MORRISON HERSHFIELD

FINAL REPORT

Red Hill Valley & Lincoln Alexander Parkways – Feasibility Study

Presented to:

City of Hamilton

Report No. 201936600
September 2023

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

APPENDICES

1. INTRODUCTION & BACKGROUND

1.1 Introduction

The City of Hamilton has engaged Morrison Hershfield Ltd. to complete a comprehensive Feasibility Study for the Red Hill Valley Parkway (RHVP) and the Lincoln M. Alexander Parkway (LINC). This feasibility study will address the long-term needs of the RHVP and the LINC while fulfilling the requirements for Phase 1 and establish conditions to complete Phase 2 as prescribed in the Municipal Class Environmental Assessment (MCEA) process. The goal of this study is to identify the existing challenges and issues relating to the current operation of both the RHVP and the LINC while addressing the implementation of potential future widening and connections with Highway 403 and Queen Elizabeth Way (QEW), goods movement, transit opportunities, and safety enhancements.

1.2 Feasibility Study Area & Scope

1.2.1 Project Area

The Project Area is located in the City of Hamilton and consists of the RHVP, a 6 km long road, and the LINC, a 12.5 km long road, as well as the surrounding areas. Together, these roadways serve as a southern bypass of downtown Hamilton, connecting the QEW in the northeast to Highway 403 and in the southwest.

RHPV and LINC are locally maintained by the City of Hamilton and have a posted speed limit of 80 km/hour. Both roads provide key commuter routes for the movement of people and goods within and across the City of Hamilton. Figure 1 displays the location of the Project. The pavement condition of both the LINC and RHVP is considered poor after approximately two decades of operation, and rehabilitating the roadways is anticipated to cost in the tens of millions of dollars once additional engineering studies and construction are complete.

The two roadways are largely within the Red Hill Creek Valley and Red Hill Creek Watershed, which drains an area of approximately 6,400 hectares. As such, environmental features are most pronounced within the RHVP segment which is a sensitive environmental setting; much of the Red Hill Valley is designated as an Environmentally Significant Area (ESA) comprising a wide range of vegetation communities which provide habitat for wildlife (including breeding birds), thus serving as an important ecological linkage, facilitating the movement of wildlife.

The Red Hill Creek was extensively cleared after European settlement. Past land uses, surrounding urbanization, and infrastructure in the Valley have degraded habitats and reduced the ability of the corridor to maintain its biological diversity and ecosystem functions. These extensive changes to the landscape have also impacted cultural resources. A large majority of the land area within Hamilton’s urban boundary is considered to have archaeological potential, but all the sites documented to date have been compromised to some extent by past human intervention.

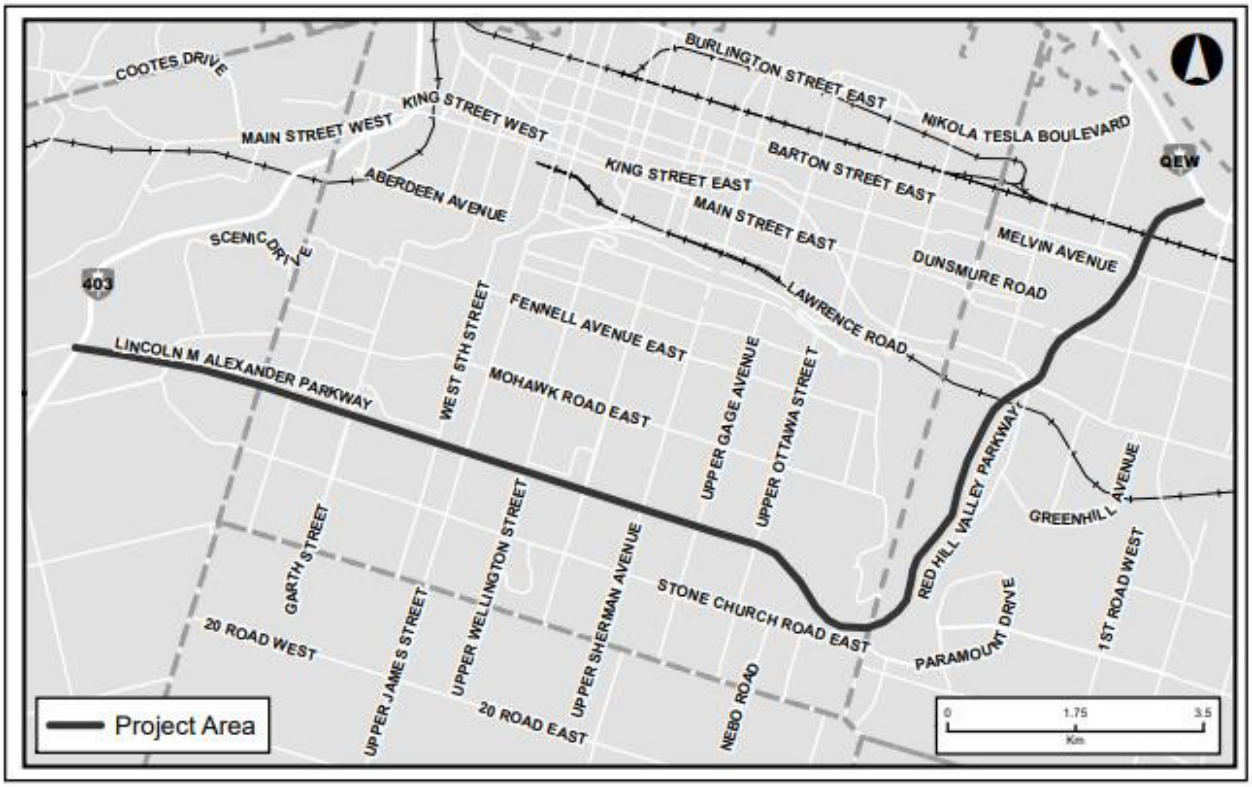


Figure 1: Project Area

Economically, Hamilton's strategic location at the western end of Lake Ontario, mid-way between Toronto and the Canada-USA border, affords the City many advantages. This location at the head of the lake has allowed the City to develop a strong industrial base centered on Hamilton Harbour. That said, an aging population, a declining number of people per household, the effects of the global economy on local companies, increasing pressures on community services, and urban pressure on rural resources will result in physical, economic, and social change. To help the community prepare for this change, the City has emphasized developing strong communities, which are defined as communities that are complete, healthy, diverse, and vibrant.

Finally, the City of Hamilton has a unique and valuable mix of the four key transportation modes (highway, rail, marine and air) due to geographic location and proximity to large commercial markets. Therefore, the design, creation, delivery, and maintenance of an efficient and effective mix of transportation modes is essential to the competitiveness of Hamilton's economy and the health, safety and prosperity of its residents and visitors.

1.2.2 Scope

This study identifies and evaluates the feasibility of implementing improvements based on a review of existing conditions, key constraints and challenges within the combined RHVP and LINC corridor. This includes:

- Reviewing existing conditions, key constraints and challenges related to the natural environmental, socio-economic environment, cultural environment, and technical environment within the corridor.
- Conducting transportation analysis of existing and future conditions, including traffic volume, transit services, and active transportation facilities.
- Identifying, evaluating, and recommending practical solutions (alternatives) to address the interim and long-term needs of both the RHVP and LINC.
- Identifying a Preferred Alternative(s) and developing a Functional (Proof of Concept) Design for long-term transportation improvements to both the RHVP and LINC.
- Estimating the cost and develop an implementation plan for the Preferred Alternative(s).
- Identifying next steps (e.g., future Municipal Class Environmental Assessment requirements, detailed engineering studies, permitting, utility requirements, etc.).

The findings of the Feasibility Study will guide the scoping and development of the framework for a future MCEA study. The MCEA is an approved Class EA process that applies to municipal infrastructure projects including roads, water, and wastewater. The MCEA outlines a comprehensive planning process as follows and will be required to be completed for the RHVP and LINC project.

- **Phase 1:** Identify Problem and/or Opportunity
- **Phase 2:** Identification of Alternative Solutions
- **Phase 3:** Examine Alternative Design Concepts for the Preferred Solution
- **Phase 4:** Prepare and File Environmental Study Report
- **Phase 5:** Implementation

This Study encompasses the technical portion of Phases 1 and 2 of the Class EA process. In order to complete Phase 2 as part of the official MCEA process, public and stakeholder consultation on these phases will be required. Phases 3 through 4 will follow this study to complete the MCEA and ultimately to Phase 5 for detailed design, construction, and operation.

1.3 Project Background & Previous Studies

The Red Hill Valley Project was implemented over various stages which included planning, design, and construction between 1956 and 2007. In 1982 the former Region of Hamilton-Wentworth (now the City of Hamilton) submitted a provincial EA which documented the need, scope, and timing to expand its regional road network. The EA identified a need for a roadway to connect Highway 403 in Ancaster to the QEW in the eastern portion of Hamilton. The roadway consisted of an East-West section, now called the LINC, and a North-South valley section, now called the RHVP. The Ontario Municipal Board and the Environmental

Assessment Board approved the project in 1985, with endorsement by Provincial Cabinet in 1987.

Construction of the LINC was completed in 1997. Construction of the RHVP began in 1990, but was only partially completed and resumed in the early 2000s and was completed in 2007, including connection to the QEW by the Ontario Ministry of Transportation (MTO).

1.3.1 Indigenous Partnerships and the Joint Stewardship Board

In 2002 the City of Hamilton and the Six Nations community came together through agreements intended to preserve the Haudenosaunee interest in the Red Hill Valley with the onset of the construction for the RHVP. All parties agreed on the nature of each of their responsibilities and about how those responsibilities will be fulfilled. The agreements reflect those objectives, and represent an expression of cooperation, respect, and good faith, intended to govern the conduct of the Parties in their work together. The Agreements speak to the issues of:

- Archaeology and Burials,
- Joint Stewardship of Red Hill Valley,
- Hunting, Fishing, Gathering, and Trapping,
- Medicine Plants,
- Tolling Human Heritage, and
- Economic Opportunities.

In 2005, an Implementation Plan was developed and finalized, signaling the ratification of the Haudenosaunee - Hamilton Red Hill Agreements. The Sub-Agreement on Joint Stewardship of the Red Hill Valley provides that the Haudenosaunee and Hamilton will work together to help ensure that any future work in the Valley is responsive to the needs of both parties, and ultimately focused on the principles of sustainability. Under this Joint Stewardship Agreement, the Joint Stewardship Board was formed. Comprised of equal representation from the City of Hamilton and the Haudenosaunee, it is the Board's responsibility to ensure cooperation and successful continuation of the environmental management plans for the Red Hill Valley. Further, it is the Board's responsibility to create a Master Plan for the Valley that can be considered and approved by both Councils, and after that, to serve as a first forum of joint thought and consideration about any changes or developments in the Valley.

The Master Plan adopted the principle that, with respect to any permitted development in the Valley, there should be no net loss of wildlife habitat, wetlands, or populations of indigenous species. The Valley's ecosystem and urban environment will change over time, and the Master Plan provided for sustained monitoring of the changes and the flexibility to adapt to accomplish its objectives. The Master Plan was divided into two parts. The first part was specific to the initial construction of the RHVP, and the second set out long-term values and objectives of the Parties in the Valley. Integral to the Master Plan was inclusion of a continually developing program to communicate the Parties' values in conservation, environmental restoration and remediation, and long-term thinking about the ecosystem, to visitors to the Valley and to the population of the Haudenosaunee and Hamilton in general.

Finally, the Board also has the authority to review any changes to the parkway in the future. The vision of the Board is to facilitate a deeper connection to the cultural landscape of the Red Hill Valley watershed to promote human and environmental well-being, with the following primary objectives:

- Acknowledge and honor ancestral experiences,
- Provide a link between the Haudenosaunee and Hamilton residents,
- Enlighten the access to the Valley for all,
- Protect and enhance the ecosystem and the environment,
- Understand human impacts in the Red Hill Valley ecosystem, and
- Capitalize on economic opportunities without compromising the ecological integrity of the Red Hill Valley.

Any proposed changes in the use of any land in the Valley, or an activity or use of land in the Valley that could affect the Valley's ecosystem or other aspects of the Valley covered by this Agreement, require an application to be made to the Board for authorization of such activity, use or change of use. This requirement includes if the City of Hamilton proposes to add to the paved portion of the RHVP or make any substantial changes to the RHVP after its initial construction. In arriving at each of their decisions, the members of the Board will weigh and consider the following:

- The impact of their decision on the natural world and on the Valley ecosystem,
- The impact of their decision on future generations,
- The impact of their decision on the relations between the Parties,
- Every written Board decision will include an explanation of how each of the above factors was taken into account in arriving at the decision, and
- The social and economic needs of each of the Parties.

1.3.2 Previous Studies

Listed below are the recent applicable studies and plans that have discussed the need for improvements along the RHVP and LINC, which will support the feasibility study and options analysis going forward.

RHVP Impact Assessment and Design Process Report (2003)

In 2003, the City of Hamilton prepared an Impact Assessment and Design Process report of the RHVP as a condition of approval from the Ministry of Environment. The report provided an overview of the design and construction measures for the north-south section of the RHVP. This EA detailed associated expressway design refinements, assessment of impacts, and impact prediction/mitigation. It included information on the existing natural and socio-cultural features that would be affected by the Red Hill Valley Project. The report also outlined all the mitigation, monitoring, maintenance, and contingency that must be in place prior to construction of any particular part of this project.

City of Hamilton Transportation Master Plan Review and Update (2018)

The 2018 Transportation Master Plan (TMP) Review and Update is a comprehensive review and update of the 2007 TMP that continues to plan and build for the 2031 planning horizon and beyond. It is a strategic planning framework that provides direction for future transportation-related studies, projects, initiatives, and decisions. The TMP is a multi-modal plan addressing all modes including walking, cycling, transit, automobiles, and goods movement.

The TMP Review makes numerous references to LINC and RHVP. The existing conditions 2011 EMME model identifies the RHVP/QEW interchange as one of five areas that present challenges to providing an efficient transportation system. The 2031 Do Nothing AM Peak Hour EMME model identifies LINC access and the Highway 403 corridor as problem areas. As part of the identification of strategic transportation system alternatives, the TMP identified the significance of widening LINC and RHVP to six lanes, but did not recommend the widenings and other improvements as part of future capital works.

The 2018 TMP Update also flags the capacity improvements to the RHVP/LINC that will be required within the horizon of the TMP (i.e., 2031), with the most critical priorities being the connections at LINC/Highway 403 and RHVP/QEW. Additionally, it recommended that RHVP/LINC are “suitable for a managed lane approach which would seek to maximize capacity through the designation of HOV lanes, queue jump lanes for express buses and approaches such as ramp metering prior to full expansion”. A managed lane approach would support the mode share targets from the TMP, which include a 5% increase in transit mode share and a 15% decrease in single-occupancy vehicles, from the 2011 mode share statistics.

Urban Hamilton Official Plan (2013)

The Official Plan provides direction and guidance on the management of the Hamilton communities, land use changes and physical developments over the next 30 years. The policies of this Plan enable change and transformation, while balancing and respecting the history and culture of Hamilton. The Official Plan recognizes the relationship between the transportation network and its impact on quality of life and economic development potential. It discusses how an improved and efficient transportation network such as the RHVP and LINC are key components of complete communities, creating the vital link between activities and land uses throughout the City. The policies of this Plan, together with the directions and programs from the Transportation Master Plan, will contribute to an overall transportation demand management strategy for the City, which supports a managed lane approach, as identified in the City of Hamilton TMP.

Metrolinx 2041 Regional Transportation Plan (2018)

The Regional Transportation Plan (RTP) identifies numerous projects proposed or already in development as part of Metrolinx’s network in and around the Greater Toronto and Hamilton Area (GTHA). The projects already in delivery or in development around Hamilton include:

- Lakeshore West Two-Way, All-Day GO Service (Aldershot GO – Hamilton GO)

- Extension of the Lakeshore West line from West Harbour Station to Centennial Parkway in Hamilton (opening 2023 or later)
- Hamilton B-Line LRT corridor through downtown Hamilton along Main Street, King Street and Queenston Road, from McMaster University to Eastgate Square (opening 2024)
- Niagara peak period GO Rail Service from Confederation Station in Hamilton to Niagara Falls (opening 2023)

Other proposed projects as part of the RTP are listed below:

- Lakeshore West 15-min GO Service Extension (Aldershot GO – Hamilton GO)
- Hamilton A-Line BRT (West Harbour GO – Rymal Road)
- Hamilton A-Line South Priority Bus (Rymal Road – Hamilton Munro International Airport)
- Hamilton L-Line Priority Bus (Downtown Hamilton – Waterdown)
- Hamilton S-Line Priority Bus (Ancaster Business Park – Confederation GO)
- Hamilton Mohawk T-Line Priority Bus (Centre Mall – Meadowlands Terminal)

As mentioned in the Introduction, this study is intended to explore how transit could be incorporated into improvements associated with the RHVP and LINC. Sections 4.5.1 and 5.1, respectively, identify all existing transit service and all proposed future transit projects in and around Hamilton, and how they may impact or benefit the RHVP and/or LINC.

Niagara to Greater Toronto Area (NGTA) Corridor Planning and Environmental Assessment Study (MTO)

The NGTA study, completed by MTO, included four “Building Blocks”, including: Optimize Existing Networks, New/Expanded Non-Road Infrastructure, Widen/Improve Roads, and New Transportation Corridors. The study indicates that the transportation network in the study area will be sufficient up to 2031, however beyond 2031 it will likely be over capacity. A future transportation study is also recommended to determine how to meet long term needs. As a follow-up to this study, City of Hamilton staff proposed that a new corridor from the Niagara area through Hamilton linking to the GTA West area should be identified as part of the Transportation Development Strategy recommendations and not pushed off to another future study. The preferred corridor identified by the City of Hamilton would include operational improvements along Highway 403 through Hamilton and Highway 6 south of Highway 401. Improvements to this corridor may divert some traffic away from the existing QEW, including the interchange of RHVP and QEW.

City of Hamilton Cycling Master Plan Review and Update (2018)

The Cycling Master Plan Review is an update to the city-wide Transportation Master Plan, intended to accommodate for recent growth and plan for building healthy and safe communities, a sustainable and balanced transportation system, and maintaining and improving overall quality of life. Within this framework of overarching goals, the plan update proposes several enhancements and refinements. This updated plan includes the expansion of the multi-use trail network to support cycling over Highway 403, the QEW, the LINC and along the upper RHVP,

acknowledging that cycling plays a vital role in the implementation of several policies under Places to Grow, specifically intensification and trip mode share. This plan update acknowledges that the Province places high value on planning and infrastructure options that support mode shift as an important strategy for reducing our impact on climate change and for building healthier, more complete communities. Specific recommendations from the plan that are in close proximity to the RHVP/LINC corridor include bike lanes on King Street over RHVP, bike lanes on Barton Street from RHVP to Lake Avenue, bike lanes or a multi-use trail on Upper Ottawa Street from LINC to Stone Church Road, and improvements to the Red Hill Valley Trail. Implementation of these facilities may allow for shifting of some vehicular trips to cycling trips, as targeted in the City of Hamilton TMP.

City of Hamilton Recreation Trails Master Plan (2016)

The Recreation Trails Master Plan provides a framework for the City to implement a trail network throughout the City. This Plan addressing trails and trail infrastructure and makes recommendations for new connections throughout the City, for both active transportation and recreation geared towards residents and visitors alike. The proposed improvements for the RHVP and LINC will have to take into consideration current and proposed trail infrastructure. Recommendations for transportation infrastructure should be balanced with active transportation and recreation infrastructure in a way that supports mode shift as an important strategy for reducing our impact on climate change and for building healthier, more complete communities. As identified above, it is possible that implementation of new or improved trail facilities may allow for shifting of some vehicular trips to cycling or walking trips, as targeted in the City of Hamilton TMP.

Hamilton LINC and RHVP Speed Study (2018)

The Hamilton LINC and RHVP Speed Study was prepared to identify measures that could improve performance and reduce the number of severe collisions. This report looked to establish a reasonable and safe speed limit on both the LINC and RHVP. The report concluded that the 2018 posted speed limit of 90 km/h for the RHVP and the LINC be maintained.

Roadside Safety Assessment, Red Hill Valley Parkway (2019)

Through planning for scheduling of resurfacing for the RHVP, the City identified the need to complete a roadside safety assessment of the facility, including mainline and all on and off ramps. The main purpose of the study was to provide recommendations to reduce roadside related collision frequency and/or severity by correcting deficiencies and/or upgrading roadside safety devices to current standards. The recommendations included:

- Ensuring the pavement design considers the history of wet surface collisions and investigates the need for higher friction surface.
- Considering installing oversized speed limit signs/speed feedback signs and conducting regular speed enforcement, particularly in the vicinity of the King Street and Queenston Road interchanges.
- Considering installing high-friction pavement on approach and through the curve on the Mud Street E-W On Ramp.

- Considering installing pavement marking text and/or peripheral transverse bars on the Mud Street E-W On Ramp and Upper RHVP W-S Off Ramp.

City of Hamilton's Truck Route Master Plan Update (2022)

The City of Hamilton Truck Route Master Plan Update explored opportunities to provide safe and efficient movement of trucks in Hamilton, support economic activities, minimize negative impacts of truck traffic on sensitive land uses, and balance between the industry and community needs. The update recommended implementation strategies including downtown restrictions that would direct vehicles with five or more axles to alternate routes such as the LINC or RHVP instead of travelling through the downtown. This may result in an increase in heavy vehicular and truck traffic volumes on the LINC and RHVP.

Detailed LINC/RHVP Illumination Review (2019)

The objective of this Illumination Review was to identify the benefits, risks, costs, and challenges of adding continuous lighting along the LINC and RHVP. A comprehensive review and analysis were conducted to identify all contributing factors, including review of background EA documentation, collision and benefit-cost analyses, illumination warrants and review of other similar facilities, human factors, and the environmental impact of lighting. The report notes that the warrant analyses suggest that the RHVP can benefit from continuous illumination, whereas continuing lighting is not warranted for the LINC. However, the current partial illumination is not consistent with other urban highways in Ontario. Furthermore, the presence of artificial lighting at night can have negative effects on wildlife and natural areas, such as the Red Hill Valley, and that such effects should be considered as part of a future study.

Highway 6 South Widening (Highway 403 to Upper James Street)

MTO is updating the Preliminary Design and Class EA Study for Highway 6 South from Highway 403 to Upper James Street. The proposed works will include developing, reviewing, and evaluating alternatives for the widening/twinning of Highway 6 South from two lanes to four lanes as well as interchange and intersection improvements. To accommodate the expansion of Highway 6 south to four lanes, improvements are required at the Highway 403 interchange, Garner Road East, Book Road East, Airport Connection Road and the terminus of Highway 6 at Upper James Street. Any improvements to Highway 6 may have the potential to draw traffic away from the LINC and RHVP corridors.

Mohawk Road Ramp and Highway 403 Truck Climbing Lane

A Brantford-bound ramp from Mohawk Road to Highway 403 was removed when the Highway 403/LINC interchange was constructed, which has left a missing link in access from Ancaster. Due to increasing traffic demands on Wilson Street in the Ancaster core, residents have requested that the Brantford-bound ramp be constructed. While this on-ramp is unlikely to have a large impact on traffic on the LINC and RHVP, as part of this project, a southbound truck climbing lane is also proposed on Highway 403 within the vicinity of the Highway 403/LINC interchange. This truck climbing lane will provide additional capacity on Highway 403 and may provide some relief for the interchange of Highway 403/LINC. The proposed improvements from the plan are shown in the Figure 2 below.

Figure 2: Proposed Ramp at Mohawk Road

2021-2025 Economic Development Action Plan

The City of Hamilton is considered to have one of the most diversified economies in Canada due to its history of innovation, the quality of its labour force, its numerous geographic advantages and the efforts of Hamilton's business community and institutions. A number of economic development priorities have emerged as a result of the urgency of climate change, the importance of diversity, equity and inclusion, and the global pandemic. Relevant to this project is the goal of designing, creating, delivering, and maintaining an efficient and effective mix of transportation modes built with the capacity to handle current and future needs.

Climate Change Impact Adaptation Plan

Hamilton's work on climate change goes back to joining the FCM's Partner's for Climate Protection (PCP) program in 1994; more recently, the City declared a climate emergency in 2019. This adaptation plan represents the City's first effort in pulling together various existing efforts related to climate change and extending them in new ways to address a carefully considered list of priority climate impacts.

The purpose of the Climate Change Impact Adaptation Plan is to continually improve Hamilton's resilience to extreme weather and climate change impacts by increasing local adaptive capacity and decreasing sensitivity to these changes. Building on a vulnerability and risk assessment process, the City developed a list of priority climate change impacts, which included flooding, extreme heat, water quality, health and safety, erosion and infrastructure damage, power outages, and food insecurity. It will be important that future infrastructure projects include

consideration of how to design infrastructure that is resilient to these impacts, but also infrastructure that minimizes negative interactions which can create positive feedback loops with climate impacts. For example, the plan includes a commitment to conduct more studies to determine flooding and other risks throughout the City and develop plans to improve the resilience of infrastructure (such as roads) to climate-related risks from extreme weather and temperatures.

ReCharge Hamilton: Community Energy and Emissions Plan

ReCharge Hamilton is a Community Energy and Emissions Plan (CEEP) that lays out a major component of the City of Hamilton's strategy for responding to the climate emergency. This plan identifies a pathway to net zero GHG emissions by 2050 that increases the resilience of the energy system and improves economic prosperity for all. The City is projected to grow significantly by 2050 and a regional low-carbon future requires changes across all aspects of the community, including but not limited to the way we design and build transportation systems.

Closely following buildings, fossil-fuel combustion in cars, trucks, and buses are estimated to account for about 19% of the City's GHG emissions in 2016 and decline slightly to 17% of Hamilton's emissions in a 'business-as-planned' scenario by 2050. To achieve net-zero in this sector, the City will play a key role by expanding active transportation, e-mobility and transit networks, decarbonizing their fleet and transit, and by ensuring the City is designed to support electric vehicle adoption. In the short-term, the City has committed to implementing a climate lens on all budget decisions to ensure decision-making aligns with GHG targets. Relevant targets in the plan include:

- Private vehicle trips decline by 9% relative to 2016 per person by 2050
- Vehicular trip length declines by 6% from 2016 levels by 2050
- 100% of new PUV sales are electric by 2040
- By 2050, 100% of heavy-duty vehicles are green-hydrogen based and light-duty commercial vehicles are electric.

This study will consider how to increase transit and active transportation opportunities along the RHVP and LINC.

2. OVERVIEW OF ENGAGEMENT & CONSULTATION ACTIVITIES

Involvement of the local community, the general public, and road users is important in obtaining knowledge of local conditions and providing input. This information makes the proposed Project more acceptable or amenable to the local community. The primary goal is to enable the city to obtain buy in, support, or agreement in principle of the Project.

During the feasibility study, Indigenous communities and agencies were informed of the project, as described in the following sections. More in-depth engagement with Indigenous communities, and consultation with the public, agencies, and other stakeholders will take place during a future MCEA, as described in Section 2.3.

2.1 Summary of Indigenous Engagement

On June 30th, 2021 a notification letter was sent to the following Indigenous groups/ organization to inform them of the RHVP and LINC feasibility Study:

- Metis Nation of Ontario
- Six Nations of the Grand River Territory
- Mississaugas of the Credit First Nation
- Huron-Wendat Nation at Wendake
- Haudenosaunee Confederacy Council
- Joint Stewardship Board

No comments were received in response to the notification letter.

2.2 Summary of Agency Meetings

On April 21, 2021, two stakeholder meetings were held, providing an opportunity for key stakeholder agencies to provide early input on the project. Agencies in attendance included:

- Meeting 1: Metrolinx and Ministry of Transportation (MTO)
- Meeting 2: Hamilton Conservation Authority (HCA) and Niagara Escarpment Commission (NEC)

Key discussion points for Meeting 1 included:

- A key contact for the development of the Greater Golden Horseshoe (GGH) Transportation Plan currently underway by MTO.
- There are currently no expansion plans for Highway 403 or QEW. However, there is a long-term expectation to improve 403 and QEW to meet future travel demands.

- Managed/HOV lanes are not added to Metrolinx transit plans and transit improvements through municipal infrastructure and are not currently considered in Metrolinx plans beyond expanding Regional GO Bus service outlined in the 2041 plan.
- Several active transportation locations (such as pedestrian crossings) exist or are planned within the study area. Further improvements and potential impacts of widening the LINC/RHVP will be reviewed in this feasibility study.

Key discussion points for Meeting 2 included:

- Previous studies and design identified the opportunity for inside widening along LINC and RHVP which minimizes potential environmental impacts as opposed to the impacts of widening on the outside.
- Potential area of concern is at the long Escarpment Bridge between Mud Street and Greenhill Avenue.
- Inner widening is much less of concern; however, impacts to the existing flood plain, watercourse, design of storm water flow will need be reviewed/analyzed.
- Detailed information regarding the study with thorough review of all existing policies will have to be undertaken and provided to NEC for review, and First Nations and Joint Stewardship Board must be involved during the consultation.
- Visual impact assessment on Niagara Escarpment will have to be reviewed, technical requirements for this purpose are available on NEC website.

2.3 Future Strategy for Engagement and Public Consultation

This future strategy for engagement and public consultation will frame the engagement and consultation process for the MCEA of the RHVP and LINC. It involves engaging stakeholders early in the study to inform them about the Project, and to solicit their respective input during timely stages in the Class EA process. This will enable the City to identify their concerns early in the conceptual design process and to gauge the level of support for or opposition to the Project. Moreover, it provides an opportunity to address concerns during the MCEA process, and to document their resolution prior to proceeding to the design stage. Details regarding the methods and activities to be effectively employed to solicit feedback from stakeholders who are willing to become engaged in the process are provided below.

- In keeping with the MCEA requirements, the City will prepare and distribute all Public Notices throughout the Study Process. Specifically, the following notices are to be issues at key Study milestones:
  - Notice of Study Commencement
  - Notice of Public Information Centres (PICs)
  - Notice of Study Completion
- Public Information Centres (PIC) will be conducted to effectively communicate information related to the MCEA Study. The purpose of PICs will be to present and

solicit input on the problem/opportunity and the background inventory, as well as to present and solicit input on the evaluation of Alternative Solutions and Alternative Design Concepts.

- A series of city staff technical committee meetings will occur to facilitate the provision of timely input to the Project Team throughout the study. The overall purpose of the committee is to solicit feedback from internal City staff members across various departments/divisions/sections.
- External technical agency meetings will take place with the Ministry of Environment Conservation and Parks, MTO, Metrolinx, Hamilton Conservation Authority (HCA) and/or the Niagara Escarpment Commission to discuss and seek their respective feedback.
- Stakeholder meetings will be held prior to the PICs, and on an ad hoc basis when required to solicit and address stakeholder feedback throughout the study. It is envisioned that the Stakeholder Advisory Group be comprised of members of City Council (including one or more Ward Councillors), individuals who live, work and own property within the study area (including representatives from Hamilton Business Improvement Area (HBIA) and Resident Associations), and representatives from goods movement, logistics, and distribution organizations (e.g., Ontario Trucking Association).
- A project website will be developed by the City as an additional means to engage and inform stakeholders of the study.
- Given the Indigenous history in the area and their importance as stewards of the environment, coupled with provincial environmental laws, the City will engage Indigenous communities and organizations during the Class EA process. Engagement with the Indigenous communities will be undertaken at key stages of the study and will be carried out in parallel with public/agency consultation activities (i.e., Project Notifications, PICs, etc.) detailed above.
- As per the commitments outlined in the Joint Stewardship Agreement, the City will consult with, and where required, make application to the Joint Stewardship Board regarding proposed changes to the RHVP.

3. PROJECT NEED & JUSTIFICATION

The sections below describe the problems and opportunities that the project will address.

3.1 Problems to be Addressed by the Project

3.1.1 Capacity Improvements for Current and Future Volumes

The City of Hamilton is experiencing rapid growth due to mass immigration within the Greater Toronto and Hamilton Area (GTHA) and the City's relative affordability within the region. By 2051, the City is expected to achieve a population of 820,000, which represents an increase of 310,000 from 2001. This will be accompanied by employment of 360,000 people, an increase of 150,000 from 2001, as shown in Table 1 and Table 2

Table 1: Hamilton's City-Wide Population Forecasts

Year	Population
2001	510,000
2011	540,000
2021	590,000
2031	660,000
2041	733,000
2051	820,000
Change 2001 – 2051	**310,000**

* Table A.1: Population Forecasts, 2001-2051 (Source: City of Hamilton)

Table 2: Hamilton's City-Wide Employment Forecasts (by Type)

Year	Total [1]
2001	210,000
2011	230,000
2021	270,000
2031	300,000
2041	310,000
2051	360,000
***Change 2001 – 2051**	**150,000**

Table A.2: (Source[1]: City of Hamilton)

Growth will occur within the urban boundary of the City, particularly within the built- up area identified in the Official Plan, as shown in Figure 3. The proposed amendments from the Official Plan Review proposed that a minimum of 80% of all residential development occur annually within its built-up area.

The RHVP and LINC were designed to improve the movement of traffic within and through the built-up area of the City. As the population increases, these parkways will need to be improved and optimized to improve travel reliability. At the same time, both parkways connect to the provincial highway network and improvements will be needed to address the connections at the LINC/Highway 403 and at the RHVP/QEW.

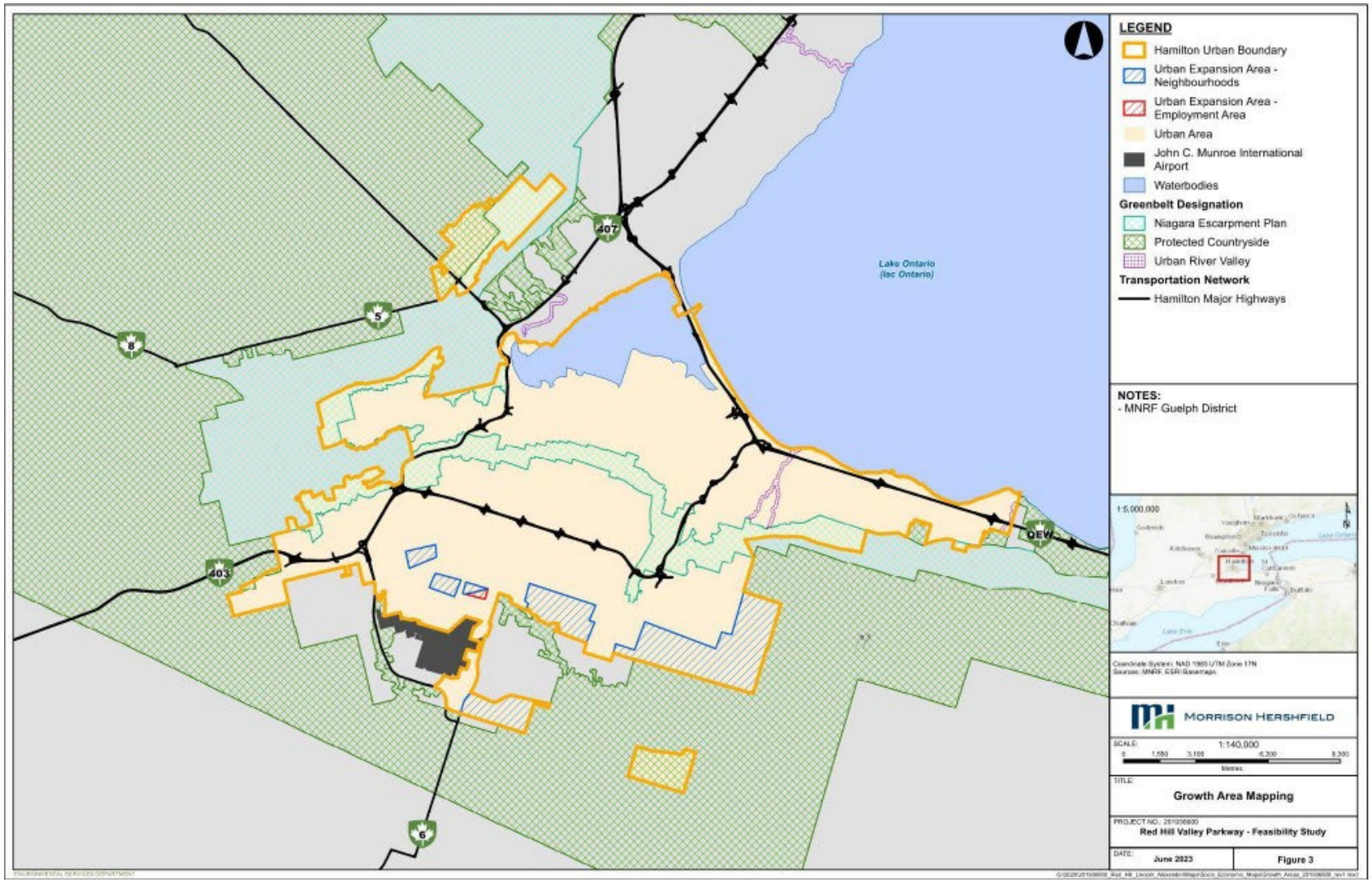


Figure 3: City of Hamilton Growth Area Mapping

Recent traffic conditions along the RHVP and LINC demonstrate that both parkways are close to their capacity during peak hours. Based on traffic counts from 2018 and 2019 (shown in Figure 4), which is the latest year that non-COVID counts are available at multiple locations on both parkways, the LINC is approaching capacity in both directions in the PM peak hour, and the RHVP is at or above capacity in the peak direction (i.e., northbound in AM peak, southbound in PM peak). While the pandemic has changed traffic patterns compared to 2019, projected growth in the City will continue to increase the volume of traffic on these parkways, conditions will worsen and it will reduce the travel reliability.

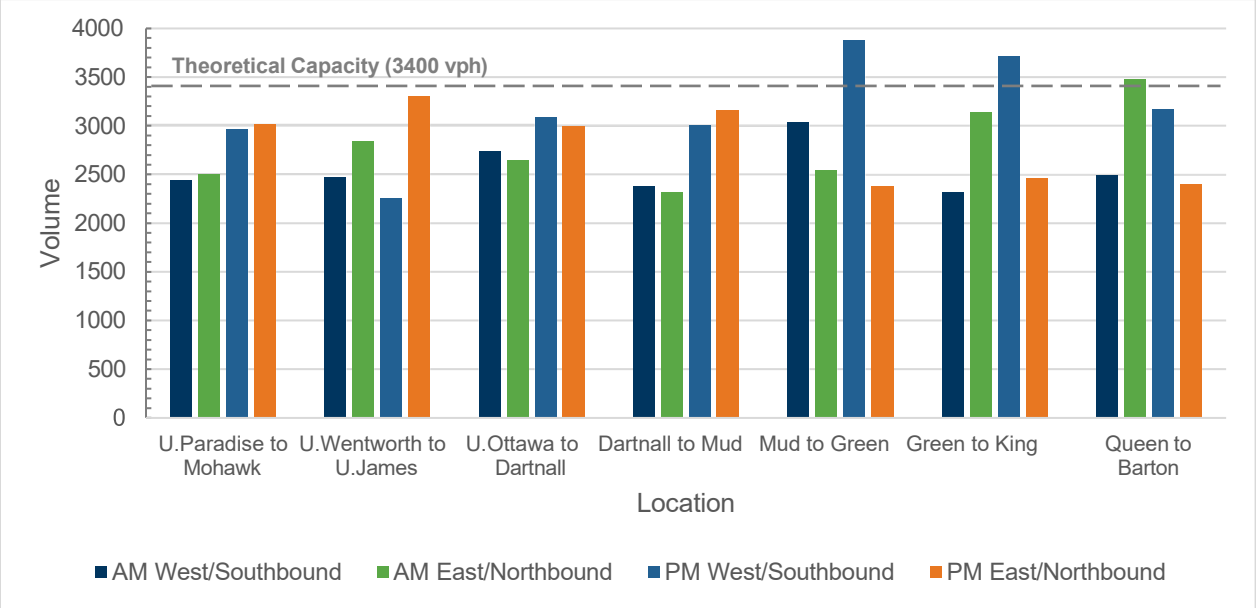


Figure 4: Traffic Volumes (2018/2019) along LINC and RHVP

The City's Truck Route Master Plan Update (2022) reinforces the importance of improving capacity along the RHVP and LINC. In response to direction from Council in April 2022, the plan promotes the use of the parkway network for trucks and prohibits them from travelling through the downtown to help improve the safety of those streets. As a result, the number of trucks using the RHVP and LINC will increase in future years, compounding the issues.

3.1.2 Safety Concerns

The RHVP and LINC are prone to congestion and lane-to-lane speed differentials resulting in incidents directly affecting safety and traffic mobility. Along RHVP, there were a total of 582 reported collisions during the period during the period from January 1, 2008, to March 20, 2018, of which over 250 resulted in injury or fatality. Most collisions were between Mud Street and King Street East on RHVP.

The impact of collisions can be significant on the capacity of the parkways, given there are only two lanes in each direction. Vehicles involved in collisions either occupy traffic lanes or the shoulders adjacent to traffic causing a direct loss of traffic capacity or a reduced traffic capacity.

As LINC and RHVP connect to the QEW and Highway 403, which have posted speeds of 100 km/hr, drivers on the LINC and RHVP often significantly overdrive the posted speeds of 80 km/hr resulting in a higher collision rate.

Both the LINC and RHVP were designed for an ultimate six- lane cross-section, but were built to four- lanes, leaving space in the median for future widening and a concrete separator barrier. The existing open median has the potential for crossover collisions and though roadside safety protection is applied, vehicles can strike infrastructure in the median such as signs, safety protection treatments, smaller unprotected drainage elements and other elements and grading slopes.

3.2 Opportunities to be Addressed by the Project

3.2.1 Increasing Capacity through a Managed Lane Approach

The current configuration of the RHVP and LINC includes only general-purpose travel lanes. The TMP identified that improvements to both parkways have the potential to maximize capacity through managed lanes, such as High Occupancy Vehicle (HOV) lanes, transit-only lanes or queue jump lanes for express buses, and approaches such as ramp metering. While no information was available regarding the existing split of auto driver to auto passenger on the Parkways, the City's Transportation Master Plan Update identifies an aspirational mode share target of 52% single occupancy vehicles (SOV), a 15% reduction from the 2011 SOV mode share of 67%. This study presents an opportunity to provide facilities for managed lanes such as HOV or transit-only lanes that will support the aspirational mode share targets in the TMP.

It should be noted that any major expansion in roadway capacity, such as the widening of the RHVP and LINC, may trigger an increase in mode share of SOV at the expense of transit and HOV – everything else being equal. This risk is particularly high if the expansion in the capacity of the roadway is not accompanied (or preferably led) by improvement in the speed, reliability or and frequency offered by the transit network. Not doing so would jeopardize the City's intent to make a major change to the SOV's mode share and attain its aspirational mode share targets for local transit (an increase from 7% currently to 12% in 2031) in the TMP.

A challenge with HOV lanes on the LINC and RHVP is the type of traffic that uses the facilities. The LINC and RHVP serve an important function for local traffic from the City of Hamilton with a significant portion of these trips both entering and exiting within the LINC/RHVP boundaries. These more localized vehicle trips are not well suited for the use of HOV lanes due to the need for numerous lane changes in a short distance that are also required at specific points to enter and exit the managed lane. The type of travel patterns better suited for the use of HOV lanes are longer distance trips. With a maximum length of an HOV trip under 20 kilometres, HOV could then be further considered with MTO in a system of HOV lanes on QEW and Highway 403. Such a longer system on HOV lanes would further encourage the use of the LINC/RHVP as a shorter bypass route that also avoids the need to traverse the Burlington Bay Skyway.

Transit use is not planned on the LINC or RHVP as far out as 2041 for Hamilton Street Railway (HSR) and GO Service, and 2051 for additional Greater Golden Horseshoe service. This is likely due to priority bus service already being proposed as part of the Hamilton BLAST network

on two corridors that parallel the LINC/RHVP, and the lack of space for transit-supportive infrastructure at LINC / RHVP ramp terminals to allow buses to exit the parkways, serve a bus stop, and return to the parkway in a timely matter. The lack of this infrastructure does not preclude transit service along LINC / RHVP; however, it makes servicing and connecting to arterial corridors along the parkways more challenging. (Note: the (Re)Envisioning HSR study was released during the later stages of this study, which now proposes future transit service on RHVP from Mud Street to Queenston Road. Further review of this is provided in Section 5.1).

3.2.2 Improvement of Pavement Condition

After approximately two decades of operation, the pavement condition of both the LINC and RHVP was considered poor. RHVP was resurfaced in 2019 following the 2019 CIMA study. LINC was closed intermittently in May 2022 for spot repairs and sections of mill and pave resurfacing. This study offers an opportunity to understand the impact of a pavement improvement project and how to best coordinate that with future operational and capacity improvements in a cost-effective manner.

3.2.3 Noise Mitigation

Noise barriers were installed along the majority of the LINC corridor and a short section of the RHVP during construction of the two parkways, as shown in Appendix A. Despite the presence of the barriers, the City of Hamilton receives noise complaints from nearby residents, particularly in the Greenhill Avenue area. Noise complaints may in part be due to noise mitigation measures lacking sufficient height since many specific developments were planned and built after the noise mitigation was installed. This study offers the opportunity to explore improvements to noise mitigation.

3.2.4 Addressing Climate Considerations

Air quality and climate change have significant direct and indirect impacts on community health, the environment, and the economy of Hamilton and will be considered throughout project planning and MCEA process. Transportation corridors (including the RHVP and LINC) are key contributors to local sources of greenhouse gases in Hamilton, with fossil-fuel combustion in cars, trucks, and buses accounting for an estimated 19% of the City's GHG emissions in 2016 (City of Hamilton, 2022). Additionally, the City has committed to climate adaptation and resilience through the Climate Change Impact Adaptation Plan. This project can contribute to the City's overall resilience to extreme weather and climate change impacts by increasing local adaptive capacity and decreasing sensitivity to these changes through climate resilient infrastructure design.

Thus, it is important to input the required mitigation and adaption/resilience measures in the planning of the road improvements. This feasibility study addresses climate change considerations in three ways: assessing the potential impacts on GHG emissions, assessing the potential for the project to be designed for the infrastructure to be resilient to projected future climate conditions, and finally, assessing considerations related to community climate resilience, sustainability, and equity and how the project's design may influence the community's overall adaptive capacity.

3.3 Problem & Opportunity Statement

Improvements to the RHVP and LINC are needed to address the City's growing and changing needs. These improvements will lessen travel demand on existing local routes and reduce travel times as the population grows and as truck traffic is diverted onto the parkway network. The improvements will also reduce the number of collisions on the RHVP and LINC through enhanced safety measures.

The project will explore maximizing capacity of the RHVP and LINC through a managed lane approach, which could prioritize high-occupancy vehicles and/or transit. Without the required improvements, these facilities will not be able to accommodate future growth and will operate at / or above capacity, which may result in negative impacts such as safety concerns, traffic infiltration and increased greenhouse gas emissions. Project improvements may also address noise complaints from adjacent residences.

4. EXISTING CORRIDOR CONDITIONS

4.1 Natural Environment

The study area is located within the jurisdiction of the HCA, and much of the RHVP and a small segment of the LINC right-of-way (ROW) is mapped within the Authority's regulated area. Additionally, the Urban Hamilton Official Plan (UHOP) contains policies that focus on protecting and enhancing the natural heritage system through stewardship, education and awareness, land use planning policies, habitat restoration and management, and acquisition. The Natural Heritage System, as defined in the UHOP, consists of the Niagara Escarpment Plan area, as well as the Core Areas and Linkages identified by the City, based on requirements of the Provincial Policy Statement. The study area passes through the Niagara Escarpment Planning Area, as well as several Core Areas, which includes Significant Woodlands. In addition, much of the Red Hill Valley is designated as an Environmentally Significant Area comprising a wide range of vegetation communities which provide habitat for wildlife (including breeding birds), thus serving as an important ecological linkage, facilitating the movement of wildlife, and warrants protection to the extent practical.

Environmental features are most pronounced within the RHVP segment which is a sensitive environmental setting. The study area is located within proximity to Red Hill Creek and its associated valley lands, paralleled by the Red Hill Valley Trail which is 7 km in length and connects to the Waterfront Trail in Confederation Park at the north end, and the Bruce Trail at its south end.

The Red Hill Creek Watershed drains an area approximately 6,400 hectares or 64 square kilometres in size. Some resources present are considered rare or vulnerable in Canada, Ontario and the Region. The Valley is particularly notable for its rare plant communities, seasonal bird migrations, waterfowl nesting and staging, and regional wildlife corridor functions. There are a number of smaller watercourses (i.e., Upper Ottawa Creek, Hannon Creek, Upper Davis Creek, and Greenhill Creek) that outlet into Red Hill Creek which flows south to north alongside the RHVP ultimately discharging into the Windermere Basin. As an urban watercourse, Red Hill Creek comprises a simple fish community dominated by tolerant resident species and migratory species, primarily white sucker, and the introduced Pacific salmon.

Terrestrial habitats in the Red Hill Creek Valley and along the Niagara Escarpment are Provincially and Regionally important due to their size, connectivity, physical diversity, and scarcity. Biophysical resources of the Red Hill Creek Valley and Niagara Escarpment form the basis of their designation as Environmentally Significant Areas, Areas of Natural and Scientific Interest, and Provincially Significant Wetlands. In addition, the Niagara Escarpment has been designated as a UN World Biosphere Reserve. The Creek and wetlands with their associated fish populations and other aquatic fauna, provide sources of food, water, and habitat for birds, mammals, reptiles, and amphibians that live in the Red Hill Creek Valley. Additionally, the Red Hill Creek system provides spawning habitat for fish which live in Hamilton Harbour and Lake Ontario, and thus is an important component of those larger ecosystems.

The Red Hill Creek Valley was extensively cleared after European settlement, and many of its resources have regenerated since the late 1950s. Past land uses, surrounding urbanization, and infrastructure in the Valley have degraded habitats and reduced the ability of the corridor to maintain its biological diversity and ecosystem functions. Habitat degradation has been caused by the channelization of sections of the Creek, as well as the landfilling of the floodplain in some areas to make room for houses, industry, and garbage dumps. Barriers to fish migration have restricted the utilization of Red Hill Creek by migratory fish, and this habitat fragmentation may contribute to the local reductions in the number of fish species present. Further, the lack of natural stormwater storage areas (wetlands, ponds, marshes) results in a Creek system which has relatively rapid flow response, high runoff potential and lower baseflow rates. Primary sources of pollutants during storm events can be attributed to combined sewer overflows, urban runoff, and creek bank erosion (which increases suspended sediment loads). Figure 5 contains an overview map of environmental features and constraints for the RHVP and Figure 6 for LINC.

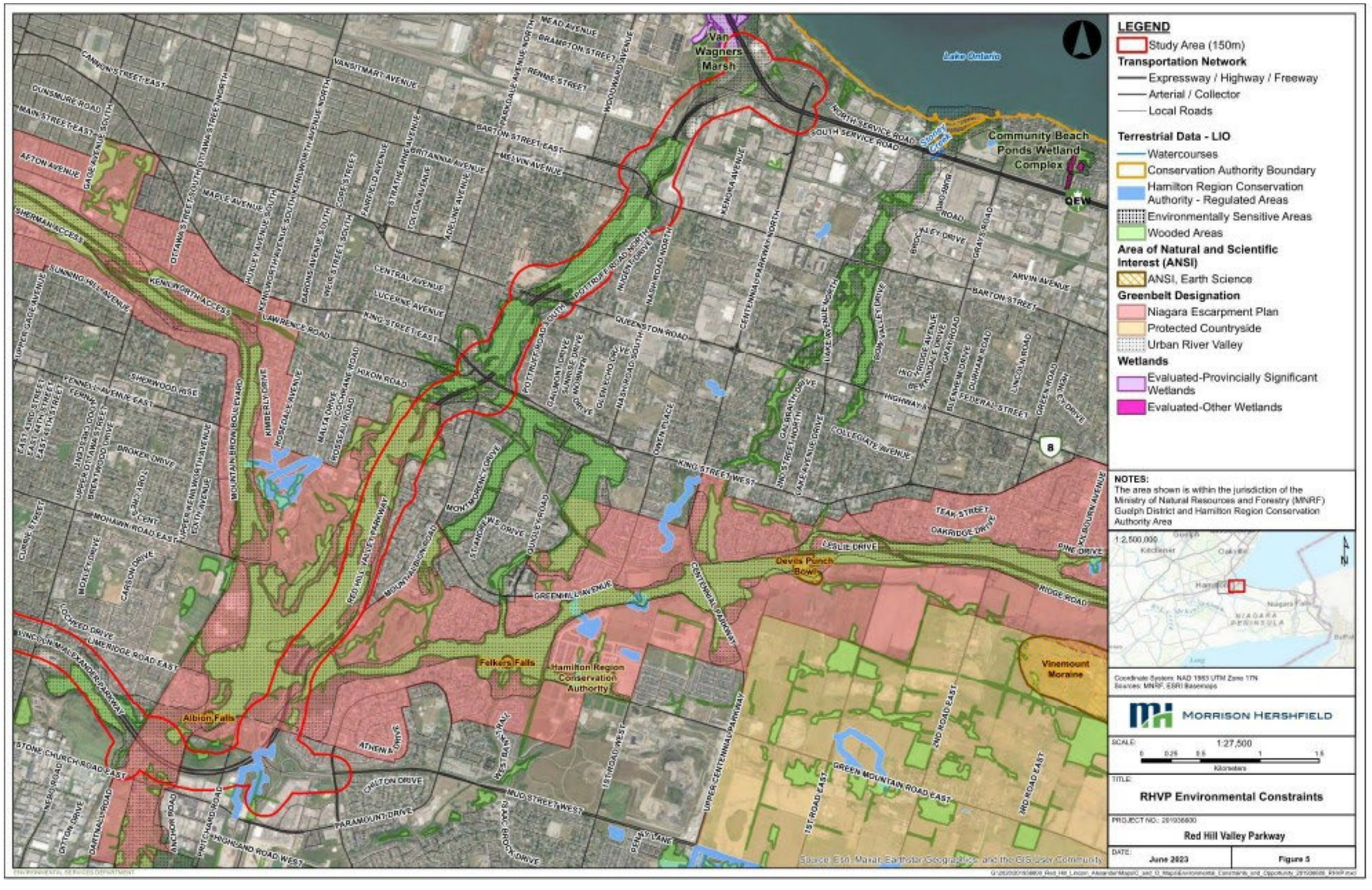


Figure 5: RHVP Environmental Constraints Overview Map

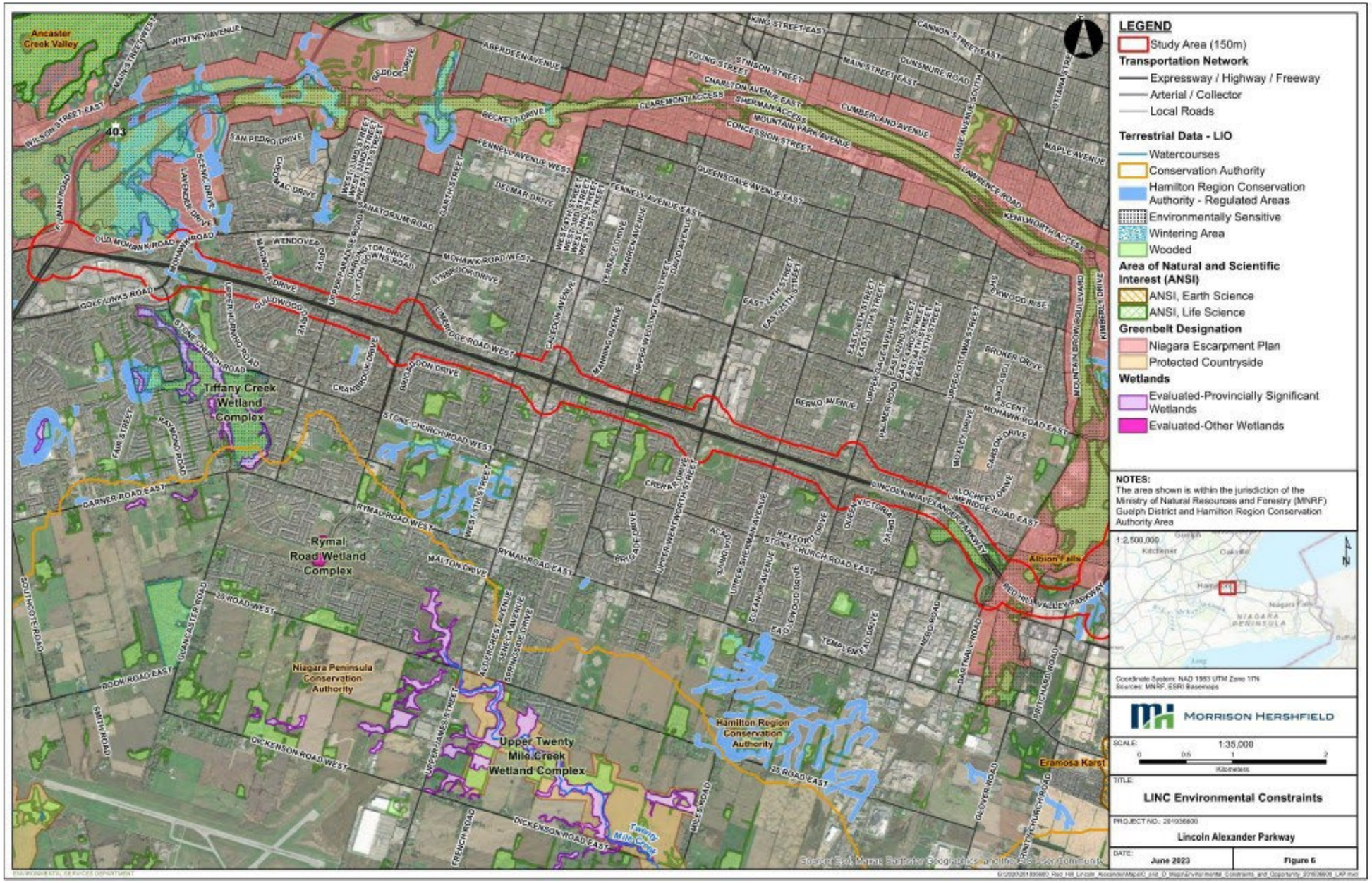


Figure 6: LINC Environmental Constraints Overview Map

4.2 Socio-Economic Environment

Hamilton's strategic location at the western end of Lake Ontario, mid-way between Toronto and the Canada-USA border, provides the City with many economic advantages. This location at the head of the lake has allowed the City to develop a strong industrial base centered on Hamilton Harbour. The City of Hamilton's 2021 population increased by 6%, surpassing the provincial average of 5.8%. The population increased by 32,435 to 569,355 in 2021 from 536,920 in 2016. Associated with this increase, is an increase of total occupied dwellings by 5.3% or 11,205 units to 222,805 dwelling units in 2021 from 211,605 dwelling units in 2016. An aging population, a declining number of people per household, the effects of the global economy on local companies, increasing pressures on community services, and urban pressure on rural resources will result in physical, economic, and social change. To help the community prepare for this change, the City has emphasized developing strong communities, which are defined as communities that are complete, healthy, diverse, and vibrant.

To this end, the City has been working diligently to improve its economic diversification and increase its competitiveness with neighbouring and global jurisdictions. There are many sectors which shape the City's economy such as traditional manufacturing, research and technology, education, healthcare, agriculture, arts and culture, transportation, retail, and office. The creation of a strong economy is contingent upon several key interdependent factors including developing and retaining a skilled labour force which is adaptable to changing technologies, providing infrastructure, creating an environment of innovation, supporting and enhancing the arts and culture sector, reducing poverty by providing better access to education, social programs, improving quality of life indicators such as housing choices, and having abundant open spaces. In support of the City's goal to diversify the economy, six priorities were developed: facilitating a skilled and adaptable workforce, enhancing digital infrastructure and services, growing business and investments, moving goods and people, revitalizing priority areas and placemaking, and building transformational projects.

The City of Hamilton has a unique and valuable mix of the four key transportation modes (highway, rail, marine and air) due to geographic location and proximity to large commercial markets. Therefore, from an economic development perspective, the design, creation, delivery, and maintenance of an efficient and effective mix of transportation modes is essential to the competitiveness of Hamilton's economy and the health, safety and prosperity of its residents and visitors. Taking into consideration the Government of Canada's estimate that transportation accounts for 25% of Canada's greenhouse gas emissions, decisions and related investments into the City's mix of transportation services and infrastructure will also have a lasting impact on the local and global environment.

From a land use perspective, the RHVP and LINC together as a linear system effectively pass through the middle of the built-up area of the City of Hamilton. The LINC travels largely through areas designated Residential with small pockets of lands designated as Open Space or Mixed Use. The RHVP travels largely through a network of Open Space that corresponds with the cultural heritage landscape described in Section 4.2.1. Beyond the linear corridor of open space

that the RHVP travels, the land use designation is predominately Residential, with Employment designations north of Barton Street. Surrounding land uses are shown on Figure 7 and Figure 8, and land use designations are shown on Figure 9 (Schedule E-1 of the Urban Hamilton Official Plan).

Decisions about transportation infrastructure have equity implications as they affect the allocation of public resources, people's quality of life and economic opportunities, and external costs (financial or otherwise) that road use, operations, and maintenance impose on their communities (Victoria Transport Policy Institute, 2022). Traditional transportation planning and system performance evaluation often includes little consideration of whether transportation systems serve equity-deserving populations (though this is changing in some jurisdictions). The Victoria Transport Policy Institute (2022) defines types of transportation equity as follows:

- Fair Share of Resources (public resources are fairly allocated)
- External costs (externalities like delay, risk, and pollution are minimized)
- Inclusivity (use of multimodal planning to capture a range of transportation needs)
- Affordability (supporting access to affordable modes of transportation)
- Social justice (making transportation systems accessible to under-served populations)

To help ensure this lens is included in the analysis, Table 3 provides a snapshot of the City's socio-demographic information as reported on the 2016 census that may be important to consider from an equity perspective.

Table 3: Equity-Related Socio-Demographic Statistics

Attribute	% In Hamilton
Aboriginal Identity	2.3
Visible Minority	19.0
Unemployment Rate	7.0
Primary Mode of Transportation is Not a Private Vehicle	16.9
Low-Income Status	15.3
OW Assistance Beneficiaries	4.0
Spending >30% on Housing Costs	26.1

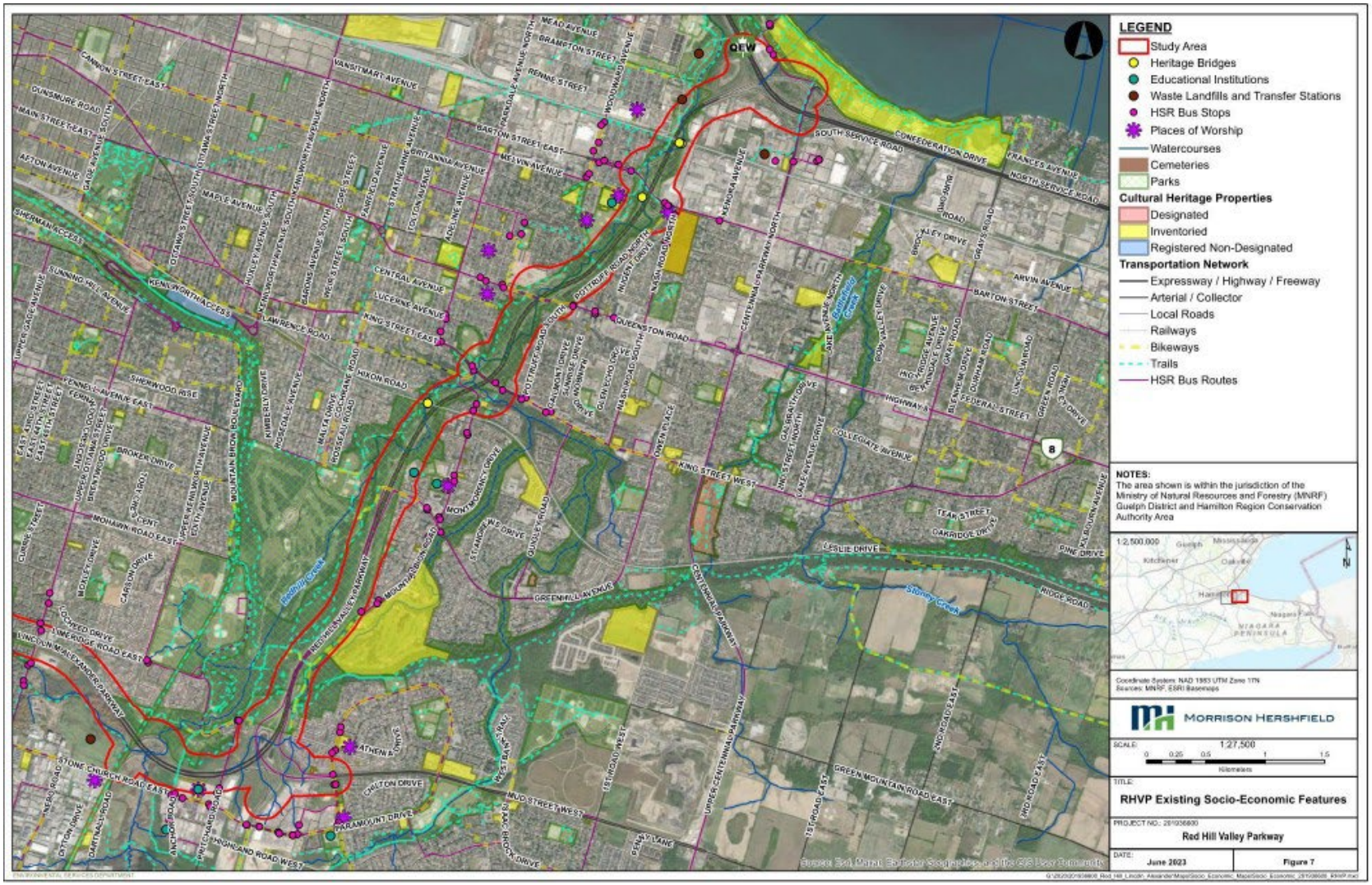


Figure 7: RHVP Existing Socio-Economic Features Map

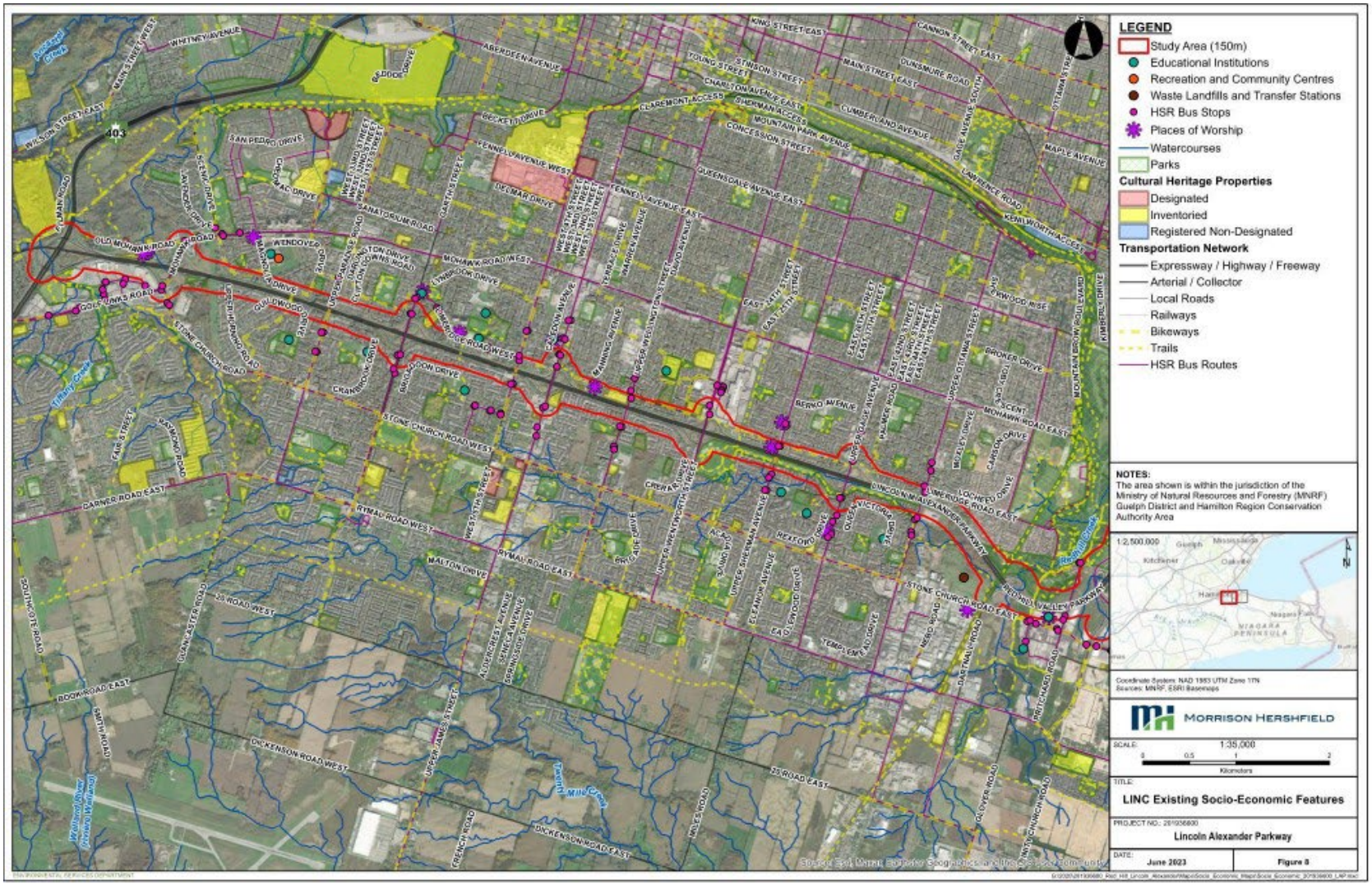


Figure 8: LINC Existing Socio-Economic Features Map

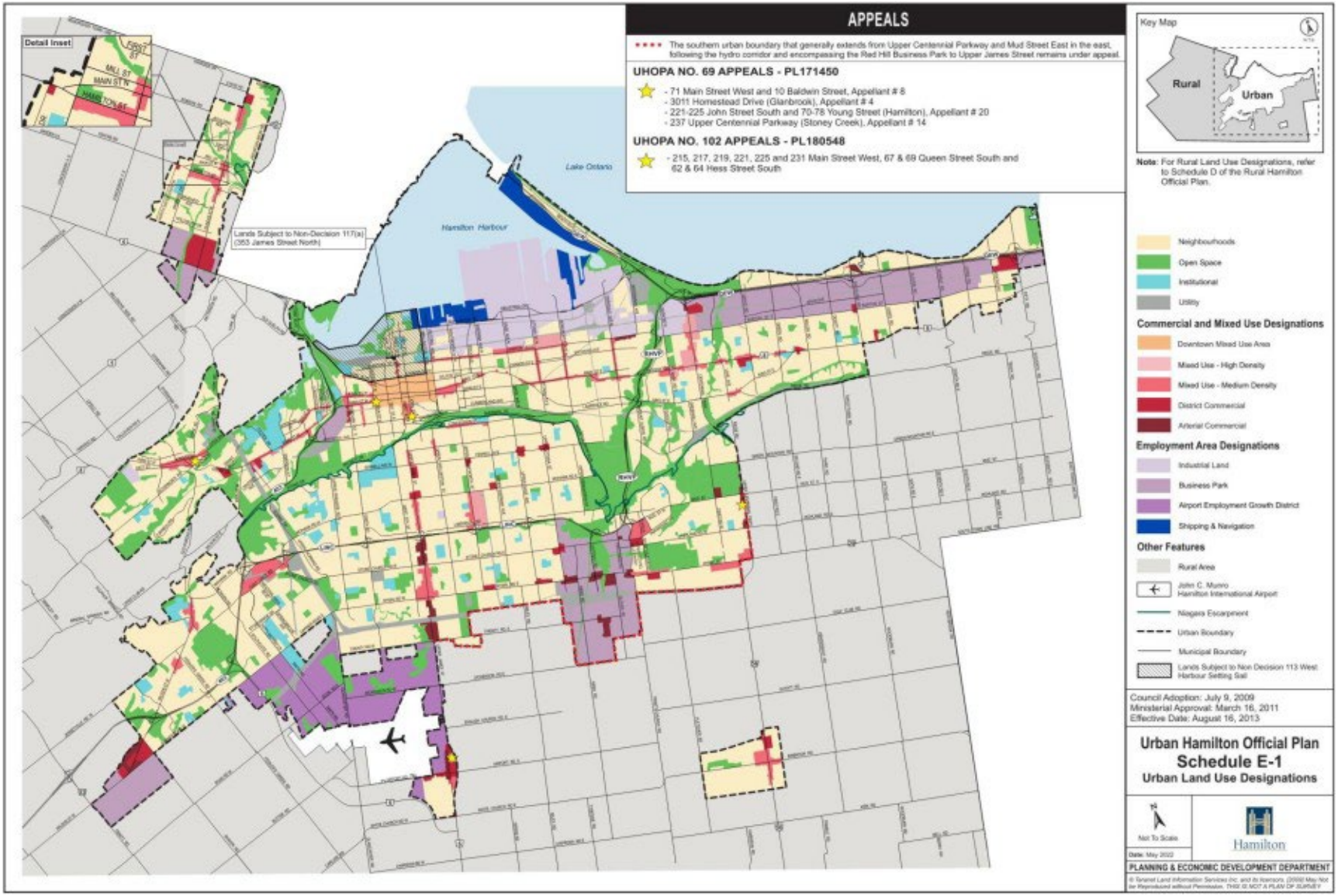


Figure 9: Urban Land Use Designations Map

4.2.1 Niagara Escarpment Commission

The NEC is a regulatory agency of the Ontario Government that manages development on the Niagara Escarpment. It works to ensure development projects are consistent with the Niagara Escarpment Plan and the *Niagara Escarpment Planning and Development Act*. Portions of the RHVP and the LINC are located within areas designated in the Niagara Escarpment Plan. The following three designations are found within the RHVP and LINC study areas: Escarpment Protection Area, Escarpment Natural Area and Urban Area. Each of these designations has an objective, criteria for designation and a series of permitted uses that needs to be considered through the planning process. As this project is a development project that will be occurring on designated lands, consultation with the Niagara Escarpment Commission is required and a Niagara Escarpment Development Permit may be required.

4.3 Cultural Environment

The cultural history of the region began approximately 11,000 years ago with radiocarbon dating suggesting that Paleo-Indian populations were present starting between 11,000-10,500 years B.P. As such, a large majority of the land area within Hamilton's urban boundary is considered to have archaeological potential (Figure 10). Within the study area, all the sites documented to date have been compromised to some extent by past human intervention, as rapid urbanization within the Red Hill Creek Watershed has resulted in significant levels of archaeological resource destruction.

A number of archaeological sites, nevertheless, contain important information that contributes to our knowledge of the region's history. In this region, the majority of archaeological sites from the precontact period represent the remains of small camps occupied for short lengths of time. Later sites represent larger and more permanently occupied agricultural villages in conjunction with smaller camps and hamlets. Archaeological findings in the Red Hill Valley area have been documented starting in 1915 with records of glass trade beads, 'chipping places', and isolated burials.

More recently, archeological findings are often associated with pre-development assessments. Within the watershed area, 92% of 113 registered sites were documented as a result of pre-development assessments. 13 of these sites are associated with the RHVP project area.

With regards to cultural heritage, most of Red Hill Valley is designated a Cultural Heritage Landscape (Figure 11). Additionally, previous studies in the RHVP portion of the study area documented 16 built heritage resources and 17 cultural landscape resources (wholly or partially within or adjacent to) the project area (City of Hamilton, 2003). Based on the cultural significance of the lands adjacent to the study area, it will be important to limit impacts to the existing disturbed area to the extent possible.

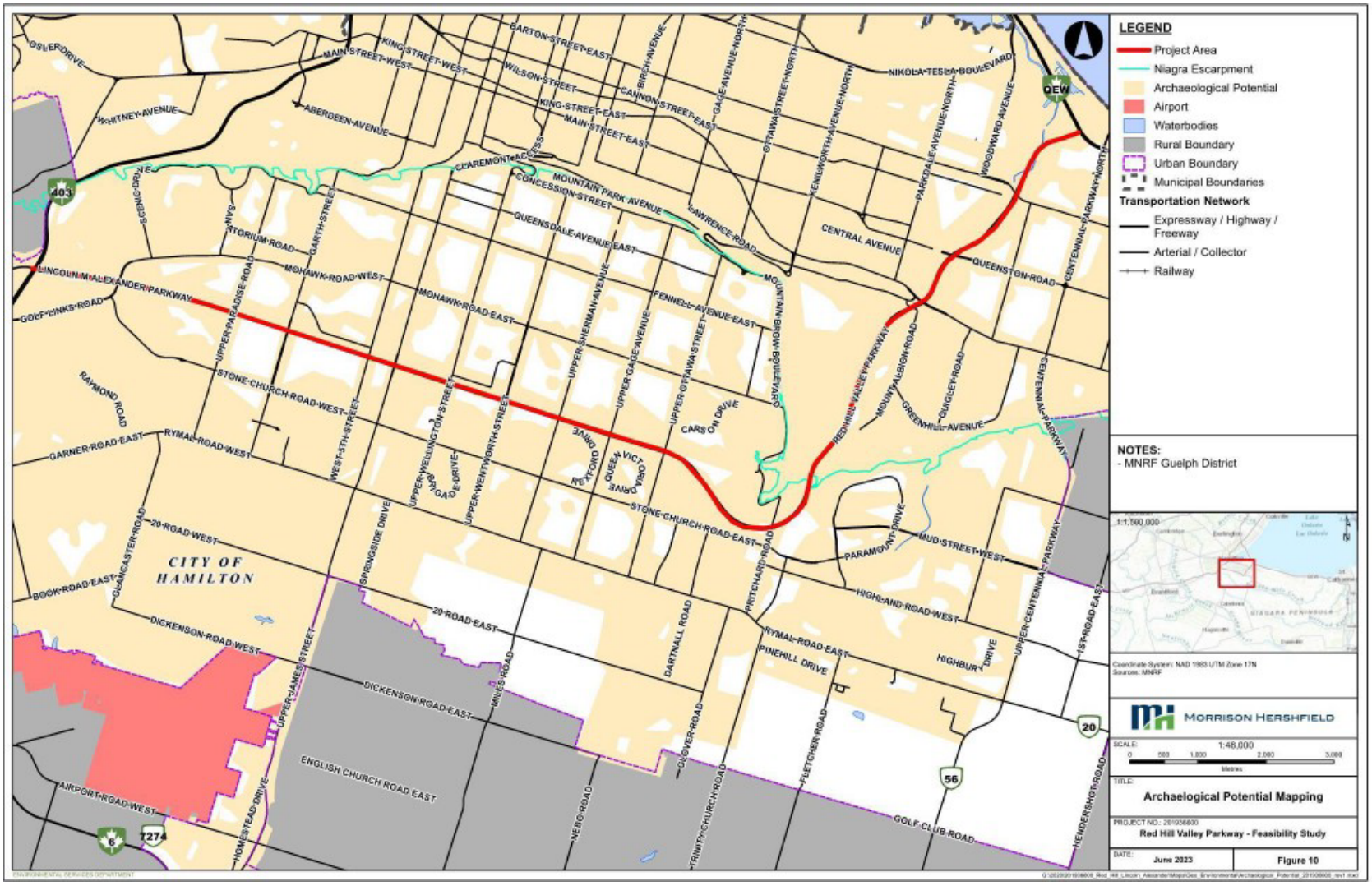


Figure 10: Map of Archaeological Potential

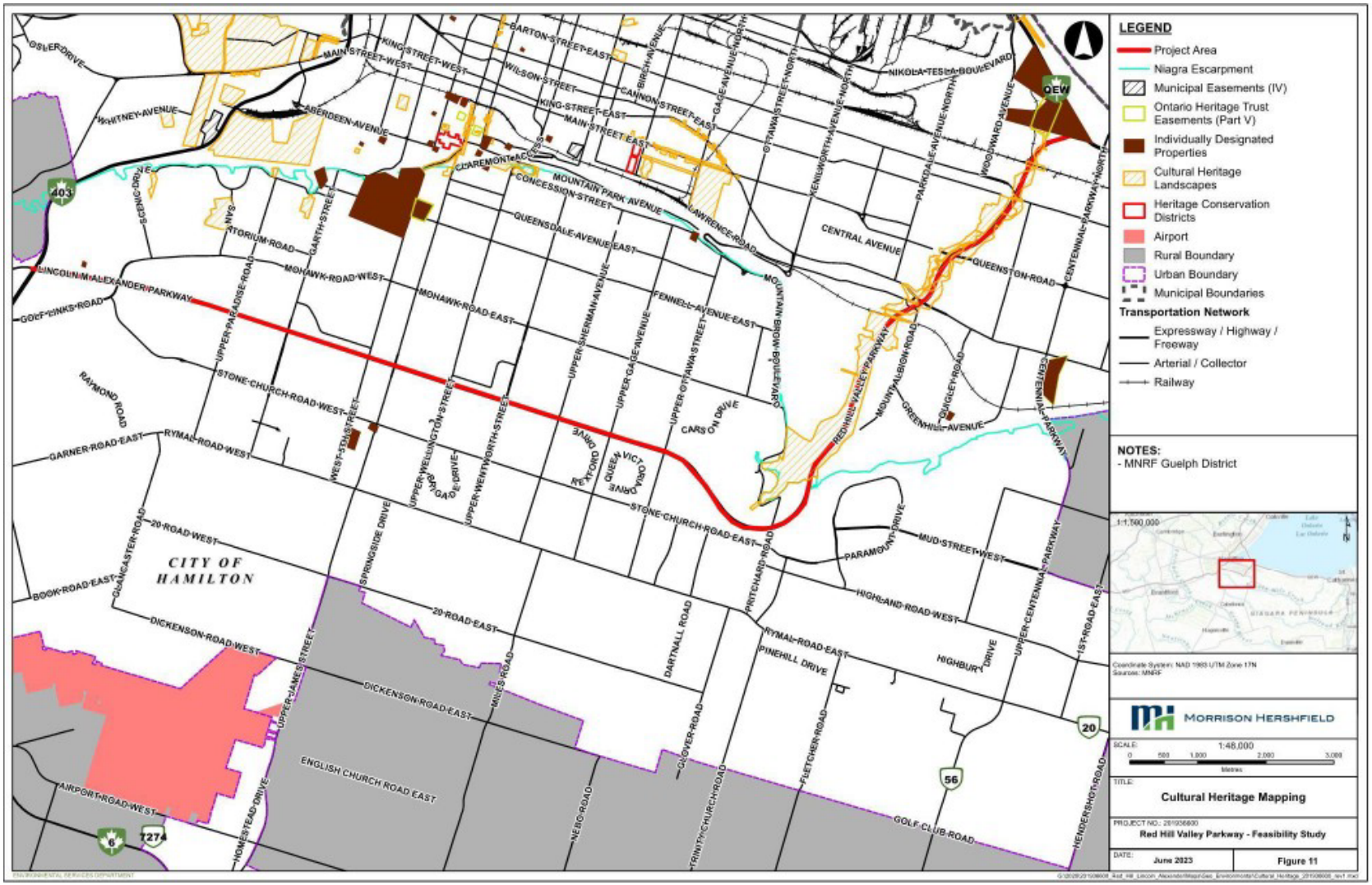


Figure 11: Map of Cultural Heritage Landscapes

4.4 Technical Environment

4.4.1 Road Design

The RHVP and LINC parkways were planned and designed to accommodate 6 lane facilities with 3 through lanes in each direction. The ROWs were set for this basic design condition and therefore many technical elements of the design and the existing condition cannot be altered, especially due to lack of space in the ROWs.

The LINC design was completed with less delay compared to the RHVP given the lesser environmental impacts to be considered and additional extensive consultation undertaken. The LINC design process was thus relatively less complex in that when it was carried to the full design process it was designed to 4 lanes as in its present state. The design was completed with elements considered for a future widening to 6 lanes in the centre median.

RHVP was also designed to 4 lanes as in its present state, with elements considered for a future widening to 6 lanes in the centre median. RHVP underwent a significant change from the original design in 1985 to its redesign. Table 4 breaks down the major design changes to the RHVP from 1985 to when it was redesigned and as it is in present conditions now in 2022.

Table 4: Comparison of the 1985 & Current Red Hill Valley Parkway (Expressway at the Time)

1985 Expressway Design RHVP	Current Expressway Design RHVP
3 northbound and 3 southbound through lanes	2 northbound and 2 southbound through lanes with provision for 2 additional lanes in the centre median. One climbing lane at the Escarpment.
Dual expressway crossings of the Niagara Escarpment to allow the northbound and southbound lanes to straddle Ontario Hydro transmission lines.	Single combined crossing of the Niagara Escarpment (on a 4% grade) with a relocation of one hydro tower
Vertical cuts through the Escarpment	A benched notch through the Escarpment to reduce the visual impact and to provide opportunities for cliff dwelling plants to grow
Extensive fill at the base of the Escarpment that would modify the landscape within the vicinity of the Expressway	A 220 meter viaduct at the base of the Escarpment that provides habitat continuity for wildlife movement and for hikers and requires minimal change in grading of landscape. A wetland is created for stormwater management
Loop interchange at Greenhill Avenue requiring maximum area of land	A diamond interchange at Greenhill Avenue reduces the land required
Mount Albion Road is closed at King Street to accommodate the interchange ramps	A bridge connection from Mount Albion Road to Lawrence Road provides a connection for the neighbourhood to King Street
Basket weave ramps between King Street and Queenston Road	No basket weave ramps in this area.

1985 Expressway Design RHVP	Current Expressway Design RHVP
4 km of creek bank in concrete channel	7 km of natural channel creek design minimizes the need for concrete. The 200 meter concrete channel at Queenston Road will be removed.
14 additional bridge/culvert crossings	8 additional bridge / culvert crossings.
Pedestrian access over the Expressway near the Escarpment and at Melvin Avenue	Pedestrian access under the Expressway at the base of the escarpment (see viaduct above). Barton Street bridge and Greenhill bridge have modified bridge designs that slow down vehicles and separate the pedestrian traffic from the vehicular traffic.
Stormwater management addressed road runoff	Stormwater management addresses both stormwater quality and quantity by using a watershed context. Stormwater management ponds also treat existing runoff from some developed areas adjacent to the Expressway as well as road runoff.
No trail system proposed.	A Master Recreational Plan has been updated to include relocation of the trails where they will be disturbed by the road and creek work.

In simple terms, previous plans protected for the widening on both parkways and planned to widen toward the centre to fill in the present open rural median with a concrete dividing barrier. This widening would remove any safety issues of collisions related to the rural median and crossover collisions for one direction to traffic in the other direction.

The outer boulevards of the LINC and RHVP in both directions were designed essentially to their ultimate condition. The LINC boulevard elements such as curb and gutter on the outsides of the LINC lanes cannot be removed due to the lack of additional width to implement a grading and drainage solution that can fit in the ROW.

There are no such similar road widening concerns on the RHVP. RHVP is built with a rural cross section and generally follows the natural profile of the valley to limit impacts. Unlike the LINC it does not have significant use of curb and gutter but rather mainly has shoulders and ditches. Some locations have a fully paved shoulder for a modest distance (5m +/-) sloping down to fencing.

4.4.2 Pavement Condition

As mentioned in Section 3, the condition of the pavement varies across the RHVP and LINC and is generally worse on the LINC due to its age and maintenance program to date. While a geotechnical study is not part of the scope of this study, we expect that the urban nature of the boulevard may be a significant factor in the deteriorating pavement condition of the LINC. The urban drainage is constrained and buried. When wet, the roadway granular materials have less structural strength and rigidity to support the asphalt which can result in more rapid deterioration of the pavement structure and the asphalt surface. Over time elements such as roadway subdrain have become clogged by fine materials and are not able to drain away water that enters the roadway structure.

There are no such similar concerns on the RHVP as the right shoulder is graded to provide ditches and rural open drainage of the roadway subdrain.

4.4.3 Noise Mitigation

As described in Section 3, noise barriers were installed along the majority of the LINC and a small section of the RHVP during construction of the two parkways. The locations of existing noise walls along the full corridor are shown on the design plans included in Appendix A. Along the RVHP, barriers are present in areas where noise barriers are present, noise complaints may in part be due to noise mitigation measures lacking sufficient height since many specific developments were planned and built after the noise mitigation was installed.

4.4.4 Stormwater Management (SWM)

The design of the RHVP includes controls for both stormwater quantity and quality. From a flood management perspective, three stormwater management facilities for flood control at Dartnall Road, Greenhill, and Davis Creek were designed to handle a 100-year storm event. The RHVP also includes 14 stormwater management facilities for water quality (11 of which are owned by the City with the remaining owned by the Ministry of Transportation) and 2.9 km of Combined Sewer Overflow (CSO) Storage Pipe. The Red Hill Valley Storage Pipe, which was constructed as part of the RHVP but did not become operational until the end of 2011, eliminated three CSO discharge points.

The City of Hamilton initiated an Integrated Monitoring Plan in 2007 to address the environmental compliance monitoring requirements of various permits and approvals for the RHVP, including those related to stormwater. A summary report was prepared by Amec Foster Wheeler (now WSP) in June 2018 at the conclusion of major monitoring activities. The findings of that report include:

- Though rare, flooding events seem due to exceedances of the design capacity, and some were noted due to water passage blockages that occurred at that time.
- The flood control facilities that were operating at the time of the report (Dartnall and Greenhill) functioned as designed, while the Davis Creek facility was not yet commissioned when the monitoring occurred.
- The 14 stormwater quality control facilities are largely performing as designed (removing 80% of total suspended solids on average annually), and contaminant levels from the facilities are far lower than concentrations within Red Hill Creek.

4.4.5 Illumination

The design plans in Appendix A show the locations of existing conventional illumination along the full corridor, which is mainly at decision points. The plan also shows illumination at the connections to QEW and Highway 403 where MTO High Mast Lighting illuminates the interchange areas under MTO control.

4.5 Transportation Planning Environment

The following table, taken from the Transportation Association of Canada (TAC) Geometric Design Guide for Canadian Roadways, shows the differences in functions and characteristics of parkways / expressways (such as LINC and RHVP) and freeways (such as QEW/Highway 403). This is important context to keep in mind when evaluating the volumes and level of service on the LINC and RHVP.

Table 5: Characteristics of Freeways vs Parkways/Expressways (Source: TAC Geometric Guide for Canadian Roads)

Category	Parkways/Expressways (RHVP/LINC)	Freeways (QEW / Hwy 403)
Traffic Service Function	Traffic Movement	Optimum Mobility
Traffic Volume	> 10,000 Veh/Day	> 20,000 Veh/Day
Flow Characteristics	Uninterrupted Except at Signals	Free-Flow (Grade Separated)
Design Speed	80 – 110 Km/H	80 – 120 Km/H
Average Run Speed	60 – 90 Km/H	70 – 110 Km/H
Assumed Lane Capacity	1,700 Veh/H/Lane	2,000 Veh/H/Lane
Accommodation of Pedestrian/ Cyclists	Prohibited	Prohibited
Transit Service	Express Buses	Express Buses

The last two rows of Table 5 are key to note in the context of this study. Multi-modal transportation solutions tend to be the best way to address future transportation issues, however the stated purpose of parkways and expressways like the LINC/RHVP corridor is to serve traffic, not transit or pedestrians and cyclists. This report will speak to the accommodation of these modes within, across and adjacent to the corridor, however providing facilities for these modes within the corridor will be challenging without major investment in supporting connections.

4.5.1 Existing Transit Service

Figure 12 displays the HSR routes that operate along or across the RHVP and LINC corridor. As shown in the figure, there is currently only one transit route that runs along the RHVP / LINC corridor – Route 11, which connects Mud Street West to downtown Burlington. Otherwise, there are numerous routes that run perpendicular to the LINC and RHVP, generally all connecting into downtown Hamilton, including Routes 1, 2, 4, 5, 20, 21, 22, 23, 24, 26, 27, 34, 35, 41, 43, 52 and 55. It should be noted that the transit routes shown in the figure don't reflect the full extent of the transit routes themselves – they are just to provide an overview of where transit operates in proximity to the RHVP/LINC corridor. It is notable that the only crossing or interchange of the RHVP/LINC corridor that doesn't feature a transit route is the Dartnall Road interchange – all other crossings or interchanges have at least one transit route serving the area.

In addition to HSR routes, the current GO Transit stations and connections are shown in green, including rail lines, bus lines, and stations. It is noted in Section 1.4.2. that the Metrolinx RTP proposes some changes to service frequency that have already been implemented, including the two-way, all-day GO service between Aldershot GO and Hamilton GO stations.

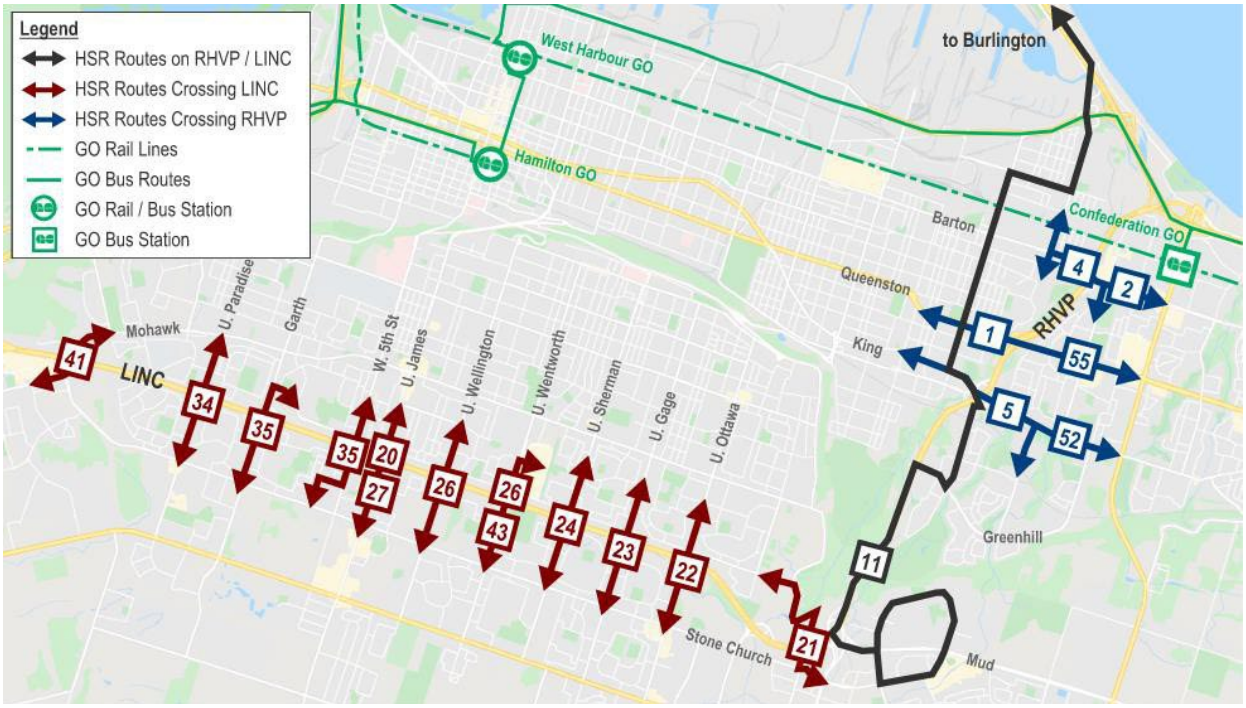


Figure 12: Existing Transit Services

4.5.2 Existing Active Transportation Network

Active transportation is a key component of the transportation network. It provides a sustainable alternative to travel by single occupancy vehicles, resulting in physical, economic, and social benefits from improved air quality, reduced energy consumption and increased physical activity. The following is a list of existing active transportation facilities across and adjacent to the LINC and RHVP that accommodate both pedestrians and cyclists, also shown on Figure 13.

Lincoln Alexander Parkway

- Golf Links Road/Mohawk Road – Sidewalks and Bike Lanes
- Active Transportation Underpass between Golf Links/Mohawk – Multi-Use Trail
- Upper Paradise Road – Sidewalks and Bike Lanes
- Active Transportation Bridge between Garth Street and West 5th Street – Multi-Use Trail
- West 5th Street – Sidewalks and Bike Lanes
- Upper Sherman Avenue – Sidewalks and Bike Lanes
- Active Transportation Bridge east of Dartnall Road – Multi-Use Trail

Red Hill Valley Parkway

- Active Transportation Underpass North of Mud Street – Unpaved Multi-Use Trail
- Greenhill Avenue – Sidewalks and Bike Lanes
- Barton Street East – Multi-Use Trail

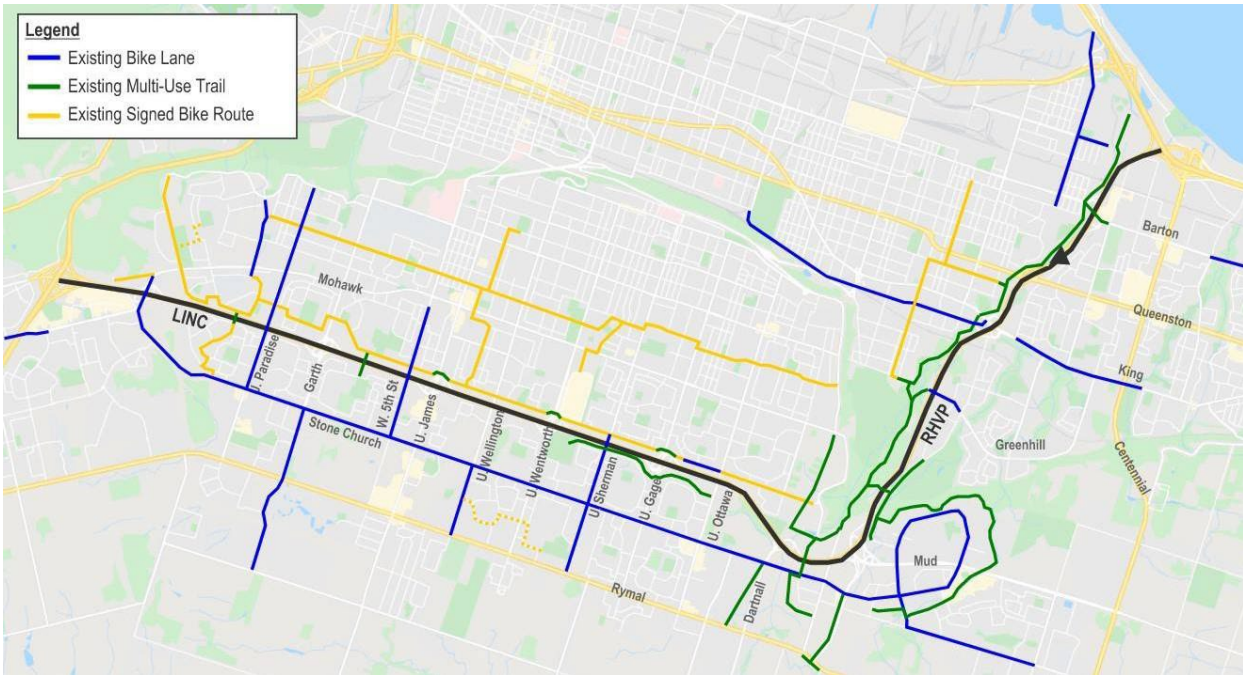


Figure 13: Existing Active Transportation Facilities

The map shows that there is good existing north-south connectivity across the LINC, including on bridges and underpasses at Upper Paradise Road, West 5th Street and Upper Sherman Avenue. It is notable that most of the roadways that feature cycling facilities are roadways that do not have interchanges with LINC. This is beneficial as free-flow on- and off-ramps can pose a safety risk to active transportation users. While the Stone Church Road bike lanes provides an east-west active transportation corridor parallel to LINC on the south side, there is not a segregated east-west corridor on the north side of LINC. There are two signed east-west bike routes, one generally running on Limeridge Road and the other generally running on South Bend Road, however a fully separated east-west facility, such as cycle tracks or a multi-use trail, may provide an attractive facility to help shift single occupancy vehicle commuter trips to cycling trips.

There are only three cycling crossings of RHVP: bike lanes on Greenhill Avenue, a multi-use trails at Barton Street and an unpaved trail underpass north of Mud Street. A noted gap in the active transportation network along RHVP is a separated facility that parallels the RHVP on either side. The Red Hill Valley Trail is a well-used walking trail but does not lend itself to commuting trips that require more direct facilities.

4.5.3 Existing Mainline Traffic Volume

Existing mainline traffic counts were provided by the City of Hamilton for five weekdays, at 15-minute intervals across 24-hour periods. Some locations included only speed or classification data, organized by number of vehicles travelling at a certain speed, and therefore the volume calculations for these sections are different than those locations with full traffic counts. The traffic volume data previously shown in Figure 4 are shown again in Figure 14 below. These data come from 2018 and 2019 traffic counts, which is the latest year that consistent data for multiple locations along the parkways was provided.

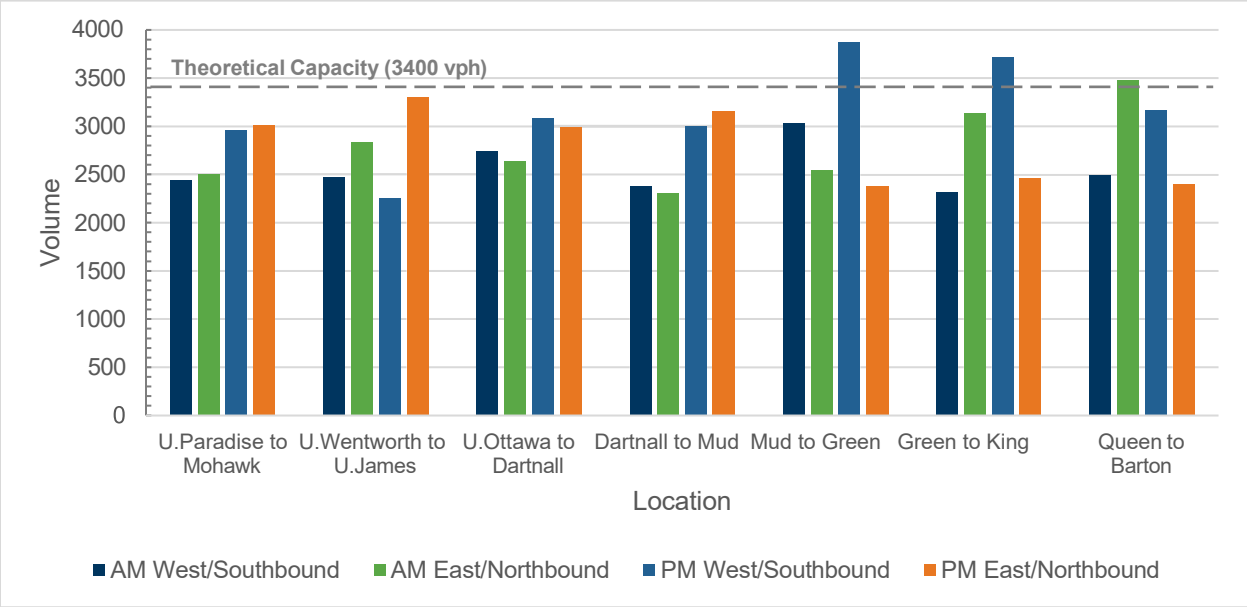


Figure 14: Traffic Volumes (2018/2019) along LINC and RHVP

Some notable takeaways from the mainline traffic volumes are listed below:

- The directional split on LINC (51% westbound and 49% eastbound in AM peak, 48% westbound and 52% eastbound in PM peak) is more balanced than on RHVP (43% southbound and 57% northbound in AM peak, 60% southbound and 40% northbound in PM peak).
- The pronounced differences in traffic flow on RHVP can likely be attributed to two reasons:
    - The heavier northbound volumes into downtown in the morning, and the heavier southbound volumes out of downtown in the afternoon.
    - The heavier northbound volumes onto the QEW into the Greater Toronto Area (GTA) in the morning, and the heavier southbound volumes from the QEW out of the GTA in the afternoon.
- The traffic flow on LINC tends to be more evenly distributed between the eastbound and westbound directions in both peak hours.

- This indicates that the benefits of widening the parkways in both directions appear to be less pronounced on RHVP than on LINC, due to the uneven directional split.

Based on previous traffic reports, a range of 30-38% of the truck traffic and 7-12% of light vehicle traffic entering the parkways is pass-through traffic. The highest percentage of pass-through truck traffic (38%) occurs during the PM peak hour and enters the LINC at its west end, exiting the RHVP at the north end.

Figure 15: Existing (2019) EMME/3 Traffic Volumes

In addition to the traffic volume counts provided by the City of Hamilton, the City also provided existing and future EMME models for the AM peak hour. It was indicated that no updates to the base (i.e., existing conditions) model were required, as the City's model was undergoing a major update that includes the model structure, coding system, zonal boundaries, and forecasting for future horizon years. While EMME models are generally used for projecting future traffic data, they do provide a good "reality check" for the existing traffic volumes. The following figure shows the volumes along different sections of LINC and RHVP for the existing conditions.

When comparing the volumes in Figure 14 to the volumes in Figure 15, there are a few conclusions that can be drawn:

- The EMME model appears to significantly underrepresent the off-peak direction traffic volumes (i.e., westbound/southbound in the AM peak hour) on the LINC and RHVP relative to the real-world traffic counts. It is not uncommon for EMME models to significantly underrepresent traffic in the off-peak direction, hence the preference to use real-world traffic volumes when evaluating the existing conditions.
- The EMME model appears to slightly underrepresent the peak hour, peak direction traffic volumes (i.e., eastbound/northbound in the AM peak hour) on the LINC and RHVP relative to the real-world traffic counts from the City of Hamilton.

- Given the above, the EMME volumes would not be recommended for use in existing conditions analysis, however, are appropriate for use in future scenario analysis.

4.5.4 Peak Hour Versus Peak Period Volume Spread

The following graphs display the traffic volumes in each direction on the LINC and RHVP, with westbound/southbound volumes shown in green and eastbound/northbound volumes shown in blue. The volumes are shown for every fifteen minutes, with AM and PM peak hours and peak periods (generally three hours) identified on each graph in dark grey and light grey, respectively.

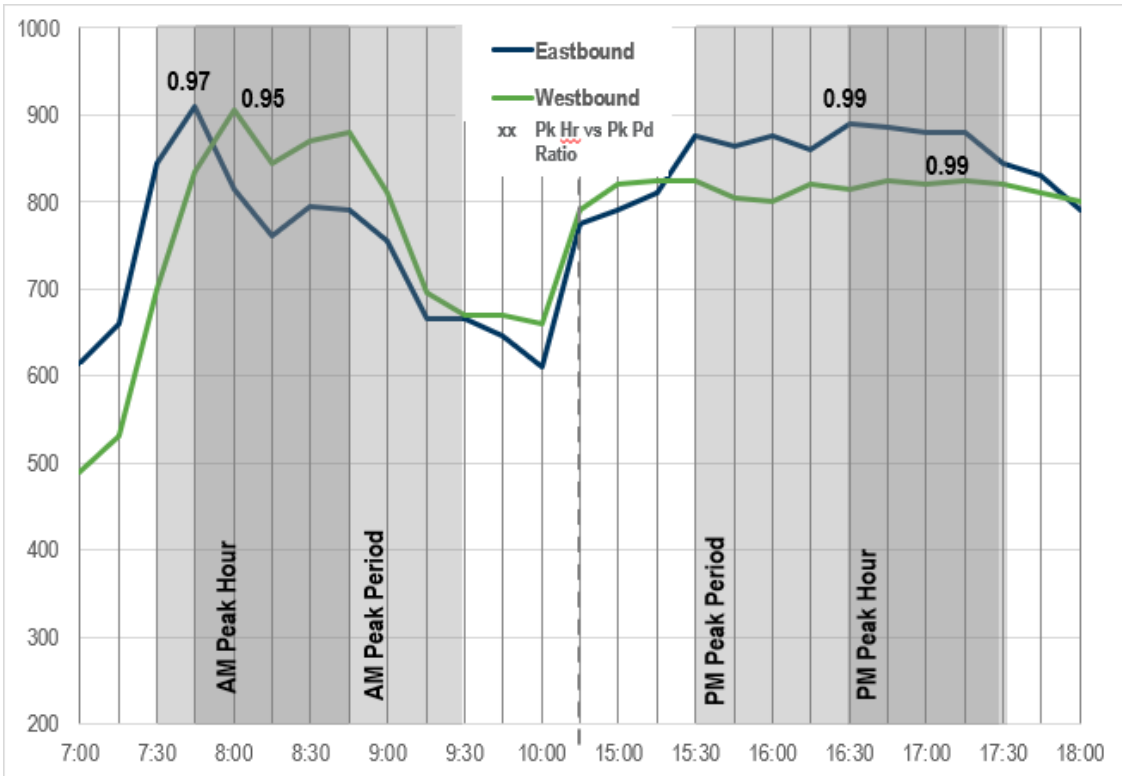


Figure 16: LINC Existing AM & PM Peak Period Volumes – West of Dartnall Road

The numbers at the top of each graph represent the peak hour versus peak period ratio of traffic volumes. The closer the ratio is to 1.0, the less potential remains for peak spreading, which encourages commuters to take their trips outside of the peak hour, reducing the traffic demand on the network at that time. This is a common form of transportation demand management (TDM) in larger municipalities.

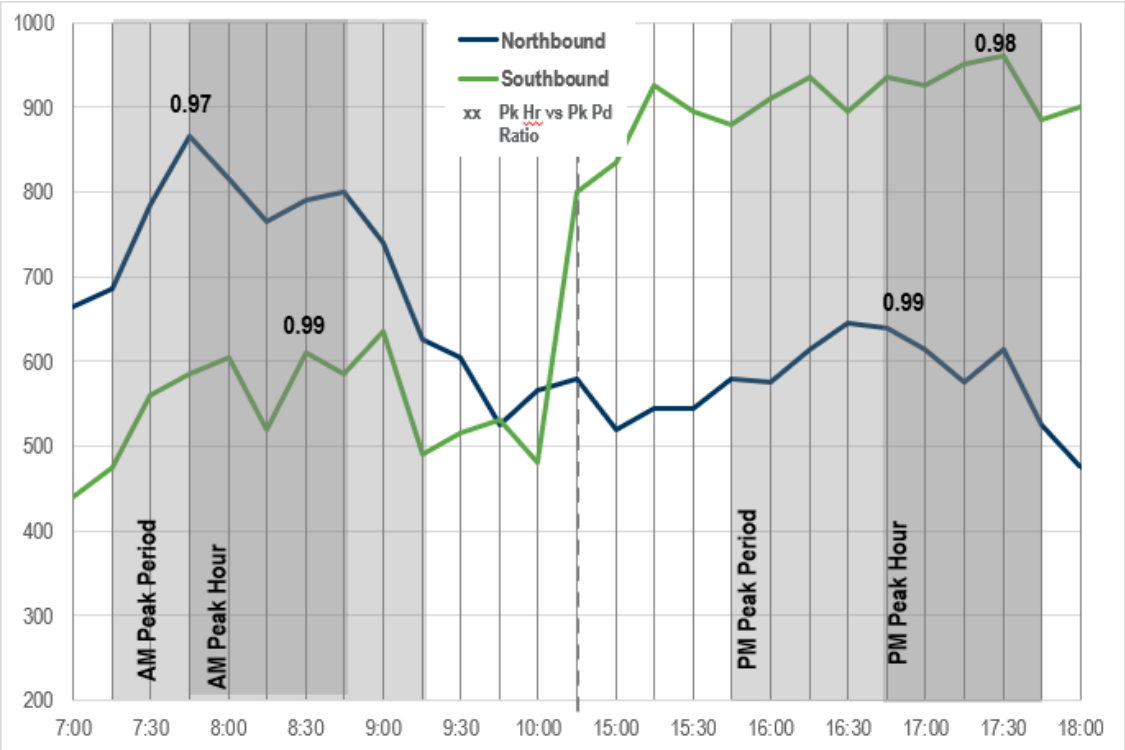


Figure 17: RHVP Existing (2019) AM & PM Peak Period Volumes – South of King

The graphs indicate that there is unrealized potential for peak spreading during the AM peak period on LINC. On the RHVP, there is unrealized potential in both peak directions (i.e., northbound in the AM peak, southbound in the PM peak).

4.5.5 Traffic Volume Growth

Of the available traffic data, the only location with traffic volumes for multiple years across the last decade was on the LINC near Upper Wellington Street. The other locations along the parkways had traffic data for only a single year, and therefore could not be used to compare volumes across multiple years. Therefore, the use of the data from this location near Upper Wellington Street to estimate traffic growth is assumed to apply to both LINC and RHVP.

The graph below shows the vehicles per hour during the AM peak hour in the eastbound and westbound directions over the last ten years. Based on the graph, it is clear that traffic volumes in the morning peak hour have been generally increasing over the last ten years in both the eastbound and westbound directions. However, there was a significant increase in traffic volumes in both directions from 2017 to 2019, with an increase of over 300 vehicles per hour (vph) in each direction. This is notable as there appeared to generally be linear growth in traffic volume from 2014 to 2016 and draws the question of if the 2019 traffic data may be an outlier relative to the rest of the data.

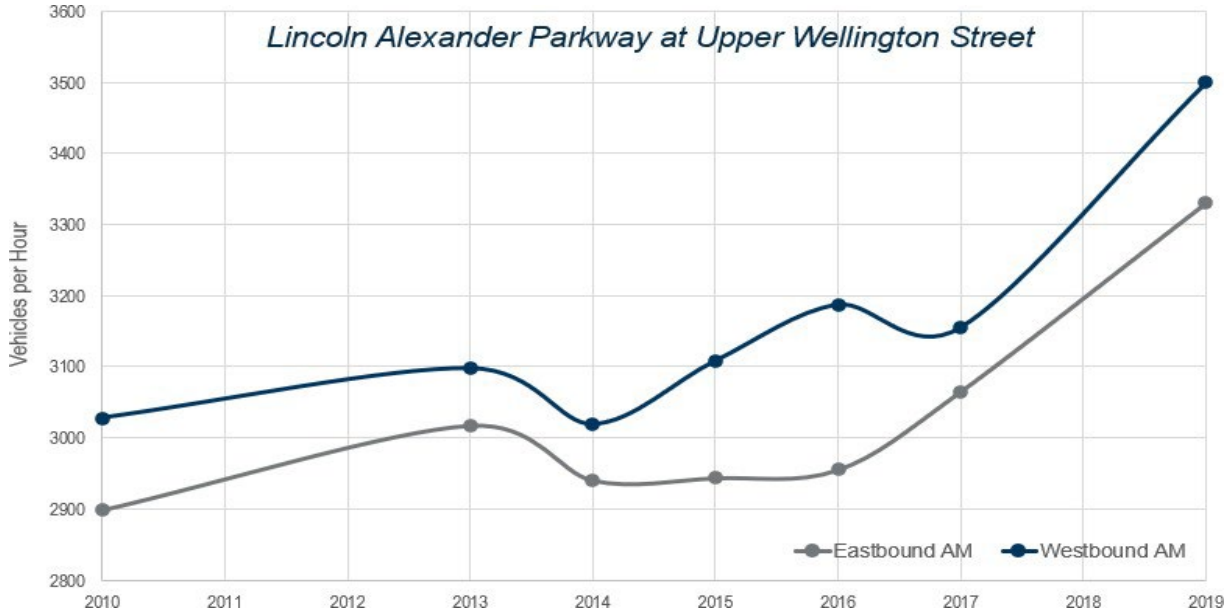


Figure 18: LINC at Upper Wellington Street (2010 - 2019)

4.5.6 Existing RHVP and LINC Capacity

The following section will provide a high-level overview of the assumed capacity of the RHVP & LINC corridors based on different evaluation methods. It will also review the volume to capacity (v/c) ratio which is one method for evaluating if a given roadway should be improved or expanded.

Theoretical Capacity

As shown in Table 6, the TAC Geometric Design Guide for Canadian Roadways (GDGCR) has a default assumed lane capacity of 1,700 vehicles per hour per lane (veh/H/lane) for parkways and expressways like RHVP and LINC. It should be noted that this figure is intended for high-level estimates and should not be used for detailed analysis. Factors such as roadway grades, lane widths, percentage of truck traffic and other inputs can change the actual capacity of a roadway. As stated in the TAC GDGCR: “the Highway Capacity Manual (HCM) continues to be the single most important reference for capacity and level of service calculations”. This report undertakes capacity and level of service calculations using the HCM in Section 5.6 for future traffic volumes.

Based on the traffic volumes shown above, and the theoretical capacity from the TAC GDGCR the following table reflects the theoretical volume to capacity ratio for different portions of the LINC and RHVP.

Table 6: Theoretical Volume to Capacity Ratio of LINC and RHVP

Parkway	Location	Direction	Capacity (veh/h/dir)	Peak Hour Volume		V/C Ratio	
				AM	PM	AM	PM
LINC	U. Paradise to Mohawk	Eastbound	3400	2505	3010	0.74	0.89
		Westbound	3400	2440	2965	0.72	0.87
	U. James to U. Wentworth	Eastbound	3400	2840	3304	0.83	0.97
		Westbound	3400	2470	2255	0.73	0.66
	U. Ottawa to Dartnall	Eastbound	3400	2645	2995	0.78	0.88
		Westbound	3400	2740	3090	0.81	0.91
RHVP	Dartnall to Mud	Northbound	3400	2315	3160	0.68	0.93
		Southbound	3400	2380	3005	0.70	0.88
	Mud to Greenhill	Northbound	3400	2545	2380	0.75	0.70
		Southbound	3400	3040	3875	0.89	1.14
	Greenhill to King	Northbound	3400	3140	2465	0.92	0.73
		Southbound	3400	2320	3715	0.68	1.09
	Queen to Barton	Northbound	3400	3475	2400	1.02	0.71
		Southbound	3400	2490	3170	0.73	0.93

Based on the theoretical capacity in the TAC GDGCR, there are some sections of RHVP that appear to be operating over capacity, while there are no sections of LINC over capacity (albeit with two sections approaching capacity with a v/c ratio over 0.90). It is notable that the majority of over-capacity sections (and the two approaching capacity sections on the LINC) are in the PM peak hour rather than in the AM peak hour.

EMME Volume to Capacity

Notwithstanding the above notes on the existing EMME model underrepresenting traffic volumes relative to the real-world traffic volumes, an EMME plot of the existing volume to capacity (v/c) ratio for RHVP and LINC is provided below to compare the results against the theoretical capacity.

Two important considerations should be noted regarding the EMME model results: the assumed lane capacity in the EMME model is 1800 veh/h/lane, which is slightly different than the capacity noted in the TAC GDGCR, and due to the lengthy merge lanes on the RHVP between Mud Street and King Street, the EMME model assumes there are three lanes in this section, rather than two.

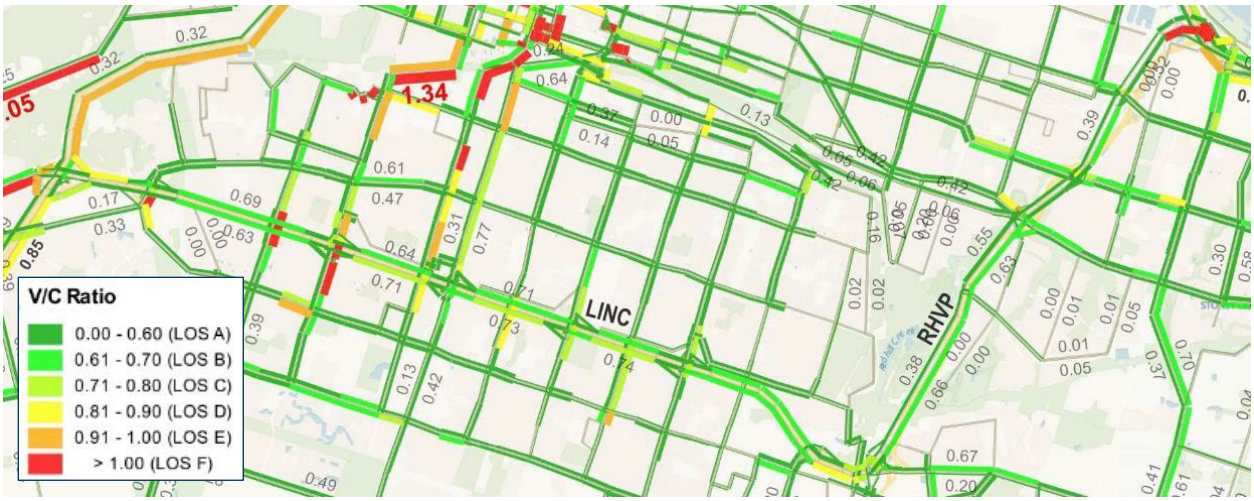


Figure 19: Existing EMME Model Volume to Capacity Ratio

It is notable that based on the City's EMME model, the only location shown as approaching (LOS 'E' or orange links) or over capacity (LOS 'F' or red links) is the interchange with RHVP and QEW, specifically the northbound RHVP approach to the interchange.

4.6 Parkway Safety

The following section provides a summary of previous safety studies undertaken on the LINC/RHVP corridor, followed by an assessment of specific areas of concern along the LINC and RHVP.

4.6.1 Previous Road Safety Assessment Findings

Roadside Safety Assessment – Red Hill Valley Parkway (2019)

The collision statistics provided below are from the detailed safety assessment completed in 2019 titled Roadside Safety Assessment – Red Hill Valley Parkway. Higher collision rates can be linked to congestion and weaving (i.e., differential in vehicular speeds entering the parkway versus those already on the parkway as traffic changes lanes) at the Mud Street on-ramp (E-W). The immediate area around the Mud Street interchange with RHVP lacks connectivity to other arterial north-south corridors, with Centennial Parkway the only alternative over 3.0 km to the east. This forces the majority of peak direction traffic from the area (i.e., northbound in the morning, southbound in the afternoon) to use Mud Street or the Upper RHVP.

Figure 20: Total Collision by Location (Mainline)

Figure 21: Fatal + Injury Collisions by Location (Mainline)

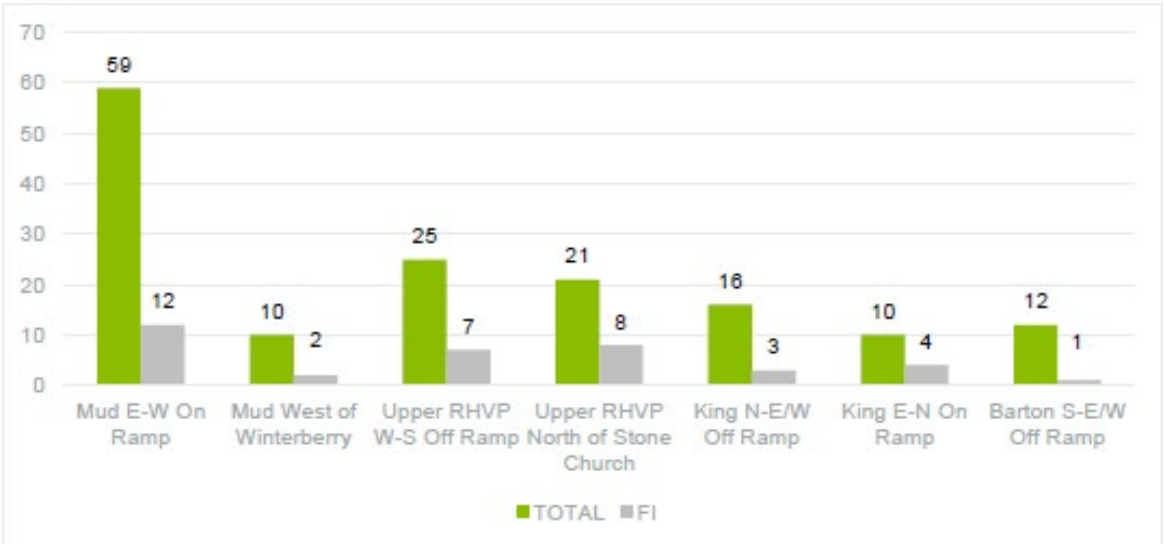


Figure 22: Collisions by Location (Ramp with 10 or More Collisions)

Hamilton LINC and RHVP Speed Study

The following conclusions are taken from the 2018 Hamilton LINC and RHVP Study that looked to establish a reasonable and safe speed limit along both the LINC and RHVP. Some improvements have already been implemented and some are being monitored.

- Signage has been improved and resurfacing is planned to address findings
- 100% of collisions on the Upper Red Hill Valley Parkway W-S Off-Ramp occurred on wet surface, and 80% of drivers were reported to having lost control or being too fast for conditions.
- 78% of all collisions on Mud Street E-W on-ramp on wet surface, with 67% of drivers having lost control or being too fast for conditions.
- Consider installing oversized speed limit signs/speed feedback signs and conducting regular speed enforcement, particularly in the vicinity of the King Street and Queenston Road interchanges.
- None of the ramps require modifications from the existing curve advisory speeds.
- Generally, traffic is overdriving the design, given the RHVP and LINC have lower design speeds of 100-110 km/h, compared to typical freeway design speed of 120 km/h.

The recommended locations and additional details for installing speed feedback signs are:

- Eastbound, 200m west of Pritchard Road
- Northbound, 550m north of Greenhill Avenue
- Southbound, 700m north of Queenston Road

- Southbound, 300m north of King Street

4.6.2 Collision Assessments – Geometry Review

In past safety studies, the focus was mainly on collision statistics, with minimal focus on the parkway's geometry. While statistics can help to identify specific areas that appear to be problematic, reviewing the geometry and design elements gives additional insight on what may be causing a higher number of collisions. The following section will review the geometry at one high-collision area in the LINC/RHVP corridor, and the juncture of the two parkways. We also provide a general review of the interchange types and issues.

Southbound RHVP – Mud Street to Dartnall Road

In this section of the RHVP, weaving on mainline and with ramp traffic causes increased collision potential and rates. In particular, a large portion of traffic from the pair of exit ramps from westbound and eastbound crosses the stream of the other exit ramp resulting in weaving on the short portion of the combined ramps approaching Stone Church Road. This situation is exacerbated by the ramp area for the weave shortened by the queuing traffic at the Stone Church Road signals. Space in the area limits major changes. These are the significant issues in the area impacting performance and operations:

- 7% less traffic than the segment just to the north on RHVP for SB to WB
- Lower speed average of segment at 92 km/hr vs 96 km/hr
- Many **more low speeds** <=79 km/hr, especially below 49 km/hr due to the on/off ramp movements causing turbulence, though less large trucks
- Many **more high speeds** in the 109-129 km/hr range, likely due to drivers rushing through the turbulent area, likely moving to inside lane to avoid weaving traffic
- Many **less than expected** in operating speed zone just above posted speed zone, especially 90-99 km/hr
- As traffic volumes increase in the future, the likelihood for collisions will also likely increase

Extending the third westbound lane on RHVP in the Dartnall Road area would improve these problematic issues and reduce the collision rate.

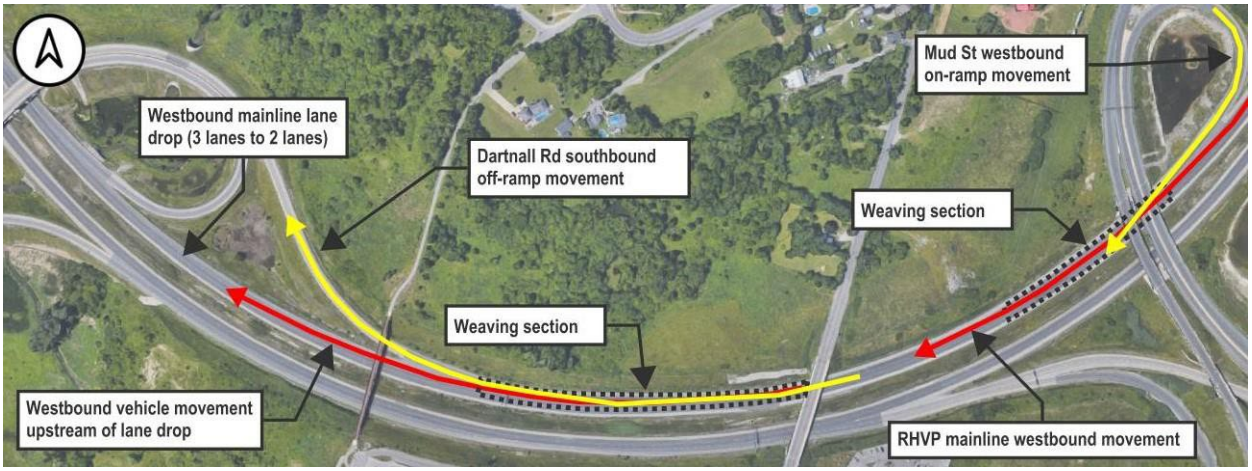


Figure 23: Existing Design Issues - Dartnall Road Interchange

At the Stone Church Road intersections for the ramp exits, signal timing may be changed to provide more green time to address queuing that forces earlier weaving further up the ramps and closer to the parkway traffic.

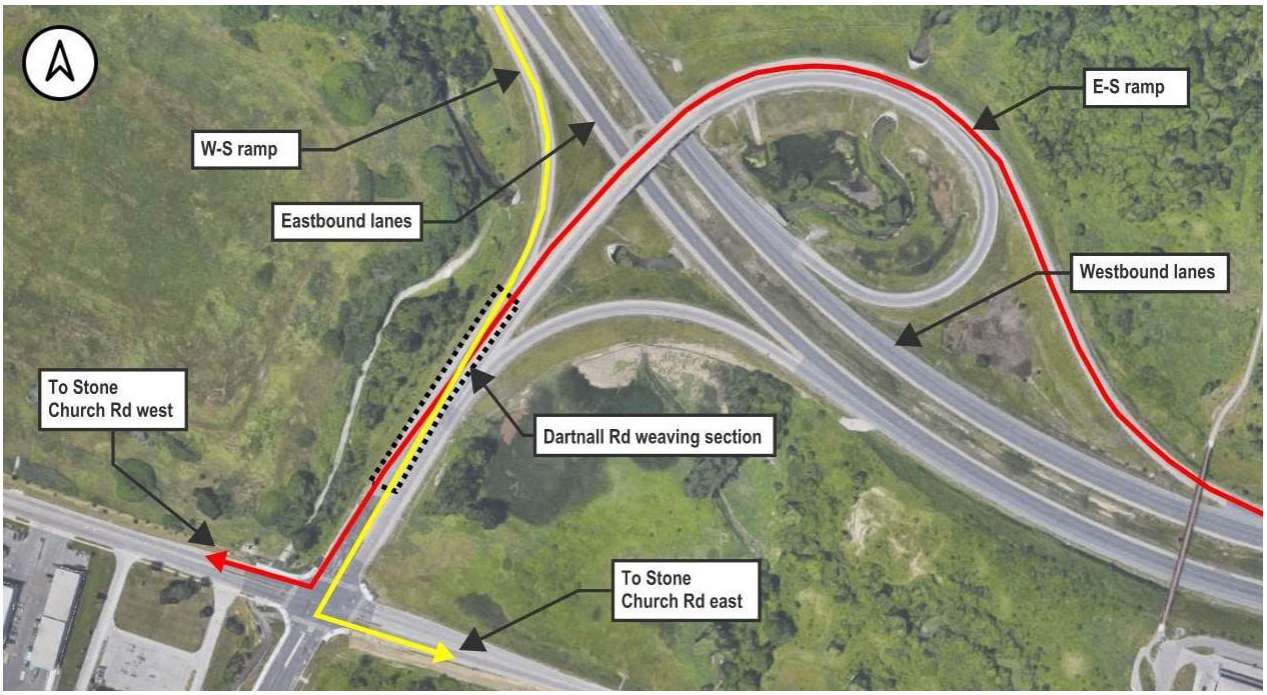


Figure 24: Existing Design Issues - Stone Church Road Intersections

Interchange Ramp Issues, including Trumpet Interchange Ramp Issues

Interchange ramps on the LINC are typical standard high performing Parclo A-4 ramps, MTO's preferred ramp configuration. RHVP and the connection to the LINC is configured with several other interchange configurations that are less desirable and more challenged as far as

operations due to the elevation differences some must address. Trumpet interchange layouts at Dartnall and Upper RHVP have inherent operational issues.

We expect ramp operational issues are due to a nearly tangential ramp exit turning into a tight radius followed by the southbound merging of two ramps before Stone Church Drive. The traffic on the ramps are changing speeds due to changes of geometry and then have an inherent weave when westbound traffic often continuing west causing weaving to make left turns and vice versa for eastbound traffic. Both interchanges exhibit queuing at the Stone Church Drive ramp terminal, quickly ending from higher speeds of the parkways at a traffic signal that at times is on a red phase require a quick stop by ramp traffic. This results in rear ending due to speed and side swipe collisions due to weaving traffic making turns onto Stone Church Drive.

There are tight ramp cross sections, especially for trumpet curved ramps at Dartnall and Upper RHVP with tight left shoulders and modest 2.5m right shoulders, as shown on Figure 25. High ramp collision rates especially on ramps in part are likely tied to tight cross section with many on steep grades so require guiderail on one or both sides that constrains width/sightlines. Dartnall and Upper RHVP trumpet ramps are more of a concern but also King E-N on ramp, and a lesser concern for 2 lane ramps that open to 3 lanes such as at King E-W exit and Barton S-E/W exit. Geometry is more challenging with high large truck traffic and especially when a disabled or parked vehicle further constrains the ramp width. This is a review to be completed as part of the future program for upgrading.

Figure 25: Interchange Ramp Issues, including Trumpet Ramps

5. FUTURE TRANSPORTATION ANALYSIS

5.1 Future Transit Services

In addition to the Existing Transit Services, as summarized in Section 4.6.1, there are several future transit services identified for the Hamilton area, including the Hamilton B-line Light Rail Transit (LRT) along Main Street-King Street-Queenston Road that received a significant investment in 2021 from the Province of Ontario and Government of Canada. This is part of the proposed Hamilton BLAST network, which also includes the L-line (priority bus service on Highway 6-York Boulevard), A-line (BRT and priority bus service on James Street and Upper James Street), S-line (priority bus service on Centennial Parkway-Upper Centennial Parkway-Rymal Road-Garner Road), and the T-line (priority bus service on Kenilworth Avenue-Upper Ottawa Street-Mohawk Road). This network is shown in blue in Figure 26 below. Over the course of this project, the City completed its (Re)Envision the HSR study, which is a major redesign of the City of Hamilton's transit network. The conclusions from this study, which include provision of transit service on RHVP between Mud Street and Queenston Road, will result in changes to the future transit network, therefore it is acknowledged that the information provided below may be different for what ultimately is put in place for HSR.

Proposed GO Rail improvements, including increases to service frequency and the new Confederation GO Rail Station are shown in green. Additional proposed transit improvements as part of the Greater Golden Horseshoe (GGH) Transportation Plan are shown in maroon, which include express bus service from Hamilton to Guelph and Hamilton to Kitchener.

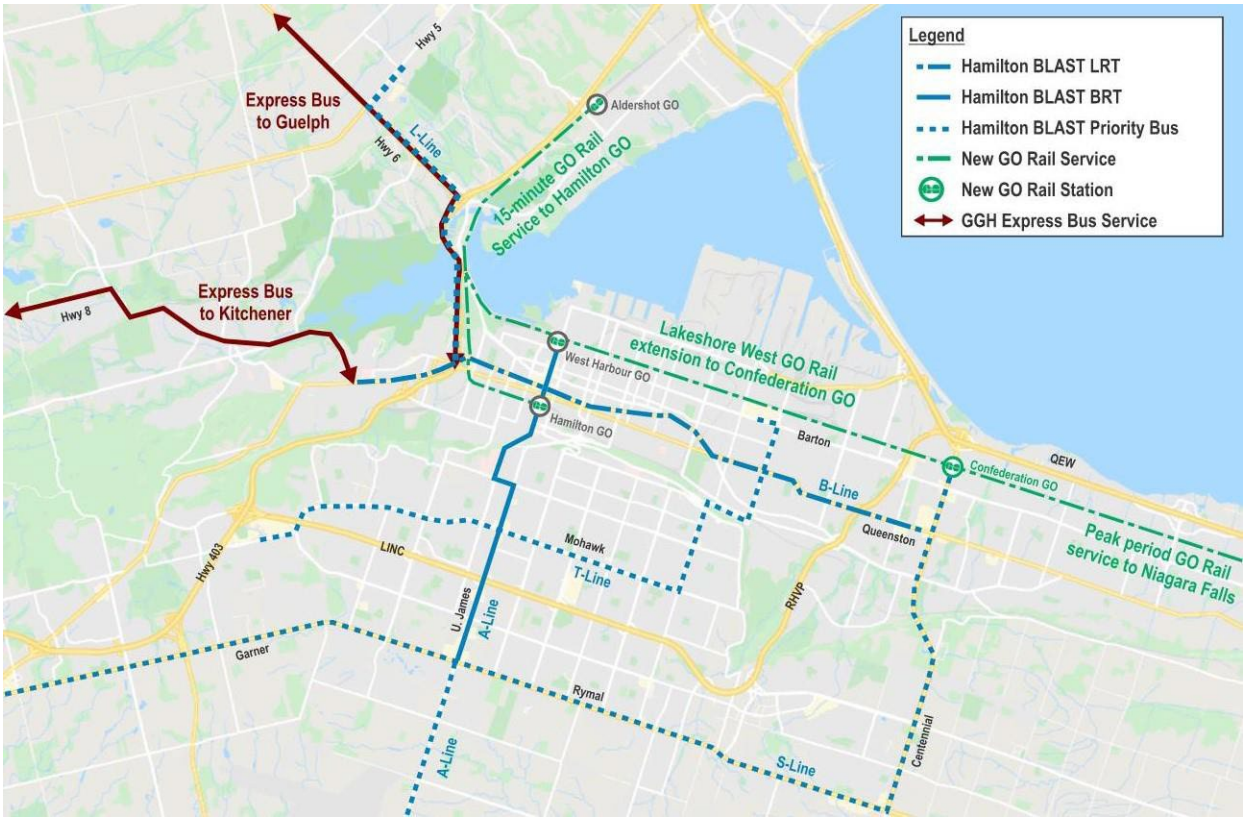


Figure 26: Potential Future Transit Services

As noted above, the (Re)Envisioning HSR study proposes transit service on RHVP from Mud Street to Queenston Road. This provision of transit service for a short section of the parkway is notable for a few reasons:

- Priority bus service is already being proposed as part of the Hamilton BLAST network on two corridors that parallel the LINC/RHVP on the T-line (Kenilworth-Upper Ottawa-Mohawk) and the S-line (Centennial-Upper Centennial-Rymal-Garner). Route 30 is one of the routes proposed to run on the RHVP, which forms one of the routes on the S-line.
- Information provided by the City of Hamilton as part of this study indicated that the projected daily transit vehicle trips on the section of RHVP is 81 northbound trips and 119 southbound trips in 2031, increasing to 116 northbound trips and 180 southbound trips in 2051.
- There is a lack of transit-supportive infrastructure at LINC/RHVP ramp terminals to allow buses to exit the parkways, serve a bus stop, and return to the parkway in a timely matter. The lack of this infrastructure does not preclude transit service along LINC/ RHVP, however it makes servicing and connecting to arterial corridors along the parkways more challenging.

The two figures below compare an aerial image of the Garth Street ramp terminal at LINC (Figure 27) against the Woodroffe Avenue ramp terminal on Highway 417 in Ottawa (Figure 28), which features a transit connection to allow buses to easily exit and re-enter the ramps with a transit stop at the crossing road.

Figure 27: Garth Street at LINC Interchange with no Transit Infrastructure

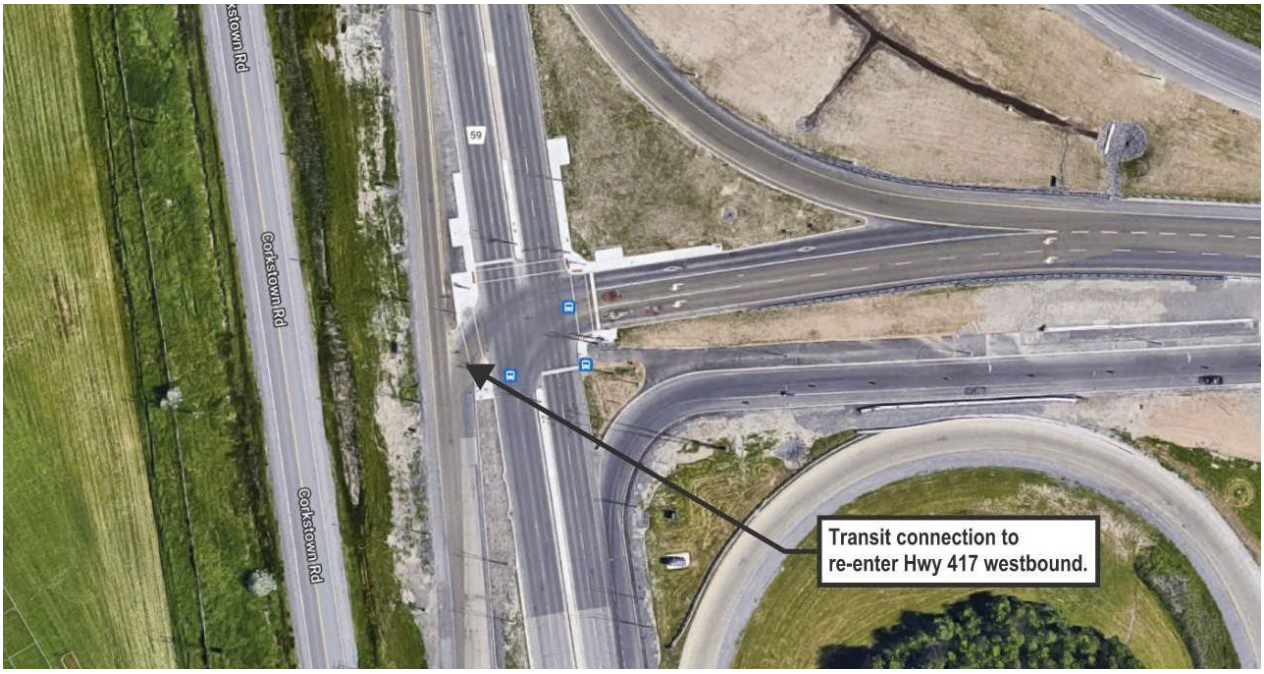


Figure 28: Example at Moodie Drive at Highway 417 Interchange with Transit Infrastructure

It is worth noting that with the proposed routing on the RHVP in the (Re)Envisioning the HSR study, there is no need for transit connection across ramps as shown, since no transit routes are proposed for the LINC and the transit on the RHVP would enter at Mud Street and exit at Queenston Road. These figures are merely provided as an example of potential improvements that can be made at ramp terminals in support of additional transit service on the LINC and RHVP in the future. Additional details are provided in Section 6.4.3. The land use and urban structure (as defined in the City of Hamilton Official Plan) around LINC/RHVP and the ramp terminals does not lend itself to heavy transit usage, as it is mainly low- to mid-density residential or open space. Compared against future rapid transit corridors that run parallel to LINC/RHVP such as Rymal Road, Mohawk Road, Centennial Parkway and James Street/Upper James Street, it is notable that the land uses and urban structures on these corridors offer more mixed-use and commercial designations. This is reflected in Figure 29 and Figure 30, taken from the City's OP.

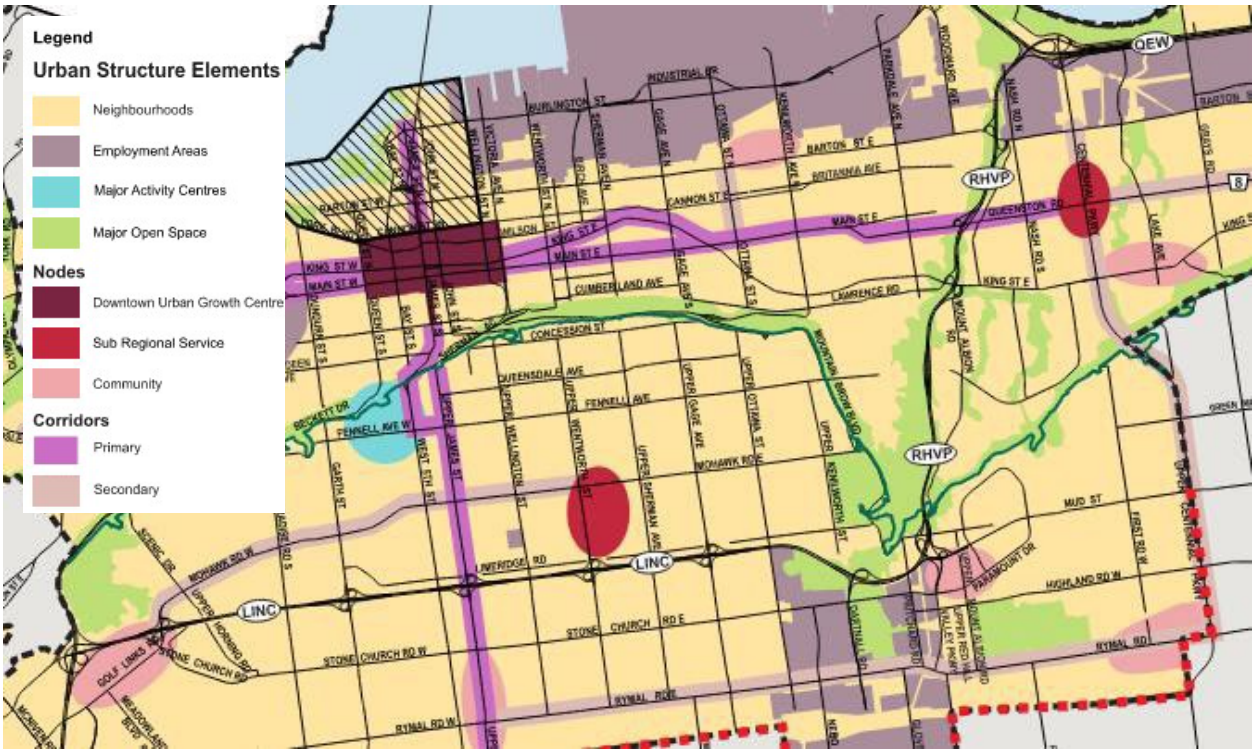


Figure 29: Urban Hamilton Official Plan Schedule E – Urban Structure

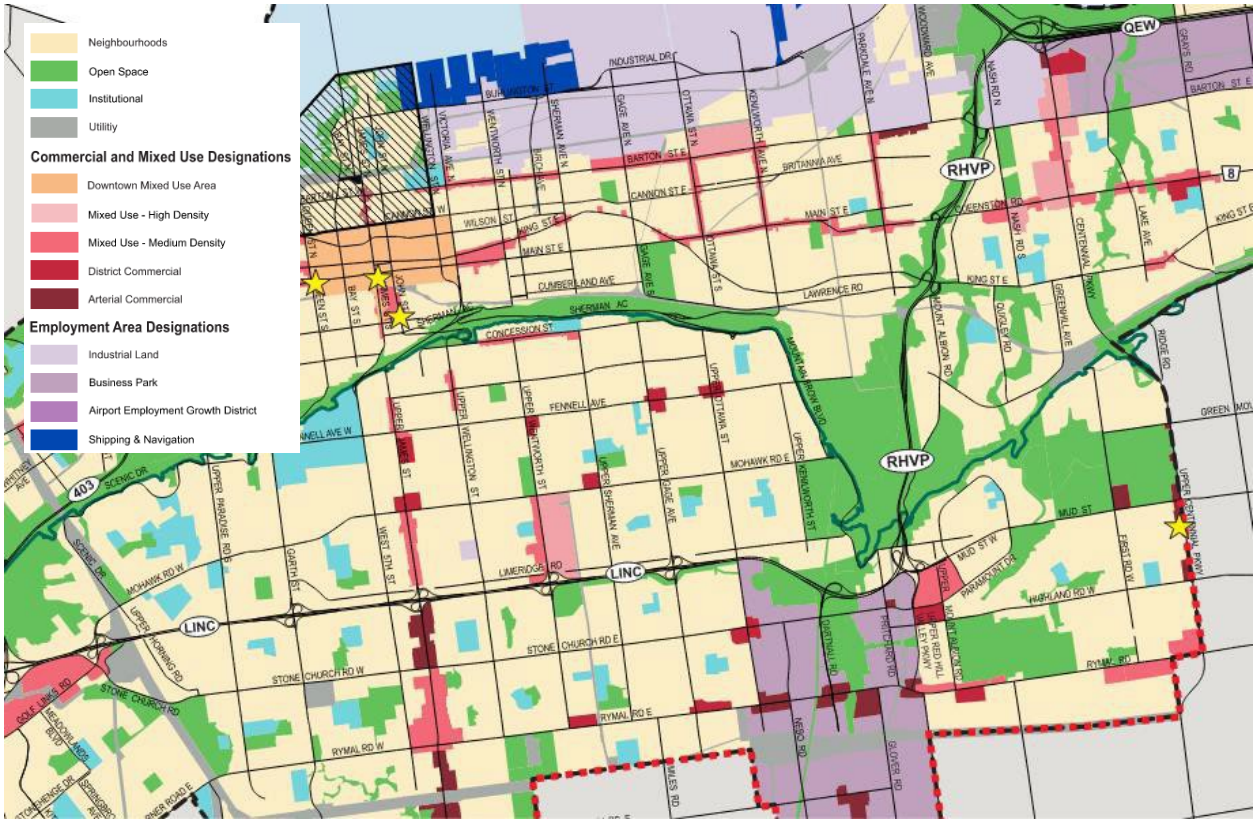


Figure 30: Urban Hamilton Official Plan Schedule E-1 – Urban Land Use Designations

These factors provide potential reasons for why rapid transit or transit priority facilities have not yet been formally proposed along LINC in long term planning documents. This will need to be considered in the evaluation of alternatives for the LINC/RHVP corridor, as the benefits of transit may not be realized without significant supporting investment in the corridor.

5.2 Future Active Transportation

In the City of Hamilton's Cycling Master Plan Update, both LINC and RHVP were flagged as major screenlines for which to monitor active transportation trips. Screenlines are generally considered to be major barriers that restrict walking and cycling connectivity, such as rivers, rail lines or highways, such as LINC and RHVP. Therefore, it is important to monitor active transportation activity on any crossings of LINC and RHVP, as well as provide safe facilities for pedestrians and cyclists.

In addition to the Cycling Master Plan, the City of Hamilton Recreational Trails Master Plan provides a reference for all trails within the City, including those running adjacent to and across LINC and RHVP.

In addition to the existing active transportation facilities identified in Section 4.6.2, the following is a list of proposed active transportation facilities across and adjacent to the LINC and RHVP that accommodate both pedestrians and cyclists. Figure 31 shows their location as outlined in the Cycling Master Plan and Recreational Trails Master Plan.

Lincoln Alexander Parkway

- Upper Wellington Street – Planned Bike Lanes
- Limeridge Mall Hydro Corridor Trail – Proposed Multi-Use Trail and Bridge
- Upper Ottawa Street – Planned Bike Lanes
- Upper Ottawa Street, Stone Church Road Link – Proposed Boulevard Trail

Red Hill Valley Parkway

- Mount Albion Link (East Mountain Trail Loop) – Proposed Multi-Use Trail
- Mt. Albion Road – Planned Bike Lanes
- King Street – Planned Bike Lanes
- Glengrove Avenue, Eugene Street, Red Hill Valley Link – Proposed Multi-Use Trail and Bridge
- Museum of Steam and Technology Link – Proposed Multi-Use Trail

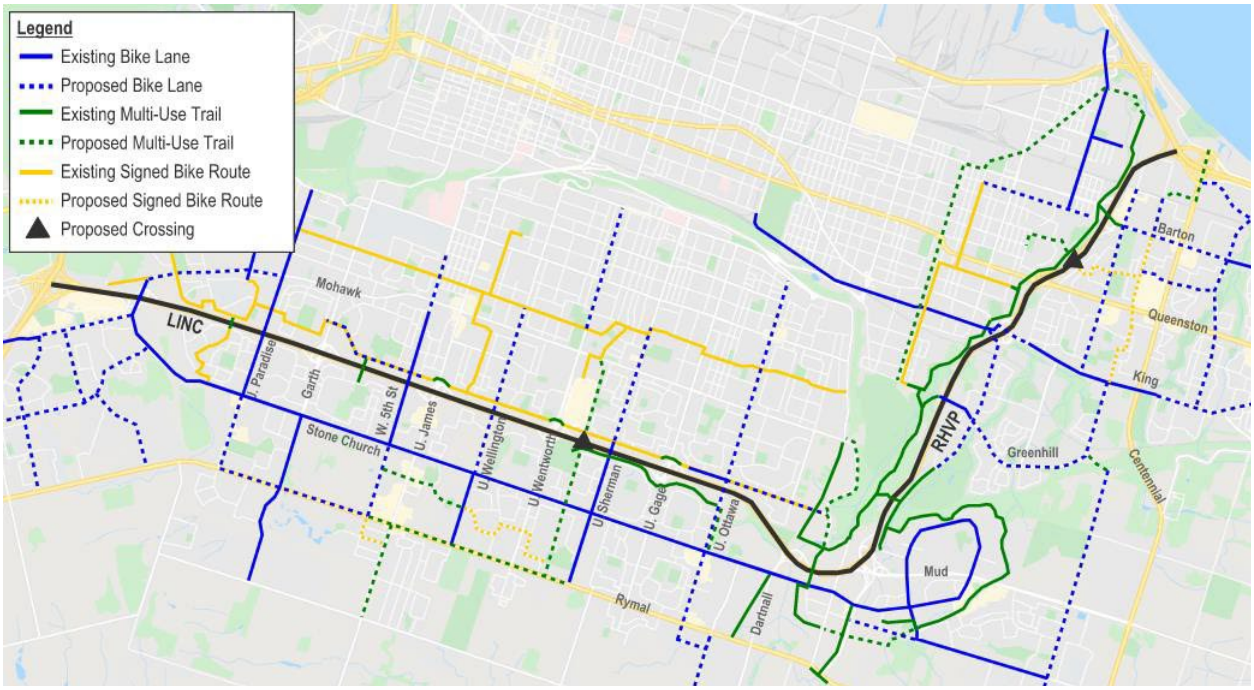


Figure 31: Existing and Proposed Active Transportation Connections

Given the significant barrier that is posed by the LINC, additional north-south cycling facilities across the LINC are proposed on Upper Wellington Street, Upper Ottawa Street, and a new active transportation bridge along the Limeridge Mall Hydro Corridor Trail. As previously identified, it is notable that there is not a segregated east-west corridor on the north side of LINC. There are two signed east-west bike routes, however a fully separated east-west facility

such as cycle tracks or a multi-use trail, may provide an attractive facility to help shift single occupancy vehicle commuter trips to cycling trips.

It is anticipated that the proposed future cycling facilities across RHVP will allow for improved connectivity, including bike lanes on King Street and Mt. Albion Road, and a new active transportation bridge between Barton Street and Queenston Road. The previously noted gap in the active transportation network along RHVP should be rectified with the completion of bike lanes on the First Road-Greenhill Avenue-Nash Road corridor on the east side of RHVP, and the Hydro Corridor Multi-Use Trail from Barton Street to Lawrence Avenue on the west side of RHVP.

5.3 Future Roadway Plans

The City of Hamilton TMP Update identifies numerous improvements to the roadway network, with the majority of the improvements in the southwest area of the City. Minimal changes are proposed within the vicinity of the RHVP/LINC corridor, with only improvements of Stone Church Road, Upper Wellington Street and Rymal Road close to the corridor. The widening of the Garner Road-Rymal Road corridor from Wilson Street west to West 5th Street may make travel in that corridor more appealing, shifting a limited number of trips away from the RHVP/LINC corridor.

One major change which could significantly increase volumes on RHVP is the future connection from the Upper Red Hill Valley Parkway to Highway 6 south of the Hamilton Airport. This link is proposed as a conceptual link in the City's TMP, and therefore is unlikely to be constructed within the 2031 horizon. However, such a link would likely see an increase in vehicles on the RHVP, including heavy vehicles, but may provide a reduction in vehicles on the LINC, as it would likely divert traffic away from the existing Highway 403 – LINC corridor used to access the RHVP.

There are additional improvements proposed to MTO facilities as part of the GGH Transportation Plan, including a widening of Highway 6 south of Highway 403 to six lanes, provision of a new on-ramp from Mohawk Road to Highway 403 westbound, and a truck climbing lane on Highway 403 within the vicinity of the Highway 403/LINC interchange. There are also proposed widenings of MTO facilities to include high-occupancy vehicle (HOV) lanes. These include Highway 403 (Highway 6 to Paris Road), Highway 403 (west of Highway 407 to Aberdeen Avenue) and the QEW (Highway 406 to Guelph Line). Figure 32, taken from the City's TMP Update with MTO facilities added in, shows the future proposed changes to the road network.

Figure 32: Proposed Future Improvements to Roadway Network

The addition of HOV lanes to highway facilities around Hamilton have the potential to change how traffic uses the LINC and RHVP in the future, with a potential mode shift to transit or carpooling based on the improved options for these modes of transportation. A widening of the parkways to accommodate transit or HOV lanes would provide users who choose to take transit or carpool with supporting facilities. The 2021 Canadian Census identified that 8% of commuters in the Hamilton metropolitan area are passengers in personal vehicles (i.e., not in transit vehicles). Additionally, information provided by the City of Hamilton from the EMME model indicates that the widening of the LINC and RHVP to accommodate an HOV lane has the potential for an HOV mode share of 8% to 14% along the corridor. In order to maintain a conservative analysis, this mode share reduction has not been applied to any of the calculations in Section 5.4 below.

5.4 Future Traffic Operations Analysis

To address existing transportation conditions and future population and employment growth, improvements to RHVP and LINC are required to accommodate additional traffic growth for both northbound-southbound and eastbound-westbound travel demand as well as modify the geometric design at specific locations to improve the safety and efficiency along both facilities. Without the required improvements, these facilities will not be able to accommodate future growth and will operate at or above capacity, which may result in a number of negative impacts such as safety concerns, traffic infiltration through neighbourhoods and increased greenhouse gas emissions.

To analyze future traffic conditions in and around the LINC and RHVP corridors, traffic volumes from the City of Hamilton's EMME model were utilized. No changes were required to address future land use assumptions, although some changes to the GRIDS2 process may result in minor changes at the Traffic Zone level, but no changes that would impact the analysis and outcome of this study are anticipated. One important note is that the City of Hamilton's Transportation Master Plan targets a mode shift of 15% away from single-occupancy vehicles (SOV) to transit and active transportation modes according to a policy-based approach. It should be noted that the proposed on-ramp from Mohawk Road to Highway 403 westbound was not included as part of the future EMME model. Given that this on-ramp is intended to divert traffic away from the Wilson Street east corridor, this is not a major concern.

Some early assumptions, agree to with the City of Hamilton, that were built into the analysis with the EMME models, are summarized below:

- The 2031 EMME model incorporates all the City of Hamilton Transportation Master Plan (TMP) recommended projects.
- There is no existing transit service on LINC or RHVP, and the TMP indicates there will be regional express buses up to James Street in the future. However, as part of the (Re)Envision the HSR study, transit appears to be proposed on the RHVP, from the Mud Street interchange north to Queenston Road.
- No specifics about the potential for managed lanes (i.e., high occupancy transit or high occupancy vehicle lanes) are provided in the TMP, such as limits for implementation, and no further specifics have been made available as part of this study.

The EMME model was reviewed and updated to reflect changes to the network, coding inconsistencies and traits of the corridor. Mainline traffic volumes calculated as part of the existing traffic volumes were used as the baseline volumes for the 2031 analysis. These volumes were grown to the 2031 horizon, based on the growth in volumes in the EMME model from the existing conditions to the 2031 horizon. This process was used due to the significant underrepresentation of off-peak traffic volumes, and slight underrepresentation of peak direction traffic volumes identified in the existing EMME model, as noted in Section 4.6.3.

In addition to mainline traffic volumes, turning movement counts from each ramp terminal intersection were used to calculate the volume of traffic for each on- and off-ramp along LINC and RHVP. Similar to the mainline traffic volumes, these were grown to the 2031 horizon using the growth developed from the EMME models.

5.4.1 Highway Capacity Software Analysis

The future traffic volumes were used to undertake Highway Capacity Software analysis of the LINC and RHVP. Highway Capacity Software (HCS) uses methodology from the Highway Capacity Manual (HCM) to calculate the level of service (LOS) of different segments of highways and freeways, including mainline segments, merge, diverge, and weaving sections. The figures on the subsequent pages show the LOS for each section of the RHVP and LINC as calculated using HCS. The graphic below provides a visual example of LOS, from best (LOS 'A') to worst (LOS 'F') that correlates with the LOS for the parkways.

The HCS analysis indicates that the majority of LINC is expected to operate acceptably in the 2031 horizon, as shown in Figure 33. The majority of the mainline segments operate with a LOS ‘C’ or LOS ‘D’, while the ramp operations range from LOS ‘B’ to LOS ‘D’. This correlates with the design of the LINC, which is generally straight, with the ramps made up of what the Ministry of Transportation, Ontario considers as the most efficient and preferred interchange configuration, Parclo A-4, indicating that there are few improvements that could be made to the design of LINC.

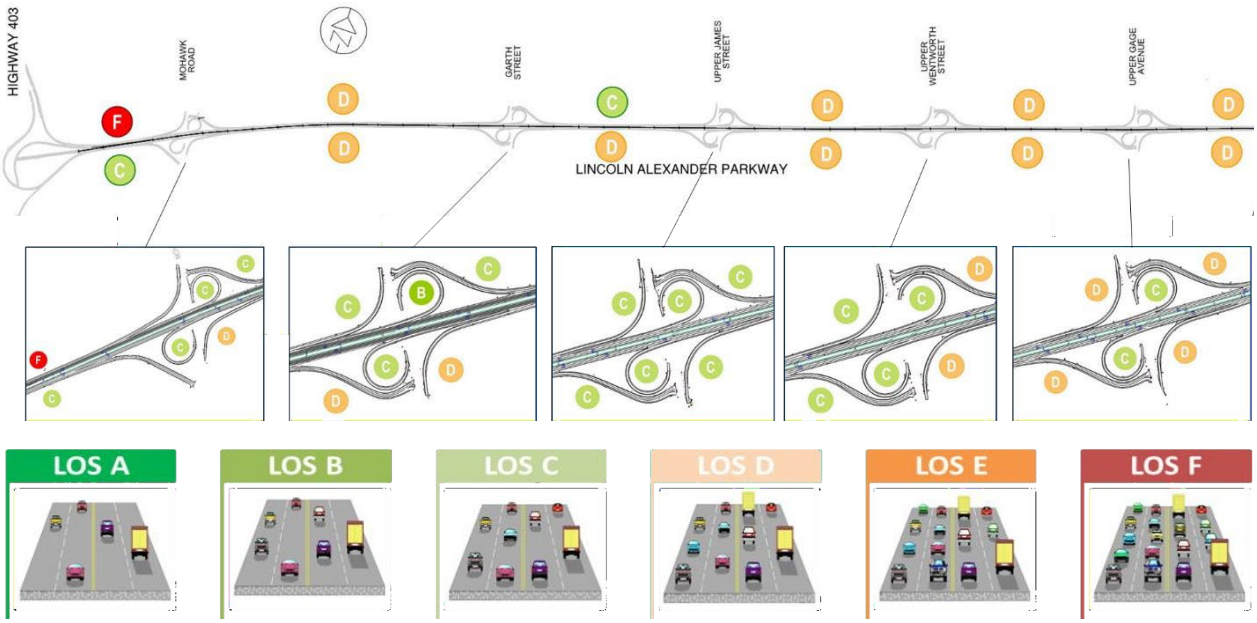


Figure 33: LINC Future Traffic Operations – Highway Capacity Software Analysis

The one section of the LINC that operates poorly is the weaving section between Mohawk Road and Highway 403. As shown in 34, this segment has two through lanes on LINC that connect with Highway 403: one to Highway 403 northbound, one to Highway 403 southbound. In addition, the north to west on-ramp at Mohawk Road (i.e., southbound Mohawk Road to westbound LINC). transitions into the ramp from LINC westbound to Highway 403 northbound.

Finally, there is an additional off-ramp to Mohawk Road west, developing from the southernmost westbound lane on the south side of the LINC. All these competing movements result in numerous weaving movements in a section of LINC less than 1.0 km long, and result in a LOS ‘F’. Section 6.4.3 provides an evaluation of two potential solutions to the poor LOS on this weaving section.

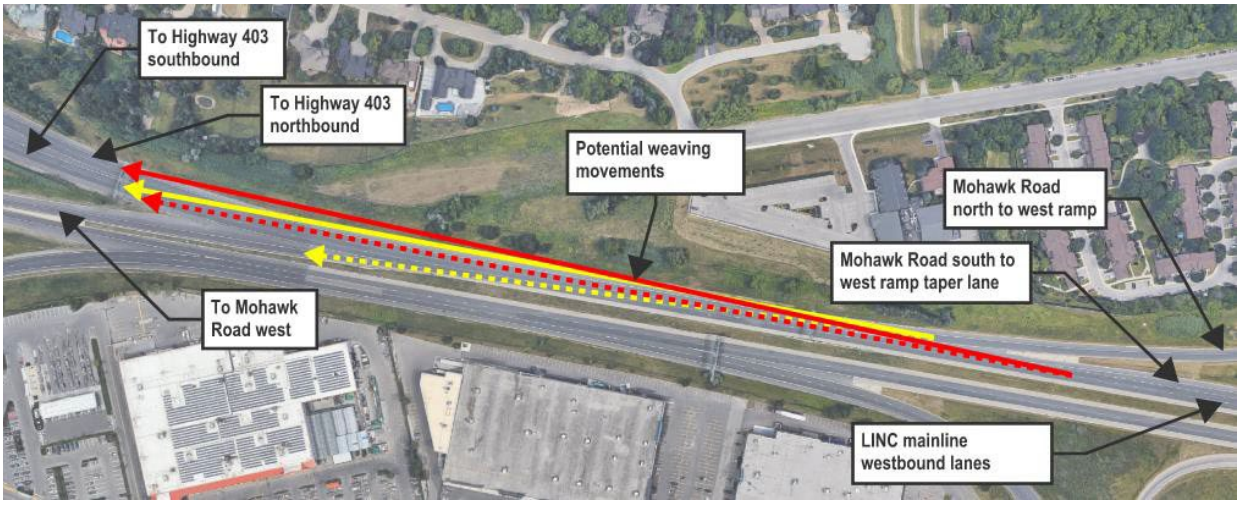


Figure 34: LINC at Highway 403 Weaving Section

It is interesting to note that while the LINC has the preferrable Parclo A-4 interchange configurations along its entire extent (as identified in Section 4.6.2), the RHVP is made of less ideal interchange configurations with none of them being Parclo A-4. Some interchanges are missing outer ramps due to a lack of space, and instead require left turn movements from arterial streets onto loop ramps which can take away green time from other movements on arterial roadways crossing the RHVP. Despite this, the majority of the ramps and mainline RHVP are expected to operate acceptably in the future according to HCS analysis. The majority of the RHVP and associated ramps will operate with a LOS 'D' or better, as shown in Figure 35.

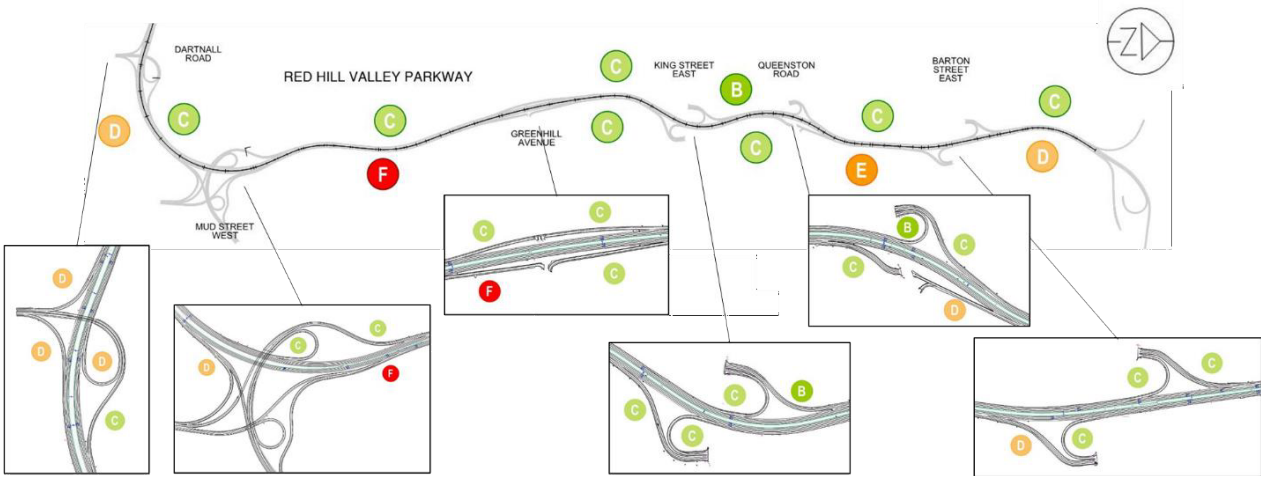


Figure 35: RHVP Future Traffic Volumes – Highway Capacity Software Analysis

There are two concerning sections of the RHVP – the first is the northbound mainline section between Queenston Road and Barton Street East, which is expected to operate with a LOS 'E'. The second is the northbound section of RHVP between Mud Street West and Greenhill

Avenue, including the on-ramp from Mud Street West, the mainline section of RHVP, and the off-ramp to Greenhill Avenue.

The main issue between Mud Street and Greenhill Avenue is the volume of traffic using this section, with approximately 4100 vehicles per hour anticipated during the AM peak hour, resulting in more than 2000 vehicles per hour per lane on RHVP. The high volumes, combined with the change in grade along this section of the RHVP, and a higher than normal heavy vehicle percentage (5%) contribute to the LOS ‘F’ on the mainline.

The high volume of traffic on the mainline also contributes to the poor LOS for the off-ramp at Greenhill Avenue. Despite a relatively low number of vehicles using the off-ramp at Greenhill Avenue (~200 vph), the heavy volume of vehicles on the mainline, combined with the grade change in the area, results in the off-ramp being LOS ‘F’. The issue for the on-ramp from Mud Street is the high volume of vehicles using the on-ramp (~1800 vph), merging onto the already busy RHVP in an area with significant grade change.

On RHVP northbound between Queenston Road and Barton Street East, the combination of high traffic volumes and high heavy vehicle percentage results in a LOS ‘E’. While not as concerning as the section upstream that is LOS ‘F’, this is still a section of the RHVP that should be monitored for timing of potential phasing of the widening improvements and a solution proposed in the phasing of the improvements. Section 6.4.3 provides an evaluation of potential solutions to the poor LOS on these sections.

5.4.2 EMME Select Link Analysis

As a follow-up exercise, a “select link” analysis in the EMME AM peak model was undertaken for the sections of RHVP and LINC that are projected to operate with a LOS ‘E’ or LOS ‘F’ in the HCS analysis. A select link analysis identifies the general origin and destination of the vehicles using a given segment of roadway. In this case, it may help identify alternative methods of accommodating the increased traffic volumes in lieu of physical changes to the RHVP and LINC, such as encouraging vehicles to use alternative corridors or shift to alternative modes of transportation.

The first section reviewed is the westbound LINC section between Mohawk Road and Highway 403, as identified in Figure 36. The select link analysis for this section is shown in the figure below.

Figure 36: Select Link Analysis – LINC Westbound, Mohawk Road to Highway 403

Some notable takeaways from the EMME Select Link Analysis for LINC westbound from Mohawk Road to Highway 403 include:

- The split of vehicles accessing Highway 403 northbound and southbound is very similar, with 54% of vehicles destined northbound (1133) and 46% of vehicles destined southbound (46%).
    - This indicates there is likely minimal opportunity to divert the northbound Highway 403 vehicles (likely destined towards the Greater Toronto Area) away from the LINC corridor, as there are no alternative connections. However, given the recent improvements and proposed future improvements to GO Transit connections to the GTA, there may be an opportunity to shift these vehicular trips to transit trips.
    - There is minimal traffic along the link that originates from the RHVP corridor or associated on-ramps (approximately 200 vehicles, or less than 10% of all vehicles).
    - Of the vehicles originating along the LINC corridor, the highest usage comes from Stone Church Road/Mohawk Road, which is not surprising given it is the closest interchange to the section in review. The second highest usage is from Upper James Street and the third highest usage from Garth Street.
    - It is interesting to note how far south some of the vehicles originate from at these interchanges, with vehicles coming from nodes south of Rymal Road. It appears that

the EMME model shows that a lack of access to the Highway 403 southbound / westbound from the interchange of Highway 6/Garner Road results in additional traffic using the LINC to travel west. As part of the Highway 6 South Widening project, consideration should be given to providing access to Highway 403 westbound from Garner Road, as this may provide an additional benefit of reducing vehicular volume on LINC.

- A significant portion of the volumes accessing Mohawk Road west appear to be destined for Wilson Street east / Main Street (potentially McMaster University). If the Mohawk Road to Mohawk Road west movement is restricted, it is likely that most of the traffic would divert to Highway 403-Aberdeen Avenue–Longwood Road–Main Street.
- These volumes have the potential to be shifted onto transit when the BLAST network is completed, as the A-line BRT and B-line LRT would provide similar service.

The second section reviewed is the northbound RHVP section between Mud Street and Greenhill Avenue, as identified in Figure 37. The select link analysis for this section is shown in the figure below.

Some notable takeaways from the Select Link analysis for RHVP northbound from Mud Street to Greenhill Avenue are included below:

- The majority of vehicles on this link appear to be destined towards the GTA on QEW westbound or Eastport Drive. This indicates there is minimal opportunity to divert these vehicles away from the RHVP corridor, given there are no alternative connections westbound.
- As previously noted, given the recent improvements and proposed future improvements to GO Transit connections to the GTA, there may be an opportunity to shift these vehicular trips to transit trips.
- The EMME model shows that the volume of vehicles that use the selected link originating from Highway 403 northbound and destined to QEW eastbound are equivalent (196 vehicles). These vehicles can readily be considered cut-through traffic (i.e., from Highway 403 towards Grimsby and Niagara); however, they make up less than 5% of all vehicles on the link.
- This is slightly lower than the volume of cut-through traffic highlighted in Section 5.1.1, which identified 7-12% of all vehicles being cut-through traffic.
- A large number of vehicles appear to be originating from the Dartnall Road–Upper Red Hill Valley Parkway–Mud Street interchange area.
- King Street appears to be the most common off-ramp access to the downtown core, with 134 vehicles (approximately 4%).
- There also appears to be some vehicles destined along King Street, Queenston Road and Barton Street west east of the RHVP. This is a trip that may show potential for

shifting to transit in the future, given that the BLAST S-line priority bus will replicate a similar origin and destination pattern.

The third section reviewed is the northbound RHVP section between Queenston Road and Barton Street, as identified in Figure 37. The select link analysis for this section is shown in the figure below.

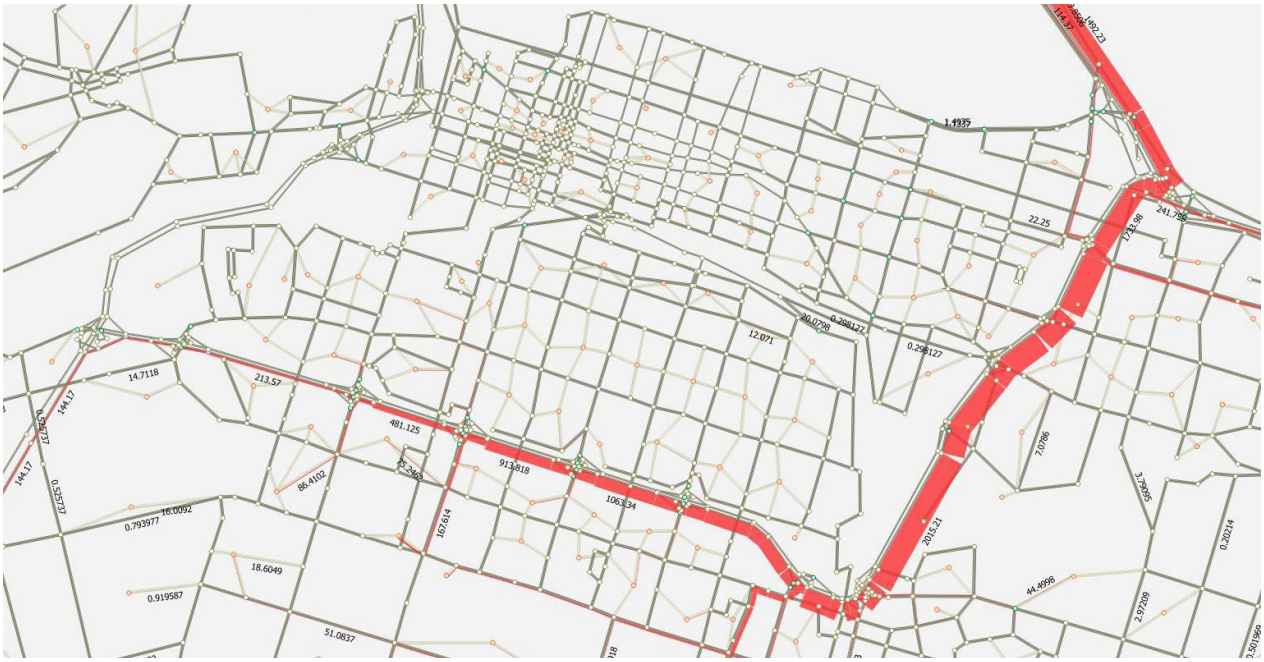


Figure 37: Select Link Analysis – RHVP Northbound, Queenston Road to Barton Street

Some notable takeaways from the Select Link analysis for RHVP northbound from Queenston Road to Barton Street are included below:

- Most of the vehicles appear to be destined to the Greater Toronto Area, on either QEW or Eastport Drive (1610, or 80%). This indicates there is minimal opportunity to divert these vehicles away from the RHVP corridor, given there are no reasonable alternative connections to the GTA from this section of RHVP.
    - As previously indicated, given the recent improvements and proposed future improvements to GO Transit connections to the GTA, there may be an opportunity to shift these vehicular trips to transit trips.
- The majority of trips originating from the Dartnall Road–Upper Red Hill Valley Parkway–Mud Street interchange area are coming from Dartnall Road. This includes vehicles originating from as far south as Rymal Road and Twenty Road.
- The volume of vehicles along the Rymal Road corridor is notable, given that the BLAST S-line priority bus project is proposed to ultimately connect into the Confederation GO station, which will provide GO Transit service to the GTA. This shows that as the BLAST network is developed there may be increased opportunities to shift trips to transit.

5.4.3 EMME 2031 Volume to Capacity Ratio

In addition to the HCS analysis, a review of the v/c ratios in the City's 2031 EMME model was undertaken. The model is an AM peak hour model. The results are shown in Figure 38 below.

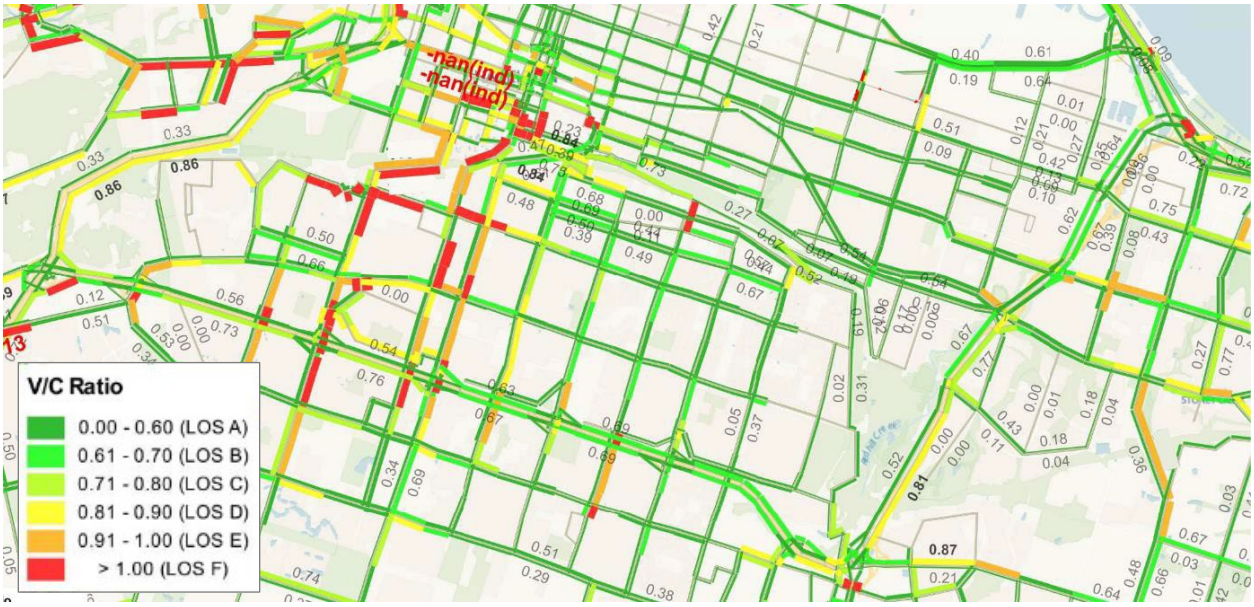


Figure 38: 2031 EMME Model v/c Ratio

It is notable that similar to the existing conditions, the interchange or RHVP / QEW is shown as having over-capacity sections. In addition, the northbound Highway 403 to eastbound LINC is shown as being over capacity. Otherwise, the rest of the RHVP and LINC are shown to be operating at an acceptable LOS, with the worst LOS being a LOS 'D' on the northbound section of RHVP between Mud Street and Greenhill Avenue. This is consistent with the HCS analysis, which shows only a few sections operating with a poor LOS, including the northbound section of RHVP between Mud Street and Greenhill Avenue.

It should be noted that in the City of Hamilton GRIDS report it is shown that by 2051 the RHVP will be over capacity and LINC will be approaching capacity.

5.4.4 Future Traffic Analysis Conclusions

Based on the results of the HCS and select link analyses, a full widening of the RHVP and LINC may not be required for the 2031 planning horizon. Instead, it may be beneficial to widen the sections of parkway that are projected to be over capacity, such as RHVP northbound from Mud Street to King Street, while monitoring sections that are projected to be approaching capacity, such as RHVP northbound from Queenston Road to Barton Street. In addition, modifications could be made to the sections that require safety improvements, such as RHVP southbound around the Mud Street and Dartnall Road interchanges. Section 6.4.3 provides a more detailed review of potential interim solutions that may provide improved traffic operations in advance of a full widening.

This would also allow for a better understanding of the benefits and impacts of other changes to the City such as:

- The BLAST transit projects, the GO Transit projects, and the (Re)Envision the HSR study, which may ultimately shift single-occupancy vehicles (SOV) away from the LINC and RHVP corridor and onto transit, reducing the long-term need for a full widening of the parkways. As shown in the select link analysis, SOV commuters in these poorly operating sections may be better served using parallel rapid transit connections in the future, such as the BLAST S-line or GO Transit connections to the GTA.
- The Highway 6 South Widening to Upper James Street, which may divert traffic away from RHVP and LINC. However if the conceptual connection of Highway 6 to RHVP, as shown in the TMP is constructed, this will likely result in an increase in traffic on the RHVP and a decrease in traffic on the LINC.
- The urban boundary expansion in the south and southeast, which may increase the traffic demand on the RHVP.

As noted in Sections 3.1 and 3.2, any major expansion in roadway capacity, such as the full widening of the RHVP and LINC, will trigger an increase in mode share of SOV at the expense of transit, particularly if the expansion in the capacity is not accompanied (or preferably led) by improvement in the speed, reliability and frequency offered by the transit network. Not doing so would jeopardize the City's intent to move the needle on SOV's mode share and attain its aspirational mode share targets for local transit (an increase from 7% currently to 12% in 2031) in most recent Transportation Master Plan Update.

6. DEVELOPMENT & EVALUATION OF ALTERNATIVE SOLUTIONS

This section describes the alternatives that were considered to address the Problem and Opportunity statement outlined in Section 3.3. The process for identifying a preferred Alternative Solution for the RHVP and LINC involved developing and screening a long list of technically feasible alternatives and assessing and evaluating the short list of alternatives for RHVP and LINC based on technical, environmental, and cost considerations.

6.1 Long List of Technically Feasible Alternatives

The development of alternatives for evaluation as part of this feasibility study took into consideration two key factors. First, expansions in roadway capacity need to consider how to achieve the required capacity while still contributing to the City's mode share targets and other important community goals. Second, congestion on the Highway 403 and the QEW may limit the benefits that can be realized from adding capacity on the RHVP and LINC, particularly for commuting trips between Hamilton and the GTA. Considering these two factors, the alternative scenarios developed and evaluated in this study include the following:

- **Do Nothing:** Maintain existing roadway design and general-purpose lanes.
- **Lane Conversion:** Convert existing general-purpose lane to transit-only or HOV lanes. High level estimate as per Section 5.3 is 8% to 14% HOV usage.
- **Development of Active Transportation Network:** Improve active transportation networks and connectivity within or adjacent to right-of-way.
- **Full Widening to Six Lanes:** Widening the current designs to accommodate an additional lane in each direction. These additional lanes would be located within the existing median and could serve many purposes, including:
  - General-purpose lanes for all traffic.
  - Transit/bus lanes for HSR and other transit services.
  - High occupancy vehicle (HOV) lanes for general-purpose vehicles with 2+ occupants, as well as transit vehicles. High level estimate as per Section 5.3 is 8% to 14% HOV usage.
  - High occupancy toll (HOT) lanes which would be free for any high occupancy vehicles or transit, but have a set fee for any single occupancy vehicles (SOV).
- **Localized Widenings to Six Lanes and Geometric Improvements:** Widening the current design in specific locations to address problem areas, while monitoring the need for a full widening as the rest of the transportation network develops. Problem areas where localized widening would occur are on the LINC westbound between Mohawk Road and Highway 403, and RHVP northbound between Mud Street and Greenhill Avenue and between Queenston Road and QEW.

- **Improved Connections to the Provincial Highway Network:** Improvements to the interchanges at either end of the RHVP / LINC corridor (Highway 403 and/or QEW) to improve capacity of these connections (e.g., the proposed on-ramp from Mohawk Road to Highway 403 westbound).
- **Improved Transit Accessibility:** Providing increased transit service along the RHVP / LINC corridor, potentially including express bus service, and bus stops / stations at some or all the interchanges.

A multi-faceted approach may be used to solve future transportation issues along the RHVP and LINC corridor. This means that while one specific alternative may not address the Problem and Opportunity on its own, it may still be worth considering in the future as a supportive measure to the preferred alternative. This is especially true for multi-modal solutions that provide improvements for all modes of transportation, including pedestrians, cyclists and transit users, in addition to general traffic.

6.2 Screening of Long List of Alternatives

To screen the long list of technically feasible alternatives to a short list of alternatives, each alternative was considered in the context of addressing the Problem and Opportunity Statement, which in summary indicates “The project will explore maximizing capacity of the RHVP and LINC through a managed lane approach, which could prioritize high-occupancy vehicles and/or transit.” Table 7 summarizes the findings of the screening process.

Table 7: Long List Screening of Alternatives for RHVP and LINC

Alternative	Does the Alternative Address the Problem/ Opportunity?	Rationale
Do Nothing (no change to current conditions)	No	While existing corridor appears to operate acceptably, future conditions will continue to deteriorate as City of Hamilton grows.
Lane Conversion	No	While lane conversion to HOV or transit-only lanes would support a multi-modal solution, the potential HOV usage of 8% to 14% wouldn’t shift enough vehicles to avoid increased congestion.
Active Transportation Network	No	Further build-out of the active transportation network is recommended to support multi-modal transportation alternatives, however this alternative does not function as a standalone solution because it is unlikely that enough users would shift to active transportation modes to preclude future issues on LINC and RHVP.
Full Widening	Yes	Full widening to six lanes supports the City’s transportation needs along the LINC and RHVP

Alternative	Does the Alternative Address the Problem/ Opportunity?	Rationale
		corridors, while providing flexibility to shift to managed lanes in the future (HOV, transit-only or HOT).
Localized Widening	Yes	Localized widening will support problematic areas in the short-term, which will increase capacity.
Improved Connections to QEW and Highway 403	No	Improved connections to facilities outside of City of Hamilton does not improve mobility within the City of Hamilton. However, these connections are needed to realize the maximum capacity of the RHVP and LINC network.
Improved Transit Accessibility	No	On its own, improved transit accessibility does not maximize capacity. However, this alternative is worth considering in the future once further investments have been made to the transit network along LINC and RHVP, including but not limited to HOV or transit-only lanes.

As the following alternatives listed below do not provide additional capacity and do not address the major safety and capacity concerns attributed to RHVP and LINC they will be screened out of the project:

- Lane Conversion
- Active Transportation Network
- Improved Connections to QEW and Highway 403
- Improved Transit Accessibility

However, several of these alternatives may have the ability to address the problems and opportunities identified in Section 3 of this report in combination with other alternatives. For this reason, the following alternative combinations were carried forward for further assessment:

- Localized Widening and Geometric Improvements combined with Improved Connections to MTO Highways
- Full Widening with Improved Connections to MTO Highways and Improved Transit Accessibility

6.3 Evaluation of Short List of Technically Feasible Alternatives

An evaluation of the Short List of Technically Feasible Alternatives has been conducted for the RHVP and for the LINC and is documented in Table 8 and Table 9 respectively. As per the requirements of the Municipal Class EA, both sets of alternatives were compared against the “Do Nothing” alternative.

Table 8: Evaluation of Alternative Solutions for RHVP

Evaluation Criteria	Do Nothing	Alternatives	
		Localized Widening (Northbound between Mud Street and Greenhill Avenue and between Queenston Road and QEW) with Improved Connections to MTO Highways	**Full Widening with Improved Connections to MTO Highways and Improved Transit Accessibility**
Technical			
Ability to increase capacity	No ability to increase capacity	Provides ability to increase vehicular capacity in areas of localized widening	Provides ability to increase vehicular capacity along the entire parkway, as well as ability to increase person capacity if HOV or transit-only lanes are implemented
Ability to improve traffic safety	No ability to improve traffic safety	Limited ability to improve traffic safety in areas of concern	Provides ability to improve traffic safety along the entire parkway
Ability to accommodate future travel demand	No ability to accommodate future travel	Addresses 2031 travel demand through localized widening but may not address 2051 travel demand	Addresses 2031 travel demand through widening and provides additional capacity to accommodate 2051 travel demand
Ability to minimize construction constraints and complexity	No construction required	Limited construction complexity as localized widening is limited to 6 km of improvements in one direction	Greatest construction complexity due to widening along the entire parkway
Ability for parkway design to be resilient to climate change impacts	No ability to address projected climate-related risks to road infrastructure	Drainage infrastructure could be designed to be resilient to projected climate change impacts Localized widening would require less infrastructure upgrade to mitigate the impacts of increased stormwater runoff due to limited increase in impervious surface area.	Drainage infrastructure could be designed to be resilient to projected climate change impacts Full widening would require greater infrastructure upgrade to mitigate the impacts of increased stormwater runoff due to increase in impervious surface area.
Preference for Technical Criteria	***Least preferred - Will not address the need for capacity improvements, safety concerns or climate change considerations***	***Moderately preferred – Will only address capacity improvements and safety concerns in localized areas, resulting in limited ability to manage future travel demand and climate change considerations.***	***Most preferred – Will increase capacity, improve safety, and meet future travel demand, while planning for resiliency to climate change impacts.***
Natural Environment			
Effect on terrestrial habitat and species	No effect on terrestrial habitat and species	Limited low value terrestrial habitat (i.e., grass) within existing median would be removed in small section of parkway due to construction Continuous illumination could negatively affect wildlife within Red Hill Valley but effect could be minimized through appropriate design	Limited low value terrestrial habitat (i.e., grass) within existing median would be removed along entire length of parkway due to construction Continuous illumination could negatively affect wildlife within Red Hill Valley but effect could be minimized through appropriate design
Effect on aquatic habitat and species	No effect on aquatic habitat and species	No effect on aquatic habitat and species	No effect on aquatic habitat and species
Potential to encounter soil and groundwater contamination	No potential to encounter soil and groundwater contamination	Limited potential to encounter soil and groundwater contamination	Greater potential to encounter soil and groundwater contamination
Ability to contribute to reduction in greenhouse gas emissions	Traffic congestion will increase GHG emissions in the short term due to longer trip times	Localized widening will increase capacity and enable increased traffic volumes on some portions of the roadway, without fully addressing congestion and capacity issues over a longer time horizon, which has the potential to increase greenhouse gas emissions. Localized widening can also provide capacity that can be utilized by transit.	Full widening may increase GHG emissions in the short term due to increased capacity for additional SOVs, however full widening in combination with transit enhancements such as lane conversion and transit network enhancements offers the ability for dedicated transit, which has the potential to reduce greenhouse gas emissions
Preference for Natural Environmental Criteria	***Moderately preferred – Fewest impacts on natural environment, but no potential for GHG emissions reductions***	***Least preferred – Limited impacts to natural environment, but no potential for GHG emissions reductions***	***Most preferred – Limited impacts to natural environment but greatest potential for GHG emissions reductions***

Evaluation Criteria	Do Nothing	Alternatives	
		Localized Widening (Northbound between Mud Street and Greenhill Avenue and between Queenston Road and QEW) with Improved Connections to MTO Highways	Full Widening with Improved Connections to MTO Highways and Improved Transit Accessibility
Social Environment			
Conformity with planning policy	Conforms with Provincial policy but does not provide opportunity to promote and enhance human health and social well-being or resilience to climate change as per PPS 2020. Does not address local planning initiatives and policies to improve roadway capacity and address safety concerns	Conforms with Provincial policy but provides limited opportunity to promote and enhance human health and social well-being or resilience to climate change as per PPS 2020. Only slightly assists municipal planning initiatives to improve roadway capacity and address safety concerns	Conforms with Provincial policy and with proactive design considerations can maximize opportunity to promote and enhance human health and social well-being and resilience to climate change as per PPS 2020. Addresses planning initiatives to improve roadway capacity and address safety concerns
Effect on adjacent properties during construction	No effect on adjacent properties	Adjacent properties would likely experience nuisance effects (noise, dust, etc.) during construction within areas of localized widening	Adjacent properties would likely experience nuisance effects (noise, dust, etc.) during construction along entire parkway
Effect on noise levels and air quality during operation	No effect on noise levels or air quality	Increased traffic associated with localized widening will affect adjacent properties during operation through increased noise levels and decreased air quality due to emissions (based on current mode shares)	Increased traffic (including heavy vehicles) associated with full widening will affect adjacent properties during operation through increased noise levels and decreased air quality due to emissions (based on current mode shares)
Effects on community climate resilience and sustainability	No change to community climate resilience, however also no opportunity to leverage new infrastructure to contribute to enhanced community climate resilience and sustainability	Limited opportunities to leverage localized widening to contribute to enhanced community climate resilience and sustainability	Full widening, designed with community climate resilience in mind, could provide opportunities to increase resilience and sustainability for example by combining full widening with enhanced transit network to reduce reliance on SOVs
Transportation Equity	No substantial opportunity to increase transportation equity through the project	Limited opportunity to increase transportation equity through the project as localized widening would not provide linear continuity for accessible/affordable modes of transportation	Designed using an equity approach, full widening could be planned with the intent to increase transportation equity by increasing access to affordable modes of transportation and modes of transportation geared to under-served populations
Preference for Social Environment Criteria	***Moderately preferred – No expected impacts to social environment as a result of construction or operations, yet does not address local planning initiatives.***	***Least preferred – Moderate impacts to social environment as a result of construction and operations, with limited opportunity to incorporate community climate resilience and equity***	***Most preferred – Addresses provincial local policies, has potential to increase transportation equity and resilience to climate change and despite having the most effect on adjacent property owners during operations these impacts are expected to be a minor change compared to existing conditions.***
Cultural Environment			
Effect on archaeological resources	No effect on archaeological resources	No effect on archaeological resources	No effect on archaeological resources
Effect on built heritage resources and cultural heritage landscapes	No effect on built heritage resources and cultural heritage landscapes	No effect on built heritage resources and cultural heritage landscapes	No effect on built heritage resources and cultural heritage landscapes
Preference for Cultural Environment Criteria	***Most preferred – No expected impacts to archaeological resources, built heritage resources, or cultural heritage landscapes***	***Most preferred – No expected impacts to archaeological resources, built heritage resources, or cultural heritage landscapes***	***Most preferred – No expected impacts to archaeological resources, built heritage resources, or cultural heritage landscapes***
Cost			
Capital cost	No capital cost	Moderate capital cost	Highest capital cost
Operations and maintenance cost	Lowest cost over the lifetime of the facility	Moderate cost over the lifetime of the facility	Highest cost over the lifetime of the facility
Preference for Cost Criteria	***Most preferred – Lowest cost***	***Moderately preferred – Moderate capital and operational cost***	***Least preferred – Highest capital and operational cost***

Based on the results of the evaluation of alternatives for the RHVP, the “Full Widening with Improved Connections to MTO Highways and Improved Transit Accessibility” is the most preferred alternative. It is best suited to addressing the Technical criteria regarding increased capacity, improved safety, future travel demand, and resiliency to climate change impacts. Regarding the Natural Environment, it has some limited effects to the terrestrial environment but offers the greatest potential for GHG emissions reductions. It is also most preferred for the Social Environment. Despite having the greatest effects on adjacent property owners due to nuisance effects during construction and a minor increase in noise and air quality impacts during operation, this alternative conforms with local and Provincial planning policy and provides the greatest opportunity to address community climate resilience, sustainability, and equity. It also has similar effects as the other two alternatives on the Cultural Environment. While it has the greatest cost compared to the other two alternatives, the other benefits from the project outweigh this disadvantage.

Table 9: Evaluation of Alternative Solutions for LINC

Evaluation Criteria	Do Nothing	Alternatives	
		Localized Widening (westbound between Mohawk Road and Highway 403) with Improved Connections to MTO Highways	Full Widening with Improved Connections to MTO Highways and Improved Transit Accessibility
Technical			
Ability to increase capacity	No ability to increase capacity	Provides ability to increase vehicular capacity in areas of localized widening	Provides ability to increase vehicular capacity along the entire parkway, as well as ability to increase person capacity if HOV or transit-only lanes are implemented
Ability to improve traffic safety	No ability to improve traffic safety	Limited ability to improve traffic safety in areas of concern	Provides ability to improve traffic safety along the entire parkway
Ability to accommodate future travel demand	No ability to accommodate future travel	Addresses 2031 travel demand through localized widening but may not address 2051 travel demand	Addresses 2031 travel demand through widening and provides additional capacity to accommodate 2051 travel demand
Ability to minimize construction constraints and complexity	No construction required	Limited construction complexity as localized widening is limited to 6 km of improvements in one direction	Greatest construction complexity due to widening along the entire parkway
Ability for parkway design to be resilient to climate change impacts	No ability to address projected climate-related risks to road infrastructure	Drainage infrastructure could be designed to be resilient to projected climate change impacts Localized widening would require less infrastructure upgrade to mitigate the impacts of increased stormwater runoff due to increase in impervious surface area.	Drainage infrastructure could be designed to be resilient to projected climate change impacts Full widening would require greater infrastructure upgrade to mitigate the impacts of increased stormwater runoff due to increase in impervious surface area.
Preference for Technical Criteria	***Least preferred - Will not address the need for capacity improvements, safety concerns or climate change considerations***	***Moderately preferred – Will only address capacity improvements and safety concerns in localized areas, resulting in limited ability to manage future travel demand and climate change considerations.***	***Most preferred – Will increase capacity, improve safety, and meet future travel demand while planning for resiliency to climate change impacts.***
Natural Environment			
Effect on terrestrial habitat and species	No effect on terrestrial habitat and species	Limited low value terrestrial habitat (i.e., grass) within existing median would be removed in small section of parkway as a result of construction	Limited low value terrestrial habitat (i.e., grass) within existing median would be removed along entire length of parkway as a result of construction
Effect on aquatic habitat and species	No effect on aquatic habitat and species	No effect on aquatic habitat and species	No effect on aquatic habitat and species
Potential to encounter soil and groundwater contamination	No potential to encounter soil and groundwater contamination	Limited potential to encounter soil and groundwater contamination	Greater potential to encounter soil and groundwater contamination
Ability to contribute to reduction in greenhouse gas emissions	Traffic congestion will increase GHG emissions in the short term due to longer trip times	Localized widening with no ability to accommodate dedicated transit will increase capacity and enable increased traffic volumes on some portions of the roadway, without fully addressing congestion and	Full widening may increase GHG emissions in the short term due to increased capacity for additional SOVs, however full widening in combination with transit enhancements such as lane conversion and

		Alternatives	
Evaluation Criteria	**Do Nothing**	**Localized Widening (westbound between Mohawk Road and Highway 403) with Improved Connections to MTO Highways**	**Full Widening with Improved Connections to MTO Highways and Improved Transit Accessibility**
		capacity issues over a longer time horizon, which has the potential to increase greenhouse gas emissions	transit network enhancements offers the ability for dedicated transit, which has the potential to reduce greenhouse gas emissions
Preference for Natural Environmental Criteria	***Moderately preferred – Fewest impacts on natural environment, but no potential for GHG emissions reductions***	***Least preferred – Limited impacts to natural environment, but no potential for GHG emissions reductions***	***Most preferred – Limited impacts to natural environment but greatest potential for GHG emissions reductions***
Social Environment			
Conformity with Planning Policy	Conforms with Provincial policy but does not provide opportunity to promote and enhance human health and social well-being or resilience to climate change as per PPS 2020. Does not address local planning initiatives and policies to improve roadway capacity and address safety concerns	Conforms with Provincial policy but provides limited opportunity to promote and enhance human health and social well-being or resilience to climate change as per PPS 2020. Only slightly assists municipal planning initiatives to improve roadway capacity and address safety concerns	Conforms with Provincial policy and with proactive design considerations can maximize opportunity to promote and enhance human health and social well-being and resilience to climate change as per PPS 2020. Addresses planning initiatives to improve roadway capacity and address safety concerns
Effect on adjacent properties during construction	No effect on adjacent properties	Adjacent properties would likely experience nuisance effects (noise, dust, etc.) during construction within areas of localized widening	Adjacent properties would likely experience nuisance effects (noise, dust, etc.) during construction along entire parkway
Effect on noise levels and air quality during operation	No effect on noise levels or air quality	Increased traffic associated with localized widening will affect adjacent properties during operation through increased noise levels and decreased air quality due to emissions (based on current mode shares)	Increased traffic (including heavy vehicles) associated with full widening will affect adjacent properties during operation through increased noise levels and decreased air quality due to emissions (based on current mode shares)
Effects on community climate resilience and sustainability	No change to community climate resilience, however also no opportunity to leverage new infrastructure to contribute to enhanced community climate resilience and sustainability	Limited opportunities to leverage localized widening to contribute to enhanced community climate resilience and sustainability	Full widening, designed with community climate resilience in mind, could provide opportunities to increase resilience and sustainability for example by combining full widening with enhanced transit network to reduce reliance on SOVs
Transportation Equity	No substantial opportunity to increase transportation equity through the project	Limited opportunity to increase transportation equity through the project as localized widening would not provide linear continuity for accessible/affordable modes of transportation	Designed using an equity approach, full widening could be planned with the intent to increase transportation equity by increasing access to affordable modes of transportation and modes of transportation geared to under-served populations
Preference for Social Environment Criteria	***Moderately preferred – No expected impacts to social environment as a result of construction or operations, however local planning initiatives are not addressed***	***Moderately preferred – Moderate impacts to social environment as a result of construction and operations, with limited opportunity to incorporate community climate resilience and equity***	***Most preferred – Addresses provincial and local planning initiatives, has potential to increase transportation equity and resilience to climate change and despite having the most effect on noise and adjacent property owners the increase of impacts will be minor.***
Cultural Environment			
Effect on archaeological resources	No effect on archaeological resources	No effect on archaeological resources	No effect on archaeological resources
Effect on built heritage resources and cultural heritage landscapes	No effect on built heritage resources and cultural heritage landscapes	No effect on built heritage resources and cultural heritage landscapes	No effect on built heritage resources and cultural heritage landscapes
Preference for Cultural Environment Criteria	***Most preferred – No expected impacts to archaeological resources, built heritage resources, or cultural heritage landscapes***	***Most preferred – No expected impacts to archaeological resources, built heritage resources, or cultural heritage landscapes***	***Most preferred – No expected impacts to archaeological resources, built heritage resources, or cultural heritage landscapes***
Cost			
Capital cost	No capital cost	Moderate capital cost	Highest capital cost

		Alternatives	
Evaluation Criteria	**Do Nothing**	**Localized Widening (westbound between Mohawk Road and Highway 403) with Improved Connections to MTO Highways**	**Full Widening with Improved Connections to MTO Highways and Improved Transit Accessibility**
Operations and maintenance cost	Lowest cost over the lifetime of the facility	Moderate cost over the lifetime of the facility	Highest cost over the lifetime of the facility
Preference for Cost Criteria	***Most preferred***	***Moderately preferred***	***Least preferred***

Based on the results of the evaluation of alternatives for the LINC, the “Full Widening with Improved Connections to MTO Highways and Improved Transit Accessibility” is the most preferred alternative. It is best suited to addressing the Technical criteria regarding increased capacity, improved safety, future travel demand, and resiliency to climate change impacts. Regarding the Natural Environment, it has some limited effects to the terrestrial environment but offers the greatest potential for GHG emissions reductions. It is also most preferred for the Social Environment. Despite having the greatest effects on adjacent property owners due to nuisance effects during construction and a minor increase in noise and air quality impacts during operation, this alternative conforms with local and Provincial planning policy and provides the greatest opportunity to address community climate resilience, sustainability, and equity. It also has similar effects as the other two alternatives on the Cultural Environment. While it has the greatest cost compared to the other two alternatives, the other benefits from the project outweigh this disadvantage.

6.4 Description of Preferred Alternative Solutions

This section provides an overview of the conceptual design developed for the preferred Alternative Solutions for RHVP and LINC, an outline of proposed phasing, and an overview of potential impacts and mitigation measures.

6.4.1 Summary of Design for RHVP

As shown in APPENDIX A: and in Figure 39, the proposed design of the RHVP includes the addition of two 3.5 m wide lanes in the existing centre median for the majority of the length of the parkway. Widening in the middle will urbanize the cross section by adding storm sewers and catch basins in the median.

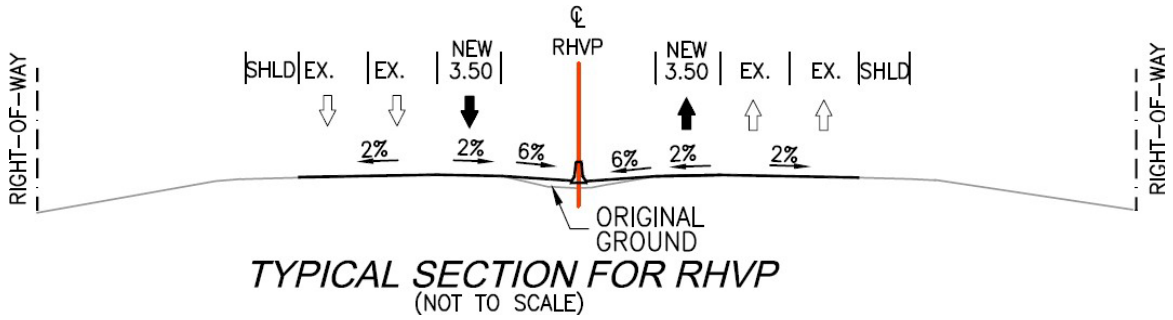


Figure 39: Typical Cross-section of RHVP

None of the bridges crossing over the parkway are expected to require any modification due to the widening. The northbound Escarpment bridge on the RHVP between Pritchard Road and Greenhill Avenue will need to be modified to accommodate the additional lanes of traffic. Several options for modifications are shown in Appendix A and include:

- **OPTION 1 – WIDENING ON OUTSIDE:** Which would involve the addition of a new 3.75 m wide lane and adjacent 2.5 m shoulder at the outer extent of the northbound bridge. These modifications would require removal of the outside barrier and would maintain the existing median shoulder and barrier. The footprint would be kept within the RHVP ROW.
- **OPTION 2 – WIDENING ON INSIDE:** Which would involve the addition of a new 3.5 m wide lane on the inside of the northbound bridge. This modification would require the removal of the inside barrier and construction of a new barrier to accommodate the new lane.
- **OPTION 3 – NO BRIDGE WIDENING:** Where the inside and outside shoulders and the existing lanes on the northbound bridge would be reduced in width to accommodate an extra lane within the existing barriers. The new cross-section would include a 0.5 m inside shoulder, 4 lanes at 3.5 m each and 1.0 m outside shoulder.

The rail crossings of the RHVP south of QEW and King Street are not impacted by the widening alternatives considered in this study and illustrated in APPENDIX A:.

There is a long pair of structures north of the CPR crossing carrying Battlefield Creek, one under southbound RHVP and one under northbound RHVP. No modifications to the structures are required as the required lanes are already present over the pair of structures.

6.4.2 Summary of Design for LINC

Similar to the RHVP, the proposed design of the LINC includes the addition of two 3.5 m wide lanes in the existing centre median for the majority of the length of the parkway, as shown in APPENDIX A: and Figure 40. To accommodate the additional lanes, the curb and gutter on the median side would be removed. The median widening would include construction of a new barrier with catchbasins on either side of the barrier.

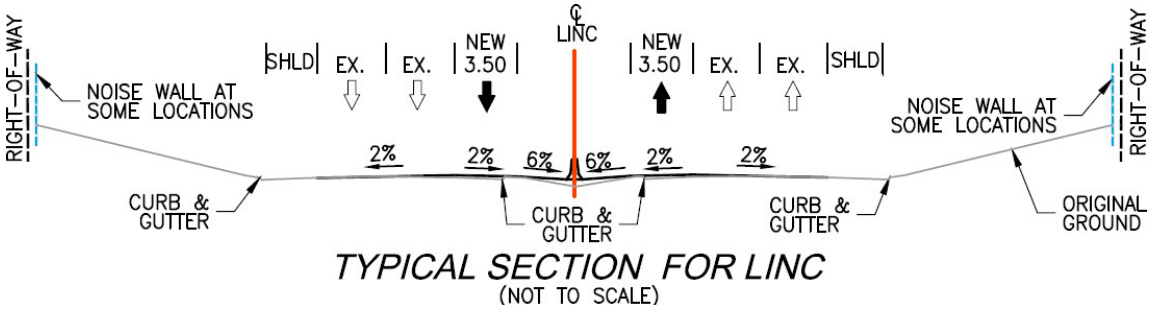


Figure 40: Typical Cross-section of LINC

Only one major culvert or bridge structure is expected to be impacted by the widening in the median. A structure to fill in the median is required between the two structures carrying an Active Transportation pathway under the LINC eastbound and westbound structures. This crossing location is aligned between Daisy Street and Greencedar Drive west of Garth Street.

6.4.3 Proposed Phasing and Interim Solutions

Prior to the full-build out of the widening of full length of both the RHVP and LINC, the City should consider implementing localized improvements as interim measures, such as those identified throughout this study. The traffic horizon for this study was 2031, therefore it is assumed that these improvements would provide a benefit up to and beyond 2031, however this can be confirmed in subsequent studies using updated traffic counts (which may reflect changes to traffic volumes due to the long-term impacts on transportation from the COVID-19 pandemic), as well as the ongoing updates to the City's EMME model, which should include the conclusions from the (Re)Envisioning the HSR study.

The City of Hamilton should consider studies required to assess the direction forward and funding regarding phasing and interim solutions. To assess operations in more detail, new collision monitoring, delay impacts and safety studies should be completed.

Furthermore, the City of Hamilton's Asset Management group should consider asset condition and the costs associated with the long-term rehabilitation / reconstruction and opportunities to identify / integrate short term solutions with long term needs. Individual scope elements (noise, Illumination, stormwater management, pavement condition, etc.) should be assessed in more detail with the City of Hamilton departments or groups that oversee these elements. Some improvements may be considered as operational improvements if advanced before the proposed road improvements. Many operational improvements can be implemented without the need for an Environmental Assessment (EA).

The section below highlights the numerous interim solutions that have been identified in this study, and outlines the next steps that may be required prior to implementation.

LINC – Mohawk Road to Highway 403 Westbound

For the LINC, a potential interim improvement would be to address the weaving issue westbound between Mohawk Road and Highway 403, identified in Section 5.4.1. This section is projected to operate with a LOS 'F' in the 2031 horizon, given the volume of weaving vehicles between the various interchanges. Two potential solutions have been identified to address this issue:

1. Extending the off-ramp to Mohawk Road W further to the east, past the bullnose of the north to west on-ramp from Mohawk Road E. This would restrict access for vehicles attempting to make the Mohawk Road E to Mohawk Road W movement, which requires three lane changes.
2. Fully close the north to west on-ramp from Mohawk Road E and re-design the south to west ramp on the east side of the interchange to accommodate a southbound left turn lane on Mohawk Road. This southbound left turn lane would allow southbound vehicles on Mohawk Road to access LINC westbound, replicating the movement provided by the existing north to west on-ramp, but removing the number of lanes that vehicles would have to weave across.

Additional Highway Capacity Software (HCS) analysis was undertaken to review the potential LOS with the interim changes to the Mohawk Road interchange identified above. The same future traffic volumes used in the analysis in Section 5.4 were used in this analysis, with ramp volumes reassigned as noted below.

For Option 1, it was assumed that any vehicles on Mohawk Road attempting to weave to Mohawk Road W would follow Golf Links Road to connect with Mohawk Road W, which is 600 metres than the existing route using LINC. The LOS for the interchange with the extended off-ramp to Mohawk Road W is shown in the figure below. With the removal of the Mohawk Road to Mohawk Road W weave, this section is projected to operate with a LOS 'C', an improvement over the projected LOS 'F' in the Do Nothing scenario.

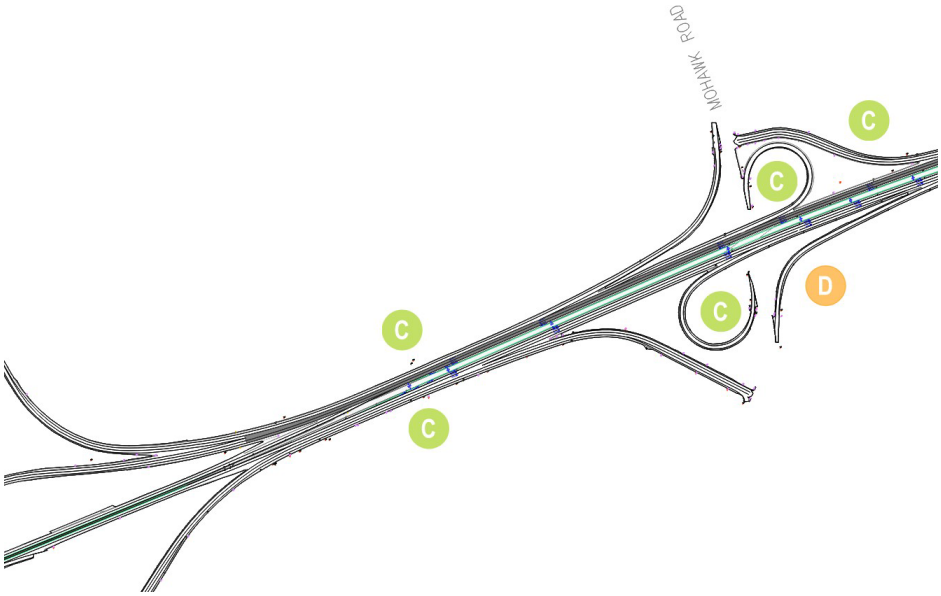


Figure 41: LINC at Mohawk Road LOS, Interim Option 1

For Option 2, it was assumed that any vehicles using the north to west Mohawk Road E on-ramp would be reassigned to the south to west Mohawk Road E on-ramp. The analysis includes the additional vehicles on this ramp for both the analysis of the Mohawk Road south to west on-ramp, as well as the LINC and Highway 403 westbound weaving section. With the reconfiguration of this interchange, this section is still projected to operate with a LOS 'F', which indicates that despite the longer distance provided for vehicles to weave from Mohawk Road E to Mohawk Road W, the flow of vehicles in this area is still too high for an acceptable level of service. Therefore, Option 1 is the preferred interim solution at this interchange.

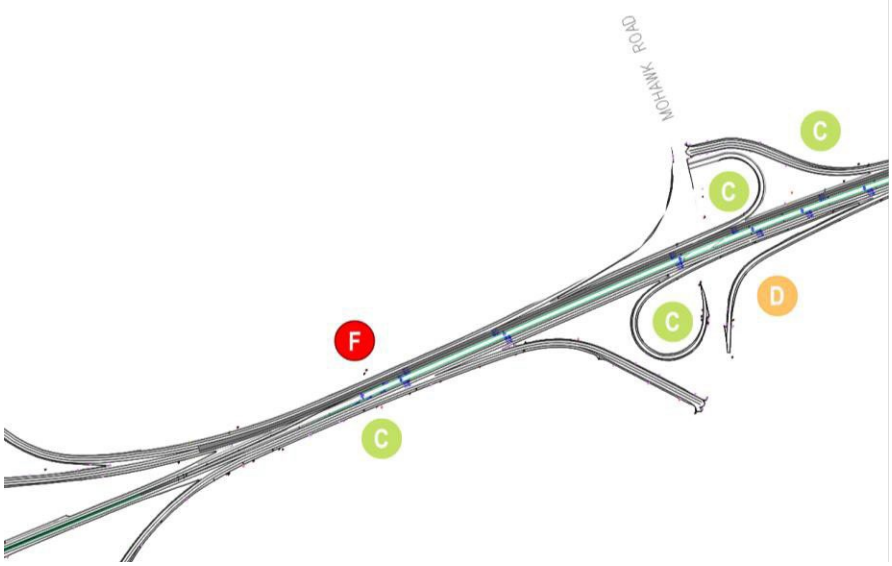


Figure 42: LINC at Mohawk Road LOS, Interim Option 2

RHVP – Mud Street to Barton Street Northbound

As previously identified in Section 5.4.1, there are two concerning sections of the RHVP northbound: Queenston Road to Barton Street E and Mud Street W to Greenhill Avenue. The section from Queenston Road to Barton Street E is projected to operate with a LOS 'E' in the 2031 horizon, while the section from Mud Street W to Greenhill Avenue is projected to operate with a LOS 'F' (including the on-ramp from Mud Street W, the mainline section of the RHVP, and the off-ramp to Greenhill Avenue).

The proposed interim solution for this section is to widen RHVP northbound starting at the Mud Street W on-ramp, and continue the widening to or past Greenhill Avenue. This is the section that is projected to operate with a LOS 'F' in the 2031 horizon and widening should provide improved level of service for traffic. It is worth noting that the (Re)Envisioning the HSR study identified future transit routes running on the RHVP between Mud Street and Queenston Road, including Route 30 for the S-line. This would indicate that if an interim widening of the RHVP is being proposed, it should likely extend from Mud Street to Queenston Road. This would provide improved LOS for all vehicles on the RHVP, including any potential transit routes. Additionally, at the time that the (Re)Envisioning the HSR study is implemented, it would allow for the potential future conversion of one of the lanes on RHVP to a transit-only or HOV lane, from Mud Street to Queenston Road. As previously noted, high level assumptions indicate that a mode shift of 8% to 14% of vehicles on the corridor may be achievable with an HOV lane in place on RHVP.

Given that the future transit routes are proposed to run to Queenston Road, and not to Barton Street, only the section from Mud Street to Queenston Road is proposed as an interim solution as part of this report. The section of RHVP from Queenston Road to Barton Street is projected to operate with a LOS 'E' in the future, and if single-occupancy vehicles are shifted to transit (as a result of the numerous transit project proposed in the Greater Hamilton Area, as identified in Section 5.1), the widening of this section may not be required for some time.

Additional HCS analysis was undertaken to review the potential LOS with the interim changes to the mainline section from Mud Street to Queenston Road above. The same future traffic volumes used in the analysis in Section 5.4 were used in this analysis, with no changes required to volumes. However, as noted above, there may be potential for a shift in general traffic trips to transit trips if a transit-only or HOV lane is applied, reducing general traffic volumes.

The section of RHVP between Mud Street and Greenhill Avenue, including the Mud Street east to north on-ramp and the Greenhill Avenue south to west off-ramp, were projected to be LOS 'F' in the Do Nothing conditions. The provision of a continuous lane on this section of RHVP will improve it to a LOS 'D', as the additional lane provides capacity improvements and longer distances for any potential weaving movements. The figure below shows the project LOS for this area with the interim changes.

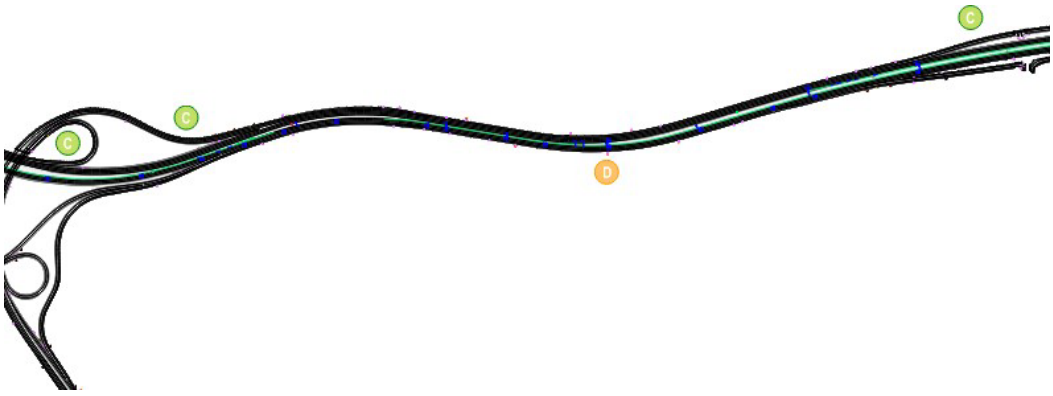


Figure 43: RHVP, Mud Street to Greenhill Avenue, Interim Option

While it is noted above that an interim widening to north of Greenhill Avenue, or further to Queenston Road, makes the most sense from a traffic and transit perspective, consideration also needs to be given to the constructability and safety of interim options. The interim widening between Mud Street to Greenhill Avenue is a shorter section and can be undertaken independent of any other interim widening.

If widening any further to the north (i.e., to Queenston Road as recommended above), this would comprise a widening of over 60% of the RHVP (from Mud Street to Queenston Road). Therefore, in the future as traffic is monitored and projections updated, consideration should be given to also include the short widening north of Queenston Road to the QEW, along with any improvements coordinated with and required by MTO. In addition, this would allow construction to be completed at the same time, reducing the need for phased improvements and reducing construction costs.

The full preferred design is to widen to the centre and build a full median with a barrier and paved shoulders. To implement this localized improvement, a northbound and southbound lane could be built beside the new median, thus avoiding having a wide paved shoulder on the southbound lanes that can result in more serious blunt collisions with the barrier. With the widening on the inside of the southbound lanes, there would be restriping of the pavement markings for 3 southbound lanes, so the inside lane is continuous with a lane drop at the exit to Queenston Road.

RHVP – Mud Street to Dartnall Road Southbound

As identified in Section 4.7.2, there is a major weaving issue in the southbound direction on RHVP between Mud Street and Dartnall Road. Physical modifications to remove these key ramp movements or to extend the weaving distances between the ramps are challenging, given the fairly standard ramp geometries. Mainline widening is recommended to continue the third lane westbound lane past the merge of the Dartnall Road westbound on-ramp. The third lane can be tapered into two lanes downstream from the Dartnall Road interchange.

Transit Improvements – Interchange Configurations

As identified in Section 5.1, it may be possible to reconfigure some of the existing interchanges along the LINC and RHVP to better support transit. These changes would allow transit to exit the mainline LINC and RHVP, serve the crossing arterial roadways, and re-enter the mainline. However, the (Re)Envisioning the HSR study which was recently released does not proposed any routes that would benefit from such an interchange configuration. There are no routes proposed for the LINC, and the routes proposed for the RHVP are not expected to exit the mainline RHVP to serve crossing streets before re-entering the mainline RHVP.

Therefore, the benefit of reconfiguring interchanges would not be realized until such a time as additional transit routing is proposed for the LINC and RHVP corridors, and is not proposed as an interim solution as part of this study. It is worth noting for future consideration that the interchanges which are readily designed to provide such a connection include: Mohawk Road (both directions), Garth Street (both directions), Upper James Street (both directions), Upper Wentworth Street (both directions), Upper Gage Avenue (both directions), Greenhill Avenue (both directions), and Queenston Road (northbound only).

Lighting Improvements

The current design does not identify lighting requirements. The City should undertake a lighting study to study existing and future lighting and to determine if and where lighting is warranted, either as a stand-alone study or as part of a future EA. An Alternatives Assessment for lighting should be undertaken to assess various technologies and lifecycle cost. Lighting alternatives could include filling in the outside existing lighting with median conventional lighting or High Mast Median Lighting (HML) which the City presently does not utilize. HML is used by the Ministry of Transportation (MTO) including on adjacent Highway 403 and the QEW, as does the City of Toronto on the Don Valley Parkway.

If continuous lighting is preferred it could be provided from the median, preferably incorporated into the median barrier for protection, or on the outsides of the roadway if space allows. Median lighting could be either HML or conventional lighting poles. As the City of Hamilton does not use HML an added cost to operate and maintain this system would be included in the lifecycle cost comparison with conventional lighting. If the widening was phased over time lighting might only be provided in those areas identified for localized improvements, which corresponds with the areas of higher traffic volumes and collision occurrences. Lighting poles should have roadside safety offsets or protection systems; in many areas, especially on RHVP, existing protection such as guiderails could be utilized.

Noise Mitigation

The City of Hamilton has noted noise complaints in the area of Greenhill Avenue that should be identified in more detail and addressed during the EA. A noise wall monitoring and maintenance program and a study of existing and future conditions should be completed to prioritize improvements. A Noise Policy update may be required. Often in areas where needed, new noise walls or noise mitigation are implemented before major contracts are undertaken to have some level of construction noise mitigation in place.

6.4.4 Overview of Potential Impacts and Mitigation Measures

As the areas to be widened for both parkways were previously disturbed, there are anticipated to be negligible impacts to terrestrial, aquatic, archeological and cultural heritage resources, with the exception of continuous lighting effects on wildlife. Adjacent residences and other land uses may experience nuisance effects during construction. Standard mitigation measures to be implemented during construction include:

- Development and implementation of an Erosion and Sediment Control Plan prior to construction.
- In the unlikely event that Eastern Meadowlark and Bobolink are encountered during the construction phase of the Project, the MNRF should be contacted immediately to determine the required next steps.
- Under the federal Migratory Birds Convention Act (1994), timing constraints on development apply to disruptive activities such as vegetation clearing (i.e., tree removal/ shrubs) where migratory birds may be nesting. Such activities should be scheduled outside the breeding bird window (i.e., April 1 to August 31). If vegetation clearing must occur during this timing window, active nest searches should be conducted by qualified biologists immediately prior to the start of vegetation clearing to ensure that no active bird nests are destroyed.
- Prior to construction, notices and contact information should be delivered to area residents and property owners informing them of construction details.
- Construction activities undertaken during the Project should conform to the City of Hamilton's Noise By-law or seek an exemption.
- The City will follow best practices to mitigate air quality effects during construction. Best practices include practices such as keeping vehicles/machinery and equipment in good repair, equipped with emission controls, as applicable and properly maintaining and operating within regulatory requirements. Construction-related air quality effects will be minimized through the utilization of dust suppression methods (such as wetting of surfaces using a non-chloride based compound). Working directly with the utility companies to ensure that any utility facilities that may be affected by the infrastructure are minimally disturbed.
- Provide sufficient notice of utility interruptions to the public. When a utility is switched from an old line to a new relocated line, small interruptions may occur.
- Verify the exact locations and depths of underground utilities during detailed design and prior to construction, including coordinating with the utility providers and performing a SUE investigation to determine horizontal and vertical locations.

A comprehensive list of environmental effects and mitigation measures will be developed as part of the Municipal Class EA.

6.4.5 Cost Considerations

The preliminary construction cost estimated for the ultimate long-term widening of the LINC and RHVP is $135M. This estimate is based on 2022 dollar unit rate examples that may have some variability related to COVID-19, inflation, etc. In addition, we have estimated $35-$40M in short-term costs that includes the studies and programs described in the Implementation Strategy (see Section 6.5), lighting for LINC and RHVP, and operational improvements, including addressing the weave on the LINC westbound from Mohawk Road to Highway 403, and extending a third westbound lane from the end at Dartnall Road beyond the Dartnall on-ramp merge.

A breakdown of costs is provided in Table 10 below. It does not include the ongoing operations and maintenance cost associated with any improvements. Appendix B contains a budget breakdown of construction costs.

Table 10: Cost Considerations

Task / Project Component	Estimated Costs Short-term improvement (by 2031)	Mid to Long-term improvement (2031+)
PLANNING		
Collision monitoring, delay impacts and safety studies	$200,000	
Develop separate noise wall maintenance program	$500,000	
Noise policy and study (set baseline and assess noise impacts and alternatives)	$500,000	
Illumination Alternatives Assessment including technologies and lifecycle cost (fill in outside lighting, median conventional lighting, High Mast Median)	$300,000	
Site specific stormwater management study if road widening deferred	$100,000	
Schedule B Environmental Assessments (EA) for illumination	$400,000	
Transit Project Assessment Process (TPAP) for transit improvements	$200,000	
Schedule C Municipal Environmental Assessment for full RHVP and LINC improvements/widening	$1,000,000	
PLANNING SUBTOTAL	***$3,200,000***	

Task / Project Component	Estimated Costs Short-term improvement (by 2031)	Mid to Long-term improvement (2031+)
LINC ONLY IMPROVEMENTS		
Geotechnical studies	$100,000	
Pavement rehabilitation and safety element design	$100,000	
Pavement rehabilitation contract	$6,000,000	
Mohawk Road to Hwy 403 weaving improvements scoping along with other City and MTO improvements	$1,000,000	
Operational improvement to extend third WB lane from end at Dartnall Road beyond Dartnall on-ramp merge (1km +/-)	$4,000,000	
9.5kms Full Illumination Design and Construction ($1M+/km)	$10,000,000	
Detailed Design for full road improvement/widening		$1,500,000
Contract for full road improvement /widening (9 km with median barrier and 1.8 km without median barrier)		$80,000,000
LINC ONLY SUBTOTAL	***$21,200,000***	***$81,500,000***
RHVP IMPROVEMENTS		
Geotechnical studies	$100,000	
Pavement rehabilitation and safety element design	$200,000	
Pavement rehabilitation contract	$4,000,000	
7.5 kms Full Illumination Design and Construction ($1.1M+/km)	$9,000,000	
Detailed Design for full road improvement/widening		$1,200,000
Contract for full road improvement /widening (5.2 kms with median barrier plus 1.5km of one lane NB)		$55,000,000
RHVP ONLY SUBTOTAL	***$13,300,000***	***$56,200,000***
TOTAL FOR LINC AND RHVP	**$37,700,000**	**$137,700,000**

6.5 Implementation Strategy

This Feasibility Study has confirmed that improvements to RHVP and LINC are needed to address congestion and safety issues. The next steps required to advance this study are as follows:

- **Schedule C Municipal Class EA** – This Feasibility Study has addressed many of the technical studies required for Phase 1 and most of Phase 2 of the Municipal Class EA process. Based on the recommended alternatives identified through the Feasibility Study, the City of Hamilton will need to complete Phases 2, 3 and 4 of the Municipal Class EA process.

  Prior to advancing the project to Phases 3 and 4, Indigenous engagement and public and stakeholder consultation must take place regarding the process for and outcomes of Phases 1 and 2, including the proposed Problem and Opportunity statement and the identification and evaluation of Alternative Solutions. Provided that those engagement and consultation activities confirm that the Problem and Opportunity statement and preferred Alternative Solutions are acceptable, the project can then proceed to the next phases of the Municipal Class EA process. This will include the Engagement and Public Consultation strategy outlined in Section 2.3.

  The following studies are recommended as part of the Class EA:

  Technical

  - VISSIM traffic analysis of the corridor, which will allow for a detailed comparison of the Do Nothing conditions against the Local Widening alternative and the Full Widening alternative, to consider the timing of these improvements. This study will also evaluate the travel time benefits that may potentially be provided through the implementation of transit-only or HOV lanes.
  - Additional traffic analysis to review potential alternatives identified as part of this Feasibility Study. These should include:
    - Intersection operation analysis for the provision of a southbound left turn at the LINC/Mohawk Road south to west on-ramp to accommodate the closure of the north to west on-ramp.
    - Intersection operation analysis for the intersection of Dartnall Road/Stone Church Road to reduce southbound queues that have the potential to restrict access from the west to south LINC off-ramp at Dartnall Road.
    - A high level EMME review of the potential benefits of accommodating a connection from Garner Road-Rymal Road westbound to Highway 403. This review should focus on the level of traffic diverted away from the LINC corridor, and specifically the westbound LINC-Highway 403 interchange, if such a connection could be implemented.

- A Clear Zone and Grading Review should be completed along the outsides of the lanes for the full Study Area. Though the widening is proposed on the inside toward the median on both LINC and RHVP and there are no changes on the right or outsides of the mainline lanes and no changes to the ramps, grading may be improved by slope flattening for better safety at any areas unprotected by guiderails. In fact, some guiderail may be the considered for removal or shortening if slope flattening can be accomplished, as the guiderail itself is an obstacle for potential collisions. Any exposed unprotected rock faces that are close to the parkways mainline, or on ramps and ramp speed change lanes can be made safer by backfilling and flattening by earth fill to remove the blunt impact to an often near vertical rock face. Slope flattening should not be limited to the clear zone as collisions do occur beyond the clear zone. Given the environmental sensitivity of the Niagara Escarpment, a review and approval may be required if fill of rock faces is recommended.
- A full lighting study considering findings from previous studies, alternative lighting locations and equipment including consideration of the condition and possible coordination of use of existing lighting in a new lighting plan. The study should be completed in conjunction with the timing for roadway improvements staging and timing and considering the most recent preferred equipment options. The review should consider the condition and appropriateness of use of existing illumination in a new lighting plan. The approach to road widening of small sections or larger section will influence the lighting study length. Similar to lighting studies for MTO projects, a cost-benefit study addressing capital and long-term operation and maintenance costs should be considered. The study should consider various lighting options above such as median or outside lighting location and the alternatives for hardware, especially for luminaire types which are evolving quickly with a goal to addressing climate change and to have lesser energy requirements. The lighting study would be most relevant if planned along with the timing for road widening so the most recent preferred equipment options is considered.
- Pavement condition assessment of the corridor.

Environmental

- A Stage 1 Archaeological Assessment (and Stage 2 assessment if required) and Cultural Heritage Assessment in consultation with Joint Stewardship Board and interested Indigenous communities.
- Natural heritage field investigations, with a focus on Environmentally Sensitive Areas and Wooded Areas located within and adjacent to the corridor, and a corresponding assessment on the effects of continuous illumination on wildlife and wildlife habitat.
- Contaminant overview study to identify actual or potential contamination within the study area.
- Air quality/greenhouse gas assessment of the preferred alternative.

  - Noise assessment of the preferred alternative, including baseline noise studies and the development of mitigation measures.
  - Drainage assessment of the preferred alternative, including development of a preliminary stormwater management plan. The operation and condition of the existing SWM system should be assessed ideally before or during the widening design and the SWM reviewed also for consideration of updating for any new standards or requirements since the original design.

- **Coordination with Ontario Ministry of Transportation (MTO) regarding improvements to QEW and Highway 403:** Given the importance of improvements to QEW and Highway 403 to the function of RHVP and LINC, coordination with MTO should begin concurrent with the Municipal Class EA. The outcome of those discussions would likely influence the preliminary design of the RHVP and LINC.
- **Preliminary design of the Preferred Alternative Design Concepts:** Once the Municipal Class EA is complete, a 30% preliminary design of the preferred alternative design concepts for RHVP and LINC will be prepared. A full geotechnical assessment and report should assess pavement and other roadway issues. A cost assessment projection should be completed to justify reconstruction of elements on the LINC shoulders and outer boulevards such as replacing subdrain, among other issues and alternatives.

7. CLOSURE

The City of Hamilton retained Morrison Hershfield to conduct the work described in this report, and this report has been prepared solely for this purpose.

This document, the information it contains, the information and basis on which it relies, and factors associated with implementation of suggestions contained in this report are subject to changes that are beyond the control of the author. The information provided by others is believed to be accurate and may not have been verified.

Morrison Hershfield does not accept responsibility for the use of this report for any purpose other than that stated above and does not accept responsibility to any third party for the use, in whole or in part, of the contents of this document. This report should be understood in its entirety, since sections taken out of context could lead to misinterpretation.

We trust the information presented in this report meets Client’s requirements. If you have any questions or need addition details, please do not hesitate to contact one of the undersigned.

Morrison Hershfield Limited

8. REFERENCES

Amec Foster Wheeler. (2018). *Integrated Monitoring Plan, Red Hill Valley Project, Comprehensive 5-Year Summary Final.* City of Hamilton.

Archaeological Services Inc. (2003). *The Red Hill Creek Expressway (North-South Section) Impact Assessment Final Technical Report, February 21, 2003, on: Cultural Heritage Resource Assessment.*

CIMA. (2018). *Hamilton LINC and RHVP Speed Study.* The City of Hamilton.

CIMA. (2018). *Roadside Safety Assessment - Red Hill Valley Parkway.* City of Hamilton.

CIMA. (2019). *LINC and RHVP Detailed Illumination Study.*

City of Hamilton. (2003). *Red Hill Valley Parkway Impact Design Assessment.*

City of Hamilton. (2013). *Urban Hamilton Official Plan.*

City of Hamilton. (2016). *Recreation Trails Master Plan.*

City of Hamilton. (2018). *Cycling Master Plan Review and Update.*

City of Hamilton. (2018). *Transportation Master Plan Review and Update.*

City of Hamilton. (2021). *2021-2025 Economic Development Action Plan.*

City of Hamilton. (2022). *Climate Change Impact Adaptation Plan.*

City of Hamilton. (2022). *ReCharge Hamilton: Community Energy and Emissions Plan.*

City of Hamilton. (2022). *Recharge Hamilton: Our Community Energy + Emissions Plan.*

City of Hamilton. (2022). *Truck Route Master Plan.*

City of Hamilton. (2022). *Ward Profiles*. Retrieved from https://www.hamilton.ca/city-council/data-maps/ward-profiles

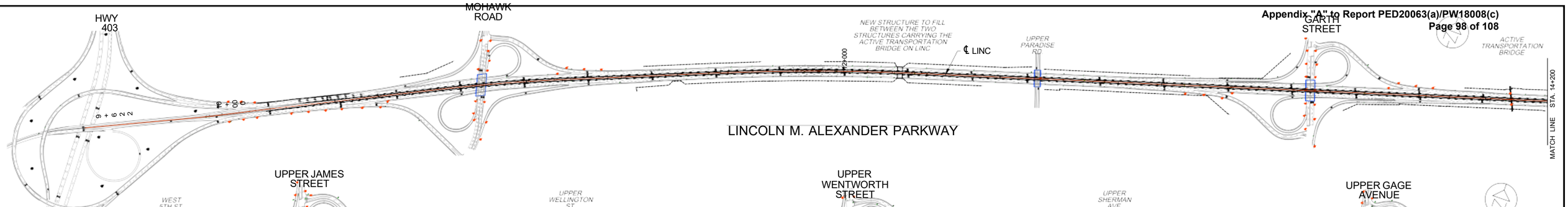
IBI Group. (2022). *Hamilton Truck Route Master Plan Update.* City of Hamilton.

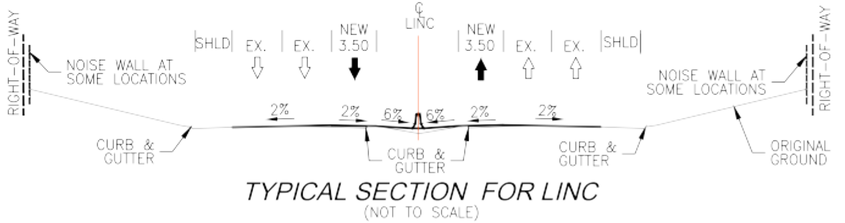
Metrolinx. (2018). *2041 Regional Transportation Plan.*

Stewart, S., & Paparella, G. (2005). *Joint Stewardship Board Between the Six Nations Community and the City of Hamilton.*

Victoria Transport Policy Institute. (2022). *Evaluating Transportation Equity: Guidance for Incorporating Distributional Impacts.* Retrieved from https://www.vtpi.org/equity.pdf

APPENDIX A: Design Drawings for Preferred Alternative Solutions





TYPICAL SECTION FOR LINC
(NOT TO SCALE)

LINCOLN M. ALEXANDER PARKWAY (LINC)
WIDENING TO SIX LANES (ON INSIDE INTO MEDIAN)

LEGEND AND NOTES

- CONTROL LINE AND STATION OF LINC
- PROPOSED NEW LANE
- EXISTING LANE
- EXISTING STREET LIGHTING
- EXISTING HIGH MAST LIGHTING (BY MTO)

STA 21+000

ONS, 3~5m± HIGH)
EXISTING BRIDGE SPAN ABOVE PARKWAY

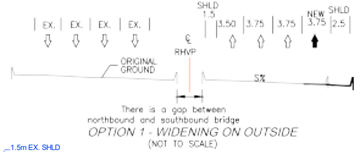
SCALE
50m 0 100m
Horizontal

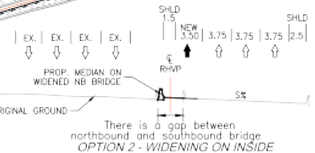
SHEET 6 OF 2

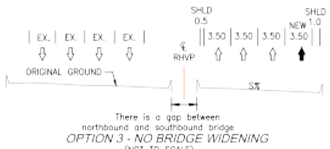
2023-01-02

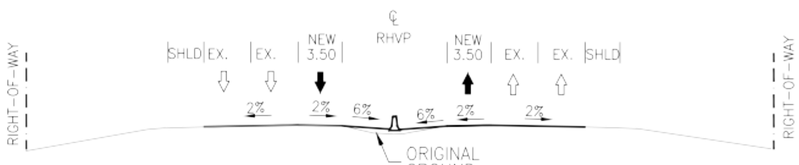
WIDENING THE NORTHBOUND ESCARPMENT BRIDGE SHOULD BE REVIEWED FOR THE MOST SUITABLE OPTION DURING EA/PRELIMINARY DESIGN. WIDENING SEEMS POSSIBLE ON THE OUTSIDE, INSIDE AND ALSO ON THE EXISTING BRIDGE, BUT WITH A TIGHTER CROSS SECTION. THERE IS NO WIDENING REQUIRED SOUTHBOUND, THE THIRD THROUGH LANE CONTINUES PAST THE EXIT RAMP.

- OPTION 1 - WIDENING ON OUTSIDE will require removal of the outside barrier and will maintain the existing median shoulder and barrier. Widening will have some minor Environmental impact on natural areas, though grading allowances seems to have been made to minimize the impact to the slopes during initial construction. All impact will be kept within the RHVP ROW.
- OPTION 2 - WIDENING ON INSIDE of the bridge will require removal of the inside barrier and widening including a new barrier. During EA/Preliminary Design consider impacts of working on the inside of RHVP and between the tight gap between the 2 structures.
- OPTION 3 - NO BRIDGE WIDENING is possible, extra lane will fit on existing bridge and maintain the existing barriers. The cross section could be tightened to 0.5m inside shoulder, 4 lanes at 3.5m each and 1.0m outside shoulder though not preferred. During EA/Preliminary Design consider suitability of narrower widths further.









RED HILL VALLEY PARKWAY (RHVP)
WIDENING TO SIX LANES (ON INSIDE INTO MEDIAN)

LEGEND AND NOTES

CONTROL LINE AND STATION OF RHVP
EXISTING ESCARPMENT BRIDGE (SPAN LENGTH 220m±)
PROPOSED SHOULDER

SCALE

28 + 00 0

SHEET 2 OF 2


RED HILL VALLEY PARKWAY
PROPOSED NEW LANE
EXISTING LANE
EXISTING STREET LIGHTING
EXISTING HIGH MAST LIGHTING (BY MTO)
EXISTING NOISE WALL
(APPROX. LOCATIONS, 3~5m± HIGH)
EXISTING BRIDGE SPAN ABOVE PARKWAY
Horizontal
2023-01-02

APPENDIX B: Construction Cost Estimate

LINC Cost Calculations on a per m basis - 18 km length divided into four different segments. **Segment 1 = Hwy 403 to Upper Ottawa (Sta. 10+200 to Sta. 19+400) on LINC**
All four segments are widening in the centre median
GRADING, MEDIAN DRAINAGE, GRANULAR BASE, MEDIAN BARRIER, etc.
(ALLOWANCES FOR STAGING AND MINOR ITEMS)

MAJOR ITEMS	UNIT	QUANTITY per km of length	Length (km)	QUANTITY	2022 UNIT PRICE	ITEM COST
Earth Excavation, Grading	m3	10380	9.2	95496	20	$ 1,910,000.00
Tack Coat	m2	20310	9.2	186852	0.6	$ 120,000.00
SMA 12.5 (40 mm)	t	1281.168	9.2	11786.7456	210	$ 2,480,000.00
Gritting of SMA	m2	13310	9.2	122452	0.75	$ 100,000.00
Superpave 19.0 (70 mm)	t	2188.662	9.2	20135.6904	135	$ 2,720,000.00
Superpave 19.0 (70 mm)	t	1205.4	9.2	11089.68	135	$ 1,500,000.00
Granular A	t	6009.6	9.2	55288.32	25	$ 1,390,000.00
Granular B, Type I	t	10724	9.2	98660.8	17	$ 1,680,000.00
600 mm x 600 mm Maintenance Holes, Catch Basins, and Ditch Inlets	each	10	9.2	92	3200	$ 300,000.00
1800 mm Maintenance Holes, Catch Basins, and Ditch Inlets	each	8	9.2	73.6	11000	$ 810,000.00
2400 mm Maintenance Holes, Catch Basins, and Ditch Inlets, Over 4 m	each	2	9.2	18.4	20000	$ 370,000.00
700 mm Pipe Sewer	m	816	9.2	7507.2	525	$ 3,950,000.00
Removal of Asphalt Pavement	m2	5000	9.2	46000	6	$ 280,000.00
Removal of Curb and Gutter	m	2000	9.2	18400	15	$ 280,000.00
Removal of Maintenance Holes, Catch Basins, Ditch Inlets and Valve Chambers	each	20	9.2	184	250	$ 50,000.00
Removal of Pipes and Culverts	m	864	9.2	7948.8	25	$ 200,000.00
Removal of Steel Beam Guide Rail	m	200	9.2	1840	13	$ 30,000.00
Removal of Concrete Barrier	m	40	9.2	368	30	$ 20,000.00
Removal of Sign Support Structure	each	11	1	11	14000	$ 160,000.00
Removal of Sign Support Structure Footings	each	22	1	22	5000	$ 110,000.00
Pavement Marking, Durable	m	3000	9.2	27600	4.5	$ 130,000.00
Tall Wall Barrier	m	1000	9.2	9200	230	$ 2,120,000.00
					Subtotal	**$ 20,710,000.00**
Additional miscellaneous quantities missed in above items (15%)					plus 15%	$ 3,106,500.00
Allowance for OTHER items not quantitifed above (50% of combined)					plus 50%	$ 11,908,250.00
Additional Grading Works - Milling/resurfacing/markings for existing lanes (not ramps)				$ 6,000,000.00		$ 6,000,000.00
Additional Grading Works - Outside shoulder strengthening for traffic staging				$ 4,000,000.00		$ 4,000,000.00
Additional miscellaneous quantities missed in above two extra items (15%)					plus 15%	$ 1,500,000.00
					Total Grading	**$ 47,224,750.00**

DRAINAGE - Median sewer outlets, cross-culvert repairs/replacements/twinning, and limited SWM ponds/facilities (excluding median sewer)					5%	$ 2,361,237.50
STRUCTURAL - OH Signs, Bridge Widening, Retaining Walls, etc.						
Concrete in Ground Mounted Static Sign Support Footings, Tri-Chord and Cantilever	each	21	1	21	30000	$ 630,000.00
Concrete in Median Mounted Static Sign Support Footings, Tri-Chord and Cantilever	each	21	1	21	35000	$ 735,000.00
Tri-Chord Static Sign Support Structures, Span 18.51 - 27.50 m	each	21	1	21	60000	$ 1,260,000.00
					Subtotal	**$ 2,625,000.00**
Contingency (15%)					plus 15%	$ 394,000.00
STRUCTURAL TOTAL:						**$ 3,019,000.00**

LINC Cost Calculations on a per m basis - 18 km length divided into four different segments.
All four segments are widening in the centre median
GRADING, MEDIAN DRAINAGE, GRANULAR BASE, MEDIAN BARRIER, etc.
(ALLOWANCES FOR STAGING AND MINOR ITEMS)

Segment 2 = Upper Ottawa to Dartnall Road (Sta. 19+400 to Sta. 21+000), on LINC

MAJOR ITEMS	UNIT	QUANTITY per km of length	Length (km)	QUANTITY	2022 UNIT PRICE	ITEM COST
Earth Excavation, Grading	m3	5300	1.6	8480	20	$ 169,600.00
Tack Coat	m2	20310	1.6	32496	0.6	$ 19,497.60
SMA 12.5 (40 mm)	t	1281.168	1.6	2049.8688	210	$ 430,472.45
Gritting of SMA	m2	13310	1.6	21296	0.75	$ 15,972.00
Superpave 19.0 (70 mm)	t	2188.662	1.6	3501.8592	135	$ 472,750.99
Superpave 19.0 (70 mm)	t	1205.4	1.6	1928.64	135	$ 260,366.40
Granular A	t	7123.2	1.6	11397.12	25	$ 284,928.00
Granular B, Type I	t	17648	1.6	28236.8	17	$ 480,025.60
600 mm x 600 mm Maintenance Holes, Catch Basins, and Ditch Inlets	each	10	1.6	16	3200	$ 51,200.00
1800 mm Maintenance Holes, Catch Basins, and Ditch Inlets	each	8	1.6	12.8	11000	$ 140,800.00
2400 mm Maintenance Holes, Catch Basins, and Ditch Inlets, Over 4 m	each	2	1.6	3.2	20000	$ 64,000.00
700 mm Pipe Sewer	m	816	1.6	1305.6	525	$ 685,440.00
Removal of Asphalt Pavement	m2	5000	1.6	8000	6	$ 48,000.00
Removal of Curb and Gutter	m	0	1.6	0	15	$ -
Removal of Maintenance Holes, Catch Basins, Ditch Inlets and Valve Chambers	each	10	1.6	16	250	$ 4,000.00
Removal of Pipes and Culverts	m	200	1.6	320	25	$ 8,000.00
Removal of Steel Beam Guide Rail	m	200	1.6	320	13	$ 4,160.00
Removal of Concrete Barrier	m	40	1.6	64	30	$ 1,920.00
Removal of Sign Support Structure	each	0	1	0	14000	$ -
Removal of Sign Support Structure Footings	each	0	1	0	5000	$ -
Pavement Marking, Durable	m	3000	1.6	4800	4.5	$ 21,600.00
Steel Beam Guide Rail	m	1200	1.6	1920	230	$ 441,600.00
					Subtotal	**$ 3,605,000.00**
Additional miscellaneous quantities missed in above items (15%)					plus 15%	$ 541,000.00
Allowance for OTHER items not quantitifed above (50% of combined)					plus 50%	$ 2,080,000.00
Additional Grading Works - Milling/resurfacing/markings for existing lanes (not ramps)				$ 1,380,000.00		$ 1,380,000.00
Additional Grading Works - Outside shoulder strengthening for traffic staging				$ 690,000.00		$ 690,000.00
Additional miscellaneous quantities missed in above two extra items (15%)					plus 15%	$ 311,000.00
					Total Grading	**$ 8,607,000.00**

DRAINAGE - Median sewer outlets, cross-culvert repairs/replacements/twinning, and SWM ponds/facilities (excluding median sewer)					5%	$ 430,350.00
STRUCTURAL - OH Signs, Bridge Widening, Retaining Walls, etc.						
Concrete in Ground Mounted Static Sign Support Footings, Tri-Chord and Cantilever	each	2	1	2	30000	$ 60,000.00
Concrete in Median Mounted Static Sign Support Footings, Tri-Chord and Cantilever	each	0	1	0	35000	$ -
Tri-Chord Static Sign Support Structures, Span 18.51 - 27.50 m	each	1	1	1	60000	$ 60,000.00
STRUCTURAL TOTAL:						**$ 120,000.00**

RHVP Cost Calculations on a per m basis - 18 km length divided into four different segments.
All four segments are widening in the centre median
GRADING, MEDIAN DRAINAGE, GRANULAR BASE, MEDIAN BARRIER, etc.
(ALLOWANCES FOR STAGING AND MINOR ITEMS)

Segment 3 = Dartnall Road to Greenhill Avenue (Sta. 21+000 to Sta. 23+800) on RHVP

MAJOR ITEMS	UNIT	QUANTITY per km of length	Length (km)	QUANTITY	2022 UNIT PRICE	ITEM COST
Earth Excavation, Grading	m3	5300	2.8	14840	20	$ 296,800.00
Earth Borrow	m3	5300	1.9	10070	20	$ 201,400.00
Tack Coat	m2	10155	2.8	28434	0.6	$ 17,060.40
SMA 12.5 (40 mm)	t	640.584	2.8	1793.6352	210	$ 376,663.39
Gritting of SMA	m2	6655	2.8	18634	0.75	$ 13,975.50
Superpave 19.0 (70 mm)	t	1094.331	2.8	3064.1268	135	$ 413,657.12
Superpave 19.0 (70 mm)	t	602.7	2.8	1687.56	135	$ 227,820.60
Granular A	t	4273.92	2.8	11966.976	25	$ 299,174.40
Granular B, Type I	t	11471.2	2.8	32119.36	17	$ 546,029.12
600 mm x 600 mm Maintenance Holes, Catch Basins, and Ditch Inlets	each	12	2.8	33.6	3200	$ 107,520.00
1800 mm Maintenance Holes, Catch Basins, and Ditch Inlets	each	9.6	2.8	26.88	11000	$ 295,680.00
2400 mm Maintenance Holes, Catch Basins, and Ditch Inlets, Over 4 m	each	3	2.8	8.4	20000	$ 168,000.00
700 mm Pipe Sewer	m	816	2.8	2284.8	525	$ 1,199,520.00
Removal of Asphalt Pavement	m2	3000	2.8	8400	6	$ 50,400.00
Removal of Curb and Gutter	m	300	2.8	840	15	$ 12,600.00
Removal of Maintenance Holes, Catch Basins, Ditch Inlets and Valve Chambers	each	15	2.8	42	250	$ 10,500.00
Removal of Pipes and Culverts	m	400	2.8	1120	25	$ 28,000.00
Removal of Steel Beam Guide Rail	m	400	2.8	1120	13	$ 14,560.00
Removal of Concrete Barrier	m	400	2.8	1120	30	$ 33,600.00
Removal of Sign Support Structure	each	0	1	0	14000	$ -
Removal of Sign Support Structure Footings	each	0	1	0	5000	$ -
Pavement Marking, Durable	m	2600	2.8	7280	4.5	$ 32,760.00
Tall Wall Barrier	m	500	2.8	1400	5.5	$ 7,700.00
Steel Beam Guide Rail	m	600	2.8	1680	230	$ 386,400.00
					Subtotal	**$ 4,740,000.00**
Additional miscellaneous quantities missed in above items (20%)					plus 20%	$ 948,000.00
Allowance for OTHER items not quantitifed above (60% of combined)					plus 60%	$ 3,420,000.00
Additional Grading Works - Milling/resurfacing/markings for existing lanes (not ramps)				$ 2,420,000.00		$ 2,420,000.00
Additional Grading Works - Outside shoulder strengthening for traffic staging				$ 1,210,000.00		$ 1,210,000.00
Additional miscellaneous quantities missed in above two extra items (15%)					plus 15%	$ 545,000.00
					Total Grading	**$ 13,283,000.00**

DRAINAGE - Median sewer outlets, cross-culvert repairs/replacements/twinning, and SWM ponds/facilities (excluding median sewer)					5%	$ 664,150.00
STRUCTURAL - OH Signs, Bridge Widening, Retaining Walls, etc.						
Concrete in Ground Mounted Static Sign Support Footings, Tri-Chord and Cantilever	each	3	1	3	30000	$ 90,000.00
Concrete in Median Mounted Static Sign Support Footings, Tri-Chord and Cantilever	each	3	1	3	35000	$ 105,000.00
Tri-Chord Static Sign Support Structures, Span 18.51 - 27.50 m	each	3	1	3	60000	$ 180,000.00
Retaining Walls	each	8	1	8	50000	$ 400,000.00
Structure Widening	m2	773.5	1	773.5	5500	$ 4,254,250.00
STRUCTURAL TOTAL:						$ 5,029,250.00

RHVP Cost Calculations on a per m basis - 18 km length divided into four different segments. **Segment 4 = Greenhill Avenue to QEW (Sta. 23+800 to Sta. 28+200) on RHVP**
All four segments are widening in the centre median
GRADING, MEDIAN DRAINAGE, GRANULAR BASE, MEDIAN BARRIER, etc.
(ALLOWANCES FOR STAGING AND MINOR ITEMS)

MAJOR ITEMS	UNIT	QUANTITY per km of length	Length (km)	QUANTITY	2022 UNIT PRICE	ITEM COST
Earth Excavation, Grading	m3	5600	4.4	24640	20	$ 500,000.00
Tack Coat	m2	20310	4.4	89364	0.6	$ 60,000.00
SMA 12.5 (40 mm)	t	1281.168	4.4	5637.1392	210	$ 1,190,000.00
Gritting of SMA	m2	13310	4.4	58564	0.75	$ 50,000.00
Superpave 19.0 (70 mm)	t	2188.662	4.4	9630.1128	135	$ 1,310,000.00
Superpave 19.0 (70 mm)	t	1205.4	4.4	5303.76	135	$ 720,000.00
Granular A	t	6009.6	4.4	26442.24	25	$ 670,000.00
Granular B, Type I	t	10724	4.4	47185.6	17	$ 810,000.00
600 mm x 600 mm Maintenance Holes, Catch Basins, and Ditch Inlets	each	10	4.4	44	3200	$ 150,000.00
1800 mm Maintenance Holes, Catch Basins, and Ditch Inlets	each	8	4.4	35.2	11000	$ 390,000.00
2400 mm Maintenance Holes, Catch Basins, and Ditch Inlets, Over 4 m	each	2	4.4	8.8	20000	$ 180,000.00
700 mm Pipe Sewer	m	816	4.4	3590.4	525	$ 1,890,000.00
Removal of Asphalt Pavement	m2	5000	4.4	22000	6	$ 140,000.00
Removal of Curb and Gutter	m	0	4.4	0	15	$ -
Removal of Maintenance Holes, Catch Basins, Ditch Inlets and Valve Chambers	each	10	4.4	44	250	$ 20,000.00
Removal of Pipes and Culverts	m	200	4.4	880	25	$ 30,000.00
Removal of Steel Beam Guide Rail	m	200	4.4	880	13	$ 20,000.00
Removal of Concrete Barrier	m	40	4.4	176	30	$ 10,000.00
Removal of Sign Support Structure	each	0	1	0	14000	$ -
Removal of Sign Support Structure Footings	each	0	1	0	5000	$ -
Pavement Marking, Durable	m	3000	4.4	13200	4.5	$ 60,000.00
Tall Wall Barrier	m	1000	4.4	4400	230	$ 1,020,000.00
					Subtotal	**$ 9,220,000.00**
Additional miscellaneous quantities missed in above items (15%)					plus 15%	$ 1,383,000.00
Allowance for OTHER items not quantitifed above (50% of combined)					plus 50%	$ 5,301,500.00
Additional Grading Works - Milling/resurfacing/markings for existing lanes (not ramps)				$ 3,000,000.00		$ 3,000,000.00
Additional Grading Works - Outside shoulder strengthening for traffic staging				$ 2,000,000.00		$ 2,000,000.00
Additional miscellaneous quantities missed in above two extra items (15%)					plus 15%	$ 750,000.00
					Total Grading	**$ 21,654,500.00**

DRAINAGE - Median sewer outlets, cross-culvert repairs/replacements/twinning, and limited SWM ponds/facilities (excluding median sewer)					5%	$ 1,082,725.00
STRUCTURAL - OH Signs, Bridge Widening, Retaining Walls, etc.						
Concrete in Ground Mounted Static Sign Support Footings, Tri-Chord and Cantilever	each	8	1	8	30000	$ 240,000.00
Concrete in Median Mounted Static Sign Support Footings, Tri-Chord and Cantilever	each	8	1	8	35000	$ 280,000.00
Tri-Chord Static Sign Support Structures, Span 18.51 - 27.50 m	each	8	1	8	60000	$ 480,000.00
					Subtotal	**$ 1,000,000.00**
Contingency (15%)					plus 15%	$ 150,000.00
STRUCTURAL TOTAL:						**$ 1,150,000.00**

Length - 18 km

HIGH LEVEL TOP-DOWN ESTIMATE AS CHECK:

	TOP-DOWN RANGE - per CL km		Estimate for 18 km limits	
Table 5 of 2021 MTO Parametric Estimating Guideline (PEG) check using Central Region values	**Low**	**High**	**Low**	**High**
1 Lane Urban Widening (assume factor of 1.0) =	$ 4,830,000	$ 11,270,000	$ 86,940,000	$ 202,860,000
1 Lane Rural Widening (assume factor of 1.5) =	$ 1,610,000	$ 3,760,000	$ 43,470,000	$ 101,520,000
2 Lane New Construction (assume factor of 0.6) =	$ 5,715,000	$ 13,335,000	$ 61,722,000	$ 144,018,000

	RANGE		Estimate for 18 km limits	
Table 5 of 2021 MTO Parametric Estimating Guideline (PEG) check using Provincial values	**Low**	**High**	**Low**	**High**
2 Lane New Construction (assume factor of 0.75) =	$ 3,135,000	$ 7,320,000	$ 42,322,500	$ 98,820,000

SUMMARY OF BOTTOM-UP ESTIMATES AS COST ESTIMATE:

	GRADE/PAVE	DRAINAGE/STRUCTURAL	
By length compare to MTO Contract 2013-2036 = $68.5M/20 km; so 18 km in 2022 =	$ 84,000,000	-	
BOTTOM-UP ESTIMATES FROM PREVIOUS TABS AS COST ESTIMATE			
Segment 1 - LINC	$ 48,000,000	$ 5,400,000	
Segment 2 - LINC	$ 9,000,000	$ 600,000	LINC=$63M
Segment 3 - RHVP	$ 14,000,000	$ 5,700,000	
Segment 4 - RHVP	$ 22,000,000	$ 2,300,000	RHVP=$45M
	$ 93,000,000	**$ 14,000,000**	
RECOMMENDED CONSTRUCTION COST RANGE - **LOW** =	**$ 95,000,000**	**$ 15,000,000**	
RECOMMENDED CONSTRUCTION COST RANGE - **HIGH** =	**$ 115,000,000**	**$ 20,000,000**	

TOTALS	
$ 110,000,000	LOW - say LINC $64M, RHVP=$46M
$ 135,000,000	HIGH - say LINC $80M, RHVP=$55M

Comments related to Cost Estimate

1	Without developing the staging of construction scheme, it is difficult to estimate the cost of construction with any accuracy. My assumption is that the existing number of lanes will be shifted toward the outside and partially onto the outside shoulder; without knowing the pavement structure on the outside shoulder, we should assume that the shoulder asphalt should be removed full-depth and replaced with three lifts of asphalt (50 mm SP 12.5 FC2 and two lifts of 50 mm SP 19.0).
1A	Associated with the above, with the shift of traffic along the length of the project and new asphalt on both sides of the original lanes, it will likely be appropriate to mill and resurface the existing highway throughout its length in order to eliminate "ghost" markings. At the same time, it may be appropriate to undertake a major rehabilitation of other elements to "reset" the maintenance schedule. Should this work be incorporated into the cost estimate or estimated separately?
2	Assuming that the cost estimate should be broken into four parts: 1) for the LINC from Hwy 403 to Upper Ottawa; 2) from Upper Ottawa to Dartnall Road; 3) from Dartnall Road to Greenhill Avenue; and 4) from Greenhill Avenue to CPR.
3	How many overhead sign support structures should be provided in advance of each interchange exit? Currently only one, but typically there would be at least two.
4	By filling in the grassed median, will be increasing the impervious area and increasing the flow; if we take into account the potential for increased precipitation as a result of "climate change", the capacity of existing median drainage outlets likely need to be increased, meaning that we should allow for a significant amount of trenchless sewer outlet installation and SWM facilities throughout. This should be estimated separately.
5	Median pavement structure assumed to be 40 mm SMA 12.5 (with gritting) over 70 mm SP 19.0 over 70 mm SP 19.0 over 150 mm Granular A and 750 mm Granular B Type I.
6	For the median pavement structure, future consideration to provide for a wider full-depth pavement to accommodate future staging of construction? That would mean paving the bottom lift of binder wider than currently planned.