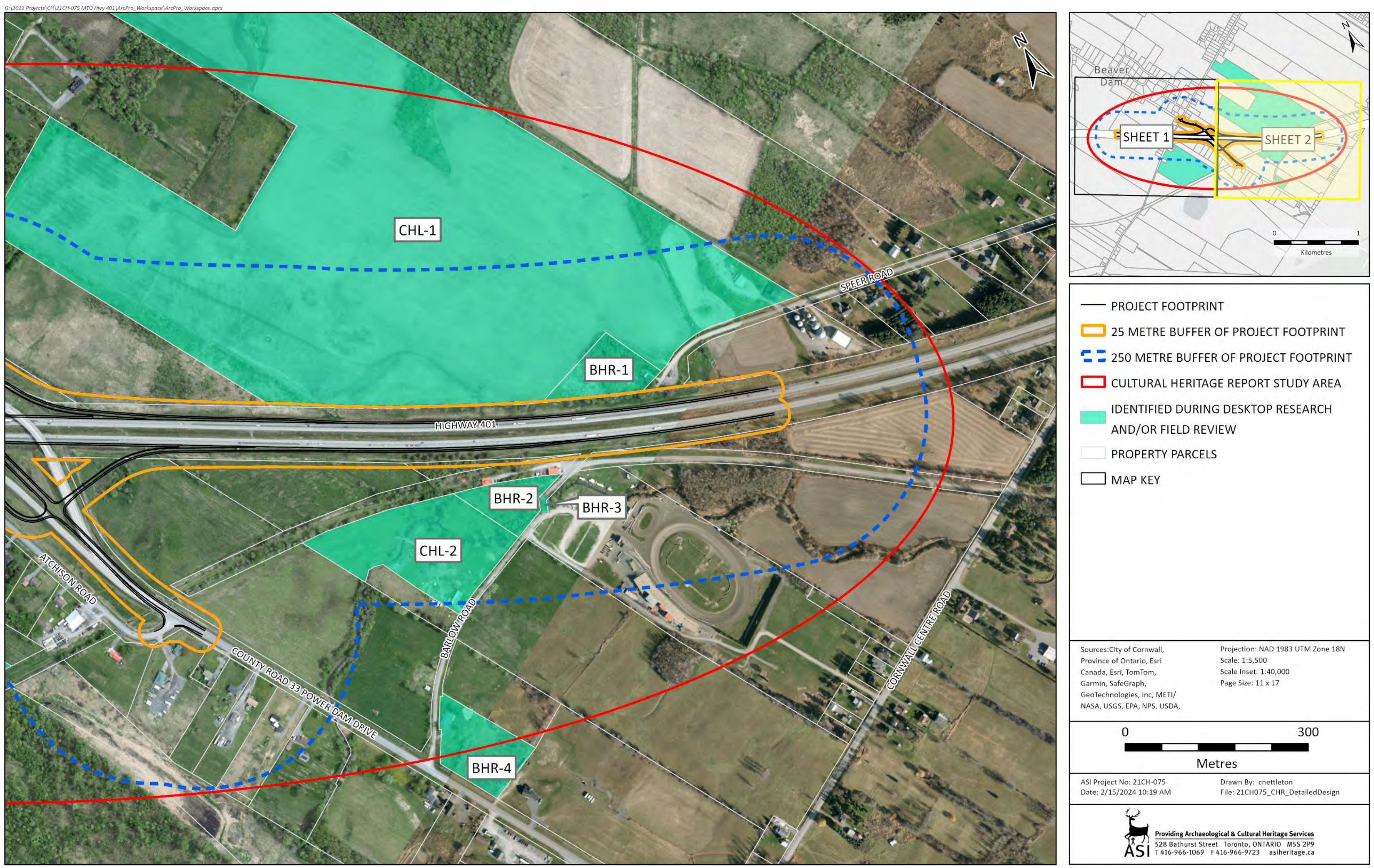

Figure 16: Location of identified B.H.R.s and C.H.L.s within the study area showing the Alternative Eight (eastern half) (Sheet 2).

6.0 Proposed Recommended Mitigation and Next Steps

This Cultural Heritage Resource Assessment Report (C.H.R.A.R.) has documented the baseline cultural heritage conditions within the C.H.R.A.R. study area and includes a historical summary of the development of the C.H.R.A.R. study area, an inventory of potential built heritage resources (B.H.R.s) and cultural heritage landscapes (C.H.L.s), and a preliminary impact assessment along with recommendations for mitigations and next steps. Four B.H.R.s and three C.H.L.s were identified during background research and field review.

Based on a review of the short-listed alternatives, and as presented in Table 2 above, Alternatives Three, Five, Six, and Eight may result in indirect impacts to B.H.R. 1 due to construction-related vibration. Alternatives Three, Five, Six, and Eight will not result in any other direct or indirect impacts to the other identified B.H.R.s or C.H.L.s in the study area. Alternative One will not result in any direct or indirect impacts to the identified B.H.R.s or C.H.L.s.

Next steps, as well as general recommendations, are presented as follows:

1. Alternatives Three, Five, Six, and Eight may result in indirect impacts from construction-related vibration to B.H.R. 1 as the structure is within 50-metres of the proposed infrastructure improvements. To address the potential for indirect impacts due to construction-related vibration, undertake a baseline vibration assessment during Detail Design to determine potential for vibration impacts and monitor where required.
2. A copy of this C.H.R.A.R. and other heritage reports for this Project, should be provided to the Ministry of Citizenship and Multiculturalism, and other interested parties for review and comment.
3. All technical cultural heritage studies are to be completed in accordance with the Standards and Guidelines (2010) and Ministry of Transportation, Ontario's cultural heritage conservation policy and process by a Qualified Person as defined in the Standards and Guidelines.

4. Should future work require an expansion or alteration of the study area, the additional area or change should be studied by a qualified heritage professional to confirm the impacts of the proposed work on potential B.H.R.s and C.H.L.s.

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Appendix A: Qualified Persons Involved in the Project

Lindsay Graves, M.A., C.A.H.P.
Senior Cultural Heritage Specialist, Assistant Manager - Cultural Heritage Division

The Senior Project Manager for this Cultural Heritage Report is **Lindsay Graves** (M.A., Heritage Conservation), Senior Cultural Heritage Specialist and the Environmental Assessment Coordinator for the Cultural Heritage Division. She was responsible for: overall project scoping and approach; development and confirmation of technical findings and study recommendations; application of relevant standards, guidelines and regulations; and implementation of quality control procedures. Lindsay is academically trained in the fields of heritage conservation, cultural anthropology, archaeology, and collections management and has over 15 years of experience in the field of cultural heritage resource management. This work has focused on the assessment, evaluation, and protection of above ground cultural heritage resources. Lindsay has extensive experience undertaking archival research, heritage survey work, heritage evaluation and heritage impact assessment. She has also contributed to cultural heritage landscape studies and heritage conservation plans, led heritage commemoration and interpretive programs, and worked collaboratively with multidisciplinary teams to sensitively plan interventions at historic sites/places. In addition, she is a leader in the completion of heritage studies required to fulfill Class Environmental Assessment processes and has served as Project Manager for over 100 heritage assessments during her time at A.S.I. Lindsay is a member of the Canadian Association of Heritage Professionals.

Kirstyn Allam, B.A. (Hon), Advanced Dipl. in Applied Museum Studies
Project Manager- Cultural Heritage Division

One of the Cultural Heritage Technicians for this project is **Kirstyn Allam** (B.A. (Hon.), Advanced Diploma in Applied Museum Studies), who is a Cultural Heritage Technician and Technical Writer and Researcher within the Cultural Heritage Division. She was responsible for preparing and contributing to research and technical reporting. Kirstyn Allam's education and experience in cultural heritage, historical research, archaeology, and collections management has provided her with a deep knowledge and strong understanding of the issues facing the cultural heritage industry and best practices in the field. Kirstyn has experience in heritage conservation principles and practices in cultural resource management, including three years' experience as a member of the Heritage Whitby Advisory Committee. Kirstyn also has experience being involved with Stage 1-4 archaeological excavations in the Province of Ontario.

Leora Bebko, M.M.St.
Cultural Heritage Technician, Technical Writer and Researcher - Cultural Heritage Division

One of the Cultural Heritage Technicians for this project is **Leora Bebko** (M.M.St.), who is a Cultural Heritage Technician and Technical Writer and Researcher within the Cultural Heritage Division. She was responsible for preparing and contributing research and technical reporting. In Leora's career as a cultural heritage and museum professional she has worked extensively in public programming and education within built heritage spaces. Leora is particularly interested in the ways in which our heritage landscapes can be used to facilitate public engagement and interest in our region's diverse histories. While completing her Master of Museum Studies she was able to combine her interest in heritage architecture and museums by focusing on the historic house museum and the accessibility challenges they face. As a thesis project, Leora co-curated the award-winning exhibit *Lost & Found: Rediscovering Fragments of Old Toronto* on the grounds of Campbell House Museum. Since completing her degree she has worked as a historical interpreter in a variety of heritage spaces, learning a range of traditional trades and has spent considerable time researching heritage foodways and baking in historic kitchens. In 2022, she joined ASI's Cultural Heritage team as a Cultural Heritage Technician.

Appendix B: Criteria for Evaluating Potential Heritage Bridges Screening Form

Many important heritage bridges have not been identified or formally recognized, and therefore will not be included in any heritage registers. This checklist is a tool to determine if a more technical Cultural Heritage Evaluation by a Qualified Person(s) is required.

This Screening Form is to be completed by the MTO's Regional Structural Section Engineers who are familiar with the bridge. Assistance can be sought from MTO's Heritage Bridge Committee, Cultural Heritage Specialist and/or Environmental Section as required.

If uncertain about the answer to one or more of the questions below, a Cultural Heritage Evaluation Report (CHER) is recommended to ensure additional research is obtained. Completing a CHER ensures that heritage bridges are appropriately identified, evaluated and conserved which will minimize potential delays and risks to an MTO project.

Please refer to Instructions when completing this form.

MTO Bridge Name: Power Dam Drive Underpass		
Bridge Location: South Stormont, Ontario		
MTO Site # 31X-0180/B0		Year/Decade Built: 1969
Form Completed By: Kaurie Casista	Office: Structural, East Region	Date: 10-13-2021
Screening Questions		

	Yes	No
1. Is the bridge known to be:	Yes	No
a. Identified as a Heritage Bridge in the Heritage Bridge List?	☐	☒
b. A National Historic Site (or part thereof)?	☐	☒
c. Subject of a municipal, provincial or federal commemorative or interpretive plaque (based on site investigation)?	☐	☒
2. Has the bridge been screened (and has it been confirmed that the information therein contained is still accurate) as a potential heritage bridge;	Yes	No
a. In the Heritage Bridges: Identification and Assessment Guide Ontario, 1945-1965 (Heritage Resources Centre, University of Waterloo) study?	☐	☒
b. By another comprehensive screening study (describe the nature of the screening study)?	☐	☒
3. Is the bridge known to:	Yes	No
a. Have a unique or complex design feature(s) that demonstrates a high degree of technical merit?	☐	☒

b. Have significant Aesthetic value with elements demonstrating a high degree of craftsmanship?	☐	☒
c. Have landmark value in the local community or contains features that are important in defining the character of the area?	☐	☒
d. Have a special association with a community, person, historical event, or cultural heritage landscape?	☐	☒
e. Sit within a Canadian Heritage River watershed?	☐	☒

If Yes to one or more of the Screening Questions, there is potential for cultural heritage value or interest for the bridge. A Qualified Person shall undertake:

- a Cultural Heritage Evaluation Report (CHER)

If the bridge is determined to have cultural heritage value or interest and alterations are proposed on or adjacent the property, then a Qualified Person shall undertake:

- a Heritage Impact Assessment (HIA)

If No to all of the above questions, there is low potential cultural heritage value or interest for the bridge. In instances where all answers are "no" but the Regional Structural Section Engineer believes a CHER should be completed for the bridge, they will provide a justification for their recommendation summarized below.

The Regional Structural Section Engineer shall:

- summarize the Screening Recommendation in the section provided
- add any supporting information or documentation if available

Supporting Information (show bridge photos and drawings and comparative table to ascertain design (size, age, etc.).

Figure 1: Bridge Elevation (facing E)

Figure 2: Bridge Along Roadway