



6 Impact Assessment, Mitigation and Monitoring

6.1 Natural Heritage

There are two key stages in development during which potential natural heritage impacts may occur: the construction stage and the operational stage. Generally, short-term impacts are temporary (construction related) and can be prevented or minimized through proper construction practices and site inspection, whereas long-term impacts are prevented and mitigated through site selection, design, buffer implementation, best management practices, and environmentally sensitive maintenance.

The following sections describe how potential impacts to the surrounding natural heritage, both during construction and operation of the Stage 2 ION LRT, will be mitigated.

6.1.1 Soils

(1) Potential Impacts

The soils located along the Stage 2 ION facility are susceptible to erosion and will be impacted during construction as a result of clearing, excavation and grading. For this reason, standard erosion and sediment control measures will be followed during construction in accordance with Ontario Provincial Standard Specification (OPSS) 805 – Construction Specification for Temporary Erosion and Sediment Control Measures (2010) to minimize construction related impacts on surface water quality and fish habitat. Site-specific erosion and sedimentation control measures to be implemented prior to construction will be identified during a future design phase.

(2) Mitigation Measures

A detailed Erosion and Sediment Control Plan will be developed during a future design phase to implement a multi-barrier solution that includes, but is not limited to the following:

- » Placing straw bale/rock flow checks at regular intervals in ditches down-gradient from areas of soil disturbance in rural sections.
- » Protecting inlets to catch basins and maintenance holes in urban sections.
- » Placing silt fence along stream margins in areas of soil disturbance.
- » Implementing erosion control products within exposed areas such as erosion control blankets, coir logs, tackifiers and mulch, etc.
- » Applying seed and mulch, tackifier and/or erosion control blanket in areas of soil disturbance to provide adequate slope protection and long-term slope stabilization.



6.1.2 Fish and Fish Habitat

(1) Potential Impacts

Stage 2 ION will require new crossings of watercourses or the extension or replacements of existing culverts. These works have the potential to result in impacts to aquatic habitats and communities. Impacts on the aquatic features crossed or present in the proximity of this new infrastructure, could include:

- » Temporary disruption or permanent loss of site-specific aquatic habitat;
- » Temporary changes to water quality;
- » Changes in water temperature;
- » Creating new barriers to fish passage;
- » Indirect impacts, including channel erosion; and
- » Impacts to fish and mussel species at risk.

A summary of the proposed works and high-level site-specific impacts at each watercourse crossing can be found in **Appendix B1**.

Additional SAR investigations will be conducted during a future design phase, however, impacts to aquatic SAR include the:

- » Killing, harming, harassment, possession, capturing or taking of species listed as extirpated, endangered or threatened under the *Species at Risk Act* or *Endangered Species Act*;
- » Damage or destruction of a residence; and
- » Destruction of any part of the species' critical habitat.

(2) Mitigation Measures

Mitigation measures recommended to maintain riparian vegetation include, but are not limited to, the following:

- » Crossings of the Grand River and Speed River have been developed to fully span the watercourse, to minimize potential barriers to fish passage.
- » Prior to construction, trees/shrubs to be retained will be clearly identified in the field by the installation of tree/shrub protection barriers.
- » In areas where riparian vegetation removal is necessary to accommodate construction, measures to protect the local fish communities shall include the following: no clearing of mature trees providing a bank stabilization function; no felling of trees into the watercourse; minimize the amount of debris produced from entering the watercourse; and only clear the vegetation required to complete the necessary works.
- » Construction material, excess material, construction debris, and empty containers will be stored at least 30 m distance from watercourses and watercourse banks to prevent their entry into watercourses.

- » No in-water work (or work on watercourse banks) will be permitted from March 15 to June 30 to protect spawning warmwater fish, incubating eggs and fry emergence (constitutes most crossings in the study area).
- » Where SAR mussels exist and instream works are deemed required, the construction instream timing window will correspond to the active season for the mussels (when stream temperatures reach 16 °C or above), or as outlined in applicable permits.
- » Where critical habitat of endangered or threatened shellfish occur, no dredging or excavation of the waterbody will take place except where exempted in the recovery strategy for that species.

6.1.3 Terrestrial Vegetation and Vegetation Communities

(1) Potential Impacts

Much of Stage 2 ION will be constructed along roadways, former railways and trail systems which have been disturbed in the past. However, construction of the Stage 2 ION has the potential to result in further impacts to vegetation and vegetation communities, these impacts include:

- » Displacement of and/or disturbance to vegetation and vegetation communities; and
- » Displacement of and/or disturbance to Rare, Threatened or Endangered Vegetation and Vegetation Communities.

In total, the proposed construction will result in the removal of approximately 21.53 ha of naturalized and/or planted areas. Overall, impacts resulting in the loss of vegetation within cultural vegetation communities is considered to be minor. All of the forest communities found within the study area are widespread throughout Ontario and the loss of a portion of these vegetation communities is not expected to have any significant negative impacts to the remaining portions of forest. Impacts to forest communities within the study area will primarily result in the new creation of forest edges.

In consultation with GRCA, wetland areas within the study area will be delineated in a future design phase. Removal of a small portion of wetlands associated with the Hidden Valley, Grandview and Speed River PSW Complexes will occur. Impacts to wetland communities within the study area will primarily be to the edge of the communities, with the exception of the Grandview PSW and Speed River PSW, where the transitway will be elevated. It is anticipated that these impacts will have no significant effect the function of the remaining portion of the wetlands.

Of the 8.37 ha of human influenced vegetation to be removed, 7.95 ha of manicured lands will be removed. The overall significance of the impact to these lands is considered low.



(2) Mitigation Measures

Mitigation measures will primarily include avoidance and restoration and enhancement to reduce potential impacts on the natural environment, additional measures include, but are not limited to the following:

- » Planting of appropriate native trees, shrubs and ground flora will be undertaken as soon as possible following vegetation removals.
- » Grading within areas where edges will be newly created will be designed to meet existing grades a minimum of 3 m away from the tree drip-line.
- » Drainage patterns adjacent to newly created edges will be maintained to avoid changes in soil moisture, this is especially important around wetland areas and forest communities with substrates that maintain increased moisture capacity.
- » A plan will be in place to immediately mitigate the spread/invasion of aggressive plant species.
- » During a future design phase, a forest edge management plan will be prepared for those communities where forest edge management is recommended.
- » Where there are dense patches of common buckthorn, swallow-wort or garlic mustard, the appropriate removal and control of these species by a qualified specialist will be undertaken.
- » No non-native and invasive ornamentals plants will be used for landscaping (e.g., Norway maple, purple loosestrife, Japanese knotweed, Japanese honeysuckle, etc.).
- » Vegetation cover will be used to protect any exposed surfaces in accordance with OPSS 804 – Construction Specification for Seed and Cover.
- » Topsoil from stockpiles will be in accordance with OPSS 802 – Construction Specification for Topsoil.
- » Tree protection will be in accordance with OPSS 801 – Construction Specification for the Protection of Trees.

6.1.4 Designated Natural Areas

The Freeport Esker ANSI is located within 120 m of the study area. However, no impacts are anticipated to the ANSI as a result of the proposed construction of Stage 2 ION. It is anticipated the proposed construction will remove a narrow strip of wetland communities located along the existing edge of a portion of the Hidden Valley, Grandview, and Speed River PSW. Edge management is recommended at the PSW, where new edges are exposed.

Stage 2 ION has been aligned to avoid the Region of Waterloo Greenlands System to the extent possible. The alignment will skirt the Hidden Valley ESPA by being built within the EA-approved River Road Extension right-of-way and skirt the Dumfries Conservation Area within the Hespeler Road right-of-way. The crossing of the Grand



River Valley and the Speed River Valley are unavoidable; however, site-specific mitigation such as elevating the LRT tracks through these floodplain areas, have been incorporated into the design to reduce the impacts of Stage 2 ION on the Greenlands System.

6.1.5 Wildlife and Wildlife Habitat

(1) Potential Impacts

Implementation of Stage 2 ION has the potential to result in impacts to wildlife and wildlife habitat. However, the proposed new Stage 2 ION stations are not expected to significantly impact wildlife habitat as they are located either on street, or in existing industrial or residential areas. Details of the impacts along each segment and the potential displacement of Rare, Threatened or Endangered Wildlife or Significant Wildlife Habitat can be found in **Appendix B1**.

No new barriers to wildlife passage are expected to occur as a result of the construction of Stage 2 ION. Major river crossings, including the Grand and Speed rivers, will be elevated, therefore, wildlife corridors associated with these valleylands will be maintained. Wildlife/vehicle conflicts also appear to be very minor at present within the Stage 2 ION corridor as it mostly follows existing roads, a railway line, and a pedestrian pathway. Given that wildlife found within the study area are acclimatized to the presence of road infrastructure, disturbance to wildlife from any increase in noise, light and visual intrusion potentially caused by the operation of Stage 2 ION are not expected to have any significant adverse impacts.

Several bird species listed under the *Migratory Birds Convention Act* (MBCA) are located within the study area. The MBCA prohibits the killing, capturing, injuring, taking or disturbing of migratory birds (including eggs) or the damaging, destroying, removing or disturbing of nests.

(2) Mitigation Measures

Mitigation measures to be implemented to protect wildlife and wildlife habitat include, but are not limited to, the following:

- » All works will be completed in accordance with the *Migratory Birds Convention Act* (MBCA).
- » Tree removals during construction will occur outside the breeding window, before April 1 or after August 15.
- » In the event that these activities must be undertaken from April 1 to August 15, a nest survey will be conducted by a qualified avian biologist to identify and locate active nests of these species, as well as other bird species covered by MBCA.
- » Lights with shields will be used to focus light beams onto the facilities only and away from natural heritage features adjacent to the Stage 2 ION LRT to reduce potential disturbance caused by light pollution.

- » Wildlife incidentally encountered during construction will be protected and will not be knowingly harmed.
- » In the event that an endangered or threatened species (pursuant to the *Endangered Species Act*) is detected while the project is being constructed, due diligence will be exercised and the MNRF will be contacted for confirmation of appropriate action in accordance with the legislation.

6.1.6 Fluvial Geomorphology

(1) Potential Impacts

The watercourse crossings assessed for Stage 2 ION are as follows (see **Figure 6-1**):

- » Grand River Reach - GR-1 and Freeport Creek - FC-1 downstream of Highway 8
- » Speed River Reach - SR-2 downstream of King Street
- » Mill Creek Reach - MC-1 between Beverly Street and Shade Street

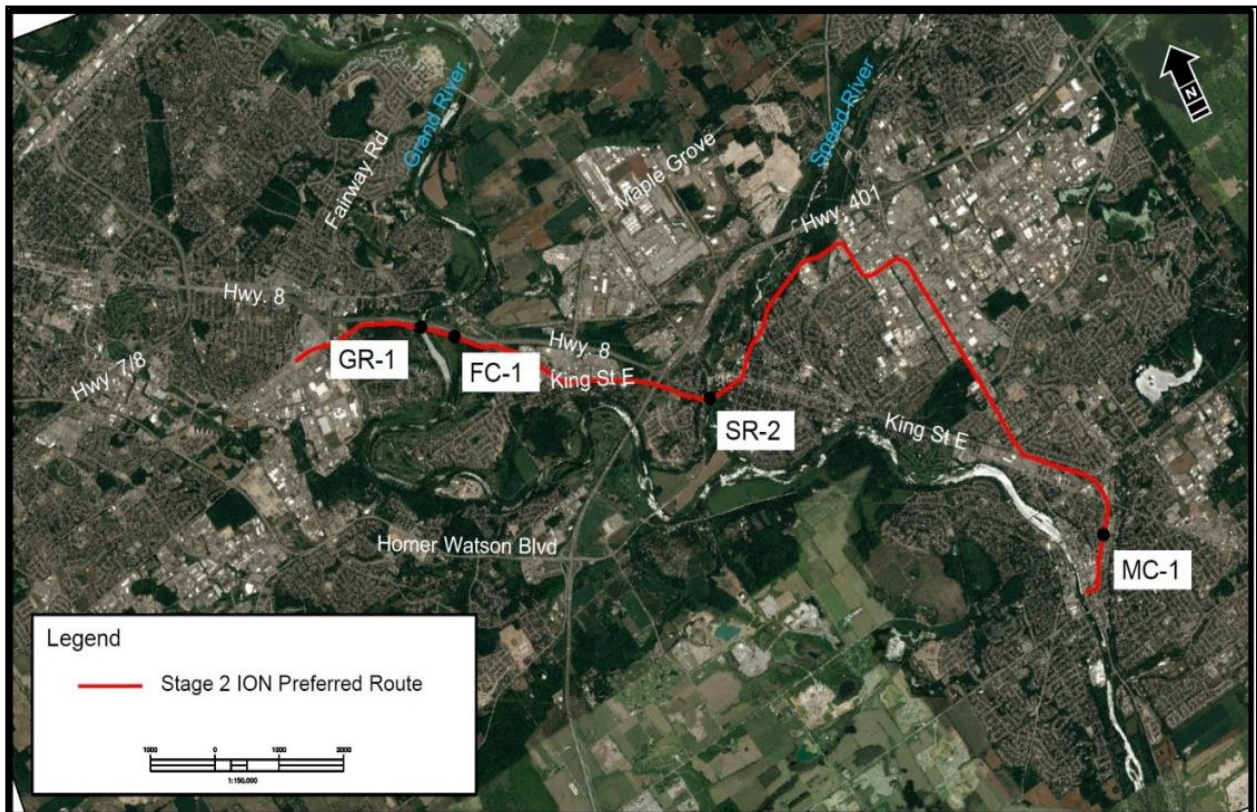


Figure 6-1: Locations of Fluvial Geomorphic Assessment

The fluvial geomorphic assessment provided input to the concept design of bridge crossings. A background review of relevant documents and aerial mapping, field observations, and geomorphic analyses were used to provide geomorphic recommendations for each crossing location.



The crossings of the Grand River, Freeport Creek and Speed River will require new structures that run parallel to existing crossings (Highway 8 and King Street). At these locations, consideration is given for the impact of the geomorphology of the channel on the crossing structures, and vice versa. Delineated meander belt width limits, bankfull widths, and erosion hazard allowances show the potential hazard of meandering channels on crossing locations and were used to provide recommendations for bridge concept design. The Grand and the Speed rivers require consideration for bankfull widths and erosion hazard allowances while the crossing of Freeport Creek should consider a three times bankfull width approach to allow channel future channel migration and minimize maintenance.

Additional analysis will be required at a future design phase to reassess the implications on watercourses as key decisions are made. This will include the future of the Riverside Dam, which could have implications for the Speed River on downstream reaches, especially given the braiding nature of the system.

(2) Mitigation Measures

The following mitigation measures are noted:

- » Bridge design considerations have minimized the number of piers to avoid potential scour at pier footings.
- » The Grand and Speed Rivers are fully spanned, with no piers in the watercourse, to avoid impacts to flow paths within the river system.
- » The Grand and the Speed Rivers crossings consider bankfull widths and erosion hazard allowances while the crossing of Freeport Creek considers a three times bankfull width approach to allow channel future channel migration and minimize maintenance.
- » Maintaining the existing channel alignment (i.e., channel armouring) will be necessary to limit channel migration.

6.1.7 Drainage and Stormwater Management

The Drainage and Stormwater Management (SWM) Report (see **Appendix B3**) identifies drainage management requirements and potential impacts to stormwater management that could result from the construction of the Stage 2 ION. Potential impacts may include increased water levels, flow rates, volumes and velocities, as well as changes to water quality. The following describes stormwater impacts for segments of the LRT route.

(1) Fairway ION Station (North Study Limit) to North Side of Grand River

The Stage 2 ION route consists of a bridge over Fairway Road South and an embedded track inside the urbanized section of the approved River Road Extension (existing Hidden Valley Road).

Potential Impacts

The proposed LRT and River Road Extension will add about 2 ha of impervious area, thereby changing the imperviousness of the corridor from 30% to 89%. Approximately



1.9 ha of additional impervious area will generate increased runoff volume and flows contributing to the Hidden Valley Creek. There will be no change in imperviousness of the Fairview Park Mall area, however about 1750 m² area of the bridge will be added to the Fairview Park Mall parking lot drainage system. This storm sewer system will require a hydraulic capacity assessment at a future design phase to avoid any adverse impacts and propose mitigations measures, if needed.

Based on the anticipated increase in peak flows, no adverse impacts are anticipated as the section discharges to the comparably larger water bodies of Hidden Valley Creek, Hofstetter Creek and ultimately to the Grand River, where no quantity controls are required.

Mitigation Measures

The area in this section discharges to Hidden Valley Creek and a Provincially Significantly Wetland (PSW). Therefore, appropriate water quality control measures as well as erosion and sediment control (ESC) measures will be required.

Water quality will be achieved through three OGS (oil and grit separator) units.

(2) Grand River to King Street at Highway 8

The proposed LRT system in this section is mainly located on structure, including the crossing of the Grand River. The bridge is 1.46 km long and the sag point is located immediately downstream of the Freeport Creek Culvert (C4) outlet south of Highway 8.

Potential Impacts

The proposed LRT route will add approximately 1.8 ha impervious area. The drainage from the proposed LRT corridor will be collected through the bridge curb / gutter or deck drainage system and discharged into or near the wetland. This concentration and transfer of flows at one point will potentially affect the existing drainage pattern and stormwater characteristics in terms of quantity and quality.

No quantity controls are required as the area discharges directly into the larger water body of the Grand River. The proposed bridge is above the Regional flood elevation and meets all applicable hydraulic design criteria.

Mitigation Measures

A treatment train approach will be implemented for water quality control, consisting of an OGS unit and approximately 50 m long flat bottom enhanced grass swale with gravel check dams before its ultimate discharge to the Freeport Creek channel.

In consultation with the Grand River Conservation Authority (GRCA), it was agreed that if discharge to wetlands cannot be avoided, then proper quality, sediment and erosion control measurements shall be implemented.

(3) King Street East and Shantz Hill Road

Stage 2 ION is an on-street alignment on King Street from Highway 8 to south of Highway 401, continuing as Shantz Hill Road to Fountain Street. Overall, the existing drainage pattern will be maintained and all catchments within the section will continue to



drain to the same pre-development outlet points. The implementation of Stage 2 ION involves widening the existing roadway corridor.

Potential Impacts

An increase in peak flows is expected at all outlets and will require a detailed assessment at a future design phase. At this location, the proposed LRT will change the imperviousness of the SWM Pond drainage area from 51% to 51.28%. This change is insignificant and is not expected to affect the functionality of the existing pond. However, a capacity assessment of the outlet pipes will be required at a future design phase to assess the impact and determine whether they require upsizing.

Mitigation Measures

To avoid surcharging of the downstream system either quantity controls in the form of super pipes under the proposed LRT route or upsizing of the outlet pipes will be required. This will be developed in a future design phase.

For water quality improvement, installation of OGS units will be evaluated further at the existing outlet points from LRT route in a future design phase.

(4) Speed River Crossing to Eagle Street North at Hedley Street

Runoff from the proposed Speed River bridge will be collected at the sag point at Chopin Drive. The stormwater will then pass through an OGS unit and be directed through an enhanced grass swale discharging to the Speed River. The existing drainage pattern along Eagle Street will be maintained and will continue to be drained at three outlets.

Potential Impacts

The proposed bridge crossing will add additional impervious area, but no flood or water quantity impacts are anticipated as the flows are directly discharged to the Speed River. All other outlets in this section also discharge to the Speed River, therefore no quantity controls will be required. The proposed alignment will impact the existing storm sewer outfalls along Queenston Road, King Street East opposite to William Street, and at the intersection of the CP Rail crossing of Eagle Street North and will require further investigation to determine the need for replacement at a future design phase. The proposed Speed River bridge is well above the Regional flood line and meets all relevant hydraulic criteria. The hydraulic analysis indicated that the proposed LRT will not cause any significant increase in the existing Regional flood elevations.

Mitigation Measures

For water quality of the Speed River crossing section, a treatment train approach will be implemented. Runoff from the proposed bridge and station area will be collected through track drains at the low point (Chopin Drive) and directed to an OGS unit and then through an enhanced grass swale or bioswale before its ultimate discharge to the Speed River.



(5) Eagle Street North at Hedley Street to Hespeler Road at Groff Mill Creek

The proposed alignment is primarily along an unused CP Rail spur line, across undeveloped lands, and along a CN Rail industrial spur. This area drains overland northwesterly to the Speed River. The entire alignment is on a ballasted track section.

Potential Impacts

The proposed ballasted track will have a minor impact on the corridor imperviousness as ballast is considered pervious and facilitates infiltration. The proposed track will not change the peak flows significantly and no quantity controls are required as it discharges to the Speed River. However, runoff from this section will discharge to a wetlands area and may impact the water quality.

The existing CSP arch culvert crossing the Groff Mill Creek meets applicable hydraulic criteria but will require further structural evaluation at a future design phase. No adverse impacts are anticipated to the floodplain of Speed River and Groff Mill Creek.

Mitigation Measures

Enhanced grass swales on both sides of the tracks are proposed to treat, attenuate and convey stormwater to the respective outlets.

(6) Hespeler Road at Groff Mill Creek to Hespeler Road at Avenue Road

The entire 3.22 km long section is an embedded track within the existing right-of-way of Hespeler Road. The proposed alignment passes through an area that is heavily urbanized.

Potential Impacts

The existing drainage pattern will be maintained. The storm runoff will be collected through the storm sewer system and discharged as per the pre-development drainage system. The proposed widening of Hespeler Road (to accommodate Stage 2 ION) will add approximately 2.4 ha impervious area in the entire section. The proposed works could potentially increase the peak flows and may affect the stormwater quality.

Mitigation Measures

Depending on the capacity assessment of the existing storm sewer system and receiving outlets (which will be conducted at a future design phase), the existing sewer system may require upsizing or quantity controls.

Opportunities exist for the improvement of stormwater quality by providing OGS units at discharge points which will be further evaluated at a future design phase.

(7) Hespeler Road at Avenue Road to Dundas Street North at Beverly Street

The Stage 2 ION runningway and Delta ION Station at Avenue Road (intersection of Norfolk Avenue and Brooklyne Road) discharges to the existing storm sewer network that discharges to the trunk sewer crossing the CP Rail Waterloo under Hespeler Road. Ultimately, these flows discharge into the Grand River outfall along Waterside Avenue.

Potential Impacts



The existing drainage pattern for the west side of this section will be maintained and drainage from the Delta ION Station and associated tracks will be directed to the existing storm sewer network. The majority of the tracks are ballasted and no significant changes in the overall imperviousness and flows are anticipated. However, the proposed swales terminating at the intersection of Dundas Street North and Beverly Street are discharged to the existing storm sewer network. Since the majority of Stage 2 ION in this section will be on ballasted tracks with enhanced grass swales on both sides, this will treat and convey the storm runoff, and therefore no additional quality treatment will be required.

Mitigation Measures

An OGS unit could be installed at the proposed Delta ION Station to treat the storm runoff from the proposed runningway before its discharge into the existing storm sewer network. This will be assessed at a future design phase.

(8) Dundas Street North at Beverly Street to Main Street at Wellington Street

The Stage 2 ION corridor drains overland to the west bank of Mill Creek (assuming Mill Creek flows in a north-south direction). The proposed drainage system will consist of enhanced grass swales on both sides of the Stage 2 ION runningway and crossing culverts to convey the track drainage to Mill Creek.

Potential Impacts

Due to the pervious nature of the ballasted tracks, the change in imperviousness is insignificant. No quantity controls are required, and quality control is provided in the form of enhanced grass swales with gravel check dams on both sides of the track. The proposed Main Street ION Station is in the existing Regional floodplain caused by the spillage of floodwater at Kerr Street. However, the Stage 2 ION tracks and station are well above the 25-year flood (Level of Service) and no adverse impacts are anticipated.

Mitigation Measures

The spillage of floodwater at Kerr St. could be avoided, if the existing twin culverts are replaced with a large single span bridge. This would be a separate undertaking and not part of the Stage 2 ION Project, and would require further assessment as part of a separate study.

(9) Main Street at Wellington Street to Bruce Street at Water Street (South Study Limit)

The existing drainage network along Wellington Street South will be maintained. The Stage 2 ION corridor on Bruce Street and associated Downtown Cambridge ION Station will be drained through the existing storm sewer system along Water Street South.

Potential Impacts

The entire section is proposed to be an on-street embedded track and drained through the existing storm sewer system that discharges at the following main outlets:

- » Outlet 32: 450 mm storm sewer along Ainslie St., ultimately discharging to the Grand River along Walnut St.



- » Outlet 33: 600 mm storm sewer outfall along Bruce St., discharging into the Grand River.

The increase in impervious area draining to Outlet 32 (20%) and 33 (24%) could be significant and requires further assessment as part of a future design phase to avoid surcharging of the storm sewer system. To avoid backwater flows from the Grand River (during large storm events), a new storm sewer network connected to the Walnut Street outfall could be considered.

Mitigation Measures

The proposed Downtown Cambridge ION Station is located within the GRCA regulated floodplain and Galt City Centre Special Policy Area and is under water during the Regional storm event due to spillage of flood water from the Grand River at the Park Hill Road bridge. A 2D hydrodynamic flood study should be carried out for this area during the next design phase to assess the backwater impacts and flood risks during various design storm events.

6.1.8 Groundwater and Contaminated Soils

A Contamination Overview Study (COS) was conducted, and can be found in **Appendix B4**, as a broad level assessment of actual and potential sources of site contamination within the study area. The COS was based on the known current and former land uses/activities within and surrounding the corridor.

(1) Potential Impacts

Based on the findings of the COS, two hundred and twenty-three (223) Areas of Potential Environmental Concern (APECs) have been identified within the study area. The APECs correspond to locations within the study area where potential environmental impacts may be present and have been categorized (low, moderate and high) by assessing the overall relative potential of environmental impacts to be present within the subsurface.

Of the 223 APECs, 182 were identified as having high potential for impacts. The APECs with high potential for contamination include land uses that are gas stations (active and historical), automotive repair shops (active and historical), dry cleaners (active and historical), industrial manufacturers, railway lines, rail yards, transportation depots, historical coal and oil gasification plants, historical landfills, automobile wrecking, hydro stations, and waste transfer sites. These areas are suspected of using chemical compounds or performing activities that may impact soil and/or groundwater within the study area.

Of the 223 APECs, 41 APECS were identified as having moderate potential for impacts. The APECs with moderate potential for contamination are represented by land uses that are commercial/light industrial properties suspected of using chemical compounds or performing activities that may impact soil and/or groundwater within the study area.

All other areas not included as APECs indicate land use features considered to have low potential for environmental impacts. Land use features considered to have a low potential for site contamination are generally classified as natural areas, open space,



residential, institutional, or community land use, which are not suspected of using chemical compounds harmful to the environment or human health.

Construction is not anticipated to have a significant effect on local water supply based on typical depths for utility excavations and the inferred aquifer properties of supply wells in the study area. Provisions for avoiding impacts related to releases of salt or other contaminants during construction or operation will be established with the preparation of a groundwater assessment report/hydrogeological study during a future design phase and as part of the environmental protection plan and construction monitoring programs. Particular focus for groundwater receptors includes significant areas of groundwater recharge, intake protection zones and wellhead protection areas as outlined in Section 5.1.8.

(2) Mitigation Measures

Standard mitigation measures will be implemented prior to and during construction and operation to reduce the potential impacts on groundwater resources. Mitigation measures will include:

- » Properties identified as high and/or moderate APECs which are directly impacted by the footprint of Stage 2 ION will be subject to further environmental studies/investigations to confirm the environmental conditions of such lands in support of both property acquisition environmental due diligence, and road construction excess material management (soil and groundwater). These studies/investigations include Phase One Environmental Site Assessments (ESAs) (and Phase Two ESAs if necessary).
- » If contamination is identified, mitigation measures will include environmental site clean-up/remediation, and/or risk assessment.
- » Where excavation is proposed, a contaminant investigation will be carried out by a qualified environmental consultant to assess soil quality (and, if necessary, groundwater quality) in construction areas adjacent to APECs with high potential for contamination.

The principal objective of the COS was to identify and review properties/areas with actual or potential sources of contamination that may impact the proposed improvements; and to identify appropriate future environmental studies and mitigation measurements required to be implemented during the future design phases. Soil testing in future design phases will confirm if material can remain in place or must be removed and disposed of at an appropriately approved facility. Contaminated soils or groundwater encountered during construction will be appropriately characterized and disposed of in accordance with O. Reg. 347.

A Permit to Take Water (PTTW) may be required for construction dewatering for bridge and culvert expansions (i.e. foundation construction) related to the project. Future design phases will identify and consider various technologies to minimize dewatering. If dewatering in excess of 50,000 litres per day is required during construction, then a PTTW will be required from the MECP, which may necessitate a detailed hydrogeological assessment be completed prior to construction. Most issues relating to



a PTTW will be dealt with through standard hydrogeological/engineering assessment combined with appropriate contingency and monitoring plans.

6.2 Cultural Environment

Potential impacts to the cultural environment, including built heritage resources and cultural heritage landscapes as well as archaeological resources, are identified below. Mitigation measures are described, where applicable, to reduce or eliminate the impact of the Stage 2 ION LRT system on the cultural environment.

6.2.1 Built Heritage Resources and Cultural Heritage Landscapes

The Regional Municipality of Waterloo and the Cities of Kitchener and Cambridge were consulted for information regarding potential built heritage resources and cultural heritage landscapes. A Cultural Heritage Report – Existing Conditions and Preliminary Impacts Assessment was completed in May 2020 and identified 225 cultural heritage landscapes and built heritage resources within or adjacent to the Stage 2 ION preferred route. The cultural heritage team worked collaboratively with the engineering and environmental teams throughout the assessment of impacts to make design refinements to avoid or reduce impacts to built heritage resources and cultural heritage landscapes, and 105 properties and/or cultural heritage landscapes have been identified as being directly or indirectly impacted by the proposed preliminary design. The Cultural Heritage Report can be found in **Appendix B5**. Refer to Appendix A – Table 3 of the Cultural Heritage Report for the extensive list of all the cultural heritage landscapes and built heritage resources within or adjacent to the Stage 2 ION preferred route, including the 105 properties and/or cultural heritage landscapes that have been identified as being directly or indirectly impacted by the proposed preliminary design.

Cultural Heritage Evaluation Reports (CHERs) were completed for all properties with direct impacts to structures (demolition or alteration), and for properties with significant landscape impacts likely to adversely affect the potential CHVI of the property (12 properties). CHERs will be required during a future design phase for properties with indirect impacts (such as isolation) that are likely to adversely affect the potential CHVI of the property, and for all candidate cultural heritage landscapes with direct and indirect impacts that may be mitigated during a future design phase (such as alterations to views and vistas and/or alteration of landscape features such as curbs, sidewalks, natural landscaping and street trees within the public realm). Heritage Impact Assessments (HIAs) are recommended to be completed as part of a future design phase for all properties that have been evaluated using O. Reg. 9/06 where direct or indirect impacts are anticipated to adversely impact the property.

The following sections describe the potential impacts to cultural heritage properties along the Stage 2 ION corridor for which CHERs were completed. Additional details can be found in the Cultural Heritage Report – Existing Conditions and Preliminary Impacts Assessment and the Cultural Heritage Evaluation Reports (CHERs) found in **Appendix B5**.



(1) General Impact Considerations

The conservation of built heritage resources and cultural heritage landscapes is considered to be a matter of public interest and each municipality reviews development and building applications affecting designated or listed properties or properties that may exhibit heritage potential. Ontario Regulation (O. Reg.) 9/06 of the *Ontario Heritage Act* (OHA) provides criteria for determining whether a property has cultural heritage value or interest. If a property meets one or more of the criteria in O. Reg. 9/06, a property is eligible for designation under the OHA. Negative impacts, as outlined in the Ontario Heritage Tool Kit may include, but are not limited to:

- » Destruction of any, or part of any, significant heritage attributes or features;
- » Alteration that is not sympathetic, or is incompatible, with the historic fabric and appearance;
- » Shadows created that alter the appearance of a heritage attribute or change the viability of an associated natural feature or plantings, such as a garden;
- » Isolation of a heritage attribute from its surrounding environment, context or a significant relationship;
- » Direct or indirect obstruction of significant views or vistas within, from, or of built and natural features;
- » A change in land use (such as rezoning a church to a multi-unit residence) where the change in use negates the property's cultural heritage value; and
- » Land disturbances such as a change in grade that alters soils, and drainage patterns that adversely affect a cultural heritage resource, including archaeological resources.

As noted above, twelve Cultural Heritage Evaluation Reports (CHERs) were completed as part of the Stage 2 ION preliminary design; these reports can be found in **Appendix B5**. Based on the results of the research, site investigation, and application of the criteria in O. Reg. 9/06, the following seven properties were determined to retain Cultural Heritage Value or Interest (CHVI). As such, a Heritage Impact Assessment (HIA) is required at a future design phase for these seven properties to determine the appropriate mitigation measures.

4336 King Street East, City of Kitchener

Potential Impacts

The property at 4336 King Street East contains a one-storey former single room schoolhouse built in 1889. The property is constructed of buff-brick in a common bond and Flemish bond every seventh course, with a fieldstone foundation and a gable roof. A front (north) addition with a gable roof is attached to the former schoolhouse as well as a long one-storey commercial strip building attached to the east side of the former schoolhouse which is split into multiple units that provide a variety of restaurant and retail uses. The property was identified as being a directly impacted potential cultural heritage property.



105 Hespeler Road, City of Cambridge

Potential Impacts

The property at 105 Hespeler Road contains a two-storey white stucco commercial building with art modern influences with attached one-storey stucco garage constructed between 1946 and 1954 in the City of Cambridge. The property was identified as being a directly impacted potential cultural heritage property.

Grantham Rail Bridge, City of Cambridge

Potential Impacts

The structure known as the Grantham Rail Bridge was identified as being a directly impacted potential cultural heritage property. The subject structure consists of three plate-girder single-span structures on stone and concrete abutments that transports the Canadian Pacific Railway (previously it transported the Canadian National Railway which was formerly the Credit Valley Railway) over the former Great Western Railway right-of-way in the City of Cambridge, which will be the alignment of Stage 2 ION in this area. The property was identified as being a directly impacted potential cultural heritage property.

127 Beverly Street, City of Cambridge

Potential Impacts

The property at 127 Beverly Street is a one-and-a-half-storey, rectangular plan dwelling with a side gable roof built circa 1858. The front façade is symmetrically arranged with a central doorway flanked by window openings. A garage structure at the rear of the property is the only structure that will be impacted by the proposed LRT infrastructure. This property was identified as a directly impacted potential cultural heritage property.

1 Wellington Street, City of Cambridge

Potential Impacts

The property at 1 Wellington Street two-storey brick commercial building with Italianate influences constructed between 1892 and 1904 in the City of Cambridge. The building features an irregular footprint and a hipped roof with a flat top. The irregular footprint due to the angled east elevation, conforms to the former railroad line. The structure on the subject property will be directly impacted by the proposed LRT infrastructure.

69 Ainslie Street South, City of Cambridge

Potential Impacts

The property at 69 Ainslie Street South consists of a former stone industrial vernacular milling complex built in 1878 and was identified as being a directly impacted potential cultural heritage property. The property is located south of the former route of Mill Creek. The milling complex as it exists today has been significantly altered and does not represent its milling history between 1878 to 1966. Based on the results of research, site investigation, and application of the criteria in O. Reg. 9/06 and the City of Cambridge criteria identified in their official plan, the property at 69 Ainslie Street South was found



to have historical or associative value as a former mill complex built in 1878, which operated as a mill from 1878 to 1966, supporting the Cambridge area farming industry. However, due to the deteriorated state of the built form, any heritage attributes that would have effectively communicated the cultural heritage value or interest of the site have been lost. The integrity of the site has been compromised due to the derelict condition of the associated milling complex, and few heritage attributes remain which represent or support the cultural heritage value or interest. However, the remnant landscape still retains some CHVI and accordingly, a Heritage Impact Assessment (HIA) is required at a future design phase to identify appropriate mitigation measures.

63 Water Street South, City of Cambridge

Potential Impacts

The property located at 63 Water Street South consists of a two-and-a-half storey former dwelling converted for commercial use. The former dwelling was constructed prior to 1916 and reflects the Queen Anne style of architecture. The property was identified as being a directly impacted potential cultural heritage property.

Based on the results of the research, site investigation, and application of the criteria in O. Reg. 9/06, the following five properties were not determined to retain Cultural Heritage Value or Interest (CHVI). As such, no additional heritage assessments are required.

- » 333 and 339 Hidden Valley Road, City of Kitchener
- » Highway 401 Overpass at Regional Road 8 (King Street), City of Kitchener
- » 320 Shantz Hill Road, City of Cambridge
- » 99 Beverley Street, City of Cambridge
- » 41 Kerr Street, City of Cambridge

Further details related to these five properties are available in their respective CHERs (**Appendix C5**).

6.2.2 Archaeology

(1) Potential Impacts

The Stage 1 Archaeological Assessment (AA) background research identified elevated potential for the recovery of Aboriginal and Euro-Canadian archaeological remains within portions of the study corridor based on the Region of Waterloo's Archaeological Facilities Master Plan, and based on the study corridor's close proximity (within 300 metres) to: historic structures, historic villages, several historic transportation routes, numerous designated and listed heritage properties, commemorative plaques, previously registered archaeological sites, three historic pioneer cemeteries, and primary water sources. A complete list of the registered archaeological sites within one kilometre of the study corridor and features contributing to archaeological potential can be found in **Appendix B6**.



Background research revealed that portions of the study corridor have been previously subjected to a Stage 1 and/or Stage 2 AA, and subsequently freed of further archaeological concerns. While disturbances and areas of low or no archaeological potential exist within the study corridor, areas retaining archaeological potential still remain. The Stage 1 AA recommended a Stage 2 AA to be completed for all parts of the study corridor which retain archaeological potential, this includes shallow test pit surveys. The Stage 1 AA has been submitted to the Ministry of Heritage, Sport, Tourism and Culture Industries (MHSTCI) and entered into the registry on March 5, 2020.

Stage 2 AA, and any subsequent studies recommended by the Stage 2 AA, will be completed as early as possible during a future design phase and prior to any ground disturbing activities. A map showing areas where Stage 2 AA is required can be found in the Stage 1 AA in **Appendix B6**.

(2) Mitigation Measures

General mitigation measures to be implemented include the following:

- » Should construction activities extend beyond the assessed limits of the study corridor, further archaeological investigation will be required to assess the archaeological potential of these lands.
- » The Stage 2 AA will be submitted to the MHSTCI as a condition of licensing in accordance with Part VI of the *Ontario Heritage Act*, R.S.O. 1990, c 0.18. The report is reviewed to ensure that it complies with the standards and guidelines that are issued by the Minister, and that the archaeological fieldwork and report recommendations ensure the conservation, protection and preservation of the cultural heritage of Ontario. When all matters relating to archaeological sites within the project area of a development proposal have been addressed to the satisfaction of the MHSTCI, a letter will be issued by the ministry stating that there are no further concerns with regard to alterations to archaeological sites by the proposed development.
- » No construction activities shall take place within the study corridor prior to the MHSTCI confirming in writing that all archaeological licensing and technical review requirements have been satisfied.
- » It is an offence under Sections 48 and 69 of the *Ontario Heritage Act* for any party other than a licensed archaeologist to make any alteration to a known archaeological site or to remove any artifact or other physical evidence of past human use or activity from the site, until such time as a licensed archaeologist has completed archaeological fieldwork on the site, submitted a report to the Minister stating that the site has no further cultural heritage value or interest, and the report has been filed in the Ontario Public Register of Archaeology Reports referred to in Section 65.1 of the *Ontario Heritage Act*.
- » Should previously undocumented archaeological resources be discovered, they may be a new archaeological site and therefore subject to Section 48 (1) of the *Ontario Heritage Act*. The proponent or person discovering the archaeological resources must cease alteration of the site immediately and



- engage a licensed consultant archaeologist to carry out archaeological fieldwork, in compliance with Section 48 (1) of the *Ontario Heritage Act*.
- » The *Cemeteries Act*, R.S.O. 1990 c. C.4 and the *Funeral, Burial and Cremation Services Act*, 2002, S.O. 2002, c.33 (when proclaimed in force) require that any person discovering human remains must notify the police or coroner and the Registrar of Cemeteries at the Ministry of Consumer Services (MCS).
 - » Parts of the study corridor that were identified as no longer retaining archaeological potential are exempt from requiring Stage 2 AA; extents of these areas to be confirmed during the Stage 2 AA.
 - » Parts of the study corridor that were identified as having no or low archeological potential are exempt from requiring Stage 2 AA; extents of these area to be confirmed during Stage 2 AA.
 - » All parts of the study corridor which retain archaeological potential must be subjected to a Stage 2 AA. These areas must be subjected to test pit survey at five metre intervals in accordance with *Section 2.1.2* of the *Standards and Guidelines for Consultant Archaeologists* (2011).
 - » Should construction activities extend beyond the assessed limits of the study corridor, further archaeological investigations will be required to assess the archaeological potential of these lands.
 - » Stage 2 AA, and any subsequent studies recommended by the Stage 2 AA, will be completed as early as possible during a future design phase and prior to any ground disturbing activities.

6.3 Socio-Economic Environment

Stage 2 ION will contribute to guiding and managing growth within the Region in association with the RGMS and other plans and strategies. The project will lead to increased opportunities for development, intensification and revitalization along the corridor, and improve the socio-economic environment overall. Where negative impacts cannot be avoided, mitigation measures will be implemented to eliminate or minimize the impact.

6.3.1 Land Uses and Economic Characteristics

(1) Potential Impacts

Stage 2 ION is expected to result in several positive impacts to land uses and the economic environment along the project corridor. Businesses along the route will gain increased exposure and there is potential for future Transit Oriented Development (TOD) at station locations and along the LRT corridor. Some negative impacts, such as temporary disruption during construction or changes in access to individual properties, will occur, but these are anticipated to be minor.

Stage 2 ION will contribute to development in existing urban areas, specifically the Region's three designated Urban Growth Centres (UGC's) of Uptown Waterloo,



Downtown Kitchener and Downtown Cambridge. Over the next 30 years, the Region's population is projected to reach 923,000 people (excluding students) and employment will increase to 470,000 by 2051. Building on the rapid transit network initiated with Stage 1 ION, Stage 2 ION offers a means of managing urban growth by promoting intensification in existing urban areas. This will preserve the Region's agricultural lands, natural beauty, and distinct heritage and culture. Policies to guide growth management are set out in the RGMS and the Regional Official Plan.

Investments in the LRT system are expected to help establish the infrastructure required to support the knowledge-based economy in the Region. The business community, specifically the high-tech industry, has expressed its strong support for implementing LRT and anticipates it being a key factor in attracting and retaining a talented workforce in the area.

All efforts will be made to minimize neighbourhood impacts and to maintain access to reduce out-of-direction travel. During construction, access to adjacent residences and businesses will be maintained. Infrastructure and facilities construction may result in temporary and intermittent traffic delays. Rerouting traffic may be required in some areas. Once Stage 2 ION is operational, some vehicular access modifications (i.e. right-in/right-out only) may be required in certain areas.

Property takings will be required where the design of the LRT extends beyond the existing right-of-way (ROW). Based on the functional design, an estimated forty-two (42) properties require full buyout and portions of approximately 209 additional properties may be required. The final number of property takings will be confirmed during a future design phase and property owners will be contacted to discuss the project and proposed acquisitions.

Stage 2 ION will connect key nodes such as the downtown areas, post-secondary institutions, employment areas, cultural attractions, medical facilities, local transit facilities and major shopping centres. These connections will offer residents and visitors increased access to locations and destinations across the Region.

(2) Mitigation Measures

The overall impacts of introducing Stage 2 ION to the community are expected to be positive. However, where impacts cannot be avoided, the following mitigation measures will be implemented:

- » Construction along major arterial corridors or in downtown areas will be staged to minimize adverse effects on businesses and residents along the corridor.
- » Traffic detouring will be implemented during construction to minimize community effects.
- » Prior to and during construction, the Region will contact and communicate with local businesses and property owners adjacent to the corridor to confirm how access will be maintained to their properties during and after construction.

- » Construction notification will include contact information for the Project Team to allow the public to raise issues and concerns in an effective manner.
- » Consultation with property owners regarding property acquisition will be initiated closer to the time of construction. Compensation will be provided at fair market value of the land and address the project impacts (e.g. repairing or replacing landscaping, fencing or paving). The Region prefers to acquire property on a willing buyer/willing seller basis. If expropriation is required, the process set out in the *Ontario Expropriations Act* will be followed to ensure the rights of property owners provided under the Act are protected.
- » Acquisition of property from the Grand River Conservation Authority will be carried out in accordance with GRCA property approvals and requirements.
- » Changes to access both during and after construction will be discussed with individual property owners prior to construction. Where changes occur near community facilities, the Region will work with land owners to integrate appropriate signage so that transit users and commuters are directed to facilities affected by access changes.

6.3.2 Air Quality

(1) Potential Impacts

Local air quality impacts were assessed by estimating contaminant concentrations resulting from the transit operations in three scenarios:

- » Current Scenario: existing conditions in the Study Area (2018);
- » No-Build Scenario: 2031 horizon (future scenario) with no LRT; and,
- » Full-Build Scenario: 2031 horizon (future scenario) with LRT.

For the three scenarios, roadway traffic in the current and future scenarios were utilized to determine the local impacts of the LRT on sensitive receptors within the identified study areas. To evaluate the air quality impacts, the study area was divided into smaller areas to conduct more targeted and detailed air quality impact assessments. These identified sub-study areas represent where the worst-case air quality impacts are expected for the entire study area. The selection of the study areas was defined based on the following criteria:

- » The intersections with the largest expected changes in traffic (Full-Build vs Current);
- » The areas with the closest proximity to residential areas and sensitive receptors as defined in Section 1.2 which represent where the worst-case air quality impacts are expected; and,
- » The areas with changes in infrastructure (i.e., road widening).

With the above outlined criteria, the following four sub-study areas were selected to complete “hot spot” modelling:



- » Study Area 1: King Street East between Sportsworld Crossing and Gateway Park Drive
- » Study Area 2: Shantz Hill Road between north of Preston Parkway to Fountain Street South;
- » Study Area 3: Eagle Street North between Hedley Street and Industrial Road; and,
- » Study Area 4: Hespeler Road between Isherwood Avenue/Munch Avenue and Coronation Boulevard/Dundas Street North.

Several areas, including the neighbourhood of Preston, were not selected as part of the modelling as they did not best represent the criteria outlined above.

Stage 2 ION vehicles will operate using electric power and not fuel combustion. As a result, the expected contaminants from LRT vehicle operations include particulates from wheel wear and brake dust. Compared to tire wear and brake dust emissions from passenger vehicles, brake dust emissions from LRT vehicles are expected to be minimal and would not significantly impact local air quality. The majority of deceleration for LRT vehicles is done using electromagnetic regenerative braking sending current back into the overhead catenary system (OCS). If the OCS is overloaded and cannot take the current, it is released through thermal energy and the OCS brake dust is negligible. In addition, tire wear and brake dust emissions from passenger vehicles represent approximately 10% of the particulate emissions. Therefore, it is expected that the tire wear and brake dust from the limited number of LRT vehicles travelling and overhead catenary system (OCS) system (or physical breaking system) at any given time will be negligible when compared to total particulate emissions from the passenger vehicles travelling on the neighbouring road networks.

Greenhouse gases (GHGs) are contributors to the radiative warming effect of the environment that results in global climate change. To investigate the impact of Stage 2 ION on GHG emissions, the future GHG emissions following implementation of the project (the Future Full-Build scenario) were compared with the future GHG emissions if Stage 2 ION was not constructed (the Future No-Build scenario), based only on the reduction of cars in the study area by 2031. The results of the GHG emissions estimates (**Appendix B7**) for the sub-study areas showed a reduction in total CO_{2eq} emissions from the No-Build to Full-Build scenarios which is an indication of an improvement in total GHG emissions with Stage 2 ION than if Stage 2 ION was not implemented. Vehicle kilometres travelled by passenger vehicles decrease in the 2031 Full-Build Scenario when compared to the 2031 No-Build Scenario.

For all scenarios considered (Current, Future No-Build, and Future Full-Build) in Study Areas 1, 3, and 4, the annual CO_{2eq} emissions reductions were less than 0.01% of the total 2015 Provincial emissions and approximately 0.1% of the 2015 Regional emissions. Therefore, it was concluded that Stage 2 ION does not significantly impact the Regional and Provincial GHG inventories by this measure. For all scenarios considered (Current, Future No-Build, and Future Full-Build) in Study Area 2, the CO_{2eq} emissions were less than 0.01% of the total 2015 Provincial emissions and less than



0.1% of the 2015 Regional emissions. Therefore, it was concluded that Stage 2 ION does not significantly impact the Regional and Provincial GHG inventories.

Overall, the results of the Future No-Build and Future Full-Build scenarios indicate that Stage 2 ION is expected to result in a decrease in criteria air contaminants and GHG emissions as compared to future conditions without Stage 2 ION. This overall decrease in concentrations is attributed to the expected decrease in roadway traffic from the Future No-Build scenario to the Future Full-Build scenario, increased efficiency of vehicles, more stringent emission standards, and emission control devices on future vehicles. From a climate change perspective this project will assist the Region of Waterloo to achieve their GHG reduction targets.

Stage 2 ION is expected to support the Region's ambitious commitment to reducing greenhouse gas emissions by 80% below 2010 levels by the year 2050, in several ways that are difficult to quantify precisely. First, it is a direct fuel-switching project that would be expected to nearly eliminate the approximately 1,800 tonnes of CO_{2eq} emitted annually by the ION buses currently serving a similar route, while serving many more riders than the current bus system. For comparison, based on pre-COVID service levels, Stage 1 ION produces only an estimated 141 tonnes annually to move the trains, while providing considerably more passenger capacity. Second, Stage 2 ION is also part of the Region's development of a fast, frequent, and high capacity transit network that will support broad changes in travel behaviour both inside and outside of the study area. This network is expected to support many more people to use transit and reduce their reliance on energy inefficient personal vehicles. Third, Stage 2 ION will attract more people and jobs to core areas, supporting intensification. Denser communities are more energy efficient for the movement of people and goods and the provision of services.

(2) Mitigation Measures

A comparison of scenarios indicates that Stage 2 ION will decrease GHG emissions as compared to future conditions without Stage 2 ION, therefore improving local air quality within the general study area. Stage 2 ION therefore has a positive impact from a GHG (climate change) perspective. As a result, there is no proposed mitigation required during the operations with the exception of the continued regular vehicle and road maintenance along the route. Nuisance fugitive dust can be managed through an Air Quality Management Plan (AQMP) for fugitive dust following the recommendations outlined in the "Region of Waterloo Rapid Transit Project Environmental Project Report", dated March 2012.

Nuisance fugitive dust will be the primary air quality impact during the construction phase of the project. Nuisance fugitive dust can be managed through a Construction Air Quality Management Plan (CAQMP), which must be submitted to the Region of Waterloo and MECP for review to ensure it is adequate to control fugitive releases caused by construction. Mitigation measures may include:

- » Dust suppression measures during construction (e.g., application of water wherever appropriate, or the use of approved non-chloride chemical dust suppressants, where the application of water is not suitable);



- » Use of dump trucks with retractable covers for the transport of soils and other friable materials;
- » Minimize the number of loadings and unloading of soils and other friable materials;
- » Minimize drop heights, use enclosed chutes, and cover bins for debris associated with deconstruction of affected structures;
- » Washing of equipment and/use of mud mats where practical at construction site exits to limit the migration of soil and dust off-site;
- » Stockpiling of soil and other friable materials in locations that are less exposed to wind (e.g., protected from the wind by suitable barriers or wind fences/screens, or covered when long-term storage is required) and away from sensitive receptors to the extent possible;
- » Reduction of unnecessary traffic and implementation of speed limits;
- » Permanent stabilization of exposed soil areas with non-erodible material (e.g., stone or vegetation) as soon as practicably possible after construction in the affected area is completed;
- » Ensuring that all construction vehicles, machinery, and equipment are equipped with current emission controls, which are in a state of good repair; and
- » Dust-generating activities should be minimized during conditions of high wind.

Additional mitigation measures to be implemented during the construction phase can be found in the Air Quality Report found in **Appendix B7**.

6.3.3 Noise and Vibration

(1) Noise Impact Criteria

The noise and vibration impact assessment criteria used to evaluate the implications of Stage 2 ION were based on a set of draft protocols developed through the combined efforts of the Ministry of the Environment, Conservation, and Parks (MECP) and the Toronto Transit Commission (TTC). As per the MECP/TTC protocol, sensitive receptors are identified as existing or municipally-approved residential developments, nursing homes, group homes, hospitals, and other such institutional land uses where people reside. Residential receptors dominate the sensitive receptors along the Stage 2 ION route. Noise is considered an undesired or unwanted sound and is measured in decibels (dB). When measuring noise impacts, the decibel scale is often weighted using an “A” frequency adjustment factor because it is the frequency best heard by the human ear.

The first and most common component in transit projects is the noise impact as a result of changes to the roadway sound levels at the receptors. For this analysis, sound levels without Stage 2 ION in 2031 are compared to the sound levels with Stage 2 ION in 2031. The horizon year used to project the traffic volumes on the affected streets is



2031, to allow for the project and its surrounding roadways to reach a mature level of use.

The comparison is based on a daytime (0700–2300 hours) and nighttime (2300–0700 hours) equivalent sound level comparison, which is appropriate for non-highway projects. In some cases, the future sound levels are relatively low. In such conditions, minimum exclusion criteria of 55 dBA during the daytime and 50 dBA during the nighttime are used instead of the lower actual ambient sound levels. Where the sound levels with the project exceed the sound levels without the project by at least 5 dBA, noise control needs to be considered where it would be technologically, economically, and administratively feasible. While existing sound levels do not play a role in the assessment, they have been calculated to provide an indication of the overall change from today's sound levels.

The second set of noise criteria applies to ancillary facilities. The ancillary facilities analyzed as part of this project include traction power substations. No new off-street bus terminals are proposed, though on-street bus stops will be added in areas. Off-street bus terminals and traction power substations are treated as stationary noise sources and are evaluated based on the Ministry of the Environment's *NPC-300* Publication "Environmental Noise Guidelines". If the facility's sound level can remain below the quietest ambient sound level during that period, then the facility is likely to meet the guidelines during all periods of the day. Where the facility exceeds the guidelines by any measurable amount, noise control needs to be implemented, as per *NPC-300*.

Further information about noise impact criteria is found in the Noise and Vibration Report included in **Appendix B8**.

(2) Vibration Impact Criteria

The vibration impact criteria attempt to address two potential impacts from vibration generated by Stage 2 ION:

- » First, the criteria document considers perceptible (ground-borne) vibration levels. This addresses vibration that can be felt by residents in a building.
- » Second, the criteria document also mentions the sound from vibration (vibration-induced sound) but does not set a limit.

The limit for perceptible vibration levels has been set to 0.1 mm/s RMS (root-mean-square) velocity. If absolute vibration levels are expected to exceed this limit, mitigation methods need to be determined during the future design phase to meet the limit to the extent technologically, economically, and administratively feasible. Vibration levels are evaluated at the nearest point of a residential or sensitive-use building. The review of vibration-induced noise potential involves identifying the locations where the rail system passes close to buildings. The points of reception for each of the sensitive receptors are generally the closest façade or point of a building.

Further information about vibration impact criteria is found in the Noise and Vibration Report included in **Appendix B8**.



(3) Traction Power Substations

The preliminary design includes a total of 13 traction power substations (TPSS) along the route. These TPSS have been considered in the assessment of noise and vibration (see **Figure 6-2**). It is assumed the substations will be designed similar to those on Stage 1 ION. In many cases, the substations are located in non-residential areas. Because the substations are located in enclosures, the dominant noise sources are often the cooling equipment for the TPSS. A more detailed assessment of the TPSS will be completed during a future design phase, when more information is known and when their locations are finalized.

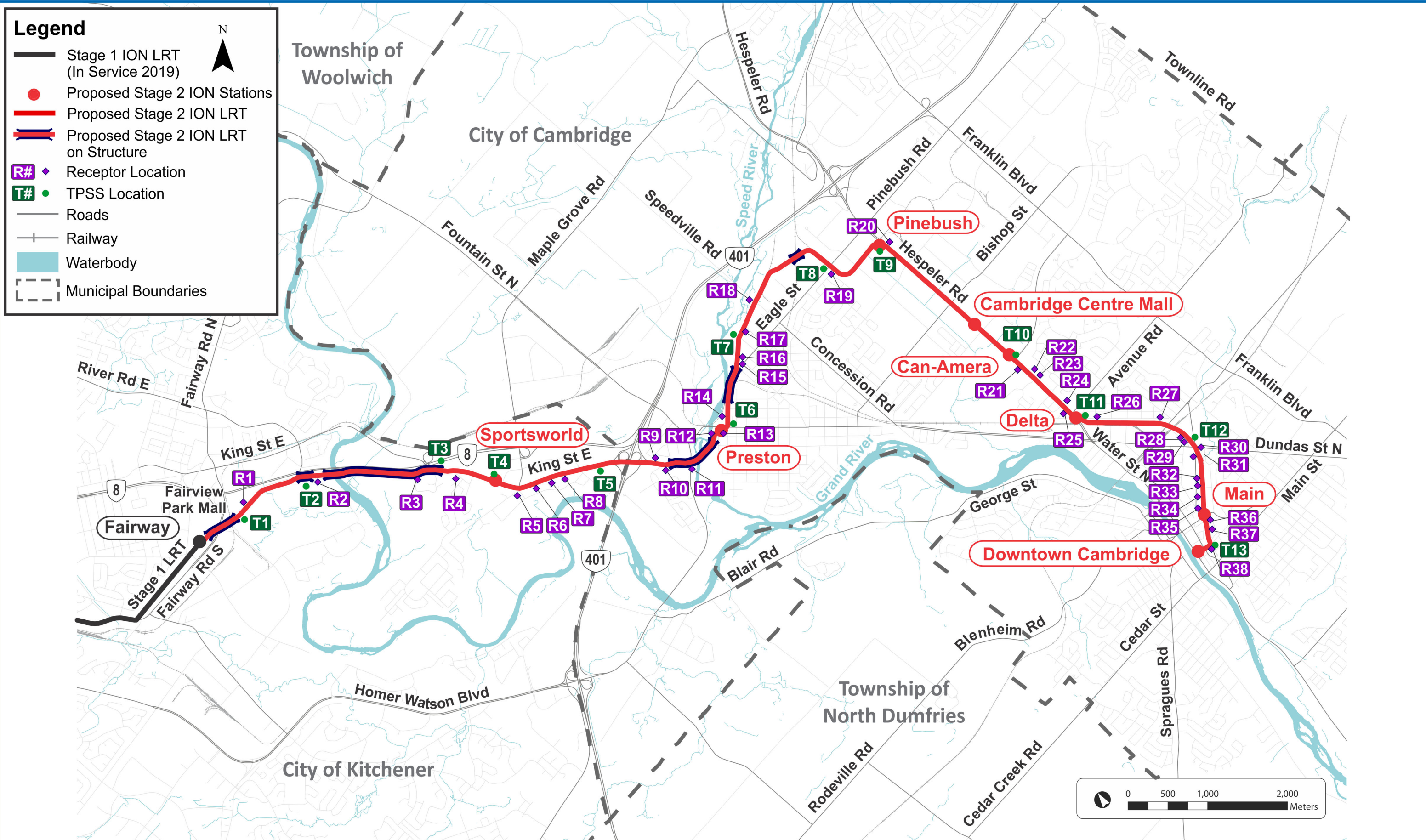
(4) Potential Impacts

Based on Stage 2 ION alignment, traffic volumes, and receptor characteristics, 38 representative Points of Reception (POR) were identified. The POR locations and noise predictions are summarized in the Noise and Vibration Report in **Appendix B8**. It was concluded that Stage 2 ION will not generate a notable increase in sound levels when introduced along busy roadways or adjacent to railways with regular vehicle traffic. Where Stage 2 ION operates in abandoned railway corridors or as it crosses through residential areas with minimal road traffic, the sound level increases range up to a maximum of 4 dB. Due to the close proximity of the Stage 2 ION LRT and low ambient sound levels, increases of 7 dB and 6 dB are expected during the daytime and nighttime period.

Unlike Stage 1 ION, the Stage 2 ION LRT does not have many sharp corners. As a result, the potential for wheel squeal is significantly lower. The primary areas of concern for wheel squeal are in the residential area south of Eagle Street and where the LRT terminates along Ainslie Street. Wheel squeal will be controlled by rail and/or wheel lubrication along with wheel damping systems. These areas will again be reviewed further during a future design stage.

The LRT-only sound levels will be higher in areas with tight curves or special trackwork (crossovers, pocket track, etc.). The special trackwork locations will be detailed during the next phase of the project's design, and will be avoided in residential areas where possible. If necessary, track design can be adjusted to minimize the additional noise generated by special trackwork. Short noise barriers, built close to the tracks, can also be very effective in areas with low-rise residential. This item will be reviewed further during a future design phase.

The vibration impact assessment was completed based on a prediction of future vibration levels due to the operation of Stage 2 ION in the rapid transit corridor. The closest sensitive receptors to the corridor were considered but vibration impacts will be negligible beyond 50 m from tangent track. Both the ground-borne vibration (perceptible vibration) and the vibration-induced noise resulting from proposed Stage 2 ION were estimated. Based on the measured vibration levels, residential receivers located beyond 15 m from the nearest track centreline will not require significant vibration control measures. Residential receptors located less than 15 m from the nearest track centreline may require vibration control beyond the standard embedded rail vibration isolation. Detailed vibration testing and analysis will be conducted during a future design phase.





The noise and vibration impact that results from the anticipated construction methods required to build the Stage 2 ION system has also been examined. This will include the installation of tracks, the construction of ancillary facilities, road widening, and any new bridges to accommodate the LRT. During the future design stage, the Region will complete an updated noise impact assessment based on final equipment specifications, final alignment, and more detailed topographical information.

(5) Mitigation Measures

Overall, noise and vibration impacts from the operation of Stage 2 ION are expected to be minor. At one receptor near Kerr Street, the increase in sound levels during the daytime is expected to be 5 dBA due to the proximity of Stage 2 ION. Noise mitigation will be considered for this location in a future design phase, once the alignment is finalized and property requirements are confirmed. Refer to **Appendix B8** for a complete list of mitigation measures to help control the noise and vibration impacts during construction.

The following mitigation measures will be considered further to help control noise and vibration:

- » There are several forms of vibration isolation that can be used for light rail systems running on both embedded-in-concrete and tie-on ballast. For rail embedded in concrete, the typical vibration isolation systems are:
 - Rubber-embedded or encapsulated track (also referred to colloquially as the “rubber boot”). The rubber material reduces the vibration transmission into the concrete and subsequently into the adjacent structures.
 - The use of a floating slab system. This system floats on a concrete rail bed mounted on rubber isolators, reducing the transmission of vibration from the concrete into the soil and adjacent structures.
- » Special exemptions where night construction is to occur. In this case, residents are notified several weeks in advance of pending nighttime construction activities.
- » LRT wheel squeal noise control should be implemented in the form of rail and/or wheel lubricators and/or wheel damping.
- » Construction is generally limited to between 7 a.m. and 7 p.m. on weekdays and Saturdays, with more stringent hours on Sundays and holidays. It is likely that some of the construction will need to be carried out through the night, to minimize the impact on local traffic in the area. As such, special exemptions will need to be obtained where the night construction is to occur.
- » All equipment used during nighttime (11 pm – 7 am) construction, regardless of size, will use broadband backup alarms.
- » Localized noise barriers such as around stationary equipment, staging areas, or long-term work areas will be used.
- » Haul and truck routes will be designed to minimize truck traffic through lightly travelled residential streets.

- » The communications and complaints protocol designed for the public to inform them of construction activities and allow for any concerns will include noise and vibration provisions.

6.4 Transportation and Utilities

Potential impacts to the transportation and infrastructure system, including road network, transit service, cycling and pedestrian facilities, utilities and railway operations are identified below. Mitigation measures are described, to reduce or eliminate the impact of Stage 2 ION both during construction and operation.

6.4.1 Road Network

(1) Potential Impacts

The key road network impacts of Stage 2 ION are described from north to south.

- » High voltage overhead hydro transmission line relocations are proposed as part of Stage 2 ION at Fairview Park Mall which could allow for reconfiguration of parking to increase parking capacity. Final layout design will be determined through consultation with Cadillac Fairview and the Region in the future design phase.
- » The Region's approved River Road Extension project is being developed with a 4-lane section from Wabanaki Drive to Highway 8 which will accommodate an ultimate 2-lane section with centre running LRT. The LRT runningway will cross River Road at grade near the east and west sections of roadway with gates and flashing lights used to control access.
- » On all roadways where Stage 2 ION is being constructed in the median, access to adjacent properties will be limited to right-in/right-out only, except at signalized intersections. Intersections will be designed to allow for U-turns for passenger vehicles and small trucks, however businesses located along these roadways (including King Street and Hespeler Road) will need to give consideration to alternate routing for deliveries by larger vehicles and transport trucks, which may have difficulty making U-turns.
- » Chopin Drive will be realigned between Queenston Road and King Street to accommodate the Preston ION Station. Left turns from Chopin Drive to King Street and from King Street to Chopin Drive will not be permitted. The driveway to 100 and 200 Eagle Street will be realigned to intersect with King Street opposite the new Chopin Drive intersection.
- » Eagle Street South will be reduced to a single lane with one-way southbound only traffic south of King Street.
- » Hespeler Road's six-lane cross-section will be modified to accommodate four through lanes (two in each direction), cycling facilities on both sides of the roadway, turning lanes and Stage 2 ION in the median.
- » Brooklyne Road will be closed at Hespeler Road and reconfigured to connect to Norfolk Drive. Access to Hespeler Road will be via Avenue Road.

- » Stage 2 ION will cross a planned roundabout at Dundas Street and Beverly Street, which is being implemented by the Region under a separate project. The design will include gates, bells and flashing lights to control vehicles and pedestrian access during LRT operation. Details will be coordinated during the future design phase.
- » Wellington Street will be reconstructed from Main Street to Bruce Street, and will include the closure of the Lutz Street intersection. Bruce Street will be limited to one-way eastbound traffic between Wellington Street and Ainslie Street, and restricted to bus, pedestrian and cyclist use only between Ainslie Street and Water Street.

A Traffic Impact Assessment was conducted to review intersection level of service and turn lane capacity requirements with Stage 2 ION. A detailed traffic assessment including micro-simulation to confirm signal phasing and roadway geometry will be required in a future design phase. A summary of key intersections with low level of service (LOS) and alternative solutions is summarized in **Table 6-1**. These alternative solutions will be assessed further during the detailed traffic assessment such that the roadway improvements are balanced with the needs of active transportation users to ensure an inclusive final design. Further details can be found in **Appendix B9**.

Table 6-1: Summary of Key Intersection Operations Issues

Intersection	Impacts and Alternative Solutions
King Street and Deer Ridge Drive	<ul style="list-style-type: none"> • Centre-running LRT on King Street. • Northbound and southbound left movements operate under protected phase. • To reduce vehicle delays, additional through/turning lanes for side street will be considered, with possible additional green time assigned to King Street to increase capacity.
King Street and Baxter Place/ Sportsworld Drive	<ul style="list-style-type: none"> • Centre-running LRT on King Street. • Northbound and southbound left movements operate under protected phase. Eastbound and westbound movements operate under split phase. • Intersection geometry could be revised to allow simultaneous eastbound and westbound operation along with signal timing adjustments to improve the overall intersection efficiency.
King Street and Highway 401 Ramps	<ul style="list-style-type: none"> • Centre-running LRT on King Street. • Northbound and southbound left movements operate under protected phase. • Analysis considered future Highway 401/King Street interchange improvements. • Additional turning lanes on the Highway 401 exit ramps at the King Street intersections could improve overall intersection efficiency, but will require detailed analysis during next phase of design.

Intersection	Impacts and Alternative Solutions
Hespeler Road and Bishop Street	<ul style="list-style-type: none"> • Centre-running LRT on Hespeler Road, reducing Hespeler Road from 6 lanes to 4 lanes. • Northbound and southbound left movements operate under protected phase. • To reduce vehicle delays, additional through/turning lanes recommended for side street, with additional green time assigned to Hespeler Road to increase capacity.
Hespeler Road and Dunbar Road	<ul style="list-style-type: none"> • Centre-running LRT on Hespeler Road, reducing Hespeler Road from 6 lanes to 4 lanes. • Northbound and southbound left movements operate under protected phase. • To reduce vehicle delays, additional through/turning lanes recommend for side street, with additional green time assigned to Hespeler Road to increase capacity.
Hespeler Road and Can-Amera Parkway	<ul style="list-style-type: none"> • Centre-running LRT on Hespeler Road, reducing Hespeler Road from 6 lanes to 4 lanes. • Northbound and southbound left movements operate under protected phase. • Higher traffic volumes are expected for westbound left during peak hour. To reduce vehicle delays, dual left turn lane recommended for Can-Amera, and geometric and signal timing adjustments to increase capacity.

The intersection capacity analysis results for the King Street and Eagle Street intersection indicate that this intersection is expected to operate with an acceptable level of service (LOS C/D) for the future peak hour conditions. However, the northbound queue length along King Street is expected to extend upstream beyond Dover Street during morning peak hour. In order to accommodate this queue length and provide an acceptable LOS, it is proposed that the existing on-street parking on the east side of King Street be prohibited during peak hours. In addition, potential signal coordination between vehicular and transit operations could also be explored/assessed in the future design phase by designing signal timings to improve the overall intersection performance for all modes. For example, the westbound through/left movements at the King Street and Eagle Street intersection could be operated simultaneously with the LRT operation.

(2) Mitigation Measures

As described above, the Traffic Impact Assessment has identified opportunities to improve levels of service at key intersections. These will require further study during a future design phase.

In general, traffic impacts for roadways where Stage 2 ION is located in the median (King Street, Shantz Hill Road, Hespeler Road, Wellington Street) are mitigated by operating Stage 2 ION concurrently with the through traffic movements. In other words, unless the LRT vehicle is entering or exiting the roadway median, there is no need to stop all traffic. In areas where Stage 2 ION operates adjacent to a roadway (Eagle



Street) or transitions from off street to on-street (River Road/Hidden Valley Road intersection, King Street/Eagle Street intersection, Hespeler Road at Pinebush ION Station, Hespeler Road/Avenue Road intersection, Main Street/Wellington Street intersection), gates, flashing lights, bells, traffic signals or a combination of these controls will be used to warn traffic and pedestrians during LRT movements.

Additionally, gates and flashing lights will be used where Stage 2 ION crosses roads at grade (Chopin Drive, entrance to the multi-use trail parking area beyond Russ Street, Speedsville Road, Eagle Street north of Hespeler Road, Industrial Road, Samuelson Street, Dundas Street/Beverly Street roundabout, Kerr Street). Gates, signals and signage will be developed in the next design phase.

Construction of Stage 2 ION may temporarily impact general traffic lanes or require temporary closures. Staging and detour routes will be developed in the next design phase in collaboration with the Region, City of Kitchener or City of Cambridge, and GRT.

6.4.2 Transit Service

(1) Potential Impacts

Stage 2 ION has been developed with consideration of GRT local bus integration. The 2018 Regional Transportation Master Plan mode share targets for 2041 aim to increase transit ridership to 14.8% during the p.m. peak period (between 2:30 p.m. and 5:30 p.m.). This target is the basis for the Regions transit strategy which includes increases to frequency, level of service, interconnectivity and capacity to promote increased ridership.

The functional design plates in **Appendix A** show preliminary locations for GRT bus stops and **Section 4.2.3** describes common amenities found at GRT bus stops. These locations will be finalized in consultation with GRT in the next design phase. As part of the road and intersection adjustments, the bus queue jump lanes at Shantz Hill Road/Fountain Street, and Hespeler Road/Avenue Road will be reinstated. The existing queue jump lane on King Street southbound at Eagle Street will be maintained.

Stage 2 ION will end at a new Downtown Cambridge terminal station, which has been developed to service on-street buses on Bruce Street with additional lay-by capacity on Ainslie Street for interregional and coach buses. This on-street bus terminal will provide opportunities for improved bus network operations in Downtown Cambridge, including more efficient routing and reduced transfers.

With the introduction of Stage 2 ION service, GRT will undertake a detailed review of the local transit network and frequencies, and make adjustments to improve operations and coverage. This may result in some routes be replaced by Stage 2 ION service, route changes to better service the area, or new routes.

Construction of Stage 2 ION will result in temporary impacts to transit service due to lane reductions or closures.



(2) Mitigation Measures

Implementation of Stage 2 ION will include reorganizing of existing GRT routes. GRT will conduct a thorough review of ridership and service levels to ensure passenger access and catchment areas are maintained or improved.

Staged construction along major corridors will be utilized to maintain transit service during construction. Priority will be given to transit service and temporary stop location with safe pedestrian access. Where full road closure is required, detours may be required and will be coordinated with GRT as part of a future design phase.

Negative impacts to ridership occurred during Stage 1 ION construction. In implementing Stage 2 ION, lessons learned will need to be taken from this in order to avoid loss of long-term confidence from future ION riders. Two routes that may be most affected by Stage 2 ION construction are 302 ION Bus and 206 iXpress, both of which are high frequency, express routes between Kitchener and Cambridge. Collaboration between the Stage 2 ION team and GRT will be required to stage construction phases to mitigate and minimize detour and stop closure impacts on the ridership. Without mitigation, revenues would be lost as a result of a drop in ridership, and additional costs will be incurred due to additional service hours required to run buses in longer detours.

6.4.3 Cycling and Pedestrian Facilities

(1) Potential Impacts

Stage 2 ION is designed to integrate with existing and proposed active transportation corridors identified in the Region's TMP to develop broader connectivity between active transportation facilities across the Region. The development of Stage 2 ION includes a number of new active transportation initiatives as described in **Section 4.3** which will support and promote pedestrian and cycling usage along the corridors and in proximity to Stage 2 ION stations.

During construction of Stage 2 ION, existing connections may experience access restrictions or temporary closures.

(2) Mitigation Measures

Active transportation corridors and opportunities will continue to be developed by the Region. Where the Stage 2 ION runningway has impacted existing active transportation connections, new or reinstated connections have been proposed. Additional facilities will continue to be developed during the next phase of design in consideration of the Region and Cities' integrated active transportation network.

During construction, accessible pedestrian and cycling access will be maintained and signed through the construction zone. In the case of temporary or full closure, a detour route will be identified and signed. Advancement of the staging and access plans will be developed during the next phase of design.



6.4.4 Utilities

(1) Potential Impacts

The Hydro One substation and tower located in an easement through the parking lot at Fairview Park Mall will require relocation. The final location and configuration of these facilities will require consultation with Hydro One, as well as Kitchener-Wilmot Hydro if their plant is also impacted.

Existing municipal utilities (storm sewers, sanitary sewers and watermains) impacted by Stage 2 ION construction or widening of existing roadways to accommodate Stage 2 ION will be relocated out of the Region's exclusion zone under the LRT runningway to under the travelled lanes. Future and interim utilities will be coordinated with the Region to locate and group where possible to avoid future impacts with the Stage 2 ION runningway and stations. Utilities running along the roadway corridor or crossing the roadway corridor will not be placed beneath Stage 2 ION stations, as access to these area for maintenance or repairs cannot be provided due to the platform and canopy. Final utility design will be determined during a future design phase.

A preliminary study was conducted to identify the anticipated number and general location of Traction Power Substations (TPSS). Where possible, surplus properties will be used for TPSS. A detailed assessment of locations, potential property impacts, hydro power supply and TPSS screening for aesthetics and noise will be completed during a future design phase.

The design of the Stage 2 ION runningway and associated infrastructure (such as poles for the overhead catenary system) will need to consider the large culvert carrying Mill Creek beneath Wellington Street. This will be confirmed during a future design phase.

(2) Mitigation Measures

During LRT service, buried utilities should have minimal impact to operations where utilities have been located outside the LRT runningway and station area to allow for replacements or maintenance. In areas of crossings of LRT runningway or to protect for future crossings, casings and conduits can be utilized. Locations of TPSS will be selected to minimize impacts to the surrounding area and supplemented with screening or integrated into the environment.

Staging of utility construction will be developed during the next phase of design and will include mitigation measures to minimize dust, noise, detours and pedestrian impacts due to utility relocation and installation.

6.4.5 Railway Operations

(1) Potential Impacts

Stage 2 ION will be grade separated over the existing freight rail corridors to minimize impacts to LRT and rail operations. Stage 2 ION crosses over the CP Rail corridor east of Fairway Road and near Eagle Street and William Street, and crosses over the CN Rail corridor east of Witmer Street. Crossing locations are illustrated in **Figure 4-7**. Stage 2 ION follows an unused CP Rail spur line north of Eagle Street, and parallels an existing CN Rail industrial spur from north of Eagle Street to Hespeler Road. The



Grantham Rail Bridge near Samuelson Street is expected to require improvements to allow for the safe operation of Stage 2 ION under the bridge. Modifications to bridge structure, addition of overhead catenary infrastructure and maintenance requirements will be determined through consultation with CP Rail during the next design phase.

There is one customer who receives deliveries from the CN Rail industrial spur at Industrial Road. Stage 2 ION can be designed to maintain access to the spur for this customer, if desired, however the timing of deliveries may require modification to avoid impacting Stage 2 ION operations. This will require further discussion with the property owner as part of the property acquisition process.

(2) Mitigation Measures

Stage 2 ION operations are expected to have minimal impacts on day to day operations of the existing freight rail services. Bridge and rail inspections should be coordinated between ION and rail operators to minimize impacts to operations.

Bridges at elevated crossings have been functionally designed to provide vertical and horizontal clearances required by CN Rail and CP Rail to avoid impacts to twin stack car transportation and other rail operations. Crossings (e.g. horizontal and vertical clearance) will be designed in accordance with the AREMA (American Railway Engineering and Maintenance-of-way Association) Manual for Railway Engineering, CN Engineering Specifications for Industrial Tracks, and applicable design standards and specifications provided by CP Rail during the next design phase.

Impacts during construction will depend on the final staging of the bridge crossings and will be developed in the next design phase. Construction techniques can be used to minimize impacts to the existing freight service, including phased construction, off peak work and schedule coordination with freight operators.

6.5 Climate Change Considerations

The Region has developed a Corporate Asset Management (AM) Strategy in alignment with federal and provincial legislation, and the Region's strategic goals, policies and plans (Region of Waterloo, August 2020). One of the key principles that guide the Region in making its asset management decisions is Environmental conscious. The AM Plan provides focus areas and strategic objectives for different factors that also include improving resilience to climate change and/or severe weather. The Regional Official Plan 2051, Policy Direction Paper on Climate Change (Regional Municipality of Waterloo, January 2021) is a key document for directing local action on climate change.

The Region commits to embedding climate change considerations in asset management planning, and to the development of tailored actions that make the best use of its resources to mitigate and adapt to climate change. Where practical, programs will strive to go beyond minimum legislative solutions to help ensure assets are increasingly resilient to changing social, climate, environmental and economic conditions, and to mitigate future climate impacts such as greenhouse gas emissions reduction. Bolstering resilience to climate change in the Region may involve modifying the scope of current operations, anticipating possible costs to support contingency



funds, leveraging alternative funding mechanisms, integrating the emergency management perspective to planning, and revising levels of service.

Climate Change poses a challenge to proper asset planning and management. Proper consideration of projected changes in climate ensures that infrastructure designed for today will still be resilient under uncertain future climatic conditions and provide the required level of service. Kitchener Council has also adopted a City Corporate Climate Action Plan as well as a Region-wide Community Climate Action Plan, both of which contain elements of adaptation or “future-proofing.” Kitchener’s Official Plan addresses climate change in sections on *Natural Hazards*, *Sustainable Development*, and *Energy Conservation and Generation*. Kitchener’s Integrated SWM Master Plan is a powerful and proactive tool for climate adaptation and flood-proofing.

(1) Potential Impacts

Drainage infrastructure will be designed for the collection, treatment and conveyance of future changing storm events and patterns (e.g. higher frequency and severity of storms occurring more frequently).

Climate change is defined as a significant change in long-term weather patterns including temperature, precipitation, and wind. Increased GHG emissions have played a major role in climate change, mainly from the burning of fossil fuels for energy production. If current GHG emissions trends continue, the Region of Waterloo is expected to experience increased temperatures, precipitation, and extreme weather events.⁶ These changes to climate will impact health, infrastructure and buildings, natural environment, energy supply and distribution, and the economy.⁷

(2) Mitigation Measures

The subsequent design phase shall employ best practices to design the proposed drainage infrastructure using the updated Intensity-Duration-Frequency (IDF) curves based on the Ontario Ministry of Transportation online IDF Lookup Tool (http://www.mto.gov.on.ca/IDF_Curves/terms.shtml), and a future projection period that aligns with asset design life.

In order to reach the objectives outlined in the AM Plan, the Region is committed to reducing GHG emissions through minimizing the impact of infrastructure on the environment. The design and implementation of the Stage 2 ION LRT will result in decreased GHG emissions, as the LRT prioritizes an alternative low carbon transportation option.

The Stage 2 ION LRT will be designed to operate using electricity, resulting in a significant decrease in demand for energy from fossil fuel combustion which will result in reduced GHG emissions. As described in **Section 6.3.2**, GHG emissions are expected to decrease in the future full build scenario when compared to the future no build scenario. By reducing the demand for fossil fuels and providing a low carbon transportation option to residents, the LRT will allow the Region of Waterloo to minimize

⁶ University of Waterloo, Localized Climate Projections for Waterloo Region, 2015.

⁷ Region of Waterloo, A Community Climate Adaptation Plan, 2019.



climate change impacts to health, infrastructure and buildings, natural environment, energy supply and distribution, and the economy.

6.6 Summary of Impacts, Mitigation and Future Commitments

Table 6-2 provides a summary of the potential impacts, mitigation measures and monitoring and commitments for each element of the Stage 2 ION Project.

Table 6-2: Summary of Potential Impacts, Mitigation, and Commitments to Future Work and Monitoring

ENVIRONMENTAL ISSUE/CONCERN	AGENCIES	POTENTIAL IMPACTS	MITIGATION MEASURES	COMMITMENTS TO FUTURE WORK / MONITORING
NATURAL HERITAGE				
Soils (See Section 6.1.1 for further details)	MECP	<ul style="list-style-type: none"> The soils located along the Stage 2 ION LRT facility are susceptible to erosion and will be impacted during construction as a result of clearing, excavation and grading. 	<ul style="list-style-type: none"> Straw bale/rock flow checks will be placed at regular intervals in ditches down-gradient from areas of soil disturbance in rural sections. Protection of inlets to catch basins and maintenance holes in urban sections. Placing silt fence along stream margins in areas of soil disturbance. Erosion control products within exposed areas such as erosion control blankets, coir logs, tackifiers and mulch, etc. will be implemented. Application of seed and mulch, tackifier and/or erosion control blanket in areas of soil disturbance to provide adequate slope protection and long-term slope stabilization. 	<ul style="list-style-type: none"> Site-specific erosion and sedimentation control measures to be implemented prior to construction will be identified during a future design phase. Standard erosion and sediment control measures will be followed during construction in accordance with Ontario Provincial Standard Specification (OPSS) 805 – Construction Specification for Temporary Erosion and Sediment Control Measures (2010) to minimize construction related impacts on surface water quality and fish habitat. Topsoil from stockpiles to be in accordance with OPSS 802 - Construction Specification for Topsoil.
Fish and Fish Habitat (See Section 6.1.2 for further details)	MECP MNR DFO	<p>Impacts on the aquatic features crossed or present in the proximity of this new infrastructure, could include:</p> <ul style="list-style-type: none"> Temporary disruption or permanent loss of site-specific aquatic habitat; Temporary changes to water quality; Changes in water temperature; Creating new barriers to fish passage; Indirect impacts, including channel erosion; and Impacts to fish and mussel species at risk. <p>Impacts to aquatic SAR include:</p> <ul style="list-style-type: none"> Killing, harming, harassment, possession, capturing or taking of species listed as extirpated, endangered or threatened under 	<ul style="list-style-type: none"> Crossings of the Grand River and Speed River have been developed to fully span the watercourse, to minimize potential barriers to fish passage. Prior to construction, trees/shrubs to be retained will be clearly identified in the field by the installation of tree/shrub protection barriers. In areas where riparian vegetation removal is necessary to accommodate construction, mitigation measures include the following: no clearing of mature trees providing a bank stabilization function; no felling of trees into the watercourse; minimize the amount of debris produced from entering the watercourse; and only clear the vegetation required to complete the necessary works. Construction material, excess material, construction debris, and empty containers will be stored at least 30 m distance from watercourses and watercourse banks to prevent their entry into watercourses. 	<ul style="list-style-type: none"> Additional SAR investigations will be conducted during a future design phase. Storage, stockpiling and staging areas will be delineated prior to construction and inspected in accordance with the Erosion and Sediment Control Guideline for Urban Construction (GGHA 2006). Permits and approvals will be obtained prior to construction, including work within a regulated area; Fill, Construction and Alteration to Waterways Permit from GRCA; and permit under O. Reg. 42/06 from GRCA. Fisheries Act Authorization from DFO, if required. Harmful Alteration, Disruption or Destruction (HADD) permitting from DFO if there are potential impacts to aquatic wildlife or their habitat.

ENVIRONMENTAL ISSUE/CONCERN	AGENCIES	POTENTIAL IMPACTS	MITIGATION MEASURES	COMMITMENTS TO FUTURE WORK / MONITORING
		<p>the <i>Species at Risk Act</i> or <i>Endangered Species Act</i>,</p> <ul style="list-style-type: none"> • Damage or destruction of a residence; and, • Destruction of any part of the species' critical habitat. 	<ul style="list-style-type: none"> • All spills that could potentially cause damage to the environment shall be reported to the Spills Action Centre of the MECP. In the event of a spill, containment and clean-up will be completed quickly and effectively. • No in-water work (or work on watercourse banks) will be permitted from March 15 to June 30 to protect spawning warmwater fish, incubating eggs and fry emergence (constitutes most crossings in the study area). • Cofferdams will be constructed using pea gravel bags, sheet piling or other appropriate material to isolate the work area: flow will be maintained at all stations. • Where SAR mussels exist and instream works are deemed required, the construction instream timing window will correspond to the active season for the mussels (when stream temperatures reach 16 °C or above), or as outlined in applicable permits. • Where SARA-listed shellfish occur (i.e. Grand River and Speed River), no scaffolding or support structures shall be placed directly on the bed of the watercourse. • Where critical habitat of endangered or threatened shellfish occur, no dredging or excavation of the waterbody shall take place except where exempted in the recovery strategy for that species. 	
<p>Terrestrial Vegetation and Vegetation Communities (See Section 6.1.3 for further details)</p>	<p>MECP MNR</p>	<p>Construction of the Stage 2 ION LRT has the potential to result in further impacts to vegetation and vegetation communities, these impacts include:</p> <ul style="list-style-type: none"> • Displacement of and/or disturbance to vegetation and vegetation communities; and, • Displacement of and/or disturbance to Rare, Threatened or Endangered Vegetation and Vegetation Communities. 	<ul style="list-style-type: none"> • Planting of appropriate native trees, shrubs and ground flora which shall be undertaken as soon as possible following vegetation removals. • Grading within areas where edges will be newly created shall be designed to meet existing grades a minimum of 3 m away from the tree drip-line. • Drainage patterns adjacent to newly created edges shall be maintained to avoid changes in soil moisture, this is especially important around wetland areas and 	<ul style="list-style-type: none"> • During a future design phase, a forest edge management plan shall be prepared for those communities where forest edge management is recommended. • In consultation with GRCA, wetland areas within the study area will be delineated in a future design phase. • A plan to immediately mitigate the spread/invasion of aggressive plant species will be in place.

ENVIRONMENTAL ISSUE/CONCERN	AGENCIES	POTENTIAL IMPACTS	MITIGATION MEASURES	COMMITMENTS TO FUTURE WORK / MONITORING
		<ul style="list-style-type: none"> In total, the proposed construction will result in the removal of approximately 21.53 ha of naturalized and/or planted areas. Impacts to forest communities within the study area will primarily result in the new creation of forest edges. Removal of a small portion of wetlands associated with the Hidden Valley, Grandview and Speed River PSW Complexes will occur. Impacts to wetland communities within the study area will primarily be to the edge of the communities, with the exception of the Grandview PSW and Speed River PSW, where the transitway will be elevated. Of the 8.37 ha of human influenced vegetation to be removed, 7.95 ha of manicured lands will be removed. The overall significance of the impact to these lands is considered low. 	<ul style="list-style-type: none"> forest communities with substrates that maintain increased moisture capacity. Where there are dense patches of common buckthorn, swallow-wort or garlic mustard, the appropriate removal and control of these species by a qualified specialist should be undertaken. No non-native and invasive ornamentals plants should be used for landscaping (e.g., Norway maple, purple loosestrife, Japanese knotweed, Japanese honeysuckle, etc.). Old field seed mix and mulching or erosion control blanket (in accordance with NSSP-Erosion Control Blanket) will be placed in areas of soil disturbance to provide adequate slope protection and long-term slope stabilization. 	<ul style="list-style-type: none"> Vegetation cover will be used to protect any exposed surfaces in accordance with OPSS 804 - Construction Specification for Seed and Cover. Tree permits for proposed tree removals. Tree protection to be in accordance with OPSS 801 - Construction Specification for the Protection of Trees. The contractor will ensure that all environmental mitigation and design measures are properly installed/constructed, implemented and maintained.
<p>Designated Natural Areas (See Section 6.1.4 for further details)</p>	<p>MECP MNRF</p>	<ul style="list-style-type: none"> No impacts are anticipated to the Freeport Esker ANSI as a result of the proposed construction of Stage 2 ION. It is anticipated the proposed construction will remove a narrow strip of wetland communities located along the existing edge of a portion of the Hidden Valley, Grandview, and Speed River PSW. Stage 2 ION will skirt the Hidden Valley ESPA by being built within the EA-approved River Road Extension right-of-way and skirt the Dumfries Conservation Area within the Hespeler Road right-of-way. The crossing of the Grand River Valley and the Speed River Valley are unavoidable. 	<ul style="list-style-type: none"> Site-specific mitigation such as elevating the LRT tracks through these floodplain areas, have been incorporated into the design to reduce the impacts of Stage 2 ION on the Greenlands System. 	<ul style="list-style-type: none"> During a future design phase, a forest edge management plan shall be prepared for those communities where forest edge management is recommended.
<p>Wildlife and Wildlife Habitat (See Section 6.1.5 for further details)</p>	<p>MECP MNRF</p>	<ul style="list-style-type: none"> The proposed Stage 2 ION LRT stations are not expected to significantly impact wildlife 	<ul style="list-style-type: none"> All works will be completed in accordance with the <i>Migratory Birds Convention Act</i> (MBCA); 	<ul style="list-style-type: none"> Additional mitigation and/or monitoring will be developed during future design phases.

ENVIRONMENTAL ISSUE/CONCERN	AGENCIES	POTENTIAL IMPACTS	MITIGATION MEASURES	COMMITMENTS TO FUTURE WORK / MONITORING
		<p>habitat as they are located either on street, or in existing industrial or residential areas.</p> <ul style="list-style-type: none"> No new barriers to wildlife passage are expected to occur as a result of the construction of the Stage 2 ION LRT. Major river crossings, including the Grand and Speed rivers, will be elevated, therefore, wildlife corridors associated with these valleylands will be maintained. Wildlife/vehicle conflicts also appear to be very minor at present within the Stage 2 ION LRT corridor as it mostly follows existing roads, a railway line, and a pedestrian pathway. Given that wildlife found within the study area are acclimatized to the presence of road infrastructure, disturbance to wildlife from any increase in noise, light and visual intrusion potentially caused by the operation of the Stage 2 ION LRT are not expected to have any significant adverse impacts. Several bird species listed under the <i>Migratory Birds Convention Act</i> (MBCA) are located within the study area. The MBCA prohibits the killing, capturing, injuring, taking or disturbing of migratory birds (including eggs) or the damaging, destroying, removing or disturbing of nests. 	<ul style="list-style-type: none"> Tree removals during construction will occur outside the breeding window, before April 1 or after August 15. In the event that these activities must be undertaken from April 1 to August 15, a nest survey will be conducted by a qualified avian biologist to identify and locate active nests of this species, as well as other bird species covered by MCBA. Lights with shields will be used to focus light beams onto the facilities and away from natural heritage features adjacent to the Stage 2 ION LRT to reduce potential disturbance caused by light pollution. Wildlife incidentally encountered during construction will be protected and will not be knowingly harmed. In the event that an endangered or threatened species (pursuant to the <i>Endangered Species Act</i>) is detected while the project is being constructed, due diligence will be exercised and the MNRF will be contacted for confirmation of appropriate action in accordance with the legislation. 	<ul style="list-style-type: none"> <i>Endangered Species Act</i> approvals from MNRF if there are impacts to Species at Risk within creeks and watercourses adjacent to the LRT alignment.
<p>Fluvial Geomorphology (See Section 6.1.6 for further details)</p>	<p>MECP MNRF</p>	<ul style="list-style-type: none"> The crossings of the Grand River, Freeport Creek and Mill Creek will require new structures that run parallel to existing crossings (Highway 8 and Beverly Street). At these locations, consideration is given for the impact of the geomorphology of the channel on the crossing structures, and vice versa. Delineated meander belt width limits, bankfull widths, and erosion hazard allowances show the potential hazard of meandering channels 	<ul style="list-style-type: none"> Bridge design considerations have minimized the number of piers to avoid potential scour at pier footings. The Grand and Speed Rivers are fully spanned, with no piers in the watercourse, to avoid impacts to flow paths within the river system. The Grand and the Speed Rivers crossings consider bankfull widths and erosion hazard allowances while the crossing of Freeport Creek considers a three 	<ul style="list-style-type: none"> Additional analysis will be required at a future design phase to reassess the implications on watercourses as key decisions are made. This will include the future of the Riverside Dam, which could have implications for the Speed River on downstream reaches, especially given the braiding nature of the system.

ENVIRONMENTAL ISSUE/CONCERN	AGENCIES	POTENTIAL IMPACTS	MITIGATION MEASURES	COMMITMENTS TO FUTURE WORK / MONITORING
		<p>on crossing locations and were used to provide high level recommendations for bridge concept design.</p> <ul style="list-style-type: none"> The Grand and the Speed rivers require consideration for bankfull widths and erosion hazard allowances while the crossing of Freeport Creek should consider a three times bankfull width approach to allow channel future channel migration and minimize maintenance. 	<p>times bankfull width approach to allow channel future channel migration and minimize maintenance.</p> <ul style="list-style-type: none"> Maintaining the existing channel alignment (i.e., channel armouring) will be necessary to limit channel migration. 	
<p>Drainage and Stormwater Management (See Section 6.1.7 for further details)</p>	<p>MECP</p>	<ul style="list-style-type: none"> Potential impacts may include increased water levels, flow rates, impervious area, runoff volumes and velocities, as well as changes to water quality. 	<ul style="list-style-type: none"> Appropriate water quality control measures as well as erosion and sediment control (ESC) measures shall be implemented. A treatment train approach shall be implemented for water quality control at the Grand River to King Street at Highway 8 section and Speed River Crossing to Eagle Street North at Hedley Street. Water quality will be achieved through three OGS (oil and grit separator) units. Enhanced grass swales on both sides of the tracks are proposed to treat, attenuate and convey stormwater to the respective outlets. Realignment of drainage ditches and swales may be required along existing rail corridors to maintain current conveyance capacities. The spillage of floodwater at Kerr St. could be avoided, if the existing twin culverts are replaced with a large single span bridge. This would be a separate undertaking and not part of the ION project and would require further assessment as part of a separate study. 	<ul style="list-style-type: none"> The Fairview Park Mall parking lot drainage system will require a hydraulic capacity assessment at a future design phase to avoid any adverse impacts and propose mitigations measures, if needed. Appropriate water quality control measures as well as erosion and sediment control (ESC) measures shall be implemented at a future design phase. In consultation with the Grand River Conservation Authority (GRCA), it was agreed that if discharge to wetlands cannot be avoided, then proper quality, sediment and erosion control measurements shall be implemented. At the King Street East and Shantz Hill Road section, to avoid surcharging of the downstream system either quantity controls in the form of super pipes under the proposed LRT route or upsizing of the outlet pipes will be required. This will be developed in a future design phase. Capacity assessments of existing storm sewer systems and receiving outlets will be conducted at a future design phase. A 2D hydrodynamic flood study should be carried out at the Main Street at Wellington Street to Bruce Street at Water Street (South Study Limit) area during the next design phase to assess the

ENVIRONMENTAL ISSUE/CONCERN	AGENCIES	POTENTIAL IMPACTS	MITIGATION MEASURES	COMMITMENTS TO FUTURE WORK / MONITORING
				<p>backwater impacts and flood risks during various design storm events.</p> <ul style="list-style-type: none"> • Approval for SWM in accordance with municipal requirements, as applicable. • Sewer discharge approvals in accordance with municipal requirements, as applicable. • A detailed site-specific assessment of hydrologic impacts on regulated watercourse and wetland features will be required at the permitting stage.
<p>Groundwater and Contaminated Soils (See Section 6.1.8 for further details)</p>	<p>MECP</p>	<ul style="list-style-type: none"> • Of the 223 APECs, 182 were identified as having high potential for impacts. • The APECs with high potential for contamination include land uses that are gas stations (active and historical), automotive repair shops (active and historical), dry cleaners (active and historical), industrial manufacturers, railway lines, rail yards, transportation depots, historical coal and oil gasification plants, historical landfills, automobile wrecking, hydro stations, and waste transfer sites. These areas are suspected of using chemical compounds or performing activities that may impact soil and/or groundwater within the study area. • Of the 223 APECs, 41 APECS were identified as having moderate potential for impacts. The APECs with moderate potential for contamination are represented by land uses that are commercial/light industrial properties suspected of using chemical compounds or performing activities that may impact soil and/or groundwater within the study area. • All other areas not included as APECs indicate land use features considered to have low potential for environmental impacts. • Land use features considered to have a low potential for site contamination are generally classified as natural areas, open space, 	<ul style="list-style-type: none"> • Properties identified as high and/or moderate APECs which are directly impacted by the footprint of Stage 2 ION will be subject to further environmental studies/investigations to confirm the environmental conditions of such lands in support of both property acquisition environmental due diligence, and road construction excess material management (soil and groundwater). These studies/investigations include Phase One Environmental Site Assessments (ESAs) (and Phase Two ESAs if necessary). • If contamination is identified, mitigation measures will include environmental site clean-up/remediation, and/or risk assessment. • Where excavation is proposed, a contaminant investigation will be carried out by a qualified environmental consultant to assess soil quality (and, if necessary, groundwater quality) in construction areas adjacent to APECs with high potential for contamination. 	<ul style="list-style-type: none"> • A future design phase will identify and consider various technologies to minimize dewatering. • If dewatering in excess of 50,000 litres per day is required during construction, then a PTTW will be required from the MECP, which may necessitate a detailed hydrogeological assessment be completed prior to construction. • Soil testing in a future design phase will confirm if material can remain in place or must be removed and disposed of at an appropriately approved facility in accordance with O. Reg. 347. • Provisions for avoiding impacts related to releases of salt or other contaminants during construction or operation will be established with the preparation of a groundwater assessment report/hydrogeological study during a future design phase and as part of the environmental protection plan and construction monitoring program. • Any additional environmental reports regarding soil or groundwater contamination relevant to the planning / construction of Stage 2 ION will be shared with MECP during a future design phase, as applicable.

ENVIRONMENTAL ISSUE/CONCERN	AGENCIES	POTENTIAL IMPACTS	MITIGATION MEASURES	COMMITMENTS TO FUTURE WORK / MONITORING
		<p>residential, institutional, or community land use, which are not suspected of using chemical compounds harmful to the environment or human health.</p> <ul style="list-style-type: none"> • Construction is not anticipated to have a significant effect on local water supply based on typical depths for utility excavations and the inferred aquifer properties of supply wells in the study area. • Particular focus for groundwater receptors includes significant areas of groundwater recharge, intake protection zones and wellhead protection areas as outlined in Section 5.1.8. 		
CULTURAL ENVIRONMENT				
<p>Built Heritage Resources and Cultural Heritage Landscapes (See Section 6.2.1 for further details)</p>	<p>MHSTCI</p>	<ul style="list-style-type: none"> • Potential impacts to the cultural environment, including 105 built heritage resources and/or cultural heritage landscapes, may result in a change to the visual and contextual nature of the corridor, which cannot be avoided. However, direct impacts to built heritage features are minimal and the Region is committed to avoiding or minimizing direct impacts to heritage buildings or significant heritage features. • Negative impacts as outlined in the Ontario Heritage Tool Kit may include, but are not limited to: <ul style="list-style-type: none"> – Destruction of any, or part of any, significant heritage attributes or features. – Alteration that is not sympathetic, or is incompatible, with the historic fabric and appearance. – Shadows created that alter the appearance of a heritage attribute or change the viability of an associated 	<ul style="list-style-type: none"> • The cultural heritage team worked collaboratively with the engineering and environmental teams throughout the assessment of impacts to make design refinements to avoid or reduce impacts to built heritage resources and cultural heritage landscapes. • Mitigation and/or avoidance measures have been prepared for the 105 built heritage resources and/or cultural heritage landscapes identified as being directly or indirectly impacted by the proposed preliminary design outlined in Table 3 of the Cultural Heritage Report available in Appendix B5. • Where possible, avoidance of impacts during a future design phase will be implemented. • Where avoidance of all impacts cannot be accommodated, recommendations have been made for future heritage reporting. 	<ul style="list-style-type: none"> • Heritage Impact Assessments (HIAs) will be required at a future design phase to identify appropriate mitigation measures for properties identified as having Cultural Heritage Value or Interest (CHVI). • Where possible, avoidance of impacts during a future design phase has been recommended; this includes the completion of 10 Cultural Heritage Evaluation Reports (CHERs) following the TPA Process, 14 CHERs/HIAs for Cultural Heritage Landscapes (CHLs) following the TPA Process, 9 HIAs following the TPA Process, and a Heritage Documentation Report which will document 60 properties with minor, non-adverse landscape impacts. • MHSTCI sign-off on proposed archaeological assessment documentation and agreement with findings of the additional documentation to be completed for heritage features. • If additional LRT infrastructure that was not considered as part of this report is identified during a future design phase it is to be assessed

ENVIRONMENTAL ISSUE/CONCERN	AGENCIES	POTENTIAL IMPACTS	MITIGATION MEASURES	COMMITMENTS TO FUTURE WORK / MONITORING
		<p>natural feature or plantings, such as a garden.</p> <ul style="list-style-type: none"> – Isolation of a heritage attribute from its surrounding environment, context or a significant relationship. – Direct or indirect obstruction of significant views or vistas within, from, or of built and natural features. – A change in land use (such as rezoning a church to a multi-unit residence) where the change in use negates the property’s cultural heritage value. – Land disturbances such as a change in grade that alters soils, and drainage patterns that adversely affect a cultural heritage resource, including archaeological resources. 		<p>by a qualified cultural heritage professional in an addendum and submitted to the MHSTCI for review.</p> <ul style="list-style-type: none"> • During adjacent construction or excavation, vibration impacts will be monitored, and work will stop immediately if vibration thresholds are exceeded. • Copies of all future CHERs and HIAs completed as part of the Stage 2 ION LRT Project will be sent to Regional Cultural Heritage Planning for review. • Following the completion of this report, and all future CHERs and HIAs, will be sent to the City of Cambridge Municipal Heritage Advisory Committee, Cambridge Council as information. Any HIAs which recommend the demolition of a listed heritage property will require MHAC recommendation and Cambridge Council approval for the demolition. • The Project Team will provide MHSTCI with a summary update once all CHERs and HIAs are complete, stating which properties were confirmed to have CHVI and explaining how built heritage resources and cultural heritage landscapes will be conserved.
<p>Archaeology (See Section 6.2.2 for further details)</p>	<p>MHSTCI</p>	<ul style="list-style-type: none"> • Background research revealed that portions of the study corridor have been previously subjected to a Stage 1 and/or Stage 2 AA, and subsequently freed of further archaeological concerns. • While disturbances and areas of low or no archaeological potential exist within the study corridor, areas retaining archaeological potential still remain. 	<ul style="list-style-type: none"> • Should construction activities extend beyond the assessed limits of the study corridor, further archaeological investigation will be required to assess the archaeological potential of these lands. • The Stage 2 AA will be submitted to the MHSTCI as a condition of licensing in accordance with Part VI of the <i>Ontario Heritage Act</i>, R.S.O. 1990, c 0.18. • No construction activities shall take place within the study corridor prior to the MHSTCI confirming in writing that all archaeological licensing and technical review requirements have been satisfied. • It is an offence under Sections 48 and 69 of the <i>Ontario Heritage Act</i> for any party other than a 	<ul style="list-style-type: none"> • MHSTCI sign-off on proposed archaeological assessment documentation and agreement with findings of the additional documentation to be completed for heritage features. • Stage 2 AA, and any subsequent studies recommended by the Stage 2 AA, will be completed as early as possible during a future design phase and prior to any ground disturbing activities.

ENVIRONMENTAL ISSUE/CONCERN	AGENCIES	POTENTIAL IMPACTS	MITIGATION MEASURES	COMMITMENTS TO FUTURE WORK / MONITORING
			<p>licensed archaeologist to make any alteration to a known archaeological site or to remove any artifact or other physical evidence of past human use or activity from the site, until such time as a licensed archaeologist has completed archaeological fieldwork on the site, submitted a report to the Minister stating that the site has no further cultural heritage value or interest, and the report has been filed in the Ontario Public Register of Archaeology Reports referred to in Section 65.1 of the <i>Ontario Heritage Act</i>.</p> <ul style="list-style-type: none"> • Should previously undocumented archaeological resources be discovered, they may be a new archaeological site and therefore subject to Section 48 (1) of the <i>Ontario Heritage Act</i>. The proponent or person discovering the archaeological resources must cease alteration of the site immediately and engage a licensed consultant archaeologist to carry out archaeological fieldwork, in compliance with Section 48 (1) of the <i>Ontario Heritage Act</i>. • The <i>Cemeteries Act</i>, R.S.O. 1990 c. C.4 and the <i>Funeral, Burial and Cremation Services Act</i>, 2002, S.O. 2002, c.33 (when proclaimed in force) require that any person discovering human remains must notify the police or coroner and the Registrar of Cemeteries at the Ministry of Consumer Services (MCS). • Parts of the study corridor that were identified as no longer retaining archaeological potential are exempt from requiring Stage 2 AA; extents of these areas to be confirmed during the Stage 2 AA. • Parts of the study corridor that were identified as having no or low archeological potential are exempt from requiring Stage 2 AA; extents of these area to be confirmed during Stage 2 AA. • All parts of the study corridor which retain archaeological potential must be subjected to a Stage 2 AA. These areas must be subjected to test pit survey at five metre intervals in accordance with 	

ENVIRONMENTAL ISSUE/CONCERN	AGENCIES	POTENTIAL IMPACTS	MITIGATION MEASURES	COMMITMENTS TO FUTURE WORK / MONITORING
			<p><i>Section 2.1.2 of the Standards and Guidelines for Consultant Archaeologists (2011).</i></p> <ul style="list-style-type: none"> Should construction activities extend beyond the assessed limits of the study corridor, further archaeological investigations will be required to assess the archaeological potential of these lands. 	
SOCIO-ECONOMIC ENVIRONMENT				
<p>Land Uses and Economic Characteristics (See Section 6.3.1 for further details)</p>	<p>MECP REGION</p>	<ul style="list-style-type: none"> Businesses along the route will gain increased exposure and there is potential for future Transit Oriented Development (TOD) at station locations and along the LRT corridor. Some negative impacts, such as temporary disruption during construction or changes in access to individual properties, will occur, but these are anticipated to be minor. Infrastructure and facilities construction may result in temporary and intermittent traffic delays. Rerouting traffic may be required in some areas. Once Stage 2 ION is operational, some vehicular access modifications (i.e. right-in/right-out only) may be required in certain areas. Property takings will be required where the design of the LRT extends beyond the existing right-of-way (ROW). 	<ul style="list-style-type: none"> Construction along major arterial corridors or in downtown areas will be staged to minimize adverse effects on businesses and residents along the corridor. Traffic detouring will be implemented during construction to minimize community effects. Prior to and during construction, the Region will contact and communicate with local businesses and property owners adjacent to the corridor to confirm how access will be maintained to their properties during and after construction. Construction notification will include contact information for the Project Team to allow the public to raise issues and concerns in an effective manner. Consultation with property owners regarding property acquisition will be initiated closer to the time of construction. Compensation will be provided at fair market value of the land and address the project impacts (e.g. repairing or replacing landscaping, fencing or paving). The Region prefers to acquire property on a willing buyer/willing seller basis. If expropriation is required, the process set out in the <i>Ontario Expropriations Act</i> will be followed to ensure the rights of property owners provided under the Act are protected. Acquisition of property from the Grand River Conservation Authority will be carried out in accordance with GRCA property approvals and requirements. 	<ul style="list-style-type: none"> The final number of property takings will be confirmed during a future design phase and property owners will be contacted to discuss the project and proposed acquisitions. Planning approvals will be obtained through the municipalities, as applicable.

ENVIRONMENTAL ISSUE/CONCERN	AGENCIES	POTENTIAL IMPACTS	MITIGATION MEASURES	COMMITMENTS TO FUTURE WORK / MONITORING
			<ul style="list-style-type: none"> Changes to access both during and after construction will be discussed with individual property owners prior to construction. Where changes occur near community facilities, the Region will work with land owners to integrate appropriate signage so that transit users and commuters are directed to facilities affected by access changes. 	
<p>Air Quality (See Section 6.3.2 for further details)</p>	<p>MECP</p>	<ul style="list-style-type: none"> Wheel wear and brake dust from the limited number of LRT vehicles travelling at any given time will be negligible. Stage 2 ION does not significantly impact the Regional and Provincial GHG inventories. From a climate change perspective this project will assist the Region of Waterloo to achieve their GHG reduction targets. 	<ul style="list-style-type: none"> There is no proposed mitigation required during the operations with the exception of the continued regular vehicle and road maintenance along the route. Nuisance fugitive dust can be managed through an Air Quality Management Plan (AQMP) for fugitive dust following the recommendations outlined in the “Region of Waterloo Rapid Transit Project Environmental Project Report”, dated March 2012. Nuisance fugitive dust will be the primary air quality impact during the construction phase of the project. Nuisance fugitive dust can be managed through a Construction Air Quality Management Plan (CAQMP), which must be submitted to the Region of Waterloo and MECP for review to ensure it is adequate to control fugitive releases caused by construction. Mitigation measures may include: <ul style="list-style-type: none"> Dust suppression measures during construction (e.g., application of water wherever appropriate, or the use of approved non-chloride chemical dust suppressants, where the application of water is not suitable). Use of dump trucks with retractable covers for the transport of soils and other friable materials. Minimize the number of loadings and unloading of soils and other friable materials. Minimize drop heights, use enclosed chutes, and cover bins for debris associated with deconstruction of affected structures. 	<ul style="list-style-type: none"> The Contract Administrator will ensure that dust control measures in the contract are adhered to during construction. The Contract Administrator will ensure that mitigation for construction equipment is followed.

ENVIRONMENTAL ISSUE/CONCERN	AGENCIES	POTENTIAL IMPACTS	MITIGATION MEASURES	COMMITMENTS TO FUTURE WORK / MONITORING
			<ul style="list-style-type: none"> – Washing of equipment and/use of mud mats where practical at construction site exits to limit the migration of soil and dust off-site. – Stockpiling of soil and other friable materials in locations that are less exposed to wind (e.g., protected from the wind by suitable barriers or wind fences/screens, or covered when long-term storage is required) and away from sensitive receptors to the extent possible. – Reduction of unnecessary traffic and implementation of speed limits. – Permanent stabilization of exposed soil areas with non-erodible material (e.g., stone or vegetation) as soon as practicably possible after construction in the affected area is completed. – Ensuring that all construction vehicles, machinery, and equipment are equipped with current emission controls, which are in a state of good repair. – Dust-generating activities should be minimized during conditions of high wind. 	
<p>Noise and Vibration (See Section 6.3.3 for further details)</p>	<p>MECP</p>	<ul style="list-style-type: none"> • Stage 2 ION will not generate a notable increase in sound levels when introduced along busy roadways or adjacent to railways with regular vehicle traffic. The exception is where Stage 2 ION operates in the unused CP rail spurline north of Eagle Street, or as it crosses through residential areas with minimal road traffic. • Based on the measured vibration levels, residential receivers located beyond 15 m from the nearest track centreline will not require significant vibration control measures. • Residential receptors located less than 15 m from the nearest track centreline may require vibration control beyond the standard embedded rail vibration isolation. 	<ul style="list-style-type: none"> • There are several forms of vibration isolation that can be used for light rail systems running on both embedded-in-concrete and tie-on ballast. For rail embedded in concrete, the typical vibration isolation systems are: <ul style="list-style-type: none"> – Rubber-embedded or encapsulated track (also referred to colloquially as the “rubber boot”). The rubber material reduces the vibration transmission into the concrete and subsequently into the adjacent structures. – The use of a floating slab system. This system floats on a concrete rail bed mounted on rubber isolators, reducing the transmission of vibration from the concrete into the soil and adjacent structures. • Special exemptions where night construction is to occur. In this case, residents are notified several 	<ul style="list-style-type: none"> • Municipal Noise By-law exemptions, as required. • Detailed vibration testing and analysis will be conducted during a future design phase.

ENVIRONMENTAL ISSUE/CONCERN	AGENCIES	POTENTIAL IMPACTS	MITIGATION MEASURES	COMMITMENTS TO FUTURE WORK / MONITORING
		<ul style="list-style-type: none"> Overall, noise and vibration impacts from the operation of Stage 2 ION are expected to be minor. 	<p>weeks in advance of pending nighttime construction activities.</p> <ul style="list-style-type: none"> LRT wheel squeal noise control should be implemented in the form of rail and/or wheel lubricators and/or wheel damping. Construction is limited to between 7 a.m. and 7 p.m. on weekdays and Saturdays, with more stringent hours on Sundays and holidays. It is likely that some of the construction will need to be carried out through the night, to minimize the impact on local traffic in the area. As such, special exemptions will need to be obtained where the night construction is to occur. All equipment used during nighttime (11 pm – 7 am) construction, regardless of size, will use broadband backup alarms. Localized noise barriers such as around stationary equipment, staging areas, or long-term work areas will be used. Haul and truck routes will be designed to minimize truck traffic through lightly travelled residential streets. The communications and complaints protocol designed for the public to inform them of construction activities and allow for any concerns will include noise and vibration provisions. 	
TRANSPORTATION AND UTILITIES				
Road Network (See Section 6.4.1 for further details)	MTO MECP REGION CITY OF KITCHENER CITY OF CAMBRIDGE	<ul style="list-style-type: none"> Hydro relocations are proposed as part of Stage 2 ION at Fairview Park Mall which could allow for reconfiguration of parking to increase parking capacity. The Region's approved River Road Extension project is being developed with a 4-lane section from Wabanaki Drive to Highway 8 to allow for an ultimate 2-lane section with centre running LRT. 	<ul style="list-style-type: none"> Traffic impacts for roadways where Stage 2 ION is located in the median (King Street, Shantz Hill Road, Hespeler Road, Wellington Street) are mitigated by operating Stage 2 ION concurrently with the through traffic movements. In areas where Stage 2 ION operates adjacent to a roadway (Eagle Street) or transitions from off street to on-street gates, flashing lights, bells, traffic signals or a combination of these controls will be used to warn traffic and pedestrians during LRT movements. 	<ul style="list-style-type: none"> Final layout design for hydro relocations will be determined through consultation with Hydro One, Cadillac Fairview and the Region in the future design phase. Stage 2 ION will cross a planned roundabout at Dundas Street and Beverly Street, which is being implemented by the Region under a separate project. Details will be coordinated during the future design phase.

ENVIRONMENTAL ISSUE/CONCERN	AGENCIES	POTENTIAL IMPACTS	MITIGATION MEASURES	COMMITMENTS TO FUTURE WORK / MONITORING
		<ul style="list-style-type: none"> On all roadways where Stage 2 ION is being constructed in the median, access to adjacent properties will be limited to right-in/right-out only, except at signalized intersections. Chopin Drive will be realigned between Queenston Road and King Street to accommodate the Preston ION Station. Left turns from Chopin Drive to King Street and from King Street to Chopin Drive will not be permitted. Eagle Street South will be reduced to a single lane with one-way southbound only traffic south of King Street. Hespeler Road's six-lane cross-section will be modified to accommodate four through lanes (two in each direction), cycling facilities on both sides of the roadway, turning lanes and Stage 2 ION in the median. Brooklyne Road will be closed at Hespeler Road and reconfigured to connect to Norfolk Drive. Access to Hespeler Road will be via Avenue Road. Stage 2 ION will cross a planned roundabout at Dundas Street and Beverly Street. Wellington Street will be reconstructed from Main Street to Bruce Street, and will include the closure of the Lutz Street intersection. 		<ul style="list-style-type: none"> A detailed traffic assessment including micro-simulation to confirm traffic signal phasing and intersection roadway geometry will be required in a future design phase. Key intersections with low level of service (LOS) and alternative solutions will be assessed further during the detailed traffic assessment such that the roadway improvements are balanced with the needs of active transportation users to ensure an inclusive final design. Potential signal coordination between vehicular and transit operations could also be explored/assessed in the future design phase by designing signal timings to improve the overall intersection performance for all modes. Gates, signals and signage will be developed in the next design phase. Staging and detour routes will be developed in the next design phase in collaboration with the Region, City of Kitchener or City of Cambridge, and GRT.
<p>Transit Service (See Section 6.4.2 for further details)</p>	<p>MTO MECP REGION</p>	<ul style="list-style-type: none"> As part of the road and intersection adjustments, the bus queue jump lanes at Shantz Hill Road/Fountain Street, and Hespeler Road/Avenue Road will be reinstated. Stage 2 ION will end at a new Downtown Cambridge terminal station, which has been developed to service on-street buses on Bruce Street with additional lay-by capacity on Ainslie Street for interregional and coach 	<ul style="list-style-type: none"> GRT will conduct a through review of ridership and service levels to ensure passenger access and catchment areas are maintained or improved. Collaboration between GRT and Project Team is required to stage construction phases to mitigate and minimize detour and stop closure impacts on the ridership. Staged construction along major corridors will be utilized to maintain transit service during construction. 	<ul style="list-style-type: none"> GRT bus stop locations will be finalized in consultation with GRT in a future design phase. Where full road closure is required, detours may be required and will be coordinated with GRT as part of a future design phase.

ENVIRONMENTAL ISSUE/CONCERN	AGENCIES	POTENTIAL IMPACTS	MITIGATION MEASURES	COMMITMENTS TO FUTURE WORK / MONITORING
		<p>buses. This on-street bus terminal will provide opportunities for improved bus network operations in Downtown Cambridge, including more efficient routing and reduced transfers.</p> <ul style="list-style-type: none"> • With the introduction of Stage 2 ION service, GRT will undertake a detailed review of the local transit network and frequencies, and make adjustments to improve operations and coverage. This may result in some routes be replaced by Stage 2 ION service, route changes to better service the area, or new routes. • Construction of Stage 2 ION will result in temporary impacts to transit service due to lane reductions or closures. 	<ul style="list-style-type: none"> • Priority will be given to transit service and temporary stop location with safe pedestrian access. 	
<p>Cycling and Pedestrian Facilities (See Section 6.4.3 for further details)</p>	<p>MTO MECP REGION</p>	<ul style="list-style-type: none"> • The development of Stage 2 ION includes a number of new active transportation initiatives as described which will support and promote pedestrian and cycling usage along the corridors and in proximity to Stage 2 ION stations. • During construction of Stage 2 ION, existing connections may experience access restrictions or temporary closures. 	<ul style="list-style-type: none"> • Where the Stage 2 ION runningway has impacted existing active transportation connections, new or reinstated connections have been proposed. • During construction, accessible pedestrian and cycling access will be maintained and signed through the construction zone. • In the case of temporary or full closure, a detour route will be identified and signed. • Advancement of the staging and access plans will be developed during the next phase of design. 	<ul style="list-style-type: none"> • Active transportation corridors and opportunities will continue to be developed by the Region. • Additional facilities will continue to be developed during the next phase of design in consideration of the Region and Cities' integrated active transportation network.
<p>Utilities (See Section 6.4.4 for further details)</p>	<p>REGION CITY OF KITCHENER CITY OF CAMBRIDGE</p>	<ul style="list-style-type: none"> • The Hydro One substation and tower located in an easement through the parking lot at Fairview Park Mall will require relocation. • Existing municipal utilities (storm sewers, sanitary sewers and watermains) impacted by Stage 2 ION construction or widening of existing roadways to accommodate Stage 2 ION will be relocated out of the Region's exclusion zone under the LRT runningway to under the travelled lanes. • Utilities running along the roadway corridor or crossing the roadway corridor will not be 	<ul style="list-style-type: none"> • In areas of crossings of LRT runningway or to protect for future crossings, casings and conduits can be utilized. • Locations of TPSS will be selected to minimize impacts to the surrounding area and supplemented with screening or integrated into the environment. 	<ul style="list-style-type: none"> • The final location and configuration of these facilities will require consultation with Hydro One, as well as Kitchener-Wilmot Hydro if their plant is also impacted. • Final utility design will be determined during a future design phase. • A detailed assessment of locations, potential property impacts, hydro power supply and TPSS screening for aesthetics and noise will be completed during a future design phase.

ENVIRONMENTAL ISSUE/CONCERN	AGENCIES	POTENTIAL IMPACTS	MITIGATION MEASURES	COMMITMENTS TO FUTURE WORK / MONITORING
		<p>placed beneath Stage 2 ION stations, as access to these area for maintenance or repairs cannot be provided due to the platform and canopy.</p> <ul style="list-style-type: none"> Future and interim utilities will be coordinated with the Region to locate and group where possible to avoid future impacts with the Stage 2 ION runningway and stations. 		<ul style="list-style-type: none"> The design of the Stage 2 ION runningway and associated infrastructure (such as poles for the overhead catenary system) will need to consider the large culvert carrying Mill Creek beneath Wellington Street. This will be confirmed during a future design phase. Staging of utility construction will be developed during the next phase of design and will include mitigation measures to minimize dust, noise, detours and pedestrian impacts due to utility relocation and installation.
<p>Railway Operations (See Section 6.4.5 for further details)</p>	<p>REGION</p>	<ul style="list-style-type: none"> Stage 2 ION will be grade separated over the existing freight rail corridors to minimize impacts to LRT and rail operations. The Grantham Rail Bridge near Samuelson Street is expected to require improvements to allow for the safe operation of Stage 2 ION under the bridge. 	<ul style="list-style-type: none"> Stage 2 ION operations are expected to have minimal impacts on day to day operations of the existing freight rail services. Bridge and rail inspections should be coordinated between ION and rail operators to minimize impacts to operations. Bridges at elevated crossings have been functionally designed to provide vertical and horizontal clearances required by CN Rail and CP Rail to avoid impacts to twin stack car transportation and other rail operations. Construction techniques can be used to minimize impacts to the existing freight service, including phased construction, off peak work and schedule coordination with freight operators. 	<ul style="list-style-type: none"> Modifications to the Grantham Rail Bridge structure, addition of overhead catenary infrastructure and maintenance requirements will be determined through consultation with CP Rail during the next design phase. Impacts during construction will depend on the final staging of the bridge crossings and will be developed in the next design phase.
<p>CLIMATE CHANGE CONSIDERATIONS</p>				
<p>Climate Change (See Section 6.5 for further details)</p>	<p>MECP REGION</p>	<ul style="list-style-type: none"> Drainage infrastructure will be designed for the collection, treatment and conveyance of future changing storm events and patterns (e.g. higher frequency and severity of storms occurring more frequently). If current GHG emissions trends continue, the Region of Waterloo is expected to experience increased temperatures, precipitation, and 	<ul style="list-style-type: none"> The subsequent design phase shall employ best practices to design the proposed drainage infrastructure using the updated Intensity-Duration-Frequency (IDF) curves based on the Ontario Ministry of Transportation online IDF Lookup Tool (http://www.mto.gov.on.ca/IDF_Curves/terms.shtml), and a future projection period that aligns with asset design life. 	<ul style="list-style-type: none"> The Region has developed and is committed to the Corporate Asset Management (AM) Strategy in alignment with federal and provincial legislation, and the Region's strategic goals, policies and plans (Region of Waterloo, August 2020). Kitchener Council has also adopted a City Corporate Climate Action Plan as well as a Region-wide Community Climate Action Plan,

ENVIRONMENTAL ISSUE/CONCERN	AGENCIES	POTENTIAL IMPACTS	MITIGATION MEASURES	COMMITMENTS TO FUTURE WORK / MONITORING
		<p>extreme weather events.⁸ These changes to climate will impact health, infrastructure and buildings, natural environment, energy supply and distribution, and the economy.⁹</p>	<ul style="list-style-type: none"> • In order to reach the objectives outlined in the Asset Management (AM Plan), the Region is committed to reducing GHG emissions through minimizing the impact of infrastructure on the environment. The design and implementation of the Stage 2 ION LRT will result in decreased GHG emissions, as the LRT prioritizes an alternative low carbon transportation option. • Stage 2 ION will be designed to operate using electricity, resulting in a significant decrease in demand for energy from fossil fuel combustion which will result in reduced GHG emissions. 	<p>both of which contain elements of adaptation or “future-proofing.” Kitchener’s Official Plan addresses climate change in sections on <i>Natural Hazards, Sustainable Development, and Energy Conservation and Generation</i>.</p>

⁸ University of Waterloo, Localized Climate Projections for Waterloo Region, 2015.

⁹ Region of Waterloo, A Community Climate Adaptation Plan, 2019.