Final Qualitative Climate Change Assessment Report

Highway 400 to Highway 404 Link (Bradford Bypass)

Ontario Ministry of Transportation

60636190

June 22, 2023

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AECOM: 2015-04-13

Quality Information

Prepared by

Fabianna Palacios, B.A.Sc. Air Quality Specialist

Hassan Rouhani, Climate Adaptation Specialist

Checked by

Jennifer Routhier, P.Eng. Environmental Engineer

Sonja Drueke, Air Quality Scientist

Verified and Approved By

Danielle Arsenault, P.Eng. Senior Air Quality Specialist

Derek Gray, P. Eng. Climate Change Specialist

Revision History

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1	March 16, 2023	AECOM	Draft Qualitative Climate Change Report
2	May 10, 2023	AECOM	Draft Qualitative Climate Change Report
3	June 22, 2023	AECOM	Final Qualitative Climate Change Report

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-	✓	Ontario Ministry of Transportation
-	✓	AECOM Canada Ltd.

Prepared for:

Ontario Ministry of Transportation
159 Sir William Hearst Avenue, 4th Floor
Downsview, Ontario M3M 1J8

Prepared by:

AECOM Canada Ltd.
105 Commerce Valley Drive West, 7th Floor
Markham, ON L3T 7W3
Canada

T: 905.886.7022
F: 905.538.8076
www.aecom.com

Executive Summary

The Ontario Ministry of Transportation (the Ministry) has retained AECOM Canada Ltd. (AECOM) to undertake a Preliminary Design and project-specific assessment of environmental impacts for the proposed Highway 400 to Highway 404 Link (Bradford Bypass). The Bradford Bypass (the project) is being assessed in accordance with Ontario Regulation 697/21 (the Regulation). The Ministry previously completed a route planning study for the Bradford Bypass that received subsequent approval in 2002.

The Bradford Bypass is a proposed 16.3 kilometre controlled access freeway that will extend from Highway 400 between 8th Line and 9th Line in Bradford West Gwillimbury, will cross a small portion of King Township, and will connect to Highway 404 between Queensville Sideroad and Holborn Road in East Gwillimbury. There are proposed full and partial interchanges, as well as grade separated crossings at intersecting municipal roads and watercourses, including the Holland River and Holland River East Branch. This project also includes the design integration for the replacement of the 9th Line structure on Highway 400, which will accommodate the proposed future ramps north of the Bradford Bypass corridor. The Ministry is considering an interim four-lane configuration and an ultimate eight-lane design for the Bradford Bypass. The interim condition will include two general purpose lanes in each direction and the ultimate condition will include four lanes in each direction (one high-occupancy vehicle lane and three general purpose travel lanes in each direction). The interim and ultimate designs are being reviewed as the project progresses. This Report and its findings are based on the project footprint identified within this Report. Should the footprint change or be modified in any way, a review of the changes shall be undertaken, and the Report will be updated to reflect the changes, impacts, mitigation measures, and any commitments to future work.

The Ministry of the Environment, Conservation and Parks (MECP) guidance ‘Considering Climate Change in the Environmental Assessment Process’ outlines that the scoping stage should identify the potential impact of the project on the receiving environment, the sensitivity of this environment, and take into account how this project will be affected by a changing climate. As per this guideline, qualitative climate change assessment for these aspects was conducted i.e., climate change mitigation and climate change adaptation. AECOM is pleased to provide this Report discussing the qualitative impacts of climate change related to the Preliminary Design of the Bradford Bypass.

Table of Contents

Figures

Tables

Appendices

1. Overview of Undertaking

1.1 Project Overview

The Ontario Ministry of Transportation (the Ministry) has retained AECOM Canada Ltd. (AECOM) to undertake a Preliminary Design and project-specific assessment of environmental impacts for the proposed Highway 400 to Highway 404 Link (Bradford Bypass). The Bradford Bypass (the project) is being assessed in accordance with Ontario Regulation 697/21 (the Regulation). The Ministry previously completed a route planning study for the Bradford Bypass that received subsequent approval in 2002.

The project is a new 16.3 kilometre (km) controlled access freeway. The proposed highway will extend from Highway 400 between 8th Line and 9th Line in Bradford West Gwillimbury, will cross a small portion of King Township, and will connect to Highway 404 between Queensville Sideroad and Holborn Road in East Gwillimbury. There are proposed full and partial interchanges, as well as grade separated crossings at intersecting municipal roads and watercourses, including the Holland River and Holland River East Branch. This project will also include the design integration for the replacement of the 9th Line structure on Highway 400, which will accommodate the proposed future ramps north of the Bradford Bypass corridor. The Ministry is considering an interim four-lane configuration and an ultimate eight-lane design for the Bradford Bypass. The interim condition will include two general purpose lanes in each direction and the ultimate condition will include four lanes in each direction (one high-occupancy vehicle lane and three general purpose travel lanes in each direction). The interim and ultimate designs are being reviewed as the project progresses. This Report and its findings are based on the project footprint identified within this Report. Should the footprint change or be modified in any way, a review of the changes shall be undertaken, and the Report will be updated to reflect the changes, impacts, mitigation measures, and any commitments to future work.

A review of the project documents shows that the main components of the project include the following:

Table 1-1: List of project components and elements

Components	Elements
Construction site	• Mainline road platform • Various watercourse and crossing road structures • New crossing road interchanges • Ramp terminal construction • Reprofiling and realigning crossing roads • Shoulder strengthening and temporary roadway widening • Temporary detour roads • Driveway and entrance access modifications, realignment, and reconstruction Pavement markings, signage, traffic safety and control devices, barriers, and attenuators. • Drainage culverts • Stormwater management ponds • Commuter Parking Lot(s) • Stormwater management • Landscaping • Utility relocations
Plant and equipment	• Fencing • Illumination • Intelligent Transportation Systems (ITS)
Materials	• Illumination and ITS Infrastructure

Components	Elements
	• Embedded ducts at crossing road structures and manholes to support future lighting and equipment • Aerial traffic signal spans
People	• Construction/operation/maintenance Workers • Users of the Bradford Bypass • Existing residential subdivision
Operation of the underpass / overpass infrastructure	• Structures to facilitate the Bradford Bypass • Pavement • Road users
Surrounding natural environment	• Various tributaries • Identified terrestrial ecosystems • Various agricultural lands
Indigenous communities	• Identified communities that have or may have existing aboriginal or treaty rights, as recognized and affirmed in Section 3.5 of the Constitution Act, 1982, that may be impacted by the project, and Indigenous communities that may otherwise be interested in the Bradford Bypass.

1.2 Study Area

The Study Area extends from Highway 400 between 8th Line and 9th Line in Bradford West Gwillimbury, travelling easterly to Highway 404 between Holborn Road and Queensville Sideroad in East Gwillimbury, as shown in **Figure 1-1.** The Study Area is located within Simcoe County (Town of Bradford West Gwillimbury) and the Regional Municipality of York (Township of King and Town of East Gwillimbury).

The Study Area contains land use zoned by the Town of Bradford West Gwillimbury, Township of King, and Town of East Gwillimbury. The Study Area currently consists of a mix of land uses including agricultural, natural areas and open spaces, industrial and commercial, residential, institutional and community services, community and recreational facilities. There also exists land use designated to community, institutional, health and wellness, and railway corridors within the Study Area.

LEGEND

- Bradford Bypass - MTO Right-Of-Way
- Bradford Bypass Preliminary Design
- Bradford Bypass/Detail Design (by Others)
- Separate MTO EA Study

General Features

- Municipal Boundary
- Railway
- Provincial Highway
- Other Road
- Watercourse

0 0.5 1 2 3
Kilometers

Highway 400- Highway 404 Link (The Bradford Bypass) Assignment No. 2019-E-0048

Study Area

Figure 1

Datum: NAD 1983 UTM Zone 17N
Source: MTO, Town of Bradford West Gwillimbury, Town of East Gwillimbury, Municipality of Vaughan, Region of York, Region of Simcoe
Scale: 1:45,000

Feb, 2023

Path: C:\GIS\Projects\60636190 BBP Climate\Design\01_Reports\ClimateChange_2022\60636190-BradfordBypass-ClimateChangeReport2022.aprx

1.3 Climate Change Assessment and the Ontario Regulation 697/21

In 2017, the Ministry of the Environment, Conservation and Parks (MECP) released a new guide “Considering Climate Change in the Environmental Assessment Process” (Climate Change guide) under the *Environmental Assessment Act*, R.S.O. 1990, chapter E.18. This guidance document demonstrates both quantitatively and qualitatively how proponents should address climate change impacts and mitigation considerations for new projects undergoing the environmental assessment process. In a letter dated September 28, 2020, the MECP requested this guidance be employed for the Highway 400 – Highway 404 Link (Bradford Bypass) No. 2019-E-0048.

The guidance contained in MECP’s Climate Change guide were developed to support the climate-focused policies of the Provincial Policy Statement (Section 3 of the Planning Act).

The Provincial Policy Statement was updated in 2020 to align with changes to the *Planning Act* through *More Homes, More Choice Act, 2019,* and *A Place to Grow: Growth Plan for the Greater Golden Horseshoe*. A partial listing of applicable policies in the 2020 Provincial Policy Statement include (Ontario Government, 2021):

- Policy 1.1.3.2 – Land use patterns within settlement areas shall be based on densities and a mix of land uses which:
    - Minimize negative impacts to air quality and climate change and promote energy efficiency.
- Policy 1.6.6.7 – Planning for stormwater management by minimizing erosion and changes in water balance and prepare for the impacts of a changing climate through effective management of stormwater, including the use of green infrastructure.
- Policy 1.8 - Planning authorities shall support energy conservation and efficiency, improved air quality, reduced greenhouse gas emissions (GHG), and preparing for the impacts of a changing climate through land use and development patterns, and;
- Policy 3.1.3 Planning authorities shall prepare for the impacts of a changing climate that may increase the risk associated with natural hazards.

As part of the climate change assessment under the MECP’s Climate Change guide, proponents are required to evaluate and assess:

- the project’s expected production of greenhouse gas emissions and impacts on carbon sinks (climate change mitigation), and
- the resilience or vulnerability of the undertaking to changing climatic conditions (climate change adaptation).

This Report will focus on both these key areas of assessment for the project and describe possible mitigation options available for reducing the project’s effects on climate change (climate change mitigation), and the effects of climate change on the project (climate change adaption).

2. Climate Change Mitigation

In assessing potential impacts the project may have on the local area and impacts on climate change; based on the Climate Change guide the following key questions must be considered within the planning and design stages of the project:

- How might the project/alternatives generate greenhouse gas emissions or affect carbon storage or the removal of carbon dioxide from the atmosphere?
- To what extent have the project/alternatives already considered impacts on climate change in project planning?
- Are there alternative methods to implement the project that would reduce any adverse contributions to a changing climate?
- How might the project/alternatives give rise to climate change impacts, positive or negative, on Indigenous people and/or communities?
- What commitments can be made to reduce the impacts on climate change from the project over time, i.e., when the project is implemented?

Each of these questions are addressed in the following sub-sections of this assessment, with suggested mitigation included where appropriate.

2.1 Greenhouse Gas Background

Principal transportation-related greenhouse gases emitted from vehicular traffic, construction, and other sources of carbon emission and sinks are carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). These may be emitted from sources such as tailpipe exhausts, diesel vehicular combustion, on-site generator combustion, decomposition of natural materials within existing naturalized areas, created upstream through material sourcing (e.g., concrete and steel production), and removed from the atmosphere or stored (e.g. wetlands) as part of natural biosynthesis of vegetation within the Study Area. The balance of creation and absorption of greenhouse gases from a project's construction, operation, and maintenance phases contributes to the overall climate change impact a project may have on the surrounding environment and regional climate.

Individual greenhouse gases have differing abilities to absorb heat in the atmosphere. These varying heat absorption properties are quantified by an individual global warming potential (GWP) factor for each contaminant which converts the mass of a greenhouse gas to the representative equivalent mass of CO_2 ($CO_{2\,eq}$). The Global Warming Potentials are calculated based on the amount of heat trapping potential that would result from the emission of 1 kg of a given greenhouse gas to the emission of 1 kg of CO_2. Global Warming Potentials for various greenhouse gas compounds are defined by Environment Canada in their most recently published article in the Canadian Gazette Part II, Volume 156 (October 11, 2022)[1]. These GWP values are identified in **Table 2-1**.

Table 2-1: Greenhouse Gas 100-year Global Warming Potentials

Greenhouse Gas	100-year GWP
Carbon Dioxide (CO_2)	1
Methane (CH_4)	28

[1] *Canadian Department of the Environment, Canadian Environmental Protection Act, 1999: Order Amending Schedule 3 to the Greenhouse Gas Pollution Pricing Act , Canada Gazette, Part II, Volume 156, October 11, 2022. Accessed December 15, 2022: https://gazette.gc.ca/rp-pr/p2/2022/2022-10-26/html/sor-dors210-eng.html*

Greenhouse Gas	100-year GWP
Nitrous Oxide (N_2O)	265

2.2 Net Greenhouse Gas Emissions

The impacts of greenhouse gas emissions from the project are contributed during three primary phases: construction, operation, and maintenance. Construction emissions may be categorized as both direct and indirect emissions which includes emissions from construction vehicle operation, land use change, and upstream material production for concrete, asphalt, steel, and other materials required for road construction. The upstream emissions of greenhouse gases are typically referred to as 'embodied carbon' within the buildings industry and can account for a vast majority of the emission on new construction projects as global production of concrete alone accounted for 26% of all industrial carbon dioxide emissions in 2019[2].

Construction of new projects can impact the lands surrounding the construction site, reducing the percentage of local carbon sinks and reservoirs within the area. Carbon sinks are generally defined as areas which work to remove carbon from the atmosphere, typically including agricultural lands, forests, and large bodies of water. Carbon reservoirs perform a similar function, but also have the capacity to hold carbon within their systems which may be released later within the life cycle. These can include wetlands, vegetation and soils, reservoirs of fossil fuels, and permafrost land. Based on the area of vegetated land use which would be impacted by construction and project development, and the low-biomass per square-foot ratio of the type of vegetation found within this project staging zones (i.e. grasses vs. densely forested land), the loss of carbon sink potential is significantly outweighed by the volume of GHGs associated with upstream creation of concrete, steel, asphalt, and other construction materials required for the road. Nevertheless, the impacts from loss of vegetated carbon sink land can be mitigated by swiftly re-instating greenspace with biomass dense vegetation (e.g., shrubs, etc.) as construction progresses where feasible, as an example. Additionally, replanting compensation trees (reforestation planting) that have been removed from the site is recommended between the woodlands and urban elements throughout the proposed corridor. As part of the project, a Preliminary Landscape Composition Plan, Snowdrift Analysis Report, Stormwater Management Plan and Terrestrial Existing Conditions and Impact Assessment Report has been prepared. Details of these various plans will be further refined in subsequent Detail Design phases and vegetation plantings will be implemented for the project.

The operational lifecycle of new road or road alteration projects, such as the Bradford Bypass, are typically anticipated to have the greatest impact on greenhouse gas emissions from the anticipated adjustment to road traffic and traffic behaviour patterns within the Study Area resulting from the new project implementation. A traffic analysis was performed on the project, including a comparison to existing conditions assessed during 2019, without the construction of the Bradford Bypass, assessed at the 2041 project horizon, and including the Bradford Bypass. **Table 2-2** below shows the results of these three scenario comparisons. See **Appendix A** for a visual representation of the traffic sources shown in **Table 2-2**.

[2] *Joint statement: Canada's Cement Industry and the Government of Canada announce a partnership to establish Canada as a global leader in low-carbon cement and to achieve net-zero carbon concrete (https://www.ic.gc.ca/eic/site/icgc.nsf/eng/07730.html)*

Table 2-2: Traffic Analysis

Link ID	Link Description	2019		2041 (w/o BBP)		2041 with BBP	
		AADT	Truck %	AADT	Truck %	AADT	Truck %
G1	HWY 400 North of Simcoe County Road 88	91100	12.0%	107300	21.2%	90800	20.4%
G2	HWY 400 South of Simcoe County Road 88	100000	12.0%	110800	21.4%	102400	19.5%
G3	HWY 400 Between Simcoe County Road 88 On/Off-Ramps	81000	12.0%	91800	23.2%	85900	21.1%
G4	HWY 400 / Simcoe County Road 88 E/W - N	5600	5.2%	-	-	-	
G5	HWY 400 / Simcoe County Road 88 Off Ramp - N	4500	5.1%	7900	8.7%	2900	7.6%
G6	HWY 400 / Simcoe County Road 88 Off Ramp - S	9300	6.2%	10100	13.9%	8900	12.4%
G7	HWY 400 / Simcoe County Road 88 E/W - S	9600	4.3%	-	-	-	
G8	HWY 404 North of Queensville Sideroad	38700	7.0%	59600	5.0%	102000	11.1%
G9	HWY 404 Between Queensville Sideroad On/Off-Ramps	36300	6.9%	55400	5.1%	79300	11.1%
G10	HWY 404 / Queensville Sideroad E/W - N	1000	8.0%	4100	2.0%	12200	10.7%
G11	HWY 404 / Queensville Sideroad E/W - S	3400	7.1%	5400	5.0%	2500	4.4%
G12	HWY 404 / Queensville Sideroad Off Ramp - N	1400	5.0%	1500	5.3%	10500	12.4%
G13	HWY 404 / Queensville Sideroad Off Ramp - S	5100	3.9%	6500	3.4%	2600	5.4%
G14	Leslie St N Between Queensville Side Rd & Boag Rd	9500	4.7%	10500	4.8%	12100	1.3%
G48	10 Sideroad N - Between Reagens Industrial Pkwy & Concession Rd 11	7800	3.3%	8000	4.4%	11100	3.8%
G50	Yonge St (Rd 4) - Between 8th Line & Concession Rd 11	16800	2.0%	23000	4.0%	29100	6.2%
G109	HWY 400 North of BBP intersection	-	-	-	-	104400	20.5%
G110	HWY 404 North of BBP intersection	-	-	-	-	83400	7.0%
G111	HWY 400 / BBP S-E OFF Ramp	-	-	-	-	12700	11.0%
G112	HWY 400 / BBP E-S ON Ramp	-	-	-	-	15100	7.3%
G113	HWY 400 / BBP N-E OFF Ramp	-	-	-	-	26200	12.2%
G114	HWY 400 / BBP E-N ON Ramp	-	-	-	-	24300	16.0%
G115a	BBP Between HWY 400 & 10 Sideroad – Eastbound	-	-	-	-	38900	11.8%
G115b	BBP Between HWY 400 & 10 Sideroad – Westbound	-	-	-	-	39400	12.7%
G116	10 Sideroad / BBP W-N/S Ramp	-	-	-	-	6410	6.4%
G117	10 Sideroad / BBP E-N/S Ramp	-	-	-	-	5050	8.9%
G118	10 Sideroad / BBP S-E Ramp	-	-	-	-	1450	3.4%
G119	10 Sideroad / BBP S-W Ramp	-	-	-	-	3070	2.3%
G120	10 Sideroad / BBP N-E Ramp	-	-	-	-	4150	8.4%
G121	10 Sideroad / BBP N-W Ramp	-	-	-	-	2340	6.0%
G122	BBP Between 10 Sideroad & Yonge St (Rd 4)	-	-	-	-	77100	12.7%

Link ID	Link Description	2019		2041 (w/o BBP)		2041 with BBP	
		AADT	Truck %	AADT	Truck %	AADT	Truck %
G123	Yonge St (Rd 4) / BBP - W-N/S Ramp	-	-	-	-	2930	18.1%
G124	Yonge St (Rd 4) / BBP - E-N/S Ramp	-	-	-	-	13900	7.9%
G125	Yonge St (Rd 4) / BBP - S-E Ramp	-	-	-	-	8920	4.7%
G126	Yonge St (Rd 4) / BBP - S-W Ramp	-	-	-	-	2390	12.1%
G127	Yonge St (Rd 4) / BBP - N-E Ramp	-	-	-	-	6470	5.7%
G128	Yonge St (Rd 4) / BBP - N-W Ramp	-	-	-	-	550	9.1%
G129	BBP Between Yonge St. (Rd 4) & Bathurst St.	-	-	-	-	100700	10.7%
G130	Bathurst St / BBP W-N/S Ramp	-	-	-	-	3880	9.8%
G131	Bathurst St / BBP E-N/S Ramp	-	-	-	-	320	3.1%
G132	Bathurst St / BBP N/S-W Ramp	-	-	-	-	4480	10.7%
G133	Bathurst St / BBP N/S-E Ramp	-	-	-	-	440	2.3%
G134	BBP Between Bathurst St. (Rd 38) & 2nd Concession Road (Rd 34)	-	-	-	-	93100	10.7%
G135	2nd Concession Rd / BBP W-N/S Ramp	-	-	-	-	3830	3.4%
G136	2nd Concession Rd / BBP E-N/S Ramp	-	-	-	-	1210	0.8%
G137	2nd Concession Rd / BBP S-E Ramp	-	-	-	-	2220	0.9%
G138	2nd Concession Rd / BBP S-W Ramp	-	-	-	-	3150	1.6%
G139	2nd Concession Rd / BBP N-E Ramp	-	-	-	-	110	9.1%
G140	2nd Concession Rd / BBP N-W Ramp	-	-	-	-	140	7.1%
G141	BBP Between 2nd Concession Road (Rd 34) & Leslie St.	-	-	-	-	89500	10.9%
G142	Leslie St / BBP W-N/S Ramp	-	-	-	-	4330	7.6%
G143	Leslie St / BBP N/S-W Ramp	-	-	-	-	4150	6.0%
G144	BBP Between Leslie St & Hwy 404	-	-	-	-	81200	11.5%
G145	HWY 404 / BBP W-S Ramp	-	-	-	-	28100	12.1%
G146	HWY 404 / BBP S-W Ramp	-	-	-	-	27300	17.6%
G147	HWY 404 / BBP N-W Ramp	-	-	-	-	12810	4.0%
G148	HWY 404 / BBP W-N Ramp	-	-	-	-	13070	4.4%
G149	10 Sideroad / BBP Ramp W-N/S	-	-	-	-	6410	6.4%
G150	10 Sideroad / BBP Ramp E-N/S	-	-	-	-	5050	8.9%
G151	Yonge St (Rd 4) / BBP Ramp W-N/S	-	-	-	-	2930	18.1%
G152	Yonge St (Rd 4) / BBP Ramp E-N/S	-	-	-	-	13900	7.9%
G153	Bathurst St / BBP Ramp W-N/S	-	-	-	-	3880	9.8%
G154	Leslie St / BBP W-N/S	-	-	-	-	4330	7.6%
G155	HWY 400 / Simcoe County Road 85 E-N	-	-	6700	9.1%	950	13.7%

Link ID	Link Description	2019		2041 (w/o BBP)		2041 with BBP	
		AADT	Truck %	AADT	Truck %	AADT	Truck %
G156	HWY 400 / Simcoe County Road 86 W-S	-	-	3100	9.7%	1600	15.6%
G157	HWY 400 / Simcoe County Road 87 E-S	-	-	9000	12.2%	8100	7.9%
G158	HWY 400 / Simcoe County Road 88 W-N	-	-	2700	11.5%	1700	5.3%
Signalized Traffic Sources – One Way Traffic							
G51	HWY 400 OFF Ramp North	4500	5.1%	7900	8.7%	2900	7.6%
G52	HWY 400 OFF Ramp South	9300	6.2%	10100	13.9%	8900	12.4%
G67	10 Sideroad N - At the intersection of Reagens Industrial Pkwy & 10 Sideroad (N-S)	3600	2.2%	3600	2.5%	5600	1.6%
G68	10 Sideroad S - At the intersection of Reagens Industrial Pkwy & 10 Sideroad (S-N)	4800	5.6%	9200	3.2%	7600	3.0%
G90	Yonge St (Rd 4) - At the intersection of 8th Line/Barrie St/Yonge St (Rd 4)	8700	2.2%	11400	2.5%	14400	6.9%
G108	HWY 404 Off Ramp South	5100	3.9%	6500	3.4%	2600	5.4%

AADT: Annual average daily traffic defined as the average twenty four hour.
Note: Complete Traffic Analysis including all links throughout the Study Area can be seen in Appendix D of AECOM's "Hwy 400-404 Air Quality Impact Assessment Report".

As shown in this comparison, there's a traffic variance within the Study Area with a 18% traffic decrease along Highway 400 North, 42% increase in volume along Highway 404 North and both an increase and decrease in traffic volumes on the on-ramps, off-ramps, and arterial roads between Future No-Build and Future Build conditions. The implementation of the Bradford Bypass is expected to redistribute traffic from local roads and freeway corridors surrounding the proposed Bradford Bypass. Reductions in traffic volumes are observed on corridors including Highway 11 / 1 (Bridge Street), Bathurst Street, Holland Landing Road, Yonge Street, Queensville Sideroad, Doane Road, Mount Albert Road, Green Lane, and Simcoe County Road 88 / Holland Street, among other roads, which benefits the community of Bradford, Town of Bradford West Gwillimbury, by alleviating congestion during peak hours.

It is reasonable to assume that the projected population increase within the Greater Toronto Area (GTA) and surrounding areas would also increase the traffic flow along the north-south routes to and from the County of Simcoe and major traffic routes intersecting with the GTA. When compared to the existing conditions in 2019, there is an overall increase in daily traffic on Highway 400, Highway 404, and throughout the Study Area, which coincides with an anticipated increase in traffic-based vehicular emissions. With the inclusion of the Bradford Bypass this increase in traffic would be alleviated by the re-distribution of traffic from local roads in Bradford to the bypass. In addition, traffic mitigation can also be achieved through the implementation of High Occupancy Vehicle (HOV) lanes on the Bradford Bypass to promote the use of carpooling and avoidance of single-occupant vehicles. Accordingly, three commuter parking lots are being proposed for 10th Sideroad, 2nd Concession, and Yonge Street interchanges to support carpooling uptake and HOV lane use.

Maintenance activities would create a temporary increase in greenhouse gas emissions resulting from the operation of construction vehicles operated by gasoline or diesel fuel. In addition, the resultant greenhouse gas impacts may increase due to material disposal or recycling programs.

2.3 Impacts on Climate during the Assessment Process

As mentioned above, with the inclusion of the Bradford Bypass, the community of Bradford will see a relief in traffic congestion along various roads which can reduce greenhouse gas emissions within the community of Bradford. Improving connectivity within the Study Area between Highway 400 and Highway 404, the new highway will result in the reduction of local agricultural land which currently acts as minor carbon sinks/reservoirs. Steps may be taken to reduce disturbance to natural lands during construction by remaining efficient with use of space, and re-sodding exposed soil as soon as feasibly possible following construction completion. The construction is proposed in stages, which may be conducive to retaining minimal local impact and replacing vegetation in completed segments of road construction once a given construction stage has been completed.

2.4 Alternative Designs for the Project

This project includes the assessment and comparison of three main bridge superstructure types: precast concrete girders with concrete deck, structural steel girders with concrete deck and cast-in-place concrete deck, either post-tensioned or conventional reinforcement. There are also two main foundation alternatives being considered: shallow concrete strip footings, and deep foundations with either steel piles or concrete caissons. Alternative options for pavement type are still under consideration and evaluation, including asphalt or concrete as prime paving materials. While material usage would vary for each design, the design selection process was more focused on structural requirements that best fit the overall geography and design requirements for the overpass and underpass structures.

There are potential mitigation actions that can be implemented during the design and contracting phases, including sourcing low-carbon alternatives for material selection, prioritizing low-carbon steel and concrete options, and/or sourcing materials from local suppliers. Although local and/or regional materials can reduce the impact of long transport, it is important to note they could have negative impacts on performance if those materials result in reduced durability, safety, or service life. Materials with slightly higher initial embodied carbon will have a lower net embodied carbon over the life of the project if they are more durable and less likely to require repair or replacement[3]. By designing projects to use less material, use materials more efficiently, or materials with lower embodied carbon, as well as reducing transportation distances, the overall impact of the project can be reduced.

2.5 Indigenous Community Impacts

There are several Indigenous communities that have or may have existing aboriginal or treaty rights, as recognized, and affirmed in Section 3.5 of the *Constitution Act, 1982,* that may be impacted by the project, and Indigenous communities that may otherwise be interested in the project:

- The Alderville First Nation
- Beausoleil First Nation
- Chippewas of Georgina Island First Nation
- Chippewas of Rama First Nation
- Curve Lake First Nation
- Hiawatha First Nation
- Mississaugas of Scugog Island First Nation
- Kawartha Nishnawbe First Nation
- Métis Nation of Ontario – Georgian Bay Métis Council, and
- Huron-Wendat Nation (regarding archaeological resources only)

Care must be taken not to inadvertently harm natural lands which act as a source of carbon sink and reservoir and may also act as a source of resource for communities.

2.6 Greenhouse Gas Mitigation

There are several options and technologies available at this time which can serve to mitigate a project's impact on greenhouse gas release (both direct and indirect). Projected increase in access to new technologies over time is anticipated as Provincial and Federal governments implement new focused actions related to climate change mitigation development. Preliminary mitigation options for this project can include the use of best practices and technologies that target greenhouse gas emissions and climate change impacts during all project phases (i.e., construction, operation, and maintenance).

When identifying possible carbon reduction strategies, the following carbon emissions reduction hierarchy may be implemented, as specified in PAS 2080 (2023) guidelines:

- Build nothing: Evaluate the need for an asset and explore alternative approaches that minimize whole life carbon.

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[3] Institute for Sustainable Infrastructure. Envision: Sustainable Infrastructure Framework Guidance Manual. Third Edition, 2018. Section CR1.1 "Reduce Net Embodied Carbon".

- Build less: Maximize the potential for re-using and/or refurbishing existing assets to reduce construction. Identify carbon hotspots in proposed solutions and approaches for reduction.
- Build clever: Use low carbon materials/products to minimize resource use and select technologies for efficient operation.
- Build efficiently: Embrace the use of techniques (e.g., construction, operational) that reduce resource consumption during the construction and operation phases. Strive to minimize material use, transport to site, construction waste, and maximize opportunities for reuse/recycling/recovery.

Table 2-3 details project impacts to greenhouse gas releases and climate change resulting from construction, operation, and maintenance phases of the project and potential mitigation measures which may be employed to further reduce project impacts.

Table 2-3: Greenhouse Gas Emission and Climate Change Potential Mitigation Options To Be Considered

Project Scenario	Anticipated GHG/Climate Change Impact	Examples of Possible Climate Change Mitigation Options
Construction: Reduction of natural or agricultural land acting as carbon sink and/or reservoir within the Study Area	Corresponding percentage of land use reduction in available carbon sink and reservoir capacity for removing carbon from the atmosphere.	• Limiting the requirement of naturalized land to only that which is required to construct the project, including that which is required to appropriately stage construction. • Re-naturalizing (e.g., re-sodding, vegetation, and shrub and tree planting, etc.) of staging areas immediately following construction phase end.
Construction: Embodied carbon management	Manufacturing processes and transportation of construction materials as well as actual construction operations cause an increase in greenhouse-gas emissions.	• Sourcing sustainably manufactured materials (i.e. low-carbon concrete) and using recycled materials, such as Recycled Asphalt Pavement (RAP), as opposed to energy-intensive materials such as concrete and asphalt (if feasible). • Avoiding the excessive transportation of materials by choosing local/regional materials, as well as materials sources or processed on site.
Construction: Operation of gasoline or diesel fuel powered construction vehicles and equipment during construction activities	Emissions from diesel or gasoline powered vehicles and equipment cause an increase in greenhouse gas emissions during construction operations.	• Properly maintaining vehicles and other internal combustion engines used on site (pumps, generators, etc.) to test that engines are operating as designed with optimal emissions. • Minimizing on-site vehicle idling during construction activities and implementing a vehicle maximum idling policy while on site.
Construction: Paving techniques	Approach to paving on-site during construction has a direct impact on greenhouse gases released.	• Use of reclaimed materials in the roadway - aggregate for use in new hot mix asphalt and road base, subbase, or shoulders.

Project Scenario	Anticipated GHG/Climate Change Impact	Examples of Possible Climate Change Mitigation Options
Construction: Structural work	Structural design and material component selection has an impact on both indirect upstream greenhouse gas emissions and embodied carbon of structural materials for the project.	• Use of prefabricated Bridge Elements to improve the efficiency and duration of construction is an option open to the Contractor. • Precast concrete pavement and rapid set concrete for concrete repairs to minimize congestion. • Extended life-cycle materials (ASTM 1010 or Corrosion Resistant Steel) to minimize rehabilitation requirements.
Construction: Traffic management	Approaches for traffic management on road construction projects has an impact on the indirect emissions from local vehicles passing through the construction zone.	• Design Build Reference Concept drawings includes a construction detour to reduce congestion.
Construction: Earth management	Approaches to earth management on-site during construction has an impact on direct emissions from vehicles operating onsite, and embodied carbon of the project infrastructure during its lifespan.	• Where property availability allows, using excess materials on site through slope flattening is an option that can be considered during Detail Design and by Contractor in order to minimize the need to truck excess materials away from the Site. • Minimizing double handling of materials and the associated trucks required for hauling is typically desired by contractors to reduce costs, this also has the benefit of reducing fuel requirements and emissions. • Retained soil system (RSS) walls or mechanically stabilized earth (MSE) rather than concrete retaining walls.
Operations: Electrical systems design and Intelligent Transportation Systems (ITS)	Design of electrical systems for the project has the capacity to affect the indirect emissions of greenhouse gases related to energy production for the ongoing operation of the project infrastructure during its lifespan.	• LED Traffic Signal Heads, LED Lighting and Variable Message Signs at the signalized intersections along the Bradford Bypass (10th Sideroad, Yonge Street, 2nd Concession, and Leslie Street). • Use of renewable energy sources for lighting and signage, where feasible.
Operations: Traffic management	Approaches for traffic management on the project roads impacts the indirect emissions from local vehicles passing through the project area.	• Implementation of HOV lanes on the Bradford Bypass to promote the use of carpooling and avoidance of single-occupant vehicles. • Three commuter parking lots are being proposed for 10th Sideroad, 2nd Concession, and Yonge Street

Project Scenario	Anticipated GHG/Climate Change Impact	Examples of Possible Climate Change Mitigation Options
		interchanges to support carpooling uptake and HOV lane use.

Recommended considerations on climate change may be carried forward into development of the Bradford Bypass project design. These recommended considerations are summarized in **Table 2-4** below.

Table 2-4: Greenhouse Gas Emission and Climate Change Mitigation Options Recommended to be Carried Forward to Bradford Bypass

Project Scenario	Anticipated GHG/Climate Change Impact	Examples of Possible Climate Change Mitigation Options
Construction: Increased upstream greenhouse gas emissions (embodied carbon) from material production, including concrete, asphalt, steel, and other necessary materials.	Required materials for construction, including concrete, steel, asphalt, and other materials have an indirect upstream greenhouse gas cost associated with production, typically linearly correlated with tonnes (mass) of material produced for the project. This is typically one of the largest sources of greenhouse gas impact for construction projects due to the high-carbon intensive processes of creating both concrete, steel and asphalt.	• Prioritizing use of low-carbon materials where feasible for the project budget and schedule (e.g. low-carbon concrete as an alternative to Portland cement and RAP). • Prioritizing sourcing materials from companies and suppliers with good standing track records for emissions reduction and emission efficient production methods to reduce up-stream carbon costs of material purchase. • Prioritizing transportation of materials via low-carbon, carbon neutral or carbon free shipping (e.g., local suppliers, electric powered shipping, Tier 4 locomotive rail shipping where feasible, etc.). • Using Envision® Certification and Verification for guidance and support to facilitate the reduction of greenhouse gas emissions from construction.

Project Scenario	Anticipated GHG/Climate Change Impact	Examples of Possible Climate Change Mitigation Options
Maintenance: downstream emissions from material waste practices or recycling practices resulting from road maintenance activities may provide a one-time increase in corresponding project emissions.	Emissions from landfilling of any project organic materials, incineration of project materials, or recycling/reuse of project materials may result in temporary increase in associated greenhouse gas releases.	• Employing a plan for carbon neutral modes of material disposal and/or recycling programs where possible and feasible. • Encouraging reuse of available material for future projects to reduce future material production emissions (e.g. recycling of concrete components into new concrete construction). • Effective scheduling and resourcing to mitigate and reduce waste.
Operations: Electrical systems design and ITS	Design of electrical systems for the project has the capacity to affect the indirect emissions of greenhouse gases related to energy production for the ongoing operation of the project infrastructure during its lifespan.	• Permanent solar/wind powered variable message signs, where applicable within the design (if feasible). • Solar powered traffic count stations, where applicable within the design and if feasible. • Solar Powered Cathodic Protection system for bridges, where applicable within the design and feasible. • Vehicle charging facilities to encourage and facilitate use of electric vehicles, where applicable within the design (where feasible)
Operations: Traffic management	Approaches for traffic management on the project roads impact the indirect emissions from local vehicles passing through the project area.	• Implementation of HOV lanes on the Bradford Bypass to promote the use of carpooling and avoidance of single-occupant vehicles. • Three commuter parking lots are being proposed for 10th Sideroad, 2nd Concession Road, and Yonge Street interchanges to support carpooling uptake and HOV lane use.

3. Climate Change Adaption

A Climate Change Resilience Assessment (CCRA) is being undertaken in the context of a preliminary screening to provide input and direction for the design, construction, operation, and maintenance of the project. A CCRA typically involves adopting a risk management approach to:

- anticipate climate change-related risks that may have an impact on the assets or activities under study, and
- identify potential design features or actions to help prevent, withstand, respond to, recover from, and adapt to these risks.

3.1 Methodology

The CCRA was undertaken following the five key steps described by the ISO 31000 Risk Management Standard (i.e., establishing the context, risk identification, risk analysis, risk evaluation, risk treatment, and adaptation measures), as well as the Ministry of the Environment, Conservation and Parks (MECP) guidance for Considering Climate Change in the Environmental Assessment Process. The CCRA was based on a review of project documents and available climate data for the Study Area.

3.2 Establishing the Context

The scope and boundaries of the assessment encompass time periods and areas within which the project components are likely to interact with or be influenced by climatic events. The scope of the assessment for this project considers climate change impacts on the design and construction as well as future operation and maintenance phases of the project.

After completion of the construction phase, the project time span is 75 years even though the asset remains operational afterward. Therefore, the assessment will be carried out using the projections for the time periods of the current (1981-2010) and the future (2081-2100). The end-century climate, i.e., 2040's is representative of the mid- century climate. As such, the risk of the end-century is a conservative representation of the mid-century. Therefore, the end-of-century risk was displayed in this Report.

3.3 Climate Sensitive Elements

To assess the climate change impacts on the assets and resources of the project, first, the elements that are deemed to be vulnerable to climate change were identified. These elements are selected according to their exposure and adaptive capacity to climate change impacts. See **Table 3-1** for details about these elements.

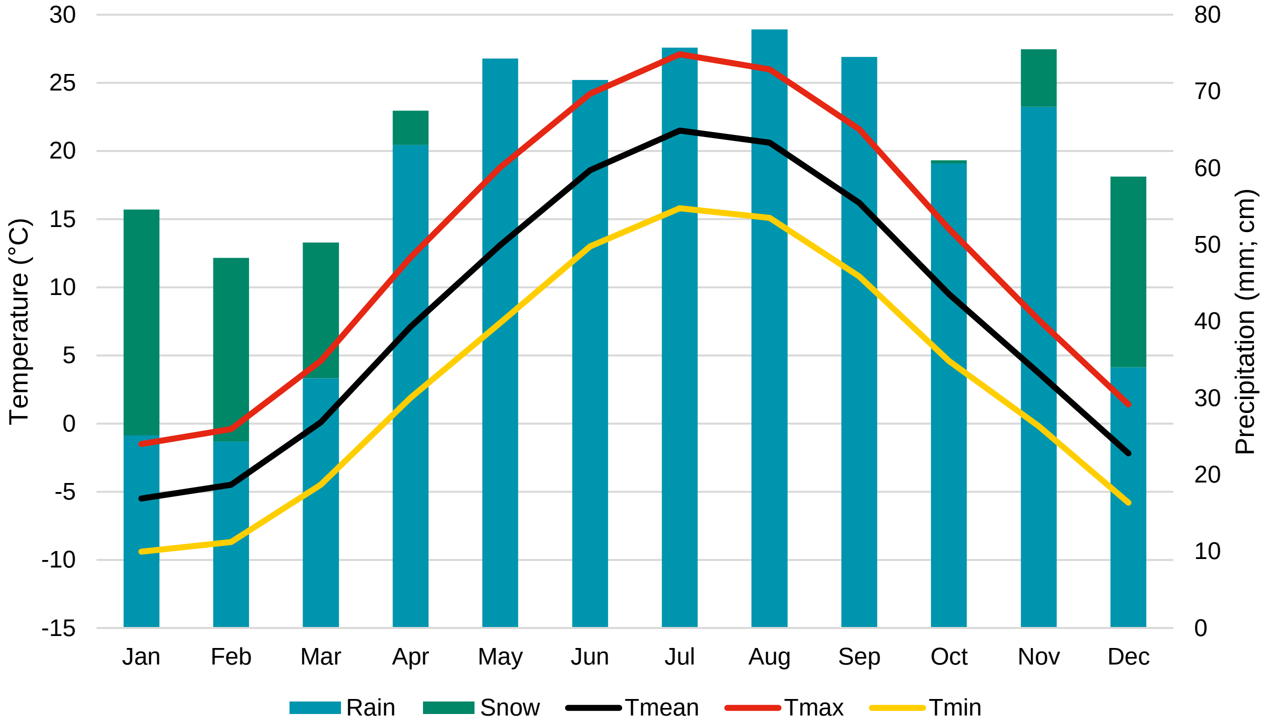
Table 3-1: Components and elements related to each component to be analyzed under climate change conditions

Components	Elements
Construction (initial and maintenance) and operation	Pavement Culverts Bridges (underpasses/overpasses) Ditches, shoulders, enhanced grass swales Equipment (fences, signs, markings)
People	Construction Workers Users Residents
Environment	Streams, tributaries, wetlands Agricultural lands Terrestrial environments (forested areas)
Indigenous Communities	This refers to Indigenous communities that have or may have existing aboriginal or treaty rights, as recognized and affirmed in Section 35 of the *Constitution Act, 1982,* that may be impacted by the project, and Indigenous communities that may otherwise be interested in the Bradford Bypass.

3.4 Climate Data Analysis

Historical climate data were analyzed based on temperature and precipitation observations at the Toronto Pearson International Airport's weather station from 1981 to 2010, obtained from Environment and Climate Change Canada (ECCC) and the Canadian Centre for Climate Services (CCCS). Due to the lack of complete data sets in close proximity to the project site for the historical reference period (1981-2010), the meteorological station at Pearson Airport about 53 km away is assumed to be representative of the climate at the project location. For the historical reference period, January is the coldest month with average minimum and maximum temperatures of -9.4°C and -1.5°C, respectively (**Figure 3-1**). The warmest month is July with average temperatures between 15.8°C and 27.1°C. The summer months are also the months with the highest monthly precipitation sums with an average of 75.1 mm of rain in June, July, and August.

Figure 3-1: Climate Normals from the Weather Station at Toronto Pearson International Airport (1981-2010)



3.5 Climate Projections

The potential climate change at the location over the lifespan of the existing and proposed infrastructures must be established to understand their future exposure. To this end, local climate change information is derived from several global climate models (GCMs) which are part of the Coupled Model Intercomparison Project Phase 5 (CMIP5). These GCMs build the basis for the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC). In these GCMs, the consequences of the anthropogenic emission of GHGs are indirectly simulated.

As future global emissions of GHGs and other pollutants are uncertain, four scenarios with different GHG concentration trajectories have been conducted. These Representative Concentration Pathways (RCP) are named after their associated level of radiative forcing (i.e., the change in the atmosphere's energy balance) in 2100 relative to the pre-industrial levels in 1750. Hence, as an example, the RCP2.6 corresponds to 2.6 W/m² of radiative forcing and a surplus of energy of 2.6 W/m² in Earth's atmosphere. Projected GHG concentration levels (including carbon dioxide (CO_2) and methane (CH_4)) depend on the anticipated population growth, changes in economic activity and energy consumption, shifts in land use, and climate policies (IPCC, 2014). A high-level description of the RCPs can be found in **Table 3-2**

Table 3-2: Description of different RCPs used in this Project

RCP	Description
RCP2.6	Stringent mitigation scenario: representative of a scenario that aims to keep global warming likely below a 2°C increase above preindustrial temperatures. An ambitious reduction of GHG emissions is required for this scenario for emissions to peak around 2020, then decline, and become net negative before 2100.
RCP4.5	Intermediate mitigation scenario consistent with relatively ambitious emissions reductions. The GHG emissions increase before starting to decline between 2040 and 2050. This scenario will likely fall short of the 2°C limit agreed upon in the Paris Agreement.
RCP6.0	Intermediate to high emissions scenario with emissions peaking in 2080 and declining for the rest of the century.
RCP8.5	Very high GHG emissions: consistent with no policy changes to reduce emissions (sometimes called the current policies or business as usual scenario).

3.5.1 Identification of Climate Indicators

A climate indicator represents a certain climate condition or a type of event (e.g., number of hot days with +30°C), defined by a threshold above which the evaluated infrastructure would be adversely affected, resulting in a loss of productivity, damage to the infrastructure or the requirement for a maintenance plan. The likelihood or probability associated with an indicator was calculated for both the historical data recorded at the weather station at Toronto Pearson Airport as well as for the future projections for the project obtained from CCCS (CCCS, 2022).

The analysis of climate data for the project highlights twelve (12) climate variables with a potentially moderate to high probability in the future. These indicators were selected based on the following criteria:

- Climate indicators identified in past extreme weather events: past extreme weather events were researched to inform the selection of the climate indicators to be studied under future conditions
- Trends found in the time series: historical and future annual and seasonal variations for both temperature and precipitation were reviewed to provide insights on future trends
- Showing significant increases in probability: Climate indicators with a pronounced trend, especially in the project time frame, were chosen for further assessment
- Relevance of climate indicators to local reality: climate indicators that are representative of the area were chosen for further assessment, and
- Potential interactions of a certain climate condition with the project component: the climate indicators that are involved within the project upon the occurrence of certain climate conditions were chosen for further assessment.

Considering the historical climate and projected changes for both the current and the future timeframe, the calculated probabilities of occurrence for each climate indicator were calculated using historical climate data and future climate projections provided by ECCC and CCCS, AECOM's updated climate data analysis tool, and the newest scientific findings. Subsequently, the probabilities were converted into a score according to **Table 3-3**.

For the twelve climate indicators, the probability scores are shown in **Table 3-4**. Along with the probability scores, the component and the sensitive element of that component are also listed in the table. As not all infrastructure elements are exposed or sensitive to all selected climate indicators, **Table 3-4** includes the relevant component and element per indicator. The climate indicators are selected based on past events, probability of occurrence in the future, or showing a pronounced trend to reflect the reality of the project. For instance, the climate indicator of *Hot Temperature*, which reflects occurrences of daily maximum temperature greater than 30°C, was chosen as it happened in the past, is showing an increase, and impacts the *operation* of the bypass by reducing the quality of the *Pavement*. A similar argument underlies the selection of the indicator drought, which refers to meteorological droughts throughout this report.

Table 3-3: Probability scoring ranging from very low to very high

Probability	Frequency of occurrence	Probability of occurrence per year	Score
Very high	Once every year or more	More than 70% (100%)	5
High	Once every 2 years	40%-70% (50%)	4
Moderate	Once every 5 years	20%-40% (30%)	3
Low	Once every 10 years	4%-20% (10%)	2
Very low	Once every 30 years	4% or less (4%)	1

Table 3-4: Climate indicators probability scoring (climate data from the Weather Station at Toronto Pearson International Airport and climate projections) and the component being impacted by the indicators

	Code	Climate Indicators	Definition	Current (1981-2010)	Future (2081-2100)	Component and Element
Temperature	T1	Hot temperature	Days with Tmax ≥ 30°C	5	5	Operation: pavement People: workers Environment: agricultural lands, wildlife
	T3	Heatwave	Instances of 3 days with Tmin ≥ 20°C and Tmax ≥ 33°C	3	5	People: workers, users, residents
	T5	Diurnal variation	Days with Tmax-Tmin ≥ 20°C	5	5	Operation: pavement People: workers
	T6	Freeze-thaw	Days with Tmin < 0°C & Tmax > 0°C	5	5	Operation: pavement
Precipitation	P2	Heavy rainfall	Days with P ≥ 25mm	5	5	Operation: culverts, ditches, swales, bridges Environment: agriculture land flooding People: flooding
	P3	Frequent heavy rain	P ≥ 10mm at least twice a month	3	5	Operation: ditches Environment: agriculture land and streams flooding

	Code	Climate Indicators	Definition	Current (1981-2010)	Future (2081-2100)	Component and Element
Wind	P9	Drought	Instances of P < 0.2mm for 10 days	5	5	Environment: agriculture land and streams Operation: Infrastructure integrity through damage to the soil
	W1	Heavy wind	Days with W ≥ 65km/h	5	5	People: workers, users construction and operation: equipment
	PW1	Blowing rain	Instances of (P ≥ 5mm) and (W ≥ 65km/h)	5	5	People: workers, users
	PW2	Blowing snow	Instances of ((S ≥ 5cm) or (SD ≥ 5cm)) and (W ≥ 65km/h)	5	5	People: workers, users
Humidity	H1	Relative humidity	Days with Hmd ≥ 90%	3	3	People: worker
	H5	Fog	Days with fog	4	4	People: users

3.5.2 Future Projections

The project is located within the Town of Bradford West Gwillimbury. The local climate is classified as a continental, wet climate with mild summers according to the Köppen-Geiger climate classifications. Hence, the winters are cold to temperate, the summers are warm, and the annual rainfall is significant, with precipitation occurring even during the driest month.

The modeled climate conditions for the time periods of the current and future were used as the near term (that includes the construction phase) and long term of the proposed project, respectively.

For the project, the trends in temperature, precipitation, and wind for the two time horizons are highlighted below.

3.5.2.1 Temperature

In general, it is anticipated that climate change will cause warmer winters and hotter summers in the Study Area see **Table 3-5**. There will be an increase in summer mean temperature relative to the 1986-2005 average by approximately up to a rise of +5.6ºC for the time horizon 2081-2100 under the high-emission scenario RCP8.5. The temperature rise will be greater during the winter period, with increases of up to 6.2 ºC (**Table 3-5**) relative to the 1986-2005 average.

Table 3-5: Projected change in seasonal mean temperature (ºC) for the project (Town of Bradford West Gwillimbury, ON) using RCP8.5 emission scenario (CCCS, 2022), relative to the current period

Season	2081-2100
Winter	+6.2ºC
Spring	+4.9ºC
Summer	+5.6ºC

Season	2081-2100
Autumn	+5.4ºC

3.5.2.2 Precipitation

Total Precipitation

The projected effects of climate change will cause significantly wetter winters, while the changes in summer precipitation are smaller, see **Table 3-6**. In addition to the increases of seasonal precipitation sum for all seasons except for the summer months 2081-2100, extreme precipitation such as heavy rainfall (days with P≥ 25mm) or frequent heavy rain (P ≥ 10mm at least twice a month) will increase in frequency and intensity with climate change (e.g., (Berg, Moseley, & Haerther, 2013), (Fischer & Knutti, 2016), and (Gründemann, van de Giesen, Brunner, & van der Ent, 2022)).

Table 3-6: Projected change in seasonal total precipitation (%) for the project (Town of Bradford West Gwillimbury, ON) using RCP8.5 emission scenario (CCCS, 2022), relative to the current period

Season	2081-2100
Winter	+21.0%
Spring	+19.7%
Summer	-0.7%
Autumn	+5.3%

Snow Depth

Rising winter temperatures are likely to reduce the amount of winter precipitation that falls as snow. The CCCS projections indicate that the Town of Bradford West Gwillimbury will consequently experience a substantial reduction in snow depth as pronounced as -83.2% for the period 2081-2100, see **Table 3-7**. The projected change is relative to the 1986-2005 average.

Table 3-7: Projected change in seasonal snow depth (%) for the project (Town of Bradford West Gwillimbury, ON) using RCP8.5 emission scenario (CCCS, 2022), relative to the current period

Season	2081-2100
Winter	-82.3%
Spring	-97.4%
Summer	-100.0%
Autumn	-99.4%

3.5.2.3 Wind

For all seasons, the projected wind speed will decrease for both time horizons by up to 6.8% in summer 2081-2100 relative to the 1986-2005 averages, see **Table 3-8**.

Table 3-8: Projected change in seasonal surface wind speed for the project (Town of Bradford West Gwillimbury, ON) using RCP8.5 emission scenario (CCCS, 2022), relative to the current period

Season	2081-2100
Winter	-0.6%
Spring	-1.1%
Summer	-6.8%
Autumn	-6.2%

3.5.3 Estimate of Likelihood of Climatic Event to Occur

Based on the climate normals and projected changes for the different timeframes, the likelihood rating assigned for the climate indicators is combined into temperature, precipitation, wind, and humidity-related indicators as it can be assumed that the impacts and the associated severity are similar. For this high-level assessment, the two lowest probability scores (1 and 2) were combined into an overall low probability (L). The probability scores 3 and 4 (moderate and high) were combined and are reflected by the moderate probability rating (M), and the highest score (5) is indicated by the high probability rating (H). The resulting probability ratings are shown in **Table 3-9**.

Table 3-9: Probability rating for climate indicators considered for the assessment

	Climate Indicators	Construction Phase (1981-2010)	Operation Phase (2081-2100)
Temperature	Hot temperature	High (H)	High (H)
	Heatwave		
	Diurnal variation		
	Freeze-thaw		
Precipitation	Heavy rainfall	High (H)	High (H)
	Frequent heavy rain		
	Drought		
Wind	Heavy wind	High (H)	High (H)
	Blowing rain		
	Blowing snow		
Humidity	Relative humidity	Moderate (M)	Moderate (M)
	Fog		

3.5.4 Risk Evaluation and Adaptation Strategies

A project's risk of climate change is determined by the severity of the consequence on the assets and the probability of relevant climate variables in the context of a changing climate. To estimate the level of consequences, three impact categories were identified based on the most important aspect of the project. These impacts are:

- on health and safety (including occupational illness and injury to staff - during construction - or public inconvenience, bodily harm),
- infrastructure integrity (including damages or deterioration of essential component materials), and
- operational impacts (including operational inefficiencies and potential bypass shutdown).

To assess the risk of each interaction between the project components and climate variables, severity levels were assessed leveraging relevant literature and professional knowledge. Subsequently, the qualitative risk analysis is determined from the combination of the severity and probability ratings, using the matrix shown in **Table 3-10**.

Adaptation measures are only suggested for interactions with moderate and high risks.

Table 3-10: Risk matrix (L = Low; M = Moderate; and H = High)

Likelihood \ Severity of consequence	Low	Moderate	High
Low	Low risk	Low risk	Moderate risk
Moderate	Low risk	Moderate risk	Moderate risk
High	Moderate risk	Moderate risk	High risk

In assessing the risks in **Table 3-10**, as a product of severity and probability, severity is evaluated according to the vulnerability of the element of interest (outlined in **Table 3-1**). Vulnerability, in turn, depends upon the sensitivity of the element and the adaptive capacity of the elements. Therefore, the severity score does not solely represent the consequence of failure, rather, it qualitatively integrates the consequence upon occurrence, the possibility to make the element resilient (adaptive capacity), and the degree to which the element changes the state of servicing upon receiving the impact (sensitivity). Then, the factor of probability needs to be taken into account to estimate the risk. The probability (in **Table 3-9**) was determined using climate projections that finds the chance of the occurrence of the climate variables in the future.

Table 3-11 demonstrates the potential impacts and proposed adaptation measures as part of the overall Bradford Bypass project design, construction, operation, and maintenance. The adaptation measures in this Report are based on high-level risks originating from the adverse impacts of climate change during the construction and life cycle of this infrastructure. The risk will not change between the near future and the far future as the probabilities of occurrence are projected to be high for climate indicators during both time periods (except for humidity which is moderate). Therefore, the table below represents adaptation strategies even for the end of the century time period.

During the construction phase, even though it will take place during the current climate, some climate-related risks originate from extreme conditions. For instance, heavy rainfall events pose a risk to the construction site. To avoid/control the adverse impacts, a drainage network system that has been designed with regard to climate change impacts is suggested. These heavy rainfall episodes also impact the construction workers, which needs to be addressed during the construction planning. Another adverse climate impact on the construction site rises from the extreme winds. To avoid critical risks during the windy period, it is recommended to schedule the work-at-height outside the extreme winds period and ensure to review wind speeds beforehand as there are limits for work with cranes under these circumstances (some crane manufacturers recommend avoiding working on winds speeds exceeding 20 m/s). It is also recommended that ensure all fences and other structures are properly secured against winds. It is also recommended to provide dust control measures such as mulching and tillage for the site and provide proper masks to the workers. Finally, another risk to the construction of this infrastructure is days with hot temperatures. To protect the workers and respect the Ontario Labor Code, it is recommended to develop a policy to make working hours flexible during the peak temperature, equip the site with cooling stations for workers, and train workers to work safely under hot temperature conditions.

Table 3-11: Risk assessment for the future time frame for the overall Bradford Bypass project

Climate Variable		Severity	Likelihood	Risk	Potential Impacts	Proposed Adaptation Measures
Construction and operation of the overpass infrastructure (Construction in this period refers to potential renovation/maintenance of the site)						
Precipitation	**Heavy Rainfall**	M	H	M	Increased precipitations could accelerate the degradation of the project structures such as roadways, bridges, culverts, and other structural elements. Additionally, heavy rainfall events cause waterlogging and flash floods. The sewage network of the project can get overwhelmed by frequent heavy rainfall events which will result in inundation. These events can also cause delays in maintenance/construction work schedules because there are considerations for road construction (asphalt and concrete) under rainy conditions (depending on which stage of pouring concrete, it may need to stop until the weather condition is suitable). Heavy rainfall events can also damage bridges and culverts through bank erosions.	To prevent degradation of the asphalt and concrete, consider enhancing the grade of concrete and the quality of protective surface coatings and barriers, or using stainless steel, or galvanized reinforcement. The Preliminary Design drainage system should be able to withstand heavy rainfall. It is suggested to design the drainage system with increased capacity to capture the future trend of increased heavy rainfalls. Frequent maintenance of the conveyance system can reduce the chance of blockage so that the system does not get overwhelmed easily. Please refer to the Storm Water Management Report for details. To avoid erosion, blankets, geotextiles, and ripraps can be used (where feasible within the design). Also, vegetation planting can prevent soil erosion (and potentially reduces drought as a co-benefit).

Climate Variable		Severity	Likelihood	Risk	Potential Impacts	Proposed Adaptation Measures
Temperature	**Drought**	M	H	M	Drought may cause soil shrinkage and instability for projects that are built on clay-rich soils.	It is suggested to consider this factor in the geotechnical design of this infrastructure.
	Hot Temperature & Heatwave	M	H	M	Hot temperatures and heat waves could result in an expansion of bridge joints, resulting in reduced bridge operations and higher maintenance costs. Higher temperatures may also cause premature deterioration to road pavements asphalt (e.g., potholes, rutting, cracking), particularly in high-traffic areas, which could result in increased maintenance costs. Also, heat waves may exacerbate urban heat islands due to increased surface temperatures of the pavement.	To improve the pavement quality, as per the MTO guidelines, to withstand future temperature trends, higher-grade asphalt binders that have higher temperature ranges asphalt binders can be used. Consider tracking the impacts of extreme heat to identify "hot spots" that may require an increased rate of inspection.

Climate Variable		Severity	Likelihood	Risk	Potential Impacts	Proposed Adaptation Measures
	Freeze-thaw cycle	M	H	M	Freeze-thaw cycles are a damaging factor to the pavements. They can cause cracks and potholes.	Consider conducting frequent inspections of pavement surfaces to monitor cracks and adopt the required corrective measure.
Wind	**Heavy wind**	H	H	H	Storms and heavy winds would pose threats to structures such as light posts, advance traffic messaging signs (ATMS), overhead sign supports, traffic signs, etc. Heavy winds can also blow away the equipment that is stored on-site during construction. Heavy winds can introduce serious risks to equipment such as cranes and work-at-height situations.	General structures such as traffic signs and others listed are recommended to be designed and installed to allow for future worst-case wind conditions. Preparedness for the extreme winds can be reached by considering the new wind patterns on the construction equipment e.g. cranes (wind speed limit to operate a crane). The structure should be adequately designed to allow for future worst-case wind conditions. Work-at-height should be transferred to the time that is safe for workers.
	Blowing rain	L		M		
	Blowing snow	L		M		
Humidity	**Relative humidity**	L	M	L	Not applicable	Not applicable
	Fog					
People						

Climate Variable		Severity	Likelihood	Risk	Potential Impacts	Proposed Adaptation Measures
Precipitation	**Heavy rainfall**	L	H	M	For users, heavy precipitation can reduce visibility and friction. Increased precipitation could lead to more weather-related accidents, delays, and traffic disruptions (loss of life and property, increased safety risks, and increased risks of hazardous cargo accidents) due to flooding and aquaplaning. On the other hand, residents may experience inundation from extreme rainfall events.	In addition to the incorporation of the proposed stormwater management plan, think about controlling speed to prevent vehicle accidents during heavy rainfall events. The risk of flooding can be reduced by using permeable material if possible, and bioswales depending on the design of the bypass.
Temperature	**Hot temperature & Heatwave**	H	H	H	There will be impacts on the health associated with heat waves for workers on the construction site, residents of the area, and freeway users, especially as dark asphalt exacerbates the hot temperature. Working under hot day conditions can potentially increase the risk of dehydration and heat stress.	For workers working under hot day conditions, adaptive measures can include providing a cooling station, sun-protective outfits, and scheduling the most intensive work package for cooler times if it is possible. Consider moving construction work schedules to cooler times in anticipation of hot weather, and incorporating appropriate breaks according to the Ontario Labor Code.
Temperature	**Diurnal variation**	L	H	M	There's a risk factor for construction workers' health when temperatures change rapidly within a day. This is particularly relevant to cardiovascular and respiratory diseases.	Instruct the workers on how to safely work on hot days or days with a wide range of diurnal temperatures.
Wind	**Heavy wind** **Blowing rain** **Blowing snow**	M	H	M	Extreme wind conditions increase the risk of traffic-related accidents.	Extreme weather conditions such as winds or fog can be communicated with the users using digital signs. Windbreaks, wind fences, and snowdrift and landscaping plans can mitigate the

Climate Variable		Severity	Likelihood	Risk	Potential Impacts	Proposed Adaptation Measures
						hazards due to the high winds and blowing rain/snow.
Humidity	**Relative humidity** **Fog**	L	M	L	Not applicable	Not applicable
Environment						
Precipitation	**Heavy rainfall** **Drought**	M	H	M	In addition to soil erosion on surrounding agricultural lands and nearby residential subdivisions, rainfall events can inundate the tributaries, damage banks, transport sediments, and disturb the ecosystem. Drought can degrade the water quality of the stream, and introduce risks to wildlife and biodiversity.	Flood control infrastructure such as barriers with water logs or dykes, can reduce the undesirable inundation impacts. Consider installing sediment barriers, riprap, and redirecting water to a vegetated area to prevent the risk of erosion and the risk of runoff from the construction site into watercourses. It is suggested to use temporary retention basins, geotextile membranes, and surface drainage ditches (such as swales etc.) to direct runoff in order to prevent accidental spills into the tributaries and surrounding agricultural lands.
Temperature	**Hot temperature & Heatwave**	M	H	M	Hot temperatures can damage agricultural lands, vegetation, and change the ecosystem of the area, introduce risks of new pests, and disturb wildlife.	It is recommended to develop restoration policies, and communicate with governmental/Non-profit organizations that help preserve the natural environment.
Wind	**Heavy wind** **Blowing rain** **Blowing snow**	L	H	M	Heavy winds (and debris/material carried by wind) can potentially damage trees and agricultural lands and property in the area.	It is recommended that the impact of winds be communicated with the local farmers/landowners so that they can take mitigative measures e.g., tree covers.

Climate Variable		Severity	Likelihood	Risk	Potential Impacts	Proposed Adaptation Measures
Indigenous communities						
Precipitation	**Heavy rainfall**	M	H	M	Heavy rainfall may result in soil erosion on surrounding agricultural lands. Heavy rainfall can also result in accidental spills of hydraulic oil or fuel into the network of streams which can damage terrestrial and aquatic ecosystems.	Consider installing sediment barriers and redirecting water to a vegetated area to prevent the risk of erosion and the potential for runoff from the construction site into watercourses It is suggested to use temporary retention basins, geotextile membranes, and surface drainage ditches (such as swales) to direct runoff in order to prevent accidental spills into the network of streams or surrounding agricultural lands.
Precipitation	**Drought**	L	H		Drought may influence agricultural lands and introduce risks to natural heritage.	It is suggested to communicate the risk with the indigenous communities, especially farmers, and train them on how to be prepared for possible droughts.
Temperature	**Hot temperature & Heatwave** **Diurnal variation**	M	H	M	A heatwave can cause heat stress, especially for vulnerable populations e.g. seniors.	It is recommended to communicate the risks and mitigative measures for a heatwave with the communities using flyers, pamphlets, municipal websites, etc. If applicable, the communities are encouraged to stay cool at local cooling stations such as community centers.
Wind	**Heavy wind** **Blowing rain** **Blowing snow**	M	H	M	Blowing rains and snow can reduce visibility significantly and cause a variety of accidents.	
Humidity	**Relative humidity** **Fog**	L	M	L	Not applicable	Not applicable

4. Sensitive Receptors and Resources

Populations nearest to transportation related emissions are at a disproportionate risk of exposure to traffic related air pollution. The climate resilience assessment considers all project components listed in **Table 4-1** to be potential sensitive receptors because they are siting residences within 115 m from the Study Area (i.e., potentially impacted by climate change and air pollution related to traffic activities).

Table 4-1: Local Sensitive Receptors

Receptor ID	Sensitive vs. Critical Receptor	Receptor Description	Address	UTM Coordinates	
SR8	Sensitive	Single-unit Dwelling	3507 8th Line Bradford, ON L3Z 2A4	609726	4885194
SR10	Sensitive	Single-unit Dwelling	3172 8th Line Bradford, ON L3Z 2A5	611240	4885881
SR12	Sensitive	Single-unit Dwelling	3538 8th Line Bradford, ON L3Z 2A5	609454	4885524
SR13	Sensitive	Single-unit Dwelling	3412 8th Line Bradford, ON L3Z 2A5	610037	4885745
SR18	Sensitive	Single-unit Dwelling	3630 9th Line Bradford, ON L3Z 2A5	608858	4886534
SR19	Sensitive	Single-unit Dwelling	3568 9th Line Bradford, ON L3Z 2A5	609142	4886659
SR20	Sensitive	Single-unit Dwelling	3521 9th Line Bradford, ON L3Z 2A5	609443	4886346
SR21	Sensitive	Single-unit Dwelling	3500 9th Line Bradford, ON L3Z 2A5	609505.25	4886740.69
SR22	Sensitive	Single-unit Dwelling	3453 9th Line Bradford, ON L3Z 2A5	609728.94	4886624.69
SR25	Sensitive	Single-unit Dwelling	3287 9th Line Bradford, ON L3Z 3S4	610542	4886673
SR48	Sensitive	Single-unit Dwelling	3236 10 Sideroad Bradford, ON L3Z 2A5	611355	4887075
SR60	Sensitive	Single-unit Dwelling	2942 Yonge St Bradford, ON L3Z 2A5	614373.84	4887694.32
SR63	Sensitive	Single-unit Dwelling	3173 10 Sideroad Bradford, ON L3Z 2A5	611506	4886802
SR64	Sensitive	Single-unit Dwelling	3163 10 Sideroad Bradford, ON L3Z 2A5	611737	4886741
SR65	Sensitive	Single-unit Dwelling	2944 8th Line Bradford, ON L3Z 2A5	612322	4886233
SR66	Sensitive	Single-unit Dwelling	468 Summerlyn Trail Bradford, ON L3Z 2A5	612733	4886286
SR67	Sensitive	Single-unit Dwelling	48 Geddes St Bradford, ON L3Z 2A5	612634	4886733
SR68	Sensitive	Single-unit Dwelling	114 Gosnel Cir Bradford, ON L3Z 2A5	612968	4886433

Receptor ID	Sensitive vs. Critical Receptor	Receptor Description	Address	UTM Coordinates	
SR71	Sensitive	Single-unit Dwelling	107 Chelsea Crescent Bradford, ON L3Z 3J6	613860	4887141
SR75	Sensitive	Single-unit Dwelling	35 Meadowview Dr Bradford, ON L3Z 3J4	614398	4887197
SR76	Sensitive	Single-unit Dwelling	3 Turner Ct Bradford, ON L3Z 2W3	614749	4886951
SR77	Sensitive	Single-unit Dwelling	2362 8th Line Bradford, ON L3Z 3G3	615099	4887134
SR92	Sensitive	Single-unit Dwelling	50 Hochreiter Rd King, ON L9N 1P6	617694	4887952
SR97	Sensitive	Single-unit Dwelling	110 Oak Ave, East Gwillimbury, ON L9N 1A3	619025	4887676
SR100	Sensitive	Single-unit Dwelling	61 Morgan's Rd, East Gwillimbury, ON L9N 1A7	619516	4887929
SR102	Sensitive	Single-unit Dwelling	20822 Yonge St East Gwillimbury, ON L9N 0J8	619912	4888008
SR103	Sensitive	Single-unit Dwelling	20901 Yonge St East Gwillimbury, ON L9N 0J6	619937	4888244
SR104	Sensitive	Single-unit Dwelling	20958 Yonge St, East Gwillimbury, ON L9N 0J8	619796	4888404
SR107	Sensitive	Single-unit Dwelling	20989 Yonge S East Gwillimbury, ON L9N 0J6	620228	4888549
SR111	Sensitive	Single-unit Dwelling	20792 2nd Concession Rd East Gwillimbury, ON L9N 1N6	621762	4888544
SR112	Sensitive	Single-unit Dwelling	20967 2nd Concession Rd East Gwillimbury, ON L9N 0K1	621792	4889020
SR113	Sensitive	Single-unit Dwelling	21153 2nd Concession Rd East Gwillimbury, ON L9N 0K1	621697	4889528
SR116	Sensitive	Single-unit Dwelling	1193 Holborn Rd, East Gwillimbury, ON L0G 1R0	622746	4890017

Receptor ID	Sensitive vs. Critical Receptor	Receptor Description	Address	UTM Coordinates	
SR140	Sensitive	Single-unit Dwelling	21014 Leslie St East Gwillimbury, ON L0G 1R0	623634	4889787
SR141	Sensitive	Single-unit Dwelling	21035 Leslie St East Gwillimbury, ON L0G 1R0	623694	4889896
SR142	Sensitive	Single-unit Dwelling	21145 Leslie St East Gwillimbury, ON L0G 1R0	623636	4890198
SR143	Sensitive	Single-unit Dwelling	21226 Leslie St East Gwillimbury, ON L0G 1R0	623514	4890367
SR144	Sensitive	Single-unit Dwelling	1737 Holborn Rd East Gwillimbury, ON L0G 1R0	624253	4890643

5. Summary of Environmental Commitments

5.1 2002 Approved Environmental Assessment Commitments

The 2002 Approved Environmental Assessment did not consider Climate Change as a factor of environmental investigation at the time it was prepared. Therefore, no proposed mitigation measures or commitments relating to climate change were identified to be carried forward. As per the request of MECP in September 2020, the Project Team has undertaken this qualitative Climate Change Assessment for the project during Preliminary Design and has flagged proposed mitigation measures and recommended commitments to future work. These items are outlined in Section 5.2 below.

5.2 Preliminary Design Commitments

Impacts as a result of climate change, recommended mitigation measures, monitoring activities and commitments have been identified in **Table 5-1** below.

Table 5-1: Summary of Proposed Mitigation Measures, Monitoring Activities and Commitments

ID	Issues / Concerns / Potential Effects	Concerned Agencies	ID	Mitigation, Protection, Monitoring, and Commitments
CC-1.00	**Construction Conditions**: Reduction of natural agricultural land, Embodied carbon management, Paving techniques, Structural work, and Emissions from diesel/gasoline powered vehicles	Ministry of Transportation and Ministry of the Environment, Conservation and Parks	CC-1.01	Limiting the requirement of naturalized land to only that which is required to construct the project, including that which is required to appropriately stage construction. Re-naturalizing (e.g. re-sodding, vegetation, and shrub and tree planting, etc.) of staging areas immediately following construction phase end.
			CC-1.02	Sourcing sustainably manufactured materials (i.e low-carbon concrete) and using recycled materials as opposed to energy-intensive materials such as concrete and asphalt (if feasible).
			CC-1.03	Avoiding the excessive transportation of materials by choosing local/regional materials, as well as materials sources or processed on site.
			CC-1.04	Properly maintaining vehicles and other internal combustion engines used on site (pumps, generators, etc.) to ensure engines are operating as designed with optimal emissions. Minimizing on-site vehicle idling during construction activities and implementing a vehicle maximum idling policy while on site.
			CC-1.05	Use of reclaimed materials in the roadway - aggregate for use in new hot mix asphalt and road base, subbase or shoulders.
			CC-1.06	Use of prefabricated Bridge Elements to improve the efficiency and duration of construction is an option open to the Contractor.
			CC-1.07	Extended life-cycle materials (ASTM 1010 or Corrosion Resistant Steel) to minimize rehabilitation requirements.
			CC-1.08	Precast concrete pavement and rapid set concrete for concrete repairs to minimize congestion.
			CC-1.09	Minimizing double handling of materials and the associated trucks required for hauling is typically desired by contractors to reduce costs, this also has the benefit of reducing fuel requirements and emissions.
			CC-1.10	Retained soil system (RSS) walls or mechanically stabilized earth (MSE) rather than concrete retaining walls.
CC-2.00	**Operating Conditions:** Electrical systems design and ITS Traffic Management	Ministry of Transportation and Ministry of the Environment, Conservation and Parks	CC-2.01	LED Traffic Signal Heads, LED Lighting and Variable Message Signs at the signalized intersections along the Bradford Bypass (10th Sideroad, Yonge Street, 2nd Concession, and Leslie Street).
			CC-2.02	Implementation of HOV lanes on the Bradford Bypass to promote the use of carpooling and avoidance of single-occupant vehicles.
			CC-2.03	Three commuter parking lots are being proposed for 10th Sideroad, 2nd Concession, and Yonge Street interchanges to support carpooling uptake and HOV lane use.
CC-3.00	**Maintenance Conditions:** Emissions from landfilling of any project organic materials, incineration of project materials, or recycling/reuse of project materials may result in temporary increase in associated greenhouse gas releases**.**	Ministry of Transportation and Ministry of the Environment, Conservation and Parks	CC-3.01	Employing a plan for carbon neutral modes of material disposal and/or recycling programs where possible and feasible.
			CC-3.02	Encouraging reuse of available material for future projects to reduce future material production emissions (e.g., recycling of concrete components into new concrete construction).
			CC-3.03	Effective scheduling and resourcing to mitigate and reduce waste.

6. Conclusion

The MECP guidance ‘Considering Climate Change in the Environmental Assessment Process’ outlines that the scoping stage should identify the potential impact of the project on the receiving environment, the sensitivity of this environment, and take into account how this project will be affected by a changing climate. As per this guideline, qualitative climate change assessment for these aspects was conducted i.e., climate change mitigation and climate change adaptation (resilience assessment).

From the qualitative climate change mitigation assessment undertaken for the project, there are several mitigation options which may be employed during the construction, operation, and maintenance phases of the project’s life span which could reduce the project’s impact on climate change, as per **Table 2-3**.

For the qualitative climate change resilience assessment, the potential impacts climate change will have on various components and elements of the project were analyzed. To this end, twelve (12) climate indicators were grouped into four themes – temperature, precipitation, wind, and humidity. While analyzing the interactions between climate change represented by these indicators and the list of project components, it was found that certain climate variables introduce high risk levels to the project. While most interactions between the project components and climate change are low and moderate, higher risks originate from hot days and extreme winds. To increase the resilience of the project, adaptation measures for both moderate-risk and high-risk interactions are offered in **Table 3-11**. These measures pertain to both the construction phase of the Bradford (Highway 400 – Highway 404 Link) Bypass as well as the operations phase. It is suggested this document be referenced by the Detail Design and Contractor Teams to provide recommended guidance on best practices for climate change mitigation and adaptation for all phases of the project. Potential impacts, proposed mitigation and proposed adaptation measures are outlined in **Section 2.6** and **3.5.4** of this Report, which include recommended measures to be implemented for the project as well as measures to be considered as part of the overall Bradford Bypass project.

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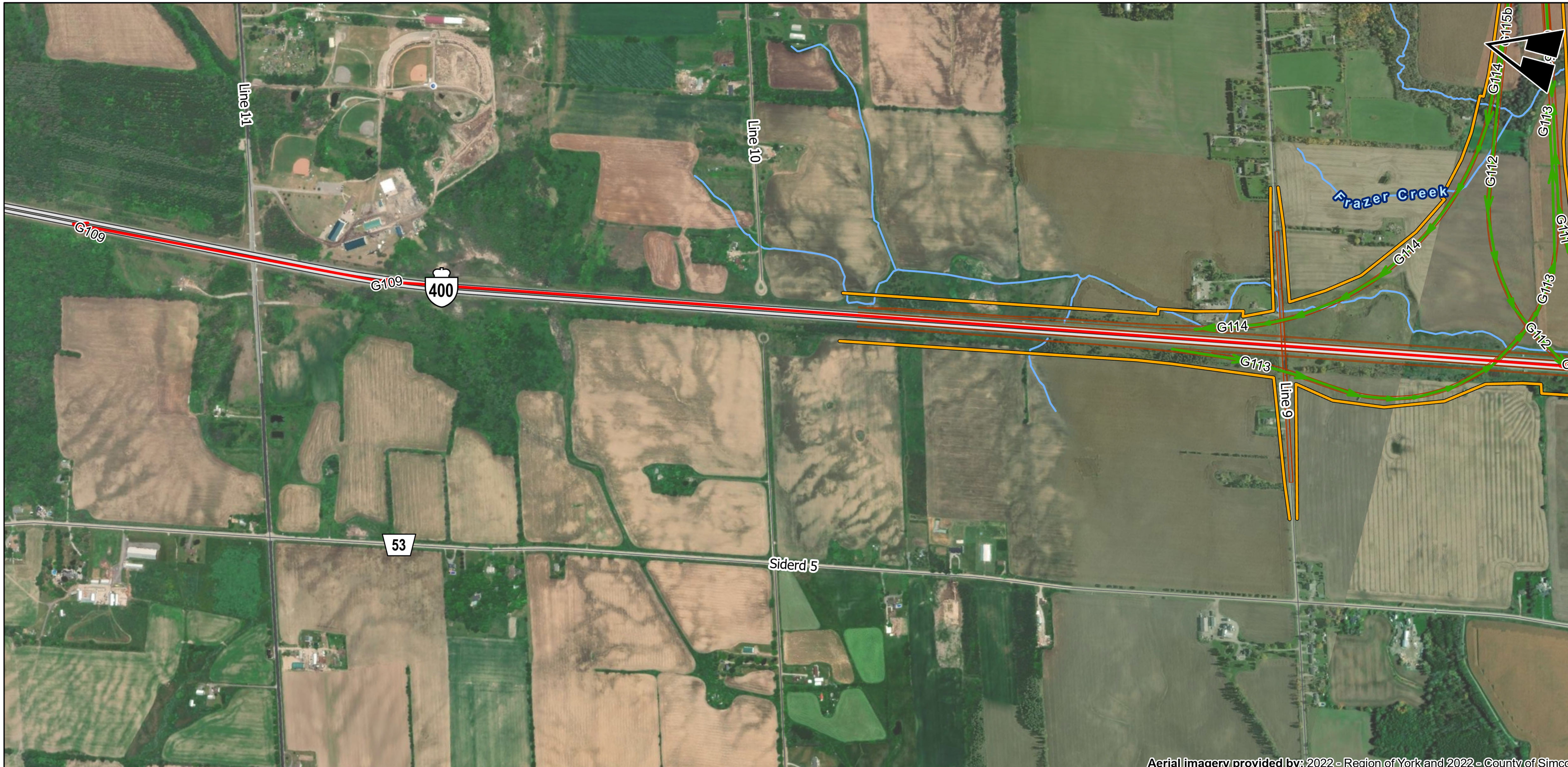
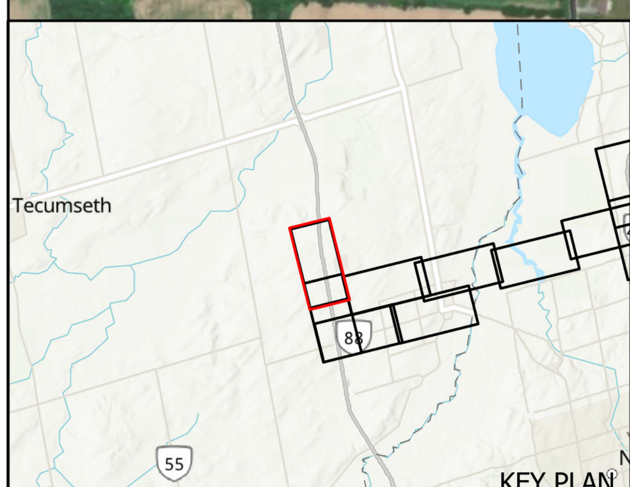
Appendix A

Traffic Sources





LEGEND

- Bradford Bypass Preliminary Design
- Bradford Bypass/Detail Design (by Others)
- Separate MTO EA Study

2041 A.A.D.T. - With the Bradford Bypass

- Low
- Medium
- High

General Features

- Municipal Boundary
- Railway
- Provincial Highway
- Other Road
- Watercourse

0 100 200 400 600
Meters

Highway 400- Highway 404 Link (The Bradford Bypass) Assignment No. 2019-E-0048

Traffic Sources

Figure 2-1

Datum: NAD 1983 UTM Zone 17N
Source: MTO, Town of Bradford West Gwillimbury, Town of East Gwillimbury, Municipality of Vaughan, Region of York, Region of Simcoe
Scale: 1:10,000

Feb, 2023

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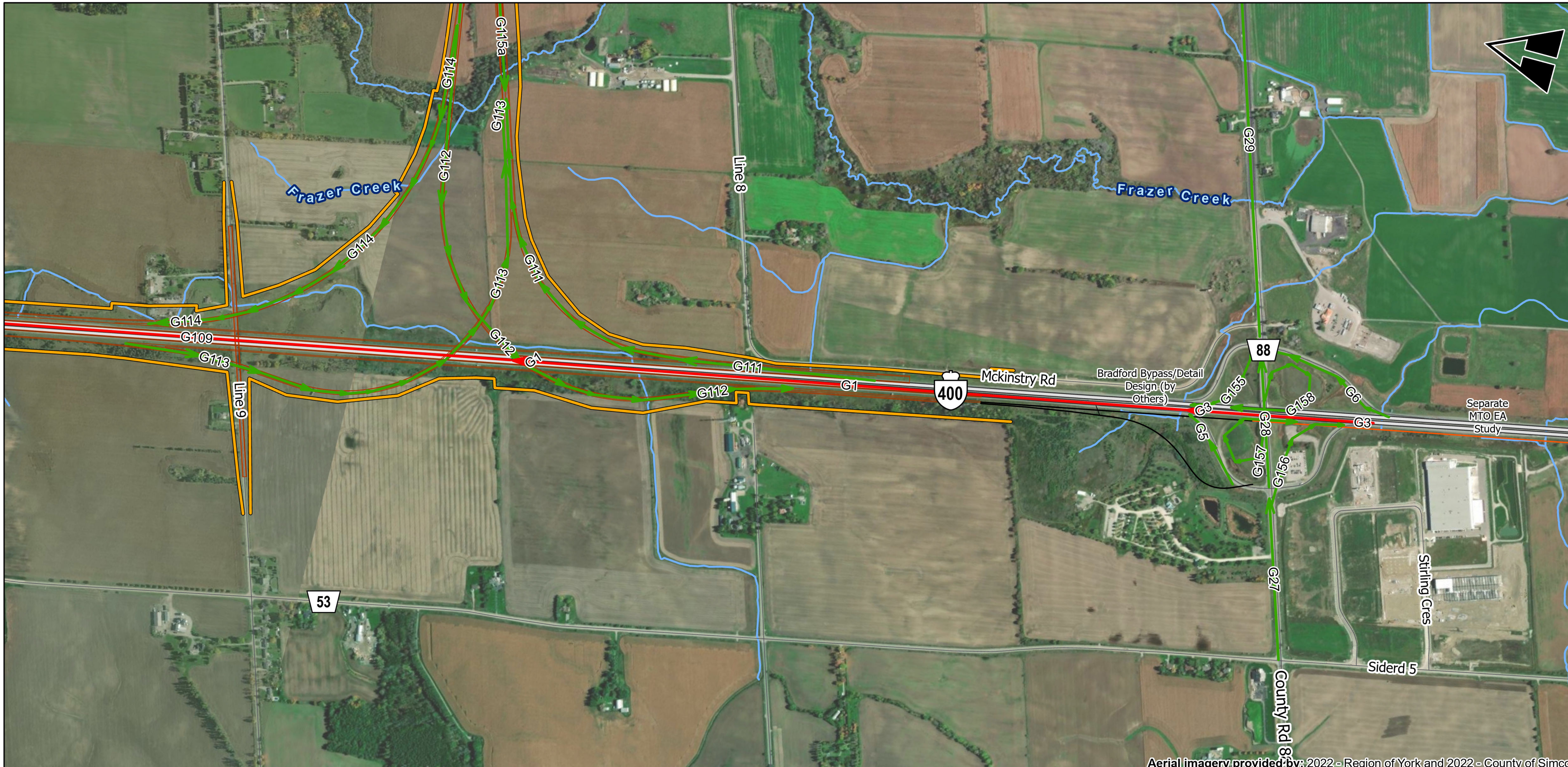

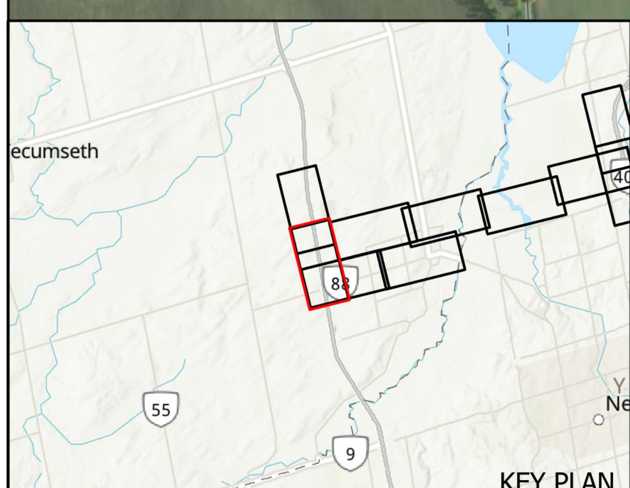

LEGEND

Bradford Bypass Preliminary Design
Bradford Bypass/Detail Design (by Others)
Separate MTO EA Study

2041 A.A.D.T. - With the Bradford Bypass

Low
Medium
High

General Features

Municipal Boundary
Railway
Provincial Highway
Other Road
Watercourse

0 100 200 400 600
Meters

Highway 400- Highway 404 Link (The Bradford Bypass) Assignment No. 2019-E-0048

Traffic Sources

Figure 2-2

Datum: NAD 1983 UTM Zone 17N
Source: MTO, Town of Bradford West Gwillimbury, Town of East Gwillimbury, Municipality of Vaughan, Region of York, Region of Simcoe
Scale: 1:10,000

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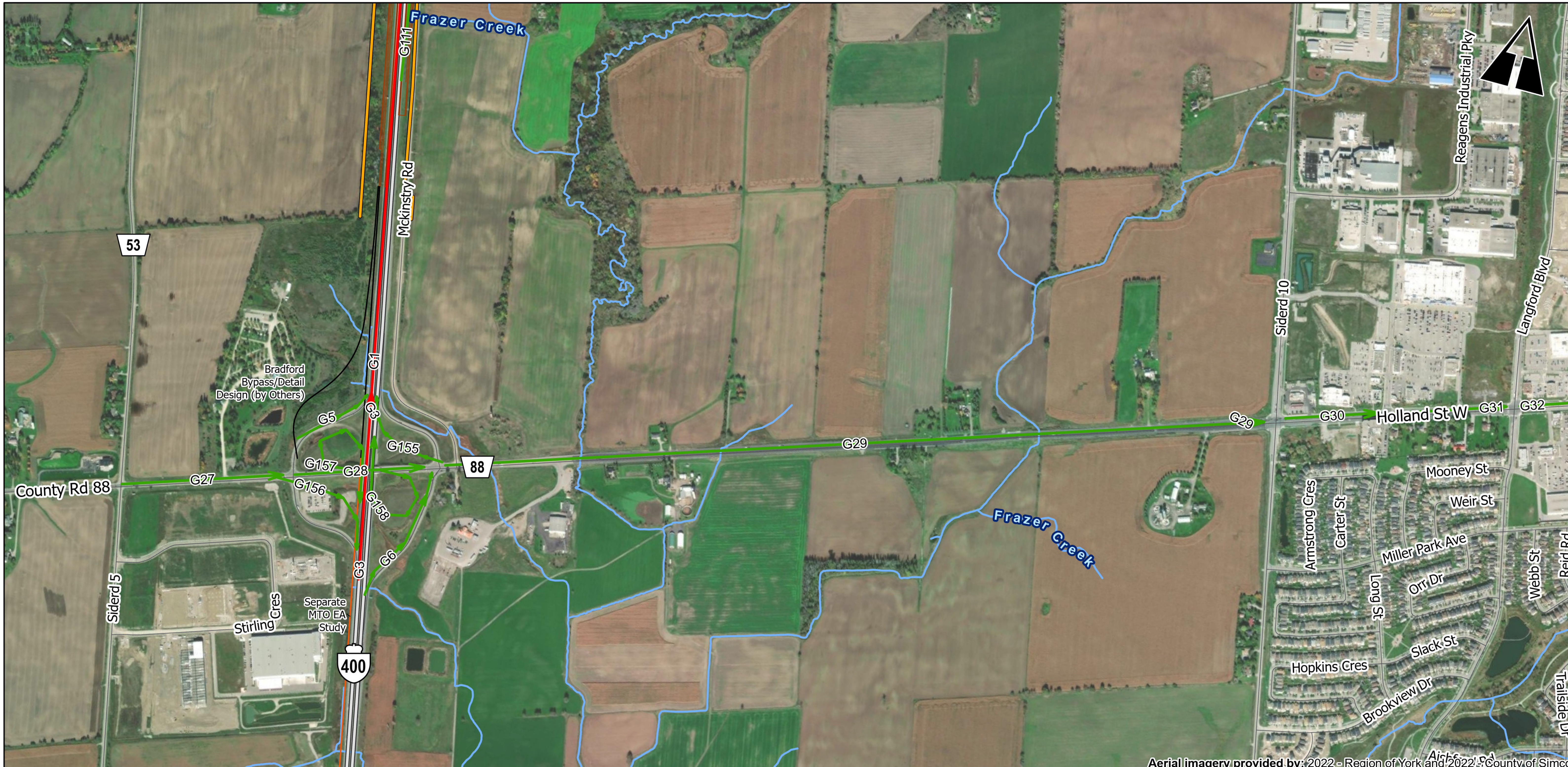

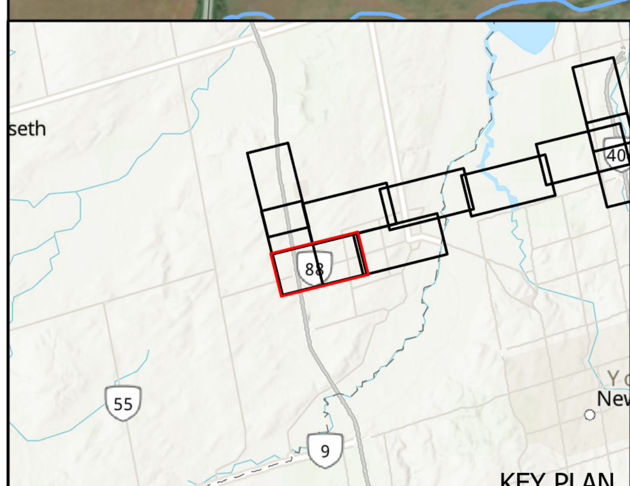

LEGEND

- Bradford Bypass Preliminary Design
- Bradford Bypass/Detail Design (by Others)
- Separate MTO EA Study

2041 A.A.D.T. - With the Bradford Bypass

- Low
- Medium
- High

General Features

- Municipal Boundary
- Railway
- Provincial Highway
- Other Road
- Watercourse

0 100 200 400 600
Meters

Highway 400- Highway 404 Link (The Bradford Bypass) Assignment No. 2019-E-0048

Traffic Sources	**Figure 2-3**
Datum: NAD 1983 UTM Zone 17N Source: MTO, Town of Bradford West Gwillimbury, Town of East Gwillimbury, Municipality of Vaughan, Region of York, Region of Simcoe Scale: 1:10,000	Feb, 2023 AECOM

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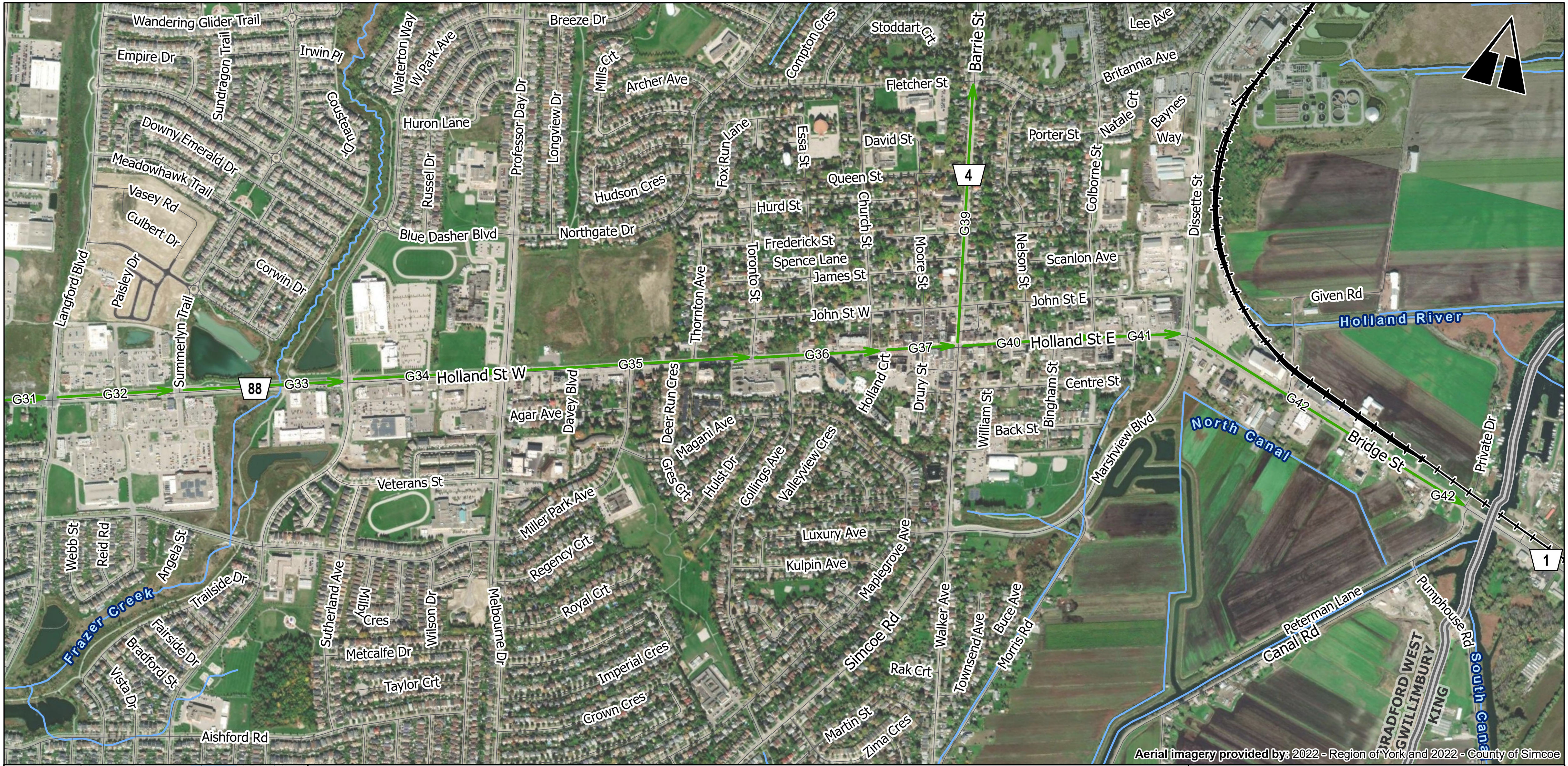

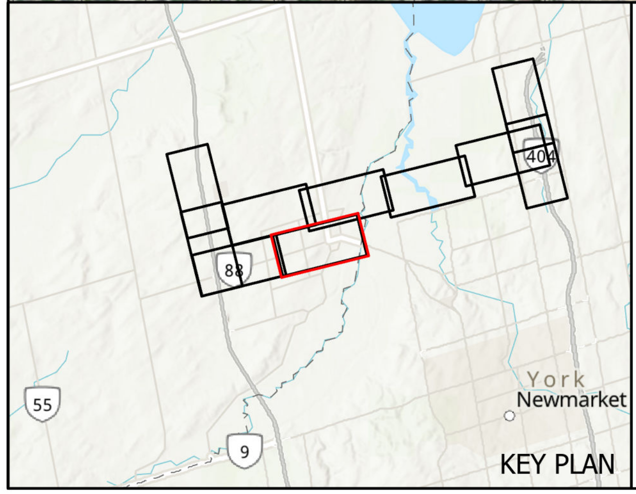

LEGEND

- Bradford Bypass Preliminary Design
- Bradford Bypass/Detail Design (by Others)
- Separate MTO EA Study

2041 A.A.D.T. - With the Bradford Bypass

- Low
- Medium
- High

General Features

- Municipal Boundary
- Railway
- Provincial Highway
- Other Road
- Watercourse

0 100 200 400 600
Meters

Highway 400- Highway 404 Link (The Bradford Bypass) Assignment No. 2019-E-0048

Traffic Sources	**Figure 2-4**
Datum: NAD 1983 UTM Zone 17N Source: MTO, Town of Bradford West Gwillimbury, Town of East Gwillimbury, Municipality of Vaughan, Region of York, Region of Simcoe Scale: 1:10,000	Feb, 2023
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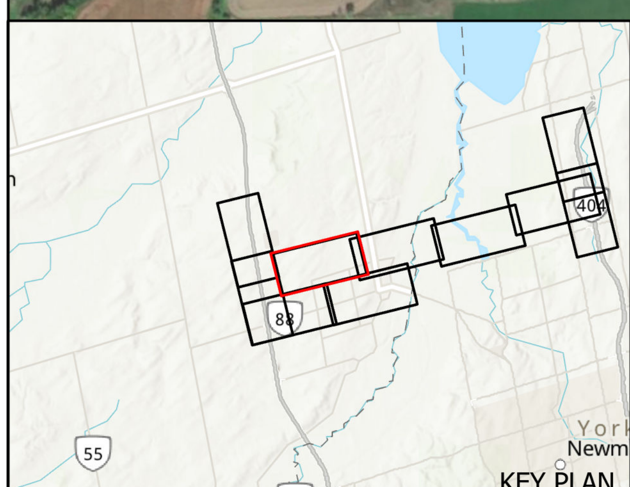

LEGEND

- Bradford Bypass Preliminary Design
- Bradford Bypass/Detail Design (by Others)
- Separate MTO EA Study

2041 A.A.D.T. - With the Bradford Bypass

- Low
- Medium
- High

General Features

- Municipal Boundary
- Railway
- Provincial Highway
- Other Road
- Watercourse

0 100 200 400 600

Meters

Highway 400- Highway 404 Link (The Bradford Bypass) Assignment No. 2019-E-0048

Traffic Sources

Figure 2-5

Datum: NAD 1983 UTM Zone 17N
Source: MTO, Town of Bradford West Gwillimbury, Town of East Gwillimbury, Municipality of Vaughan, Region of York, Region of Simcoe
Scale: 1:10,000

Feb, 2023

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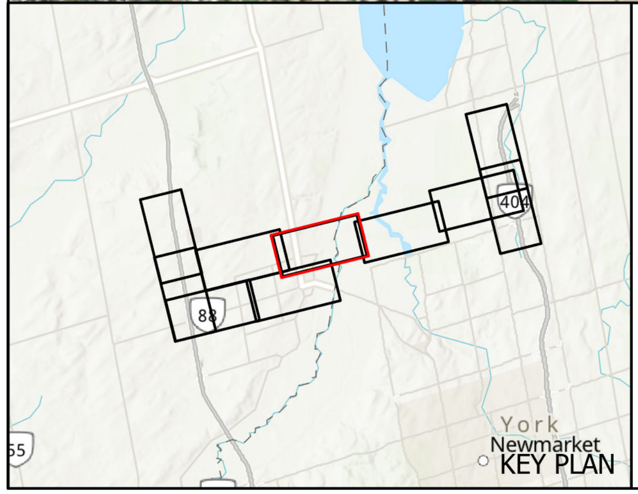

LEGEND

Bradford Bypass Preliminary Design
Bradford Bypass/Detail Design (by Others)
Separate MTO EA Study

2041 A.A.D.T. - With the Bradford Bypass

Low
Medium
High

General Features

Municipal Boundary
Railway
Provincial Highway
Other Road
Watercourse

0 100 200 400 600
Meters

Highway 400- Highway 404 Link (The Bradford Bypass) Assignment No. 2019-E-0048

Traffic Sources

Figure 2-6

Datum: NAD 1983 UTM Zone 17N
Source: MTO, Town of Bradford West Gwillimbury, Town of East Gwillimbury, Municipality of Vaughan, Region of York, Region of Simcoe
Scale: 1:10,000

Feb, 2023

AECOM

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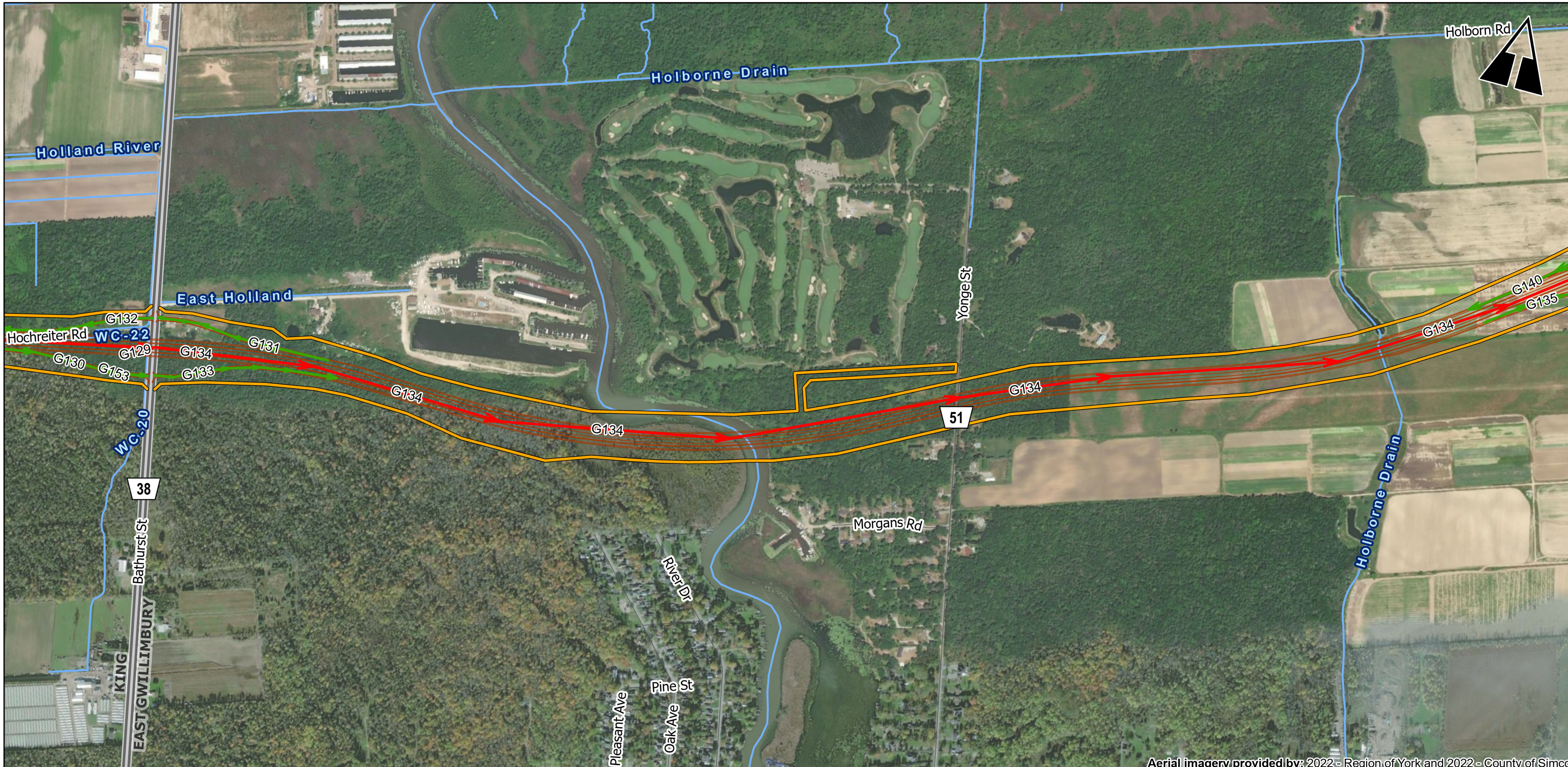

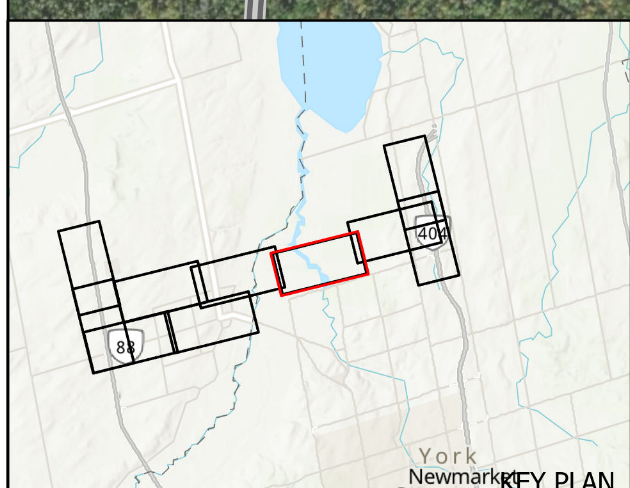

LEGEND

- Bradford Bypass Preliminary Design
- Bradford Bypass/Detail Design (by Others)
- Separate MTO EA Study

2041 A.A.D.T. - With the Bradford Bypass

- Low
- Medium
- High

General Features

- Municipal Boundary
- Railway
- Provincial Highway
- Other Road
- Watercourse

0 100 200 400 600
Meters

Highway 400- Highway 404 Link (The Bradford Bypass) Assignment No. 2019-E-0048

Traffic Sources

Figure 2-7

Datum: NAD 1983 UTM Zone 17N
Source: MTO, Town of Bradford West Gwillimbury, Town of East Gwillimbury, Municipality of Vaughan, Region of York, Region of Simcoe
Scale: 1:10,000

Feb, 2023

AECOM

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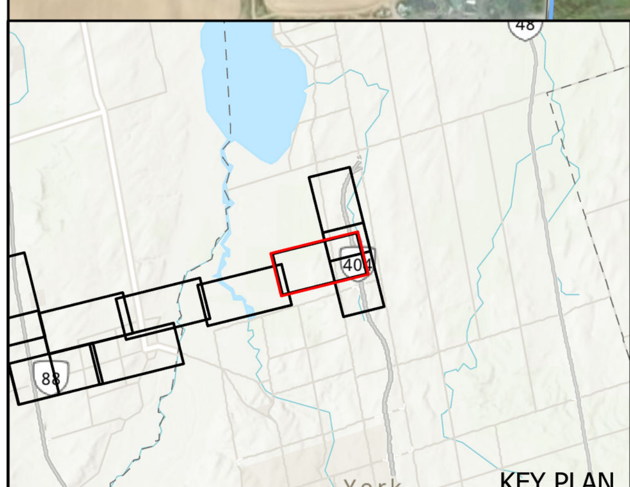

LEGEND

- Bradford Bypass Preliminary Design
- Bradford Bypass/Detail Design (by Others)
- Separate MTO EA Study

2041 A.A.D.T. - With the Bradford Bypass

- Low
- Medium
- High

General Features

- Municipal Boundary
- Railway
- Provincial Highway
- Other Road
- Watercourse

0 100 200 400 600
Meters

Highway 400- Highway 404 Link (The Bradford Bypass) Assignment No. 2019-E-0048

Traffic Sources

Figure 2-8

Datum: NAD 1983 UTM Zone 17N
Source: MTO, Town of Bradford West Gwillimbury, Town of East Gwillimbury, Municipality of Vaughan, Region of York, Region of Simcoe
Scale: 1:10,000

Feb, 2023

AECOM

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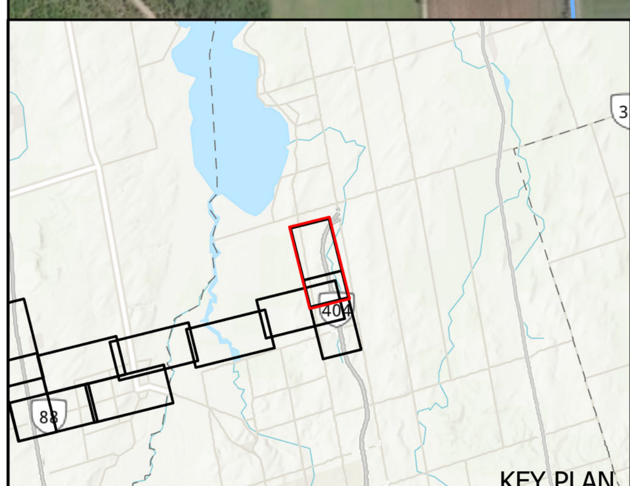

LEGEND

- Bradford Bypass Preliminary Design
- Bradford Bypass/Detail Design (by Others)
- Separate MTO EA Study

2041 A.A.D.T. - With the Bradford Bypass

- Low
- Medium
- High

General Features

- Municipal Boundary
- Railway
- Provincial Highway
- Other Road
- Watercourse

0 100 200 400 600
Meters

Highway 400- Highway 404 Link (The Bradford Bypass) Assignment No. 2019-E-0048	
Traffic Sources	Figure 2-9
Datum: NAD 1983 UTM Zone 17N Source: MTO, Town of Bradford West Gwillimbury, Town of East Gwillimbury, Municipality of Vaughan, Region of York, Region of Simcoe Scale: 1:10,000	Feb, 2023 AECOM

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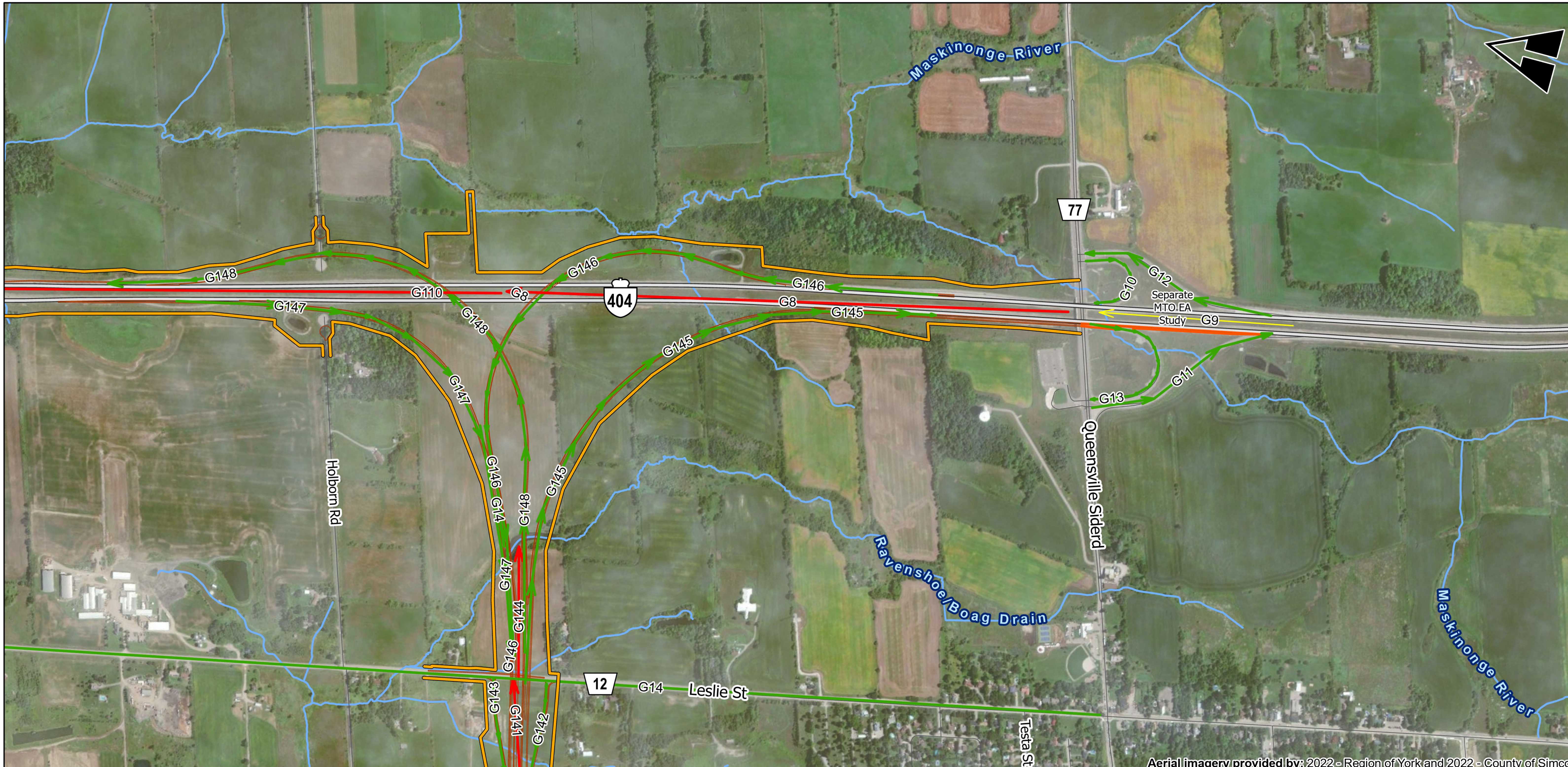

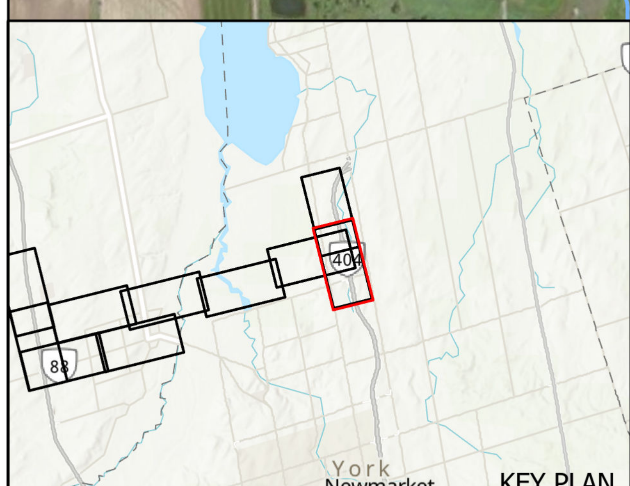

LEGEND

- Bradford Bypass Preliminary Design
- Bradford Bypass/Detail Design (by Others)
- Separate MTO EA Study

2041 A.A.D.T. - With the Bradford Bypass

- Low
- Medium
- High

General Features

- Municipal Boundary
- Railway
- Provincial Highway
- Other Road
- Watercourse

0 100 200 400 600
Meters

Highway 400- Highway 404 Link (The Bradford Bypass) Assignment No. 2019-E-0048

Traffic Sources

Figure 2-10

Datum: NAD 1983 UTM Zone 17N
Source: MTO, Town of Bradford West Gwillimbury, Town of East Gwillimbury, Municipality of Vaughan, Region of York, Region of Simcoe
Scale: 1:10,000

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AECOM Canada Ltd.
105 Commerce Valley Drive West, 7th Floor
Markham, ON L3T 7W3
Canada

T: 905.886.7022
F: 905.538.8076
www.aecom.com