REPORT

Brian Coburn Boulevard Extension/ Cumberland Transitway (Navan Road to Blair Road at Innes Road) Environmental Assessment Study

Environmental Study Report

Ottawa, Ontario

Presented to:

City of Ottawa
110 Laurier Avenue West
Ottawa, Ontario K1P 1J1

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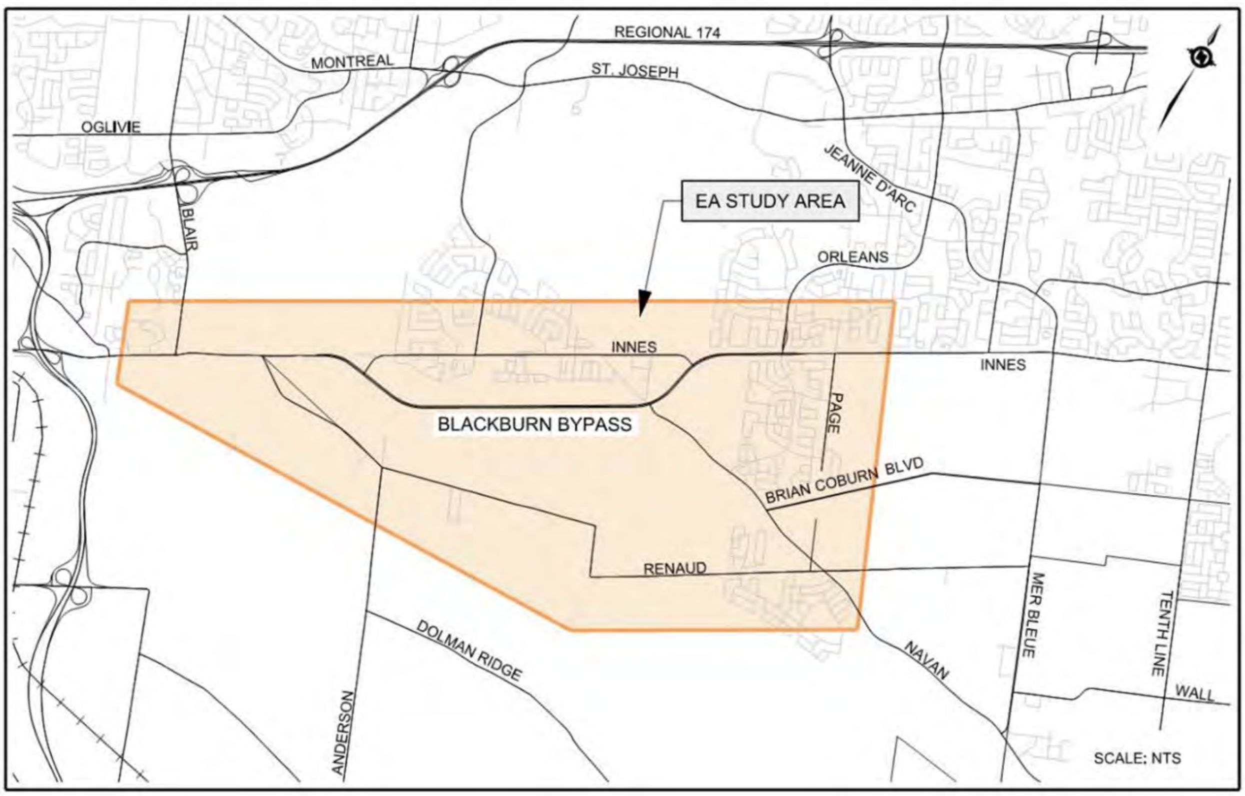
EXECUTIVE SUMMARY

Introduction

The City of Ottawa's 2013 Transportation Master Plan (TMP) identified the new four lane Brian Coburn Boulevard section from Navan Road to the Blackburn Hamlet Bypass (listed in the TMP as the Blackburn Hamlet Bypass Extension). The City of Ottawa has undertaken a Schedule "C" Municipal Class Environmental Assessment (EA) study to examine alternate corridors for the Brian Coburn Boulevard Extension (BCBE) and Cumberland Transitway Westerly (CTW), considering the City of Ottawa's 2013 TMP Affordable Network and Network Concept Plans (for 2031 and longer-term planning horizons) for both roads and transit. The study area is illustrated in **Figure Ex-1** below.

Figure Ex-1: Study Area



Study Process

The study was undertaken in accordance with Schedule C of the Municipal Class EA, which is an approved process under the Ontario *Environmental Assessment Act* (1990). The process involved developing, assessing, and evaluating alternatives, leading to a Recommended Plan.

During the study, the Municipal Class EA was updated (2023). The update conditionally exempts certain low-risk, routine municipal road, water, and wastewater projects from requiring an environmental assessment to better align assessment requirements with potential environmental impacts. These exemptions were intended to reduce duplication and streamline the process for municipal projects, while maintaining strong environmental oversight and protection. The changes do not essentially affect the planning and assessment for this project and the process has been undertaken and documented to address the requirements for a Schedule C project.

Consultation

Consultation included three rounds of meetings with the Agency Consultation Group (National Capital Commission; Ontario Ministry of Environment, Conservation and Parks; Ontario Ministry of Natural Resources and Forestry; Ontario Ministry of Heritage, Sport, Tourism and Culture Industries; Rideau Valley Conservation Authority; Hydro Ottawa; Hydro One; Transport Action Canada; Ottawa Police and various City Departments, and the combined Business and Public Consultation Group (landowners, businesses, community associations, interest groups)). Additionally, three public open houses were held along with focused consultation with the National Capital Commission (NCC) due to the potential impacts to and requirement for NCC Greenbelt lands.

Indigenous peoples were also consulted in the form of email notices at various times during the study. The Mohawk Council of Akwesasne provided a verbal response that they did not have a need to participate in this study, and no further responses were received. Notices and information were sent. No issues were identified by the Indigenous peoples that were contacted throughout the study.

Project Need & Opportunities

The communities at the eastern limits of the City of Ottawa are projected to experience continued growth in both population and employment over the next several decades (City of Ottawa, 2003a). This growth will require appropriate and targeted transportation infrastructure for transit, auto and active transportation modes) to accommodate this projected growth. The existing road network is currently at capacity, and it was determined that this condition will deteriorate unless improvements are made.

A re-examination of the need and a confirmation of the preferred alternative solution was undertaken as part of this study providing verification of the 2013 TMP assumptions and conclusions. The analysis supports the need for additional roadway capacity within the study area, as described in **Section 4**.

Existing transit services operating in mixed-use conditions are anticipated to face the same performance issues encountered by automobiles. Better transit performance is projected where transit priority measures or dedicated lanes are provided (e.g., currently provided on sections of Ottawa Road 174) or will be provided. A dedicated transit facility such as the Cumberland Transitway or the approved LRT system (as in the OR 174 corridor) provides the highest level of performance.

The study area includes predominantly NCC Greenbelt lands. Appropriate pedestrian and cycling facilities will be provided along all new infrastructure in accordance with City's planning documents and where applicable, NCC policies and guidelines. This will include linkages with the existing pathway network (i.e., City and NCC pathways) and linkages with adjacent communities such as Chapel Hill South and Bradley Estates.

Identification & Evaluation of Alternatives

The identified problems and opportunities were used to generate alternative solutions (options) and multi-modal transportation solutions for evaluation within the study area. Options considered the role of transportation demand management to reduce single occupancy vehicle traffic (alternative modes such as transit, cycling and walking). All the presented Alternative Solutions include expanded/enhanced transit service; expanded/enhanced pedestrian/cycling; travel demand management; and expanded roadway capacity. The Do-Nothing Alternative was considered and screened out as it did not meet the projected future transportation needs within the study area.

The study team developed a long list of road and transit corridor options covering the identified study area and beyond, to fulfill the EA requirement of reviewing a reasonable range of technically feasible corridor options to assess and minimize the potential for environmental effects. These options were assessed based on four broad environmental criteria groups: natural environment, social and cultural environment, transportation, and cost. Once assessed, the evaluation resulted in a high-level screening from the long list to a short list of six road and transit corridor options that were carried forward for further consideration.

When these six short listed corridor options were presented at the first round of public consultations, public response proposed a seventh option, which was subsequently added for further consideration. A second screening of the now seven options resulted in a shorter list of four corridor options that were carried forward for more detailed evaluation.

Evaluation of the Four Short Listed Corridor Options

Environmental baseline conditions for the study area were collected to provide an understanding of the existing conditions against which the potential environmental effects of the alternative solutions could be assessed. Environmental conditions which included natural, social, cultural, built, and economic environments were documented.

All four short listed corridor options were determined to have NCC Greenbelt and natural environment impacts and accordingly, NCC engagement was integral to the EA study and evaluation process. The evaluation process required developing an extensive set of indicators and measurements within the four broad environmental criteria groups to enable a comparative assessment approach of each option. Within this context, a comprehensive set of 31 criteria, along with indicators and measurements, was developed, in consultation with NCC staff, to reflect the importance of the Greenbelt and respect its policies.

Based on the identified criteria, indicators, and measurements, each of the four short listed options was assessed and compared against each other to receive a relative ranking, which was then tallied up to determine the top ranked option. This process resulted in Option 7 ranking highest overall. Given concerns about Option 7's impacts on the Greenbelt and to test the rigour of the results, a sensitivity analysis was performed. Of the five sensitivity tests conducted, Option 7 ranked first in three tests and tied with Option 4 in the other two tests. The evaluation of corridors is presented in detail in **Section 6**.

It should be noted that once the four remaining short-listed options were being carried forward for further evaluation, NCC staff indicated that they were willing to work with the City on Options 1 and 4 but did not support Options 5 and 7 as they "*do not conform to current Greenbelt Master Plan policies which discourage ecosystem fragmentation, advocate for minimal road density and favour a low infrastructure footprint*". City staff indicated that assessing and balancing the trade-offs, including potential environment impacts, are key aspects of the EA process. While potential impacts on the environment must be considered and addressed, to holistically assess a project, there are other criteria that must be considered, including community impacts/benefits and transportation effectiveness.

Furthermore, while each of the four criteria groups were weighted equally for the evaluation, of the criteria, indicators and measurements included, 71% represented the natural, social, and cultural environment, while 26% and 3% represented transportation and cost criteria groups, respectively. Irrespective of the emphasis on the natural, social, and cultural environment, the evaluation led to the selection of the Technically Preferred Option 7.

Despite the extensive consultation with the NCC on the evaluation process, a letter from NCC CEO, dated September 2, 2020, stated that "*the NCC Board of Directors passed a resolution (enclosed) on August 25, 2020…..affirming its position that federal lands required to implement the Brian Coburn Boulevard/Cumberland Transitway extension alignment Options 5 and 7 will not be made available by the NCC."* To date, the NCC position remains firm. Regardless of the NCC's position, the City has followed the EA process in accordance with provincial legislation. NCC approval will be subject to a future federal EA and Federal Land Use, Design and Transaction Approval (FLUDTA) process as well as additional legislated approvals when the project is implemented (post 2031). Subsequently, City staff developed a compensation and mitigation strategy in the form of a land exchange, offering 47 hectares of City land within the same Greenbelt area. This strategy was presented to senior NCC staff on October 7, 2021, and to-date, discussions are ongoing. Given the longer-term plan for implementation, there is time for further discussion with the NCC. Although this EA study is following the EA Act of Ontario, NCC approval will be required during implementation of the Recommended Plan (post 2031) since it is subject to the "*Federal Land Use, Design and Transaction Approval Process."*

Within this context, the following is a brief description of each of the four corridor options (at their initial stage of concept plan development), their associated predicted environmental impacts and how the ranking was assessed among the four options. **Figure Ex-2** to **Figure Ex-5** show each of the four corridor options superimposed over an aerial photo to illustrate the features being impacted.

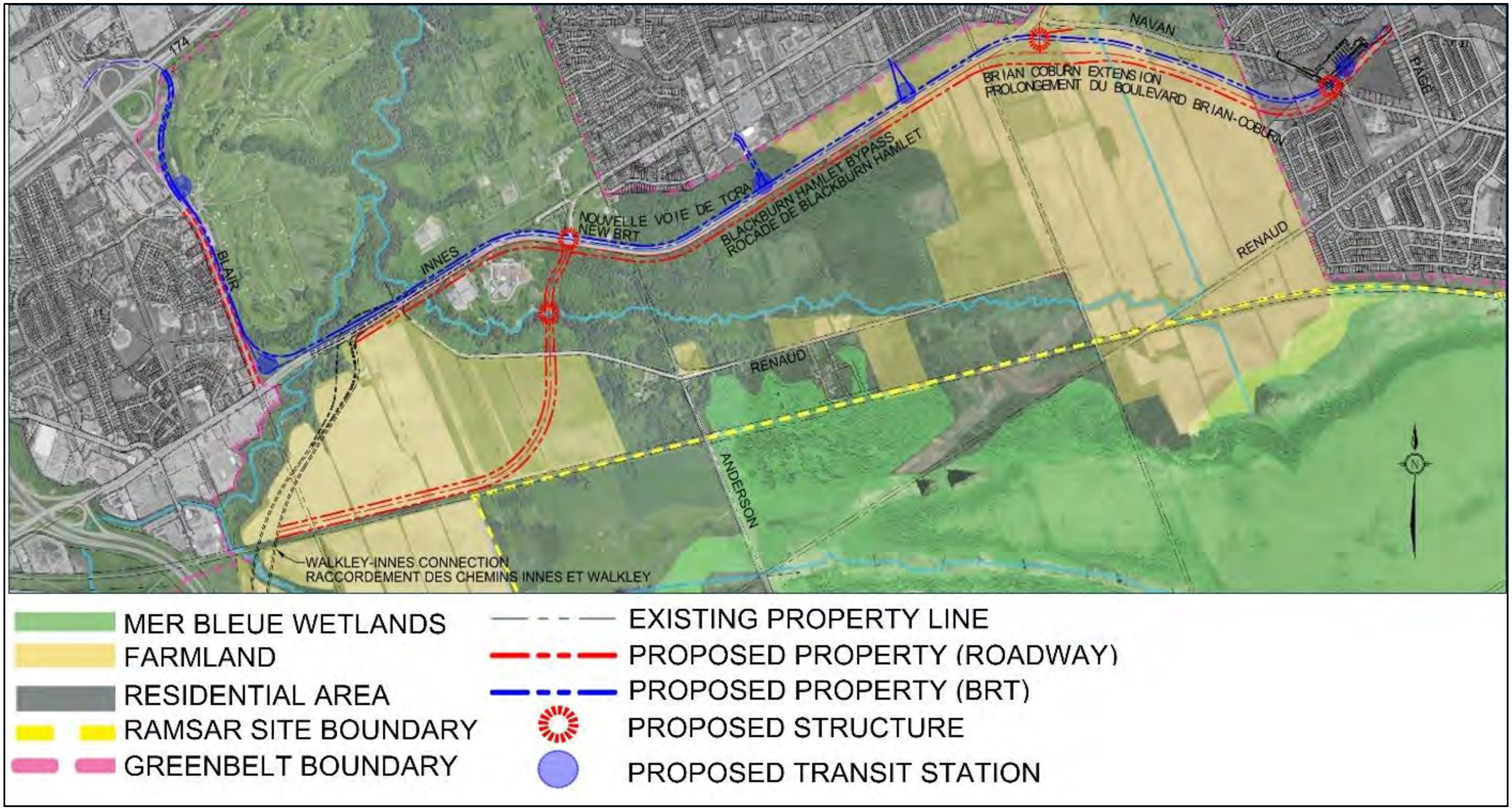


Figure Ex-2: Alternative Corridor – Option 1

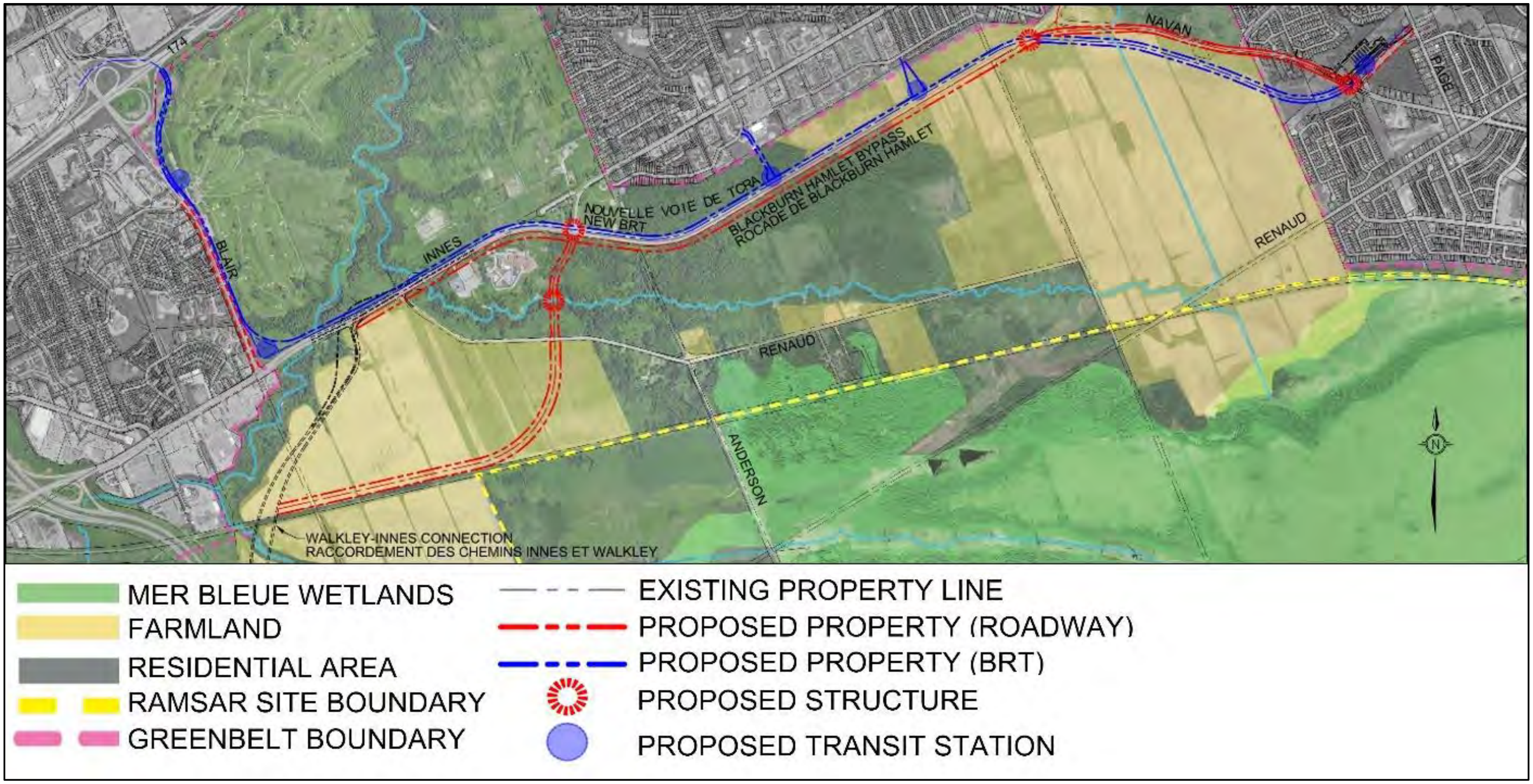


Figure Ex-3: Alternative Corridor – Option 4

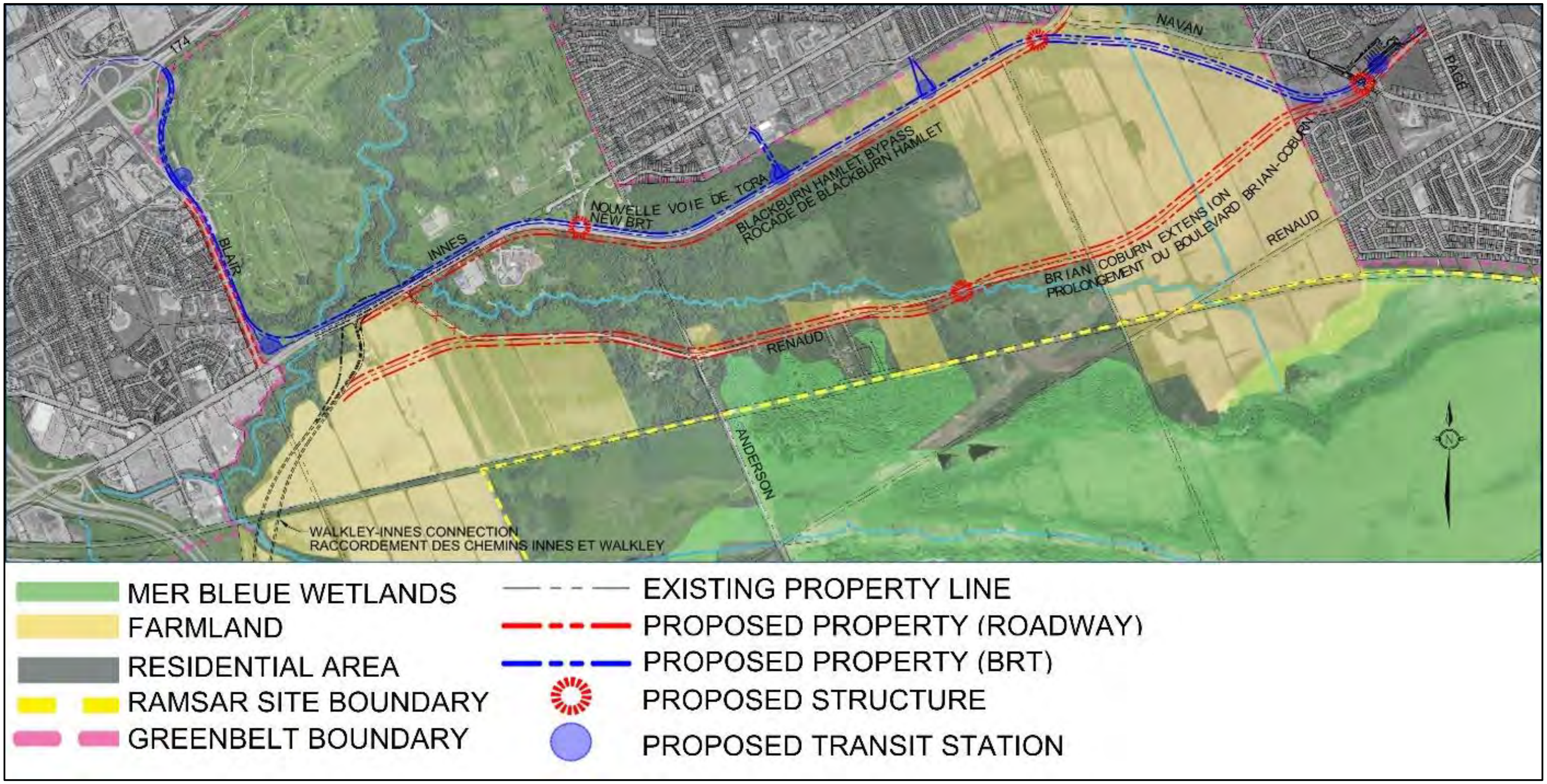


Figure Ex-4: Alternative Corridor – Option 5

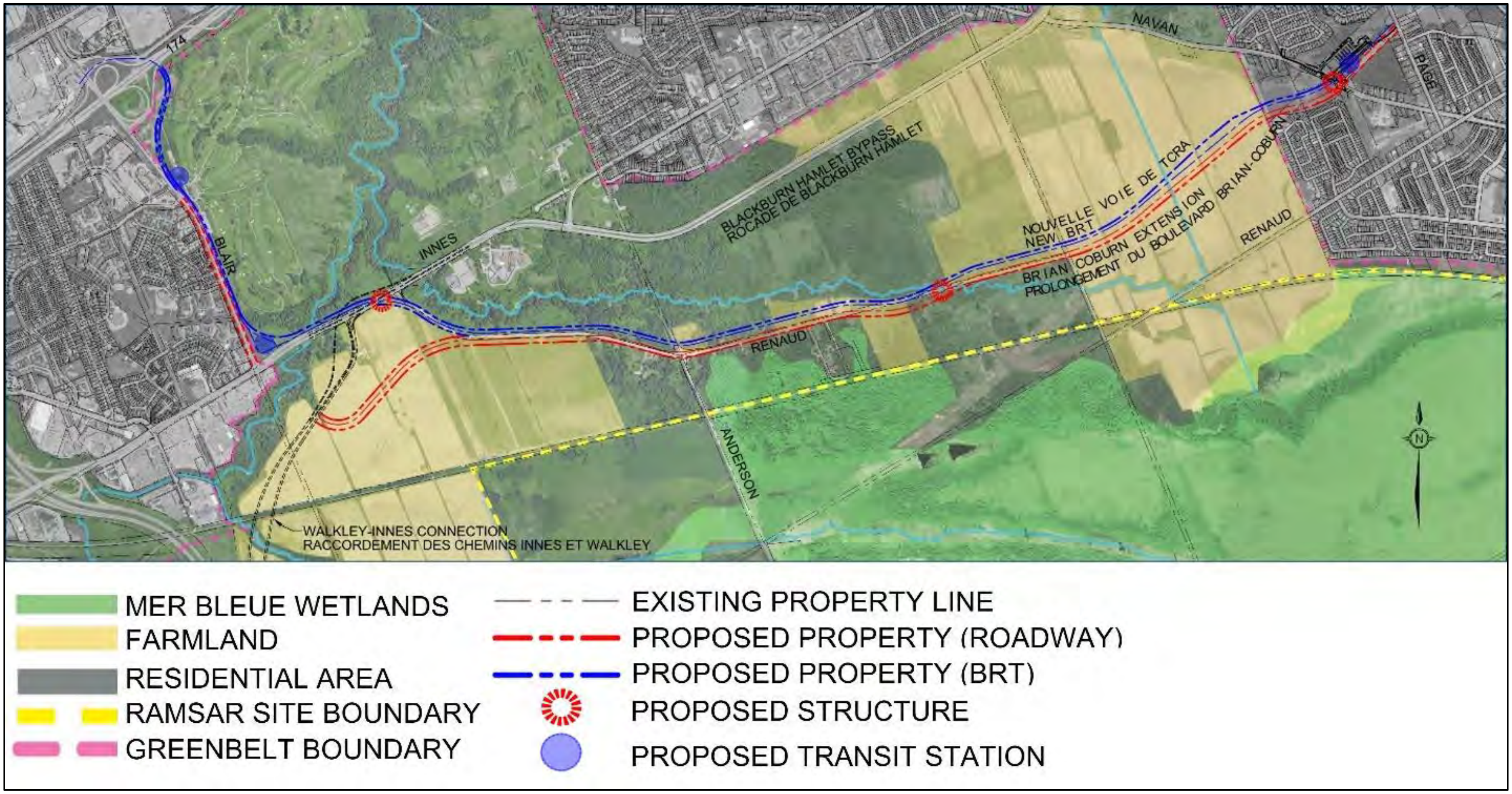


Figure Ex-5: Alternative Corridor – Option 7 (Typically Preferred Option)

Option 1: Ranked 2nd Overall

Option 1 (**Figure Ex-2**) aligns more closely with the City's TMP and the NCC's Greenbelt Master Plan (GMP). From Navan Road, the proposed road and transit corridor traverse significant Greenbelt farmland as it runs parallel to and southwest of Navan Road and along the Blackburn Hamlet Bypass (BHBP). Comparatively, it has the highest impact on farmland and higher amounts of habitat fragmentation. Along this corridor are several water crossings impacting fisheries and aquatic habitat, four grade separated structures, including a significant crossing of the Mud Creek valley south of Innes Road, and two transit stations, resulting in the highest cost of the four options.

Benefits of this route include having the least overall natural environmental impact of the four options since bundling of the road and transit corridors with existing infrastructure reduces the impact on wildlife natural linkages. It is also further away from the significant Mer Bleue wetland. Although this option ranked first for the natural environment criteria, it had the highest cost and ranked second overall in the evaluation.

Option 4: Ranked 3rd Overall

Similar to Option 1, Option 4 (**Figure Ex-3**) also aligns more closely with the City's TMP and the NCC's Greenbelt Master Plan (GMP), except that the BCBE would be located along a widened Navan Road. While comparatively there is less farmland impact, it has the highest private property impacts and associated noise and vibration impacts along Navan Road. This option ranked third overall in the evaluation due to the high social and cultural impacts and higher cost.

Option 5: Ranked 4th Overall

While the BRT in Option 5 (**Figure Ex-4**) is similar to Option 1, the new roadway splits away from the BRT in a separate corridor west of Navan Road and extends west down the escarpment, following the hydro corridor, before dropping down to existing grade through the NCC Greenbelt to connect to the existing Renaud Road and Anderson Road, both widened to four lanes. Approximately 400 m before Innes Road, the new road corridor splits away from Anderson Road to connect to the future Innes-Walkley-Hunt Club (IWHC) link.

Co-location of infrastructure can lessen the environmental impacts, while splitting the road and transit corridor into two separate corridors in this situation results in the highest overall impacts. As the transit corridor follows the Option 1 corridor, it therefore has similar impacts along that corridor, although to a slightly lesser extent due to the reduced footprint. However, new impacts are introduced along the new 4 lane road corridor extending from Brian Coburn Boulevard resulting in greater overall impacts. As the new road corridor crosses farmland, it also severs the land parcels, is closer to the significant Mer Bleue wetland and further potentially impacts natural wildlife linkages and terrestrial habitat and has the highest habitat fragmentation. In addition, the road corridor crosses and runs parallel to Mud Creek and has the highest potential impacts associated with unstable slopes. These impacts are in addition to the BRT corridor impacts. This option also has the most water crossings impacting fisheries and aquatic habitat and ranked fourth and last overall in the evaluation.

Option 7: Ranked 1st Overall

Option 7 (**Figure Ex-5**) bundles the BRT with the same roadway corridor as Option 5, with the BRT to the north of the roadway corridor. Approximately 400 m from Innes Road, the BRT follows existing Anderson Road (which is to be closed west of Renaud Road), then passes under and to the north of Innes Road to connect to Blair Road. This option further bundles the road and transitway with Renaud Road and Anderson Road on an already existing and disturbed corridor. While it traverses farmland west of Navan Road and severs farmland parcels, it has the lowest natural habitat fragmentation (as measured by total new corridor length). It also crosses and runs parallel to Mud Creek with higher potential impacts associated with unstable slopes. This corridor is closer to the significant Mer Bleue wetland and because of the wider footprint along the new corridor, it has greater impact to terrestrial at-risk and sensitive species as well as natural wildlife linkages. Although this option ranked a close second overall on the natural environment criteria, it had the lowest cost and ranked first overall under the Transportation and Social and Cultural Environment. Option 7 is therefore the Technically Preferred Option.

The table below (**Table Ex-1**) provides the high-level comparative evaluation summary by criteria group, which led to the selection of the Technically Preferred Option.

Key highlights of Option 7, the Technically Preferred Corridor Option, are as follows:

- Improves transit travel time and reliability with direct uninterrupted travel between the Chapel Hill Park and Ride and Blair Road.

- Provides a new direct arterial roadway link to the future IWHC Connection to address travel demand between Orléans South and the South Urban Area as well as Highway 417.

- New multi-use pathways (MUPs) provide east-west mobility and pedestrian and cycling connectivity to Blackburn Hamlet, the Chapel Hill Park and Ride, Bradley Estates community, Prescott Russell Trail, NCC pathways and beyond.

- Least expensive of the four options.

- Reduces traffic on Anderson Road when fully implemented with the IWHC link which is a benefit as Anderson Road passes through the environmentally sensitive Mer Bleue wetland area south of this project.

- Preserves the natural character of the Greenbelt through context sensitive rural roadway and landscaping design, along with a comprehensive recommended Ecological Restoration and Enhancement Plan.

Table Ex-1: Highlights of Comparative Evaluation Summary of the Four Short Listed Options

Criteria	Option 1 - New	Option 4 – Widen Navan/BRT off Navan	Option 5 – Renaud Extension & BRT off Navan	Option 7 – Renaud Extension & BRT on Renaud	Preferred Options
Transportation and Transit (8 Criteria)	**Moderately Preferred** Impacts neighbourhood traffic with cut-through traffic	**Moderately Preferred** Impacts Navan Road residents with more traffic	**Moderately Preferred** Provides alternate and most direct route between Orléans South to the Walkley/Hunt Club area	**Most Preferred** - Most direct route for transit Provides alternate and most direct route between Orleans South to the Walkley/Hunt Club area	**Option 7**
Natural Environment (11 Criteria)	**Most Preferred** • Highest core natural area impacts • Higher habitat fragmentation Further away from Mer Bleue wetland	**Moderately Preferred** • Highest core natural area impacts • Higher habitat fragmentation • Moderate impact on fisheries, aquatic and terrestrial habitat • Higher habitat fragmentation Further away from Mer Bleue wetland	**Least Preferred** • Moderate core natural area impacts • Highest impact on fisheries, aquatic and terrestrial habitat • Closer to Mer Bleue wetland • Moderate impact on wildlife natural link areas Highest impact within areas of unstable slopes	**Moderately Preferred** • Least core natural area impacts • Closer to Mer Bleue wetland • Least habitat fragmentation • Moderate impact within areas of unstable slopes • Highest impact on Mud Creek Higher impact on Species at Risk	**Option 1**
Social/Cultural Environment (11 Criteria)	**Moderately Preferred** • Highest impact on farmland • Highest impact on greenbelt experience Moderate impacts on air quality, noise and vibration	**Moderately Preferred** • Highest impact on private properties, noise and vibration Highest potential Heritage property impacts	**Moderately Preferred** • Severs farm parcels • Moderate impact on areas of archaeological potential Highest impact on views and vistas	**Most Preferred** • Severs farm parcels • Least impact on private properties, noise and vibration Highest impact to areas of archaeological potential	**Option 7**
Cost (1 Criterion)	**Least Preferred** 60% greater than Option 7	**Moderately Preferred** 40% greater than Option 7	**Moderately Preferred** 50% greater than Option 7	**Most Preferred** Lowest cost	**Option 7**

Recommended Plan Overview

Following the selection of the Technically Preferred Option 7, the alignment was further refined considering: preservation of the Greenbelt rural features, mitigation of potential loss of identified ecological features and functions, avoidance of areas of unstable slopes and defined flood zones, and with due consideration of potential social environmental effects including noise.

Figure Ex-6 provides an overview of the Recommended Ultimate Design for the Brian Coburn Boulevard Extension, approximately 6.1 km in length, and the Cumberland Transitway, approximately 6.5 km in length. In general, the BRT is located on the north side of the BCBE alignment and a MUP is located on the south side of the full extent of the roadway. To minimize the project footprint, the BRT and new roadway make use of the existing Renaud Road and Anderson Road transportation corridors.

There are four ‘gateway’ locations that will provide opportunities for landscaping enhancements at the intersections of BCB with Navan Road, Renaud Road, Anderson Road, and the future IWHC link. **Gateways will help create** an identifiable character along pathways to enhance the user experience.

Typical Cross Section

The recommended road and transitway cross-section design, shown facing east, includes a 13 m segregated BRT, 21.5 m for the four lanes of BCB which are separated by a 1.5 m median to improve safety, a 3.0 m MUP along the south side of the roadway, and a posted speed of 80 km/h (**Figure Ex-7**). Rural ditching of varying width will match with the existing rural conditions and context sensitive planting is recommended along the outer edges of the BRT and roadway to preserve the Greenbelt’s natural and rural landscape.

Based on the foregoing, a minimum 77 m right-of-way is required, although the next phase of the project (detailed design) will examine how this width can be reduced. The wide cross section is reflective of the desire to maintain the rural landscape and features, driving experience, and compatibility with the surrounding environment. Also, the BRT and BCB both make use of and replace sections of existing Renaud Road and existing Anderson Road, thus effectively reducing the total impact area associated with the new project footprint.

LEGEND / LÉGENDE

- PROPOSED ROADWAY / CHEMIN PROPOSÉ
- PROPOSED BRT / TCRA PROPOSÉE
- PROPOSED MULTI-USE PATH (MUP) / SENTIER POLYVALENT PROPOSÉ
- PROPOSED GRADE SEPARATED CROSSING / TRAVERSÉE À NIVEAU SÉPARÉ PROPOSÉE
- CREEK REALIGNMENT / RÉALIGNEMENT DU RUISSEAU
- PROPOSED NOISE BARRIER / BARRIÈRE ANTI-BRUIT PROPOSÉE
- GATEWAYS / POINT D'ACCÈS
- TRAFFIC SIGNALS / FEU DE CIRCULATION
- PROPOSED SHRUB PLANTING / PLANTATION D'ARBUSTES PROPOSÉE
- PROPOSED DECIDUOUS TREE / ARBRE À FEUILLES CADUQUES PROPOSÉ
- PROPOSED CONIFEROUS TREE / ARBRE CONIFÈRE PROPOSÉ
- GRADING LIMIT / LIMITE DE NIVELLEMENT
- EXISTING PROPERTY LINE / LIGNE DE PROPRIÉTÉ EXISTANTE
- PROPOSED PROPERTY LINE / LIGNE DE PROPRIÉTÉ PROPOSÉE

Figure Ex-6: Recommended Plan – Overview

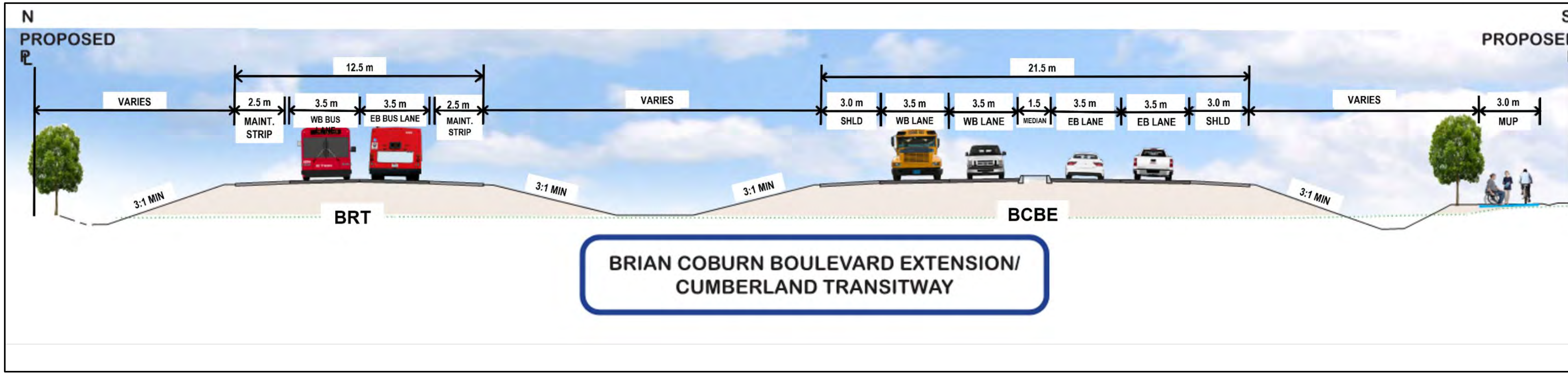


Figure Ex-7: Recommended Plan – Typical Cross-Section

Navan Road & the Chapel Hill Park & Ride

From the Chapel Hill Park and Ride (P&R) lot and below grade transit station, the BRT will pass under Navan Road, with Navan Road on a new bridge structure, while BCB will extend west down an embankment to the existing grade below the escarpment. The existing roundabout at BCB and Navan Road will be expanded to a two-lane roundabout and MUPs will be added for convenient access to/from the transit station. Also included is a direct MUP connection from the Bradley Estates community via Percifor Way to Navan Road and the transit station. To mitigate noise impacts, noise barriers are proposed along the north edge of Bradley Estates and along the south edge of a residential property to the north. **Figure Ex-8** illustrates the Recommended Ultimate Design in proximity to the Chapel Hill Park and Ride.

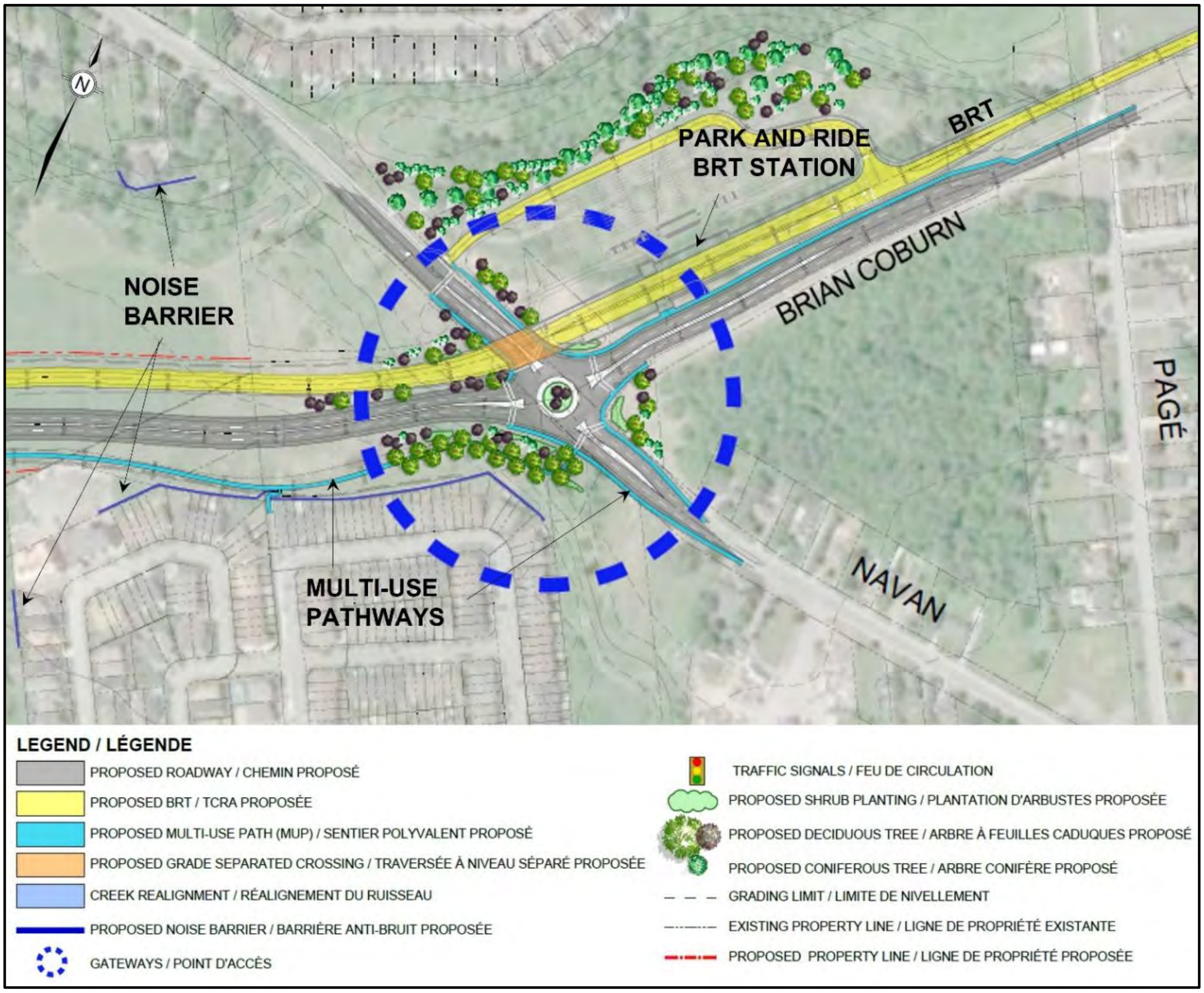


Figure Ex-8: Navan Road & Chapel Hill Park & Ride

Renaud Road Intersection & NCC Access

From Navan Road, the recommended BCBE and BRT will connect to the existing Renaud Road via existing farmland and be co-located adjacent to the existing hydro corridor to minimize the project footprint. A protected signalized intersection will be provided at the new BCBE and Renaud Road intersection and will include MUP crossings on the south and west legs of the intersection as illustrated in **Figure Ex-9**.

In the Renaud Road area, the project footprint widens as the BRT rises on an embankment to accommodate a grade-separated farm vehicle access and a proposed north-south NCC pathway, while the access roadway is lowered slightly. The MUP will connect to a proposed NCC pathway to the north and the City's Prescott Russell Trail to the south. A narrower footprint option in this area involved introducing retaining walls and a longer bridge structure that would not align with the Greenbelt rural landscape and was therefore not recommended.

Of note, members of the public raised safety concerns with vehicles travelling at high speeds along the very sharp bend on the existing Renaud Road near the Prescott Russell Trail. In this area, the trail crosses Renaud Road at two locations, resulting in conflicts between vehicles and pedestrians and cyclists. To avoid these conflicts, a realignment of Renaud Road is proposed to the north and parallel to the Prescott Russell Trail to eliminate the sharp roadway bend and the two trail crossing conflicts. This realignment also results in the removal of this section of Renaud Road to outside of the RAMSAR designated limits of the Mer Bleue wetland. Restoration of this portion of the wetland would occur following the removal. A proposal to close Renaud Road and re-naturalize the corridor is currently under discussion. The need for improvements to Renaud Road will be reviewed during detailed design.

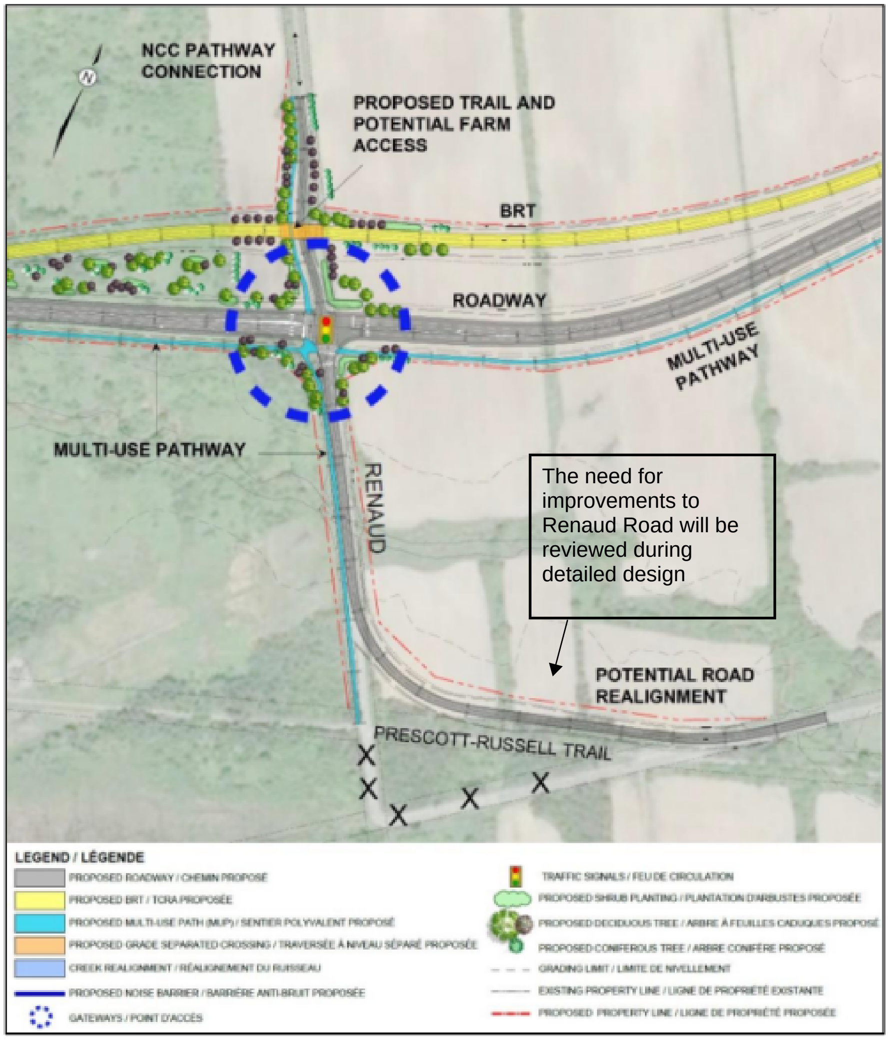


Figure Ex-9: Renaud Road Intersection & NCC Access

Mud Creek Realignment

Around the Mud Creek crossing area, the BRT and roadway corridors converge back to the minimum separation. The widening of Renaud Road for the BCBE will encroach on the erosion and slope stability zones of Mud Creek and a realignment of the existing creek, approximately 300 m long, is proposed (**Figure Ex-10**). This realignment provides an opportunity to improve existing creek conditions through natural channel design, terrestrial and aquatic habitat enhancements, erosion protection and slope stabilization measures. The MUP is proposed to pass over the realigned creek on its own pedestrian and cycling bridge.

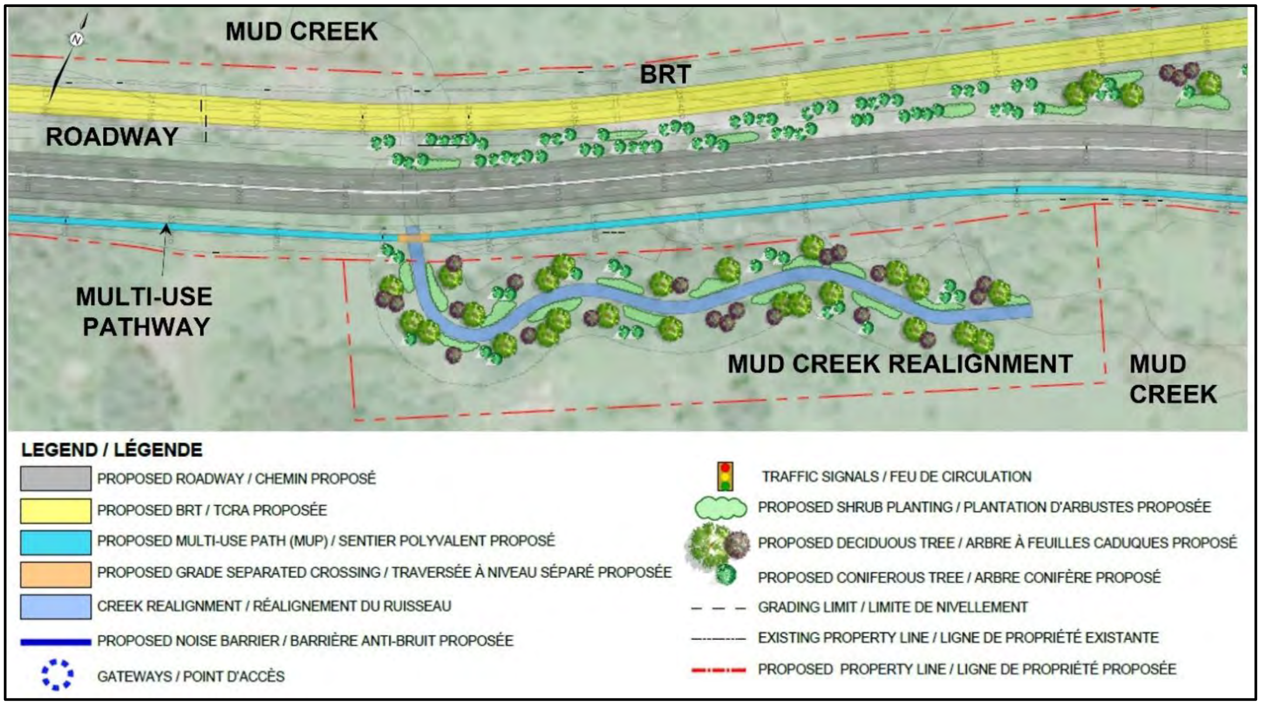


Figure Ex-10: Mud Creek Realignment

Anderson Road Intersection

A traffic analysis for the 2031 planning horizon to expand the existing Anderson Road roundabout to two lanes produced a result that identified long delays and poor levels of service. Consequently, a protected signalized intersection is proposed with the MUP crossing on the south side of the intersection (**Figure Ex-11**).

The segregated BRT will block Weir Road and eliminate all access to the community gardens, and as such, opportunities will be explored for the potential relocation of the community gardens. To mitigate noise impacts, a noise barrier is proposed along the south side of the new roadway between Maurice Street and Ida Street.

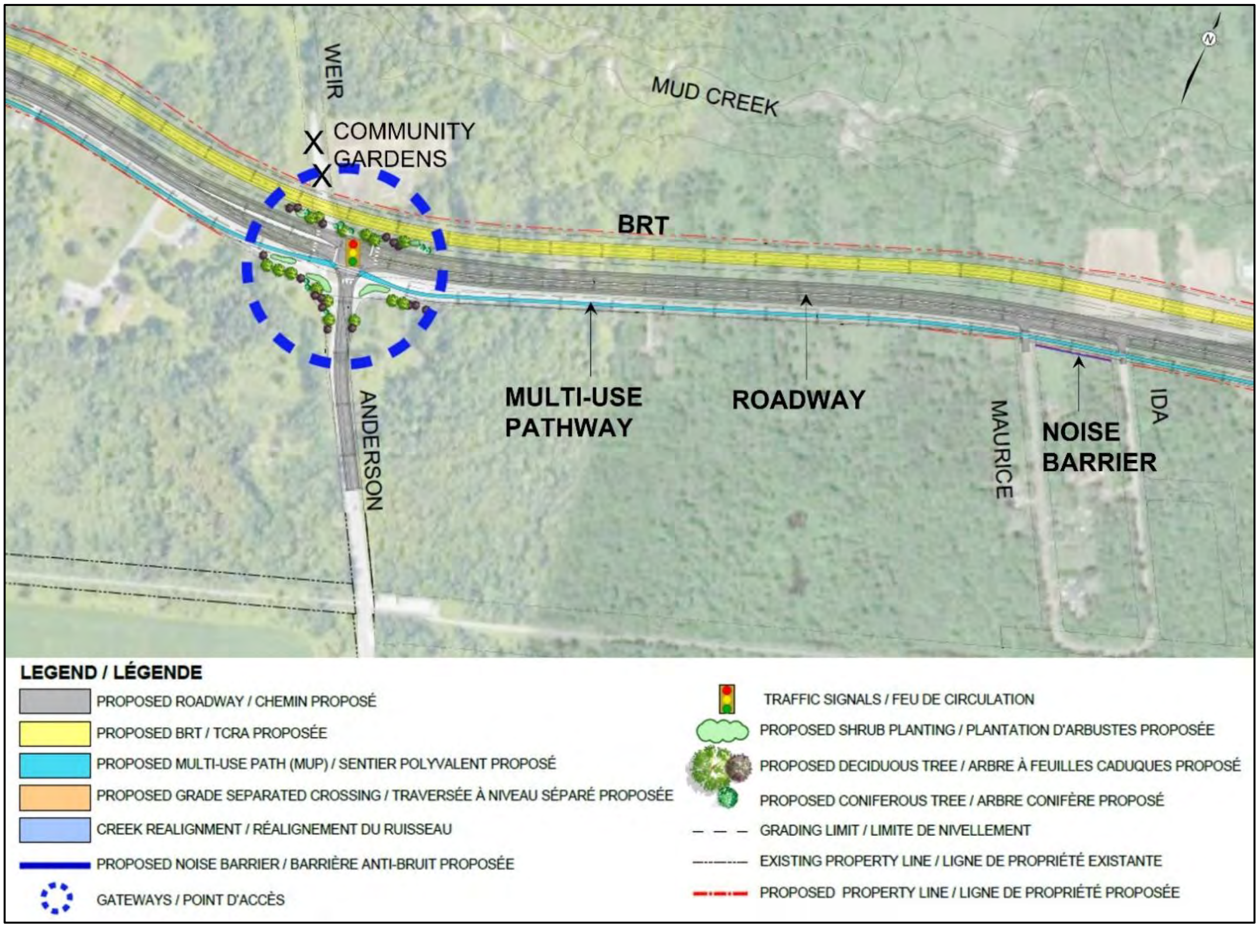


Figure Ex-11: Anderson Road Intersection

Connections to Innes-Walkley-Hunt Club & Blair Road

Between Renaud Road and Innes Road, the BRT will follow existing Anderson Road, passing under Innes Road via a tunnel, before turning west to follow the north edge of Innes Road to Blair Road. The new BCBE roadway and MUP will extend west through existing Greenbelt agricultural lands to connect to a protected signalized intersection with the future IWHC link. Although not part of this project, the EA study for the future IWHC link was previously completed in 2008.

The future MUP at the IWHC link will connect north to Innes Road, continuing along the south side of Innes Road to Blair Road. Some widening of Innes Road is required to accommodate the proposed BRT and MUP with minor impact to the existing bridge structure at Greens Creek (Figure Ex-12).

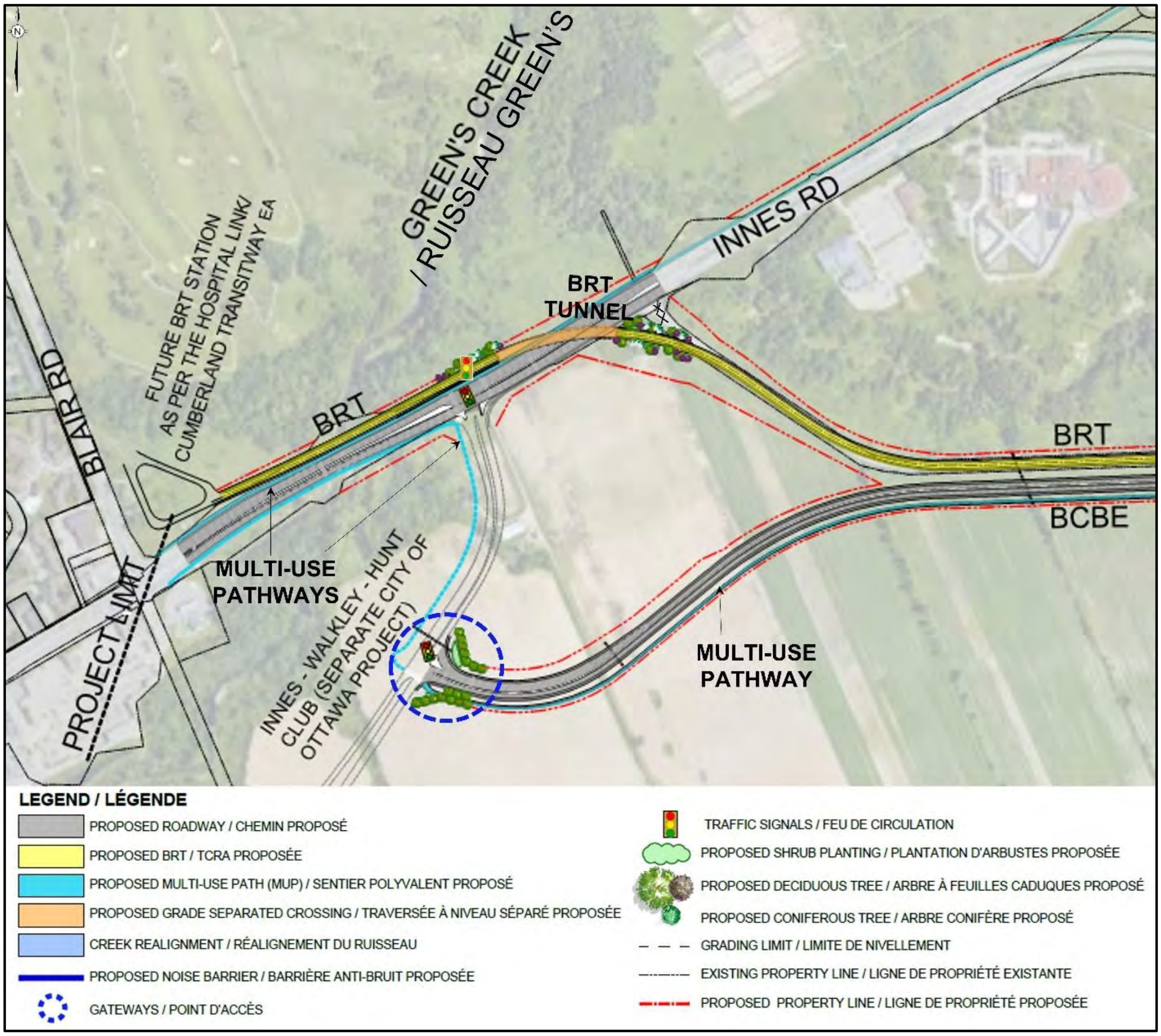


Figure Ex-12: Connections to Innes-Walkley-Hunt Club & Blair Road

Environmental Implications

This project will be designed and implemented with the benefit of current planning, engineering, and environmental management practices with regard for the legislation, policies, regulations, guidelines, and best practices of the day. Mitigation measures will be prescribed in the construction contract documents and specifications. A summary of key environmental impacts and proposed mitigation measures is provided below.

Geotechnical Conditions

This project is in an area where the subsurface conditions generally consist of fill overlying a thick deposit of firm to very stiff silty clay. The groundwater level varies from about 1.3 to 2.9 m below ground surface, with seasonal fluctuations. The silty clay beneath this site has a limited capacity to support additional stresses caused by foundation loads and/or grade raises. Lightweight fill (LWF) materials could be considered for any infilling or embankment exceeding 2.5 m in height, thereby reducing the stress increase on the compressible clay, and mitigating the anticipated settlement. Conventional cast-in-place concrete retaining walls and bridges need to be supported on deep foundations driven to bedrock, as shallow foundations would not provide sufficient bearing resistances or acceptable settlement performance for the structure.

Embankment/Excavation Stability

Embankments will be required at various locations throughout the study area, including at the farm/MUP underpass crossing at the BRT. The clay deposit is relatively weak within the study areas and therefore the potential for deep-seated rotational shear failure (i.e., bearing capacity failure) of the embankment subgrades exists. Detailed design will need to confirm LWF material requirements, to avoid excessive settlements and provide an adequate factor of safety against instability.

Unstable Slope & Ravines

This project is adjacent to ravines associated with Greens Creek and Mud Creek. The stability of the Mud Creek slopes has been documented and certain segments are known to be active for slope failures, largely connected to active erosion undercutting the toe of slopes within the creek. Encroachment in ravines associated with the watercourses poses potential fluvial geomorphological risks/impacts. An Erosion Allowance of 8 m will need to be included in the determination of the Limit of Hazard Lands given the active erosion observed along many portions of the Mud Creek bank. This value can be reduced in areas that have an existing flood plain width or where erosion control measures are being considered.

Erosion protection is required west of the Renaud Road and BCB intersection, where the Mud Creek realignment is proposed and where the recommended set-back may not be achievable. Erosion allowances will be confirmed during detailed design. Erosion protection measures may include but will not be limited to erosion protection rip-rap, placed on a maximum two horizontal to one vertical front slope up to the 100 year flood level and underlain by a non-woven geotextile, channeling of tributary flows with open (“half-pipe”) culverts along steep grades and partial infilling and live crib walls.

The clay soil in this area is susceptible to erosion particularly at the outside bends of the valley slopes. Concrete closed box culverts are considered most feasible since the foundation loads are distributed over a larger area, resulting in lower foundation stress levels, and therefore reduced settlement magnitudes (as opposed to a rigid frame open box culvert). However, open box culvert(s) with piled foundations to bedrock could also be considered. Modifications within the Mud Creek channel will be designed and constructed with oversight and input from fluvial geomorphologists or other channel design experts.

The Rideau Valley Conservation Authority (RVCA) has raised concerns about slope stability and the risk of landslides at locations where the recommended alignment is close to Mud Creek. RVCA has recommended that additional geomorphological study, slope stability analysis and landslide hazard assessment be conducted prior to finalizing an alignment. The analysis completed for this study provided Limit of Hazard Lands assessment offsets along Mud Creek within the study area that are considered sufficient at this planning stage. The City will undertake more detailed investigations and assessments to manage and identify appropriate mitigation during the design phases.

Geomorphology: Mud Creek Realignment

Realignment of Mud Creek poses potential fluvial geomorphological risks/impacts to the watercourse. More detailed hydraulic modeling will be prepared for Mud Creek during detailed design to ensure that the implementation of the proposed measures, including at creek crossings, does not negatively impact adjacent property. Erosion thresholds, cumulative impacts and changes to peak flow resulting from the project will need further consideration during detailed design.

Where stormwater management alone may not be sufficient, recommendations for in-stream works will be made. Where possible, it is proposed to increase the watercourse length by meandering with micro pools, expand the vegetated buffer and increase the resilience of the creek bed and banks by providing a layer of less erodible materials to protect the underlying finer creek substrate.

Surface Water: Stormwater Management

This project will increase the impervious surfaces and will lead to recurring increases in stormwater runoff peak and volume following rain events with enough rainfall to generate runoff into adjacent watercourses. Runoff quality treatment and quantity control (peak flow attenuation) will be achieved through enhanced grass swales with rock check dams and vegetated filter strips. Detailed design should evaluate enlarging culverts to allow for better distribution of water flow, where culvert replacements are necessary to mitigate the effects of flash flooding events within Mud Creek. Natural channel design such as roots wads/live stakes will be considered for bank stabilization and water quality improvements.

Fish & Aquatic Species: Mud Creek Realignment (Construction)

Both land-based and in-water activities are anticipated to result from the proposed construction works, including excavation, grading, vegetation clearing, use of industrial equipment, change in timing, duration and frequency of flow, and wastewater management. The Mud Creek realignment will alter the naturally occurring watercourse. The overall goal of the creek realignment will be to improve or limit potential negative impacts on both aquatic life and aquatic systems, and wildlife and terrestrial systems (e.g., riparian areas).

It is recommended that the Mud Creek realignment design incorporate natural channel features and meanders as well as fish and aquatic habitat and may include riffles, pools, and breeding areas. The goal is to increase and enhance the riparian vegetation buffer along Mud Creek; and re-establish areas where riparian features are absent or inadequate. Culverts and/or water crossings will be designed to maintain fish passage. Natural channel flow regimes will be maintained to avoid accelerated erosion and scouring in downstream areas.

Wetlands (Unevaluated)

Approximately 0.8 ha of unevaluated wetlands may be directly impacted by the project. Approximately 8 ha of unevaluated wetlands may be indirectly affected by project activities when a 120 m buffer is applied to the Ultimate Recommended Plan. The Federal Policy on Wetland Conservation requires a No Net Loss of Wetland Functions for wetlands on federal property. A project specific *Wetland Mitigation Plan* will be developed during detailed design in consultation with the NCC. The Plan will identify a series of measures to limit and where required offset the loss. In accordance with federal policies, a 4:1 compensation will be required, though compensation does not need to be strictly area based and may include natural and/or social enhancement and would be subject to review and approval from Environment and Climate Change Canada/NCC. Compensation may include eco-passage road culverts as amphibian crossings and/or invasive species (i.e., buckthorn) mitigation, educational signage or other measures as determined in consultation with appropriate authorities.

Significant Wetlands (Mer Bleue Bog)

The Recommended Plan does not intersect directly with the Mer Bleue Bog, a Ramsar Wetland of International Importance (Ramsar Convention) boundary or with the Provincially Significant Wetland (PSW) limits which, while having some overlap, are not the same.

Construction of the project does have the potential to have temporary indirect impacts on the Mer Bleue Bog. A 120 m buffer has been applied to the Recommended Plan for the purposes of evaluating the potential project environmental effects on provincially and internationally significant wetlands. The 120 m buffer extends close to the Ramsar boundary south of the existing Renaud Road/Anderson Road intersection and extends into the Ramsar boundary (an area of 4.9 ha.) along a section of Renaud Road west of Bradley Estates. However, the area of potential impact that is currently within the Ramsar boundary is associated with the existing section of Renaud Road that is proposed to be relocated outside of the boundary and some minor work associated with a new MUP connection to the Prescott-Russell Trail. A 120 m buffer beyond the project intersects with approximately 3.4 hectares of adjacent PSW in the project east of Anderson Road and south of existing Renaud Road. However, the project will have no direct impact on the PSW, based on a 2 m buffer beyond the project grading limits, and management of construction activities that will serve to manage or eliminate impacts.

There are potential impacts within the NCC's Mer Bleue Management Area which extends well beyond the Ramsar boundary limits. The project has the potential to result in an increase in recreational activity, noise, light pollution, and waste dumping due to proximity of the new infrastructure. Proximity of the proposed MUP and associated recreational activities may result in visitors walking off-trail causing damage to the bog.

Design consideration has been given to reducing proximity and potential impacts to the footprint of the wetland. Field investigations to confirm significant wetland features and boundaries are recommended closer to the time of design and implementation to properly identify wetland conditions at the time of construction. It is proposed that the "*Ecological Restoration and Enhancement Plan"* address management of invasive species, installation of key habitat features, contingency measures, and adaptive management. Consultation with the NCC will be required to consider implementation of some of the various recommendations and key actions to achieve objectives as outlined in existing wetland management plans including, the "*Mer*

Bleue Wetland Management Plan" (NCC, 2007) and the "*Ramsar Handbook for Addressing Change in Wetland Ecological Character*."

The "*Ecological Restoration and Enhancement Plan"* will be developed in consultation with the NCC, and will identify a series of measures to limit, and where required, offset the impacts of the final project footprint, as determined in detailed design. On-going collaboration with the NCC in advance of design should be undertaken to implement some of the key actions as identified in the 2007 Mer Bleue Management Plan. Actions to consider may include:

- Develop effective strategies to ensure the long term viability of species at risk occurring in the Mer Bleue Management Area within and surrounding the Ramsar designated wetland area.

- Map priority habitats to ensure maintenance of composition and structure of native vegetation communities.

- Identify appropriate prevention and control methods for invasive species that threaten native plant species and communities. Promote public awareness of, support for, and involvement in the control of non-native plants.

Species at Risk

Based on the information gathered during the background review and results of the screening level field investigations, there is potential for several Species at Risk (SAR) to be found within the project area including Butternut, Black Ash, Monarch Butterflies, Blanding's Turtle, Snapping Turtle, Western Chorus Frog, Spotted Turtle, Bobolink, Eastern Meadowlark, Evening Grosbeak and SAR bats (including Eastern Small-footed Myotis, Little Brown Myotis, Northern Myotis and Tri-colored Bat). Detailed field surveys will be required prior to construction to confirm the presence and potential impacts to Species at Risk. Following verification of presence, should any SAR or SAR habitat be determined to be impacted by the project works, appropriate mitigations will be implemented on a species-specific basis to avoid impacts. The SAR legislation (provincial and federal) are updated on a regular basis and will be consulted during the detailed design stage to identify any new species under the protection of the Acts or any new Management Plans. Permits/approvals from MECP/ECCC will be obtained as needed.

Land Use: Greenbelt Core Natural Areas & Natural Link Areas

The Recommended Plan will encroach on Greenbelt designated areas including Core Natural Areas and Natural Link Areas (1 ha. and 10.0 ha., respectively). Overall protection/ enhancement of the Greenbelt may include general Best Management Practices (BMPs) during construction such as preventing the introduction of invasive species within the project area, especially around significant and sensitive natural features. Introduction of invasive species (ex: Wild Parsnip) has the potential to reduce species diversity, encroach on wildlife habitat and out-compete native species. To mitigate this potential, all equipment must arrive onsite clean and any invasive growth within the project area or adjacent lands should be controlled.

It is proposed to work in partnership with the NCC to develop enhancements to the existing Mer Bleue Sector features; plan for trail improvements, add new signage or interpretive resources to improve visitor experience and understanding of ecological impacts. To re-establish vegetation within Greenbelt Core Natural Areas, it is proposed to install erosion blankets with native seed mix coupled with plantings of trees and shrubs to restore disturbed areas as well as exposed areas along watercourses and wetland areas. Seed mixes for these areas should include species which will thrive in that specific soil type and include pollinator plants such as milkweed and butterfly weed to provide habitat for Monarch.

There is potential for habitat fragmentation following construction. To mitigate impacts to movement patterns of reptiles and amphibians, the design of culverts will consider wildlife passage.

Property Requirements

New road and transit right-of-way to accommodate the recommended plan will require property from federal and private landowners. Approximately 42 ha. of property will need to be acquired from the NCC. Removal of 2 NCC owned buildings (one residence and one shed) will be required for construction of the Transitway. Up to 3 additional NCC owned residences may be affected along the south side of the new roadway although design modifications are possible to avoid having to remove these buildings. Acquisition of NCC property will be negotiated by the City by means of land purchase, land exchange or land lease. Federal Land Use, Design and Transaction Approval (FLUDTA) will be required for NCC lands. A federal environmental impact assessment will also be required. Discussions will need to occur and be in accordance with the land uses at the time of planned construction.

Approximately 1.1 ha. of property will also need to be acquired from one private property owner. Acquisition of the privately owned property will be negotiated by the City.

Noise & Vibration

The Recommended Plan will result in increased noise levels within noise sensitive areas. Noise attenuating berms, walls, or a combination thereof, will be required and have been incorporated into the designs.

Noise levels due to the Ultimate Design at 2870 Navan Road, 2253 Maurice Street, 70 Whispering Winds Way, in addition to the lots north of Whispering Winds Way and Percifor Way are predicted to increase by 5 dBA or above. Noise levels can be reduced by 6 dBA using a 2.8m tall sound barrier in most cases.

Vibration levels are not expected to exceed the level commonly considered perceptible by most building occupants. Future vibration would also be negligible with respect to the risk of structural damages or cosmetic damages to building finishes.

Climate Change Mitigation & Adaptation

In December 2017, the Ministry of the Environment and Climate Change (MOECC) released guidelines titled “Considering Climate Change in the Environmental Assessment Process” which lay out the Ministry’s expectations for project proponents to consider including the potential effects of a project on climate change, and the potential effects of climate change on a project. The City of Ottawa’s Climate Change Master Plan lays out a framework to reduce greenhouse gas (GHG) emissions in accordance with Council's reduction targets and respond to the current and future effects of climate change.

This EA considered the project's potential impact on GHG emissions; assessed the resiliency or vulnerability of the project to changing climate conditions; and, identified potential climate change adaptations and future monitoring requirements based on regional climate and severe weather projections to 2050 and beyond.

Climate change presents both challenges and opportunities, particularly in relation to infrastructure design, implementation, and operations/maintenance. There are two categories of response to climate change risk, namely:

1. Mitigation refers to human interventions to reduce GHG emissions, and,

2. Adaptation refers to any activity designed to reduce the negative impacts of climate change and/or take advantage of new opportunities.

The recommended design provides new infrastructure for sustainable modes of active transportation and transit, thus reducing greenhouse gas emissions. The landscaping plan will include offsetting of any loss of existing trees and vegetation, which will ensure that study area planting continues to provide a carbon sink.

Some of the potential hazards identified for this project include extreme rain impacts to the roadway/transitway, bridges, and culverts; freezing rain impacts to overhead wires, roadways, and walkways; extreme heat impacts to public health; and extreme wind impacts to landscaping and emergency access routes. To mitigate these impacts, adaptation options for the project may include engineering and technological solutions, as well as policy, planning, management, and maintenance approaches. Examples of potential climate related hazards and risk treatment options for the project include: more frequent severe storm events with increased runoff of roadway drainage may require larger roadside ditches and/or storm sewers; more frequent severe storm events may affect creek/channel erosion and slope stability requiring additional protection measures, monitoring and maintenance; and, increased frequency of extreme heat days may require additional shading and/or landscaping protection at the Chapel Hill transit station.

It is recommended that additional climate lens assessment be undertaken and that climate change adaptation measures be considered during detail design including those related to flood design, stormwater management, selection of plant species for landscaping and erosion protection. This will be particularly important in relation to the natural channel design for the realignment of Mud Creek. To account for increases in rainfall intensities due to climate change the design of culverts should be based on projected future rainfall events and the design of storm sewers should be checked against the 100-year storm plus 20%.

It is also proposed that sustainable design principles be followed including consideration of low carbon material selection and sourcing which should be based on a GHG emissions assessment of the project based on the City's carbon calculator or similar tool.

Future Commitments

This Environmental Study Report under the *Ontario Environmental Assessment Act, R.S.O. 1990* does not constitute approval under other legislation required to construct the project. Additional federal, provincial, and municipal project specific approvals will be required for components of the project moving forward.

Although this EA study is following the *Ontario Environmental Assessment Act, R.S.O. 1990* and NCC approval is not required for this legislated process, NCC approval will be required during implementation of the Recommended Plan (post 2031) since it is subject to the "*Federal Land Use, Design and Transaction Approval Process"* and the Canadian *Impact Assessment Act.* Given the longer-term plan for implementation is post 2031, there is time for further discussion with the NCC on a mitigation strategy for the required NCC Greenbelt lands.

Financial Considerations

Project costs were developed in accordance with the Council-approved Project Delivery Review and Cost Estimating process for implementing capital projects. Cost for design, construction, property, public art, and contingencies in 2023 dollars is estimated at $160M for the Roadway and $207M for the Transitway. While the Cumberland Transitway is identified in the City's TMP for implementation post 2031, the cost to implement Brian Coburn Boulevard Extension is currently not considered affordable but is needed to support growth for the rapidly growing Orléans South area in the future.

Appendices

LIST OF FIGURES

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LIST OF ACRONYMS

ACG	Agency Consultation Group
AODA	*Accessibility for Ontarians with Disabilities Act*
BCBE	Brian Coburn Boulevard Extension
BHBPE	Blackburn Hamlet Bypass Extension
CTW	Cumberland Transitway Westerly
DFO	Department of Fisheries and Oceans Canada
EA	Environmental Assessment
EA Act	*Ontario Environmental Assessment Act* Revised Statute of Ontario (R.S.O.) 1990
ECCC	Environment and Climate Change Canada
ELC	Ecological Land Classification
ERIS	Environmental Risk Information Services/Environmental Risk Limited Partnership
ESA	*Endangered Species Act*
ESR	Environmental Study Report
EUC	East Urban Community
FLUDTA	Federal Land Use, Design and Transaction Approval
FOD7	Fresh Moist Lowland Deciduous Forest classification in the Ecological Land Classification system
GCL-1	Golf Course classification in the Ecological Land Classification system
GCMs	Global Climate Models
GIS	Geographic Information System
GWE	Gradient Wind Engineers and Scientists
GMP	Greenbelt Master Plan
HLUI	Historic Land Use Inventory
HOV	High Occupancy Vehicle
IAA	*Impact Assessment Act*
IDF	Intensity Duration Frequency
IPCC	Intergovernmental Panel on Climate Change
JTBES	JTB Environmental Systems Inc.
LID	Low Impact Development
LIO	Land Information Ontario
LRT	Light Rail Transit

MASM1-1	Mineral Shallow Marsh classification in the ELC system
MASM1-12	Common Reed Mineral Shallow Marsh classification in the ELC system
MBCA	Migratory Birds Convention Act
MCEA	Municipal Class Environmental Assessment
MECP	Ministry of the Environment, Conservation and Parks
MEM	Mixed Meadow classification in the Ecological Land Classification system
MH	Morrison Hershfield Limited
MHSTCI	Ontario Ministry of Heritage, Sport, Tourism and Culture Industries
MECP	Ontario Ministry of Environment, Conservation and Parks (Formerly Ministry of the Environment (MOE)/Ministry of the Environment and Climate Change (MOECC))
MTC	Ontario Ministry of Tourism and Culture (also see MHSTCI)
MUP	Multi-Use Pathway
NCC	National Capital Commission
NCR	National Capital Region
n.d.	No date
NDMNRF	Ontario Ministry of Northern Development, Mines, Natural Resources and Forestry
NHIC	Natural Heritage Information Centre
NPC	Noise Pollution Control
NSSP	Non-Standard Special Provision
OCP	Ottawa Cycling Plan
O.Reg.	Ontario Regulation
OMAFRA	Ontario Ministry of Agriculture, Food and Rural Affairs
OP	Official Plan
OPA	Official Plan Amendment
OPSD	Ontario Provincial Specification Division
OPSS	Ontario Provincial Standard Specification
OR	Ottawa Road
P/BCG	Public and Business Consultation Group
PFCC	Plan for Canada’s Capital
PoE	Pathways of Effects
PPS	Provincial Policy Statement
PSW	Provincially Significant Wetland
PVD SHLD	Paved Shoulder

RCP	Representative Concentration Pathway
ROW	Right-of-Way
RSC/R.S.C.	Revised Statutes of Canada
RSI	Risk Sciences International
RSO/R.S.O.	Revised Statutes of Ontario
RVCA	Rideau Valley Conservation Authority
S/W	Sidewalk
SAR	Species at Risk (Canada)
SARA	*Species at Risk Act*
SN	Structure Number
SOP	Standard Operating Practice
SWLK	Sidewalk
TDM	Travel Demand Management
THD	Deciduous Thicket classification in the Ecological Land Classification system
TMP	Transportation Master Plan
TOD	Transit-Oriented Development
TPAP	Transit Project Assessment Process
TSM	Transportation System Management
TSSA	Technical Standards and Safety Authority
UNA	Urban Natural Areas
UNC	Ultimate Network Concept
WEF	Wildlife Exclusion Fencing

1. INTRODUCTION

1.1 Purpose of the Project

The overall project objective is to undertake a Schedule "C" Municipal Class Environmental Assessment (EA) study to examine alternate corridors for the Brian Coburn Boulevard Extension (BCBE) and Cumberland Transitway Westerly (CTW) considering the City of Ottawa's 2013 Transportation Master Plan (TMP) Affordable Network and Network Concept Plans (for 2031 and longer-term planning horizons) for both Roads and Transit. The study process has included both stakeholder and public consultation.

1.2 Project Background

The EA for the four-lane Blackburn Hamlet Bypass Extension (BHBPE) from the Blackburn Hamlet Bypass to Trim Road was completed and approved in 1999. The BHBPE east of Navan Road has been renamed to Brian Coburn Boulevard and a two-lane road is already built east of Navan Road. The 2013 TMP identified the section from Navan Road to the Blackburn Hamlet Bypass as a Phase 2 project (2020-2025) with retention of its original name (BHBPE). This section of new roadway is now referred to as the Brian Coburn Boulevard Extension (BCBE).

A recent geotechnical analysis concluded that the soil conditions are very poor in the vicinity of the originally planned BHBPE (Blackburn Hamlet Bypass to Navan Road). To construct the roadway as planned would require a quadrupling of the existing budget envelope from $17.5M to $70M. This planned roadway corridor is no longer considered affordable within the 2031 planning horizon and therefore a more cost-effective alternate corridor was needed with further consideration of affordable near-term alternatives. Similarly, an alternate corridor for the Cumberland Transitway in this vicinity was needed to be developed because a change in the location of the roadway has ramifications for the location of the future Transitway corridor. In response, the City's Transportation Committee (February 2017) approved the undertaking of a combined EA, referred to as the *Brian Coburn Extension and Cumberland Transitway Westerly Alternate Corridor EA Study*, following Schedule C of the Municipal Class Environmental Assessment.

The EA study limits extend from Blair Road at Innes Road in the west, to east of Brian Coburn Boulevard at Navan Road and south to Anderson Road/Renaud Road to allow for a full range of alternatives to be examined (**Figure 1-1**).

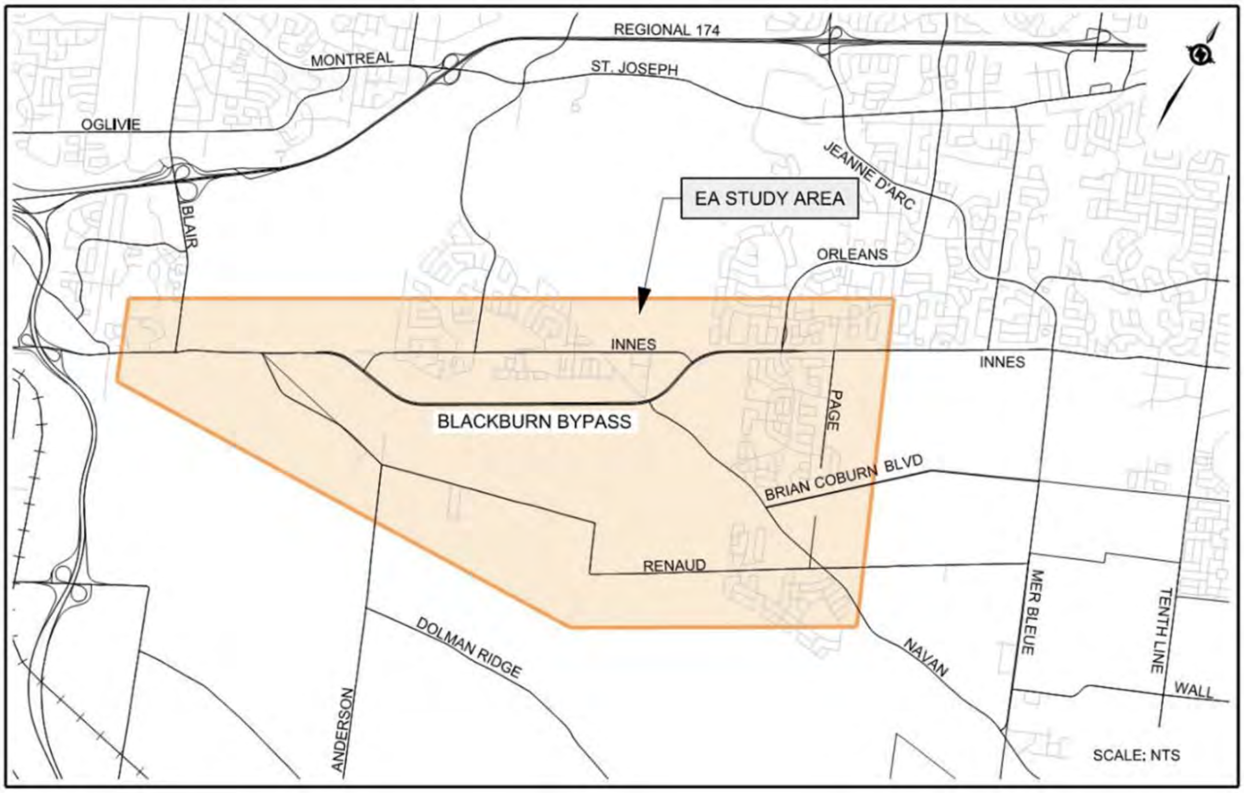

Figure 1-1: Study Area

1.3 Previous Environmental Assessments

1.3.1 Blackburn Hamlet Bypass Extension Environmental Assessment (1999)

The original Class Environmental Assessment for the four-lane Blackburn Hamlet Bypass Extension from the Blackburn Hamlet Bypass to Trim Road was completed and approved in 1999 (Figure 1-2). Similar to the Cumberland Transitway (Delcan, 1999b), the rationale for this project was to address the future transportation issues that would arise as a result of development of the East Urban Community Expansion Area and to identify land and corridor opportunities that may not be available in the future due to development. The benefits of protecting land at that time for future transportation uses was to provide for a multi-modal transportation spine through the East Urban Community and to release future development lands that were being held for appropriate transportation infrastructure to serve the developing community.

Key background studies were carried out which determined the need for the BHBPE to meet projected travel demand and transportation system capacity issues related to the East Urban Community.

As part of the 1999 EA, the recommended design of the BHBPE started from the eastern end of the Blackburn Hamlet Bypass and extended east along the base of the Navan Road Escarpment within NCC Greenbelt lands. Orléans Boulevard was also extended west and south going over the transitway before connecting with the BHBPE. The BHBPE corridor then continued southeasterly across the hydro corridor, following the existing hydro-corridor to the east. The EA also included the section of the Brian Coburn Boulevard recently built between Navan Road and Trim Road.

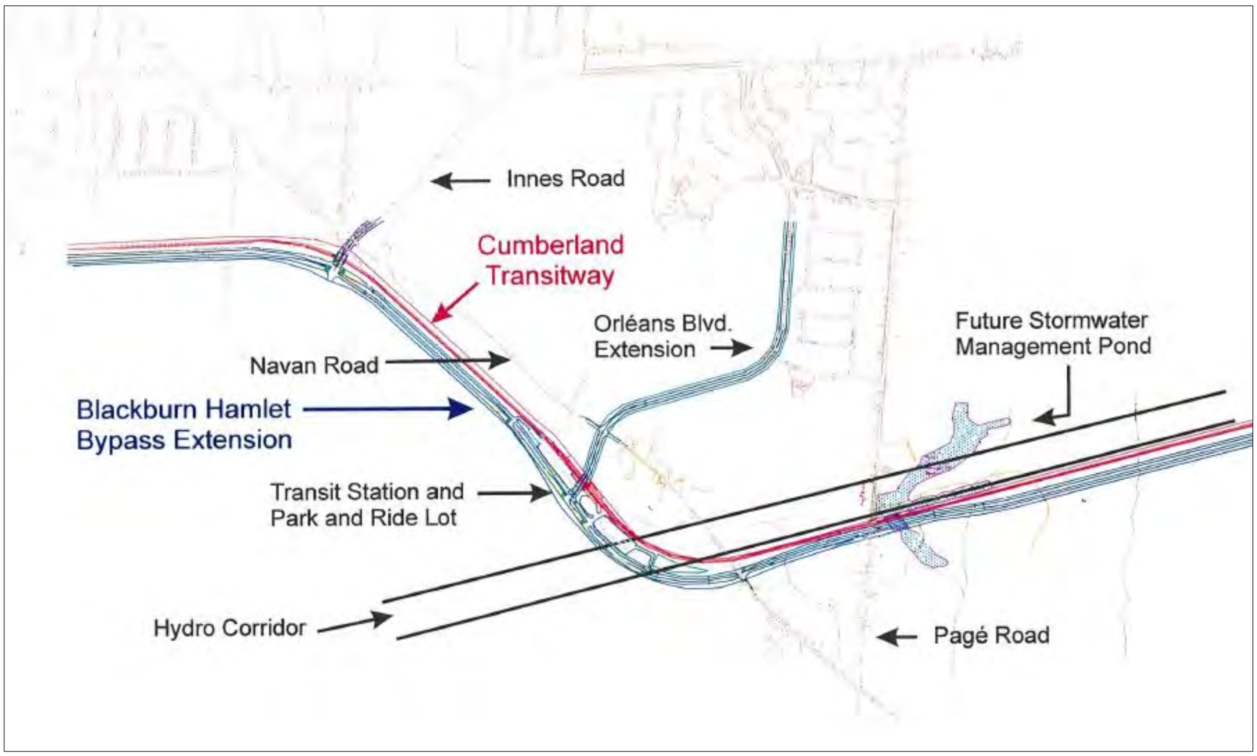

Figure 1-2: BHBPE/Cumberland Transitway Plans (1999)

1.3.2 Cumberland Transitway Environmental Assessment (1999)

In 1999, an Environmental Assessment study was approved for the Cumberland Transitway from the Blackburn Hamlet Bypass to Frank Kenny Road, following an Individual EA process. The EA for Cumberland Transitway was undertaken at the same time as the Blackburn Hamlet Bypass Extension EA because of its similar alignment, which runs adjacent and parallel to the Bypass (Figure 1-2).

The rationale for the 1999 Cumberland Transitway EA Study was to identify land required and corridor opportunities that would not be available in upcoming years due to future development pressures and to solve a projected future transportation issue. The Cumberland Transitway objective was to address the future transit needs of the East Urban Community Expansion Area, which was projected to have an additional 38,000 - 40,000 residential units by 2011. Two concurrent EA studies carried out in the late 1990s identified the future travel demand and transportation system capacity in the East Urban Community and determined that there was a significant need for improved transportation infrastructure in this location. The Cumberland Transitway was planned to address and alleviate this future transit need and encourage increased ridership.

1.3.3 Innes – Walkley – Hunt Club Connection and Hunt Club Road/ Highway 417 Interchange Environmental Assessment Study (2008)

The harmonized federal/provincial EA Study for the Innes-Walkley-unt Club Connection and the Hunt Club Road/Highway 417 Interchange was completed in 2008 (**Figure 1-3**). The Innes-Walkley-Hunt Club Connection is a future roadway through the National Capital Commission (NCC) Greenbelt linking the City of Ottawa’s East Urban Community to the South Urban Community with a new interchange accessing Highway 417 at an extension of Hunt Club Road and a new intersection on Innes Road east of Blair Road.

The Hunt Club Road Extension to and interchange with Highway 417 has been constructed. The City of Ottawa’s 2013 TMP shows the Innes-Walkley-Hunt Club connection as part of the City’s Road Network Concept Plan with implementation post 2031. The TMP gives the rationale for this project as providing a bypass of the congested section of Innes Road as well as a direct connection between Orléans and Hunt Club.

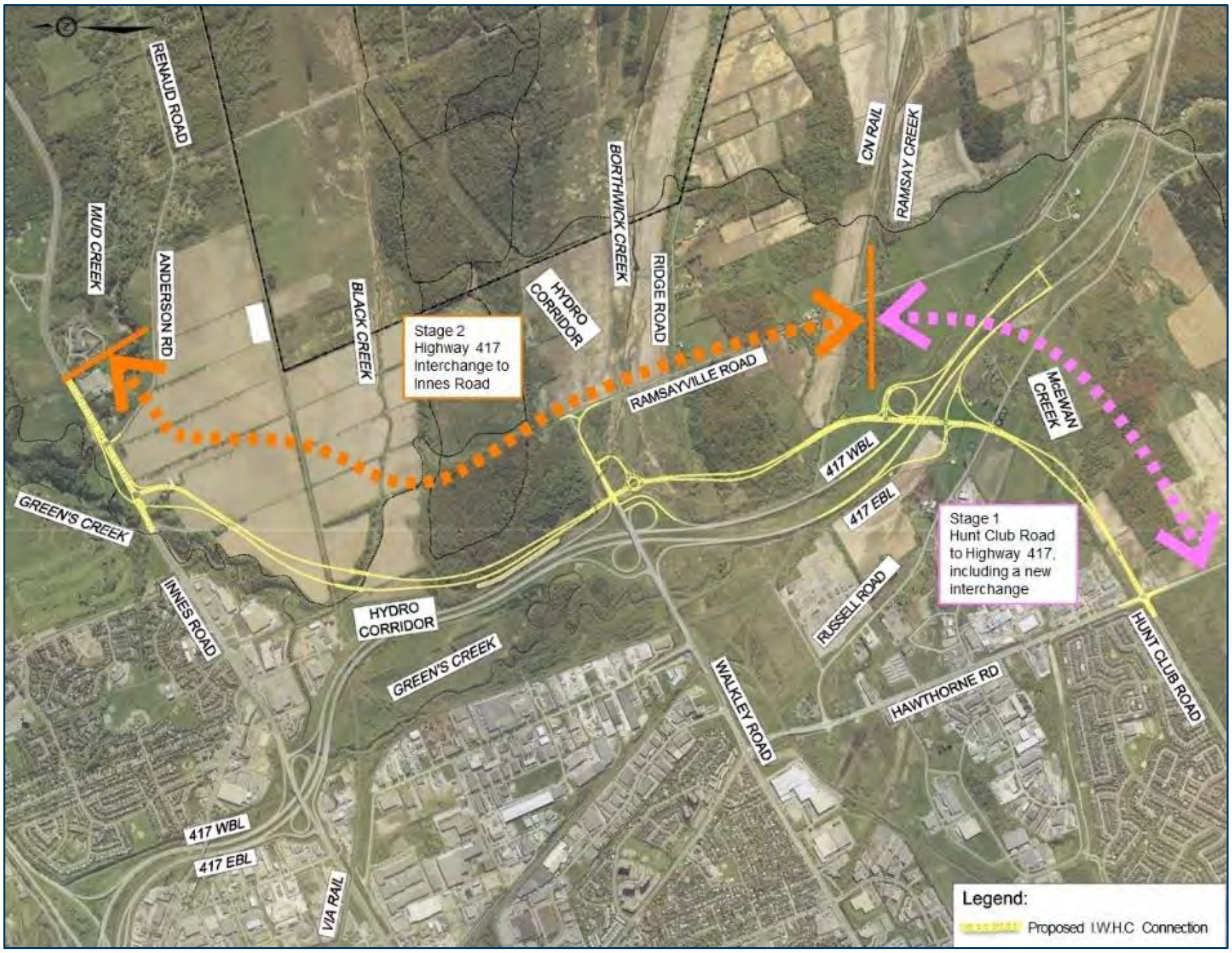

Figure 1-3: Recommended Plan for Innes-Walkley-Hunt Club Connection (2008)

1.3.4 Hospital Link and Cumberland Transitway Westerly Environmental Assessment Study (2011)

The City of Ottawa initiated an EA Study for the Hospital Link and Cumberland Transitway Westerly in 2009. The EA Study (completed in 2011) included the western portion of the Cumberland Transitway from Blair Station at Ottawa Road (OR) 174 to west of Navan Road (**Figure 1-4** to **Figure 1-6**).

Figure 1-4: Recommended Plan Cumberland Transitway Westerly, Blair Road – Innes Road to Blair Station (2011)

Figure 1-5: Recommended Plan Cumberland Transitway Westerly, Blair Road to Blackburn Hamlet Bypass (2011)

Figure 1-6: Recommended Plan Cumberland Transitway Westerly, Blackburn Hamlet Bypass (2011)

1.3.5 Chapel Hill Park and Ride: Alternative Site Environmental Assessment (2016)

The EA study (following a Schedule “B” project under the Municipal Class EA) was completed in 2016 to establish an alternate site for the Chapel Hill Park and Ride Facility. As an ancillary feature of the future Cumberland Transitway, key considerations in determining the alternate site for this facility included future transportation demand, existing and projected community needs, stormwater management and the natural environment. The final recommended location for the Park and Ride Lot was on the north side of Brian Coburn Boulevard between Navan Road and Pagé Road (**Figure 1-7**). New intersections on these roads will be constructed to provide access to the facility with approximately 400+ parking spaces provided to accommodate park and ride transit users. Until the Cumberland Transitway is constructed, an interim route will provide transit service to surrounding neighbourhoods.

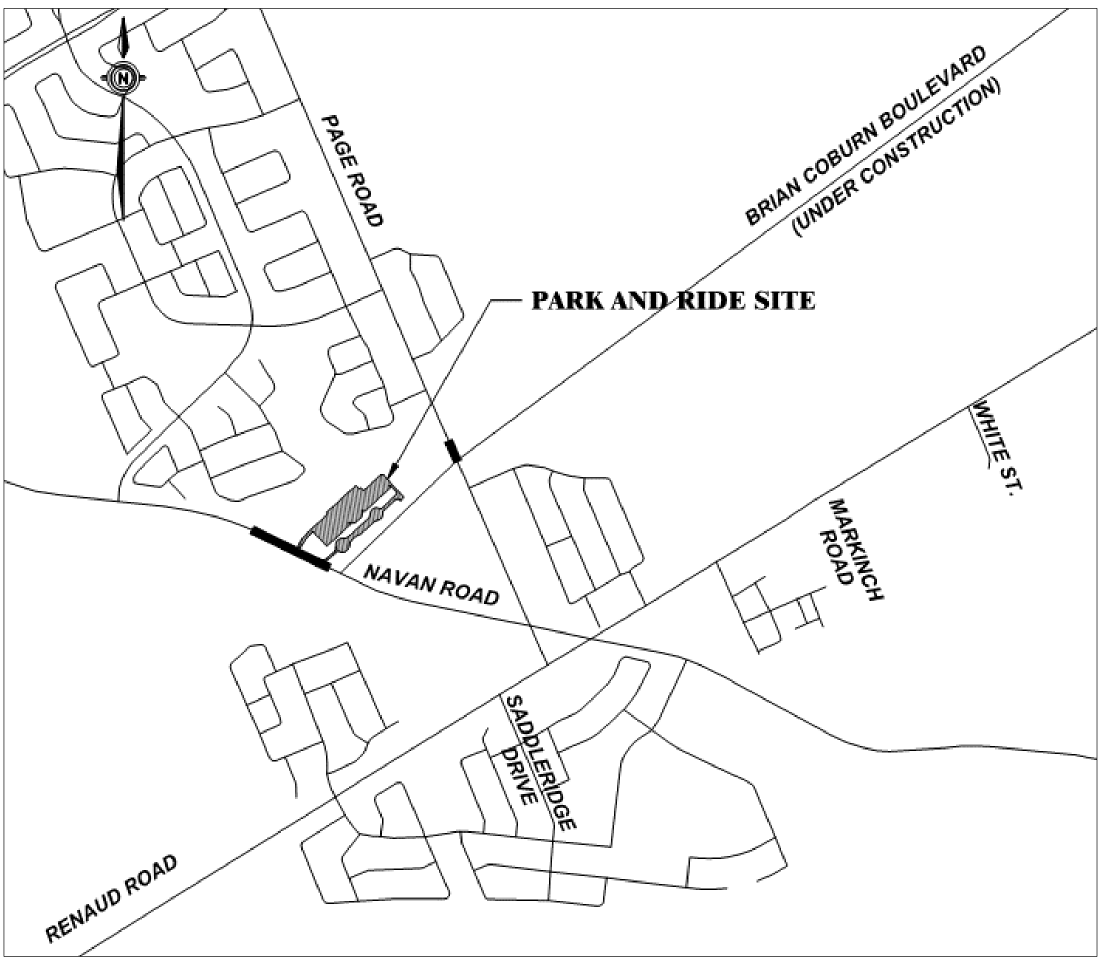

Figure 1-7: Chapel Hill Park & Ride Site (2016)

1.3.1 Blair Road Transit Priority (Innes Road to Blair LRT Station) Environmental Assessment (2021)

The 2013 Transportation Master Plan (TMP) identifies Blair Road, from the Blair Light Rail Transit (LRT) Station to Innes Road, as a transit priority corridor in the 2031 Affordable Network. An environmental assessment for the Blair Road transit priority corridor had been included in the ongoing Brian Coburn Boulevard Extension and Cumberland Transitway Environmental Assessment (BCBE/CTW EA) study due to proximity and transit system continuity. As the BCBE/CTW EA study had become increasingly more complex, on April 22, 2020, the City of Ottawa Council approved a motion to separate out the Blair Road portion from the BCBE/CTW EA study as a stand-alone project. This approximately two-kilometre section of Blair Road is shown in **Figure 1-8**.

The recommended redesign proposes providing fully accessible facilities for all modes of transportation while maintaining the two general traffic lanes per direction as well as avoiding major modifications to the structure. To reduce vehicle speeds, all three free flow interchange ramps will be realigned with smaller turning radii provided where they intersect with Blair Road. The space allocated to the existing cycling lanes and shared northbound OR174 on and off ramp auxiliary lane is proposed to be repurposed to accommodate a 4.0 m MUP on the west side and a 1.8 m sidewalk and 1.8 m cycle track on the east side. The OR174 ramps were realigned and modifications made to the original high-speed ramps. Additional enhancements for pedestrians, cyclists and accessibility include protected signalized intersections at the two intersections at Blair Station and south of OR174. There is a protected intersection design at Blair Station with improved connections to the proposed MUP on the west side of Blair Road and a separate sidewalk and cycle track on the east side. The existing pathway loop on the east side of Blair Road that passes under the Blair Road structure connecting to the LRT Station will be upgraded to a fully accessible MUP with a connection to the upcoming Stage 2 LRT Confederation Line East Extension MUP. On the west side of Blair Road, a proposed MUP will replace the existing sidewalk and connect further west into the station.

Figure 1-8: Blair Road Transit Priority Environmental Assessment Study Area (2021)

The study was undertaken in accordance with Schedule C of the Municipal Class Environmental Assessment (MCEA), which is an approved process under the Ontario Environmental Assessment Act. The process involved developing, assessing, and evaluating alternatives, leading to a Recommended Plan. Consultation included two rounds of meetings with an Agency Consultation Group and a combined Business and Public Consultation Group. Additionally, two public open houses were held along with focused consultation with the NCC because of the impacts to and requirement for NCC Greenbelt lands.

The southern extent of the Blair Road EA study limits overlaps with the BCBE/Cumberland Transitway Westerly northwestern extent.

1.4 Report Organization

The remainder of this report is organized as follows:

Section 2 – Study Process: Describes the legislative and planning processes that provide an outline for the study including the necessary consultation to gather comments from the general public and stakeholders throughout the Study.

Section 3 – Consultation: Documents the consultation undertaken for the Study in accordance with the requirements for a Schedule C Project under the Municipal Class Environmental Assessment (MCEA) Process.

Section 4 – Project Need & Opportunities: Describes the development opportunities as they relate to the City of Ottawa Official Plan and Transportation Master Plan. This review examines the future roadway needs associated with the TMP's Affordable Network and Network Road Concept scenarios. The project needs are summarized based on current and projected travel demands within the study area and associated screenlines.

Section 5 Existing Environmental Conditions: Provides an overview of the study area's existing environment conditions: natural, social, cultural, built, and economic.

Section 6 – Identification & Evaluation of Alternative Solutions: Highlights the City of Ottawa Vision and Policies, goals of the project, and planning principles and design criteria. Additionally, a description of the alternative corridors and their evaluation process, is detailed.

Section 7 – Identification & Evaluation of Alternative Designs: Outlines the process for the development of the alternative designs and an assessment of their transportation performance and effects on the components of the environment. The evaluation process for the selection of the preliminary preferred design alternative is described as well as any refinements undertaken.

Section 8 – Recommended Plan: Describes the recommended plan for the Brian Coburn Boulevard Extension/Cumberland Transitway Westerly. The Recommended Plan documents the horizontal and vertical alignment of the roadway and the transitway, general arrangements for the new and revised structures along the route and documents other relevant elements such as development connections, and pedestrian and cycling routes.

Section 9 – Assessment & Evaluation of Impacts: Identifies municipal, provincial, and federal approvals or permits that may be required for implementation of the Brian Coburn Boulevard Extension/Cumberland Transitway Westerly. Additionally, potential mechanisms for modifying the Recommended Plan for the transit project are provided. Follow-up and monitoring requirements are also detailed in this section.

Section 10 Future Commitments: Outlines the next steps committed to, including finalizing needed property acquisitions; construction and implementation timing; developing design details; completing a road safety audit; and securing federal, provincial, and municipal permit approvals.

Section 11 – Conclusions: Provides a concise overview of the scope of the project.

2. STUDY PROCESS

2.1 Ontario Environmental Assessment Act, R.S.O. 1990

The purpose of the *Ontario Environmental Assessment Act RSO 1990 (*EA Act*)* is to help protect and conserve Ontario's environment by ensuring that projects subject to the Act follow a planning process leading to environmentally sound decision-making. An environmental assessment involves identifying and planning for environmental issues and effects prior to implementing a project. The process allows for opportunities for public involvement in the decision-making process of the project. The planning and assessment is summarized in an Environmental Study Report (ESR) prepared by the proponent of the project and is subject to review by the public and government agencies.

This Study followed a Schedule "C" Municipal Class EA process, with thorough stakeholder consultation: Public, Agency, Business Consultation Groups; Public Open Houses; and Indigenous peoples contacts. Deliverables include environmental and engineering technical studies, consultation materials, EA documents, recommended plans and capital cost of the project (**Figure 2-1**).

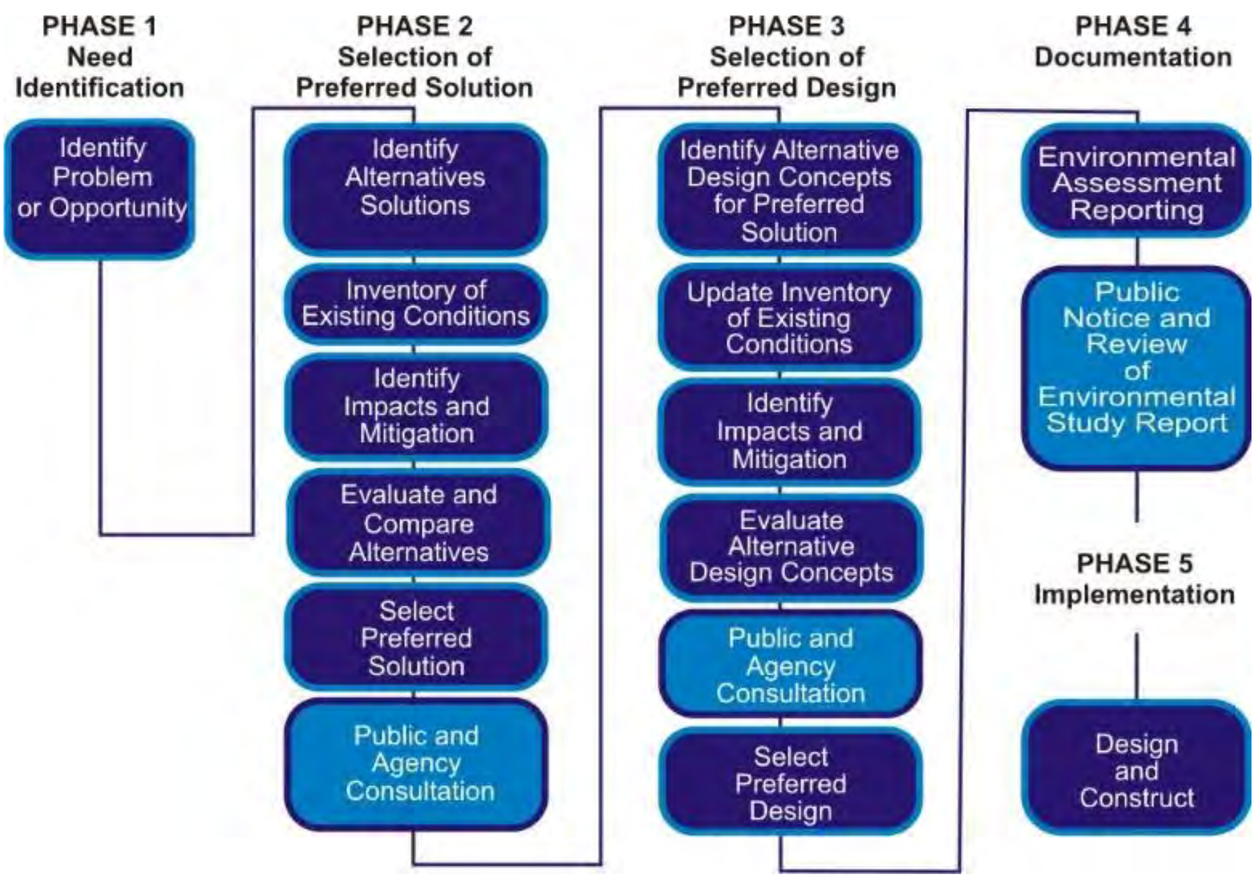

Figure 2-1: Municipal Class EA Process

As part of Phase 4 of the Municipal Class Schedule C Process, the EA study results have been documented via this Environmental Study Report. The report has been made available for public review. During the final review period, there will be an opportunity for an individual or group to provide a written submission to the Minister of the Environment, Conservation and Parks. A request for a Part II Order requiring a higher level of study (i.e., requiring an individual/comprehensive EA approval before being able to proceed), or that conditions be imposed (e.g. require further studies), may be made to the Ministry of the Environment, Conservation and Parks but only on the grounds that the requested Order may prevent, mitigate or remedy adverse impacts on constitutionally protected Aboriginal and treaty rights. Requests on other grounds will not be considered.

During the study, the Municipal Class EA was updated (2023). The update conditionally exempts certain low-risk, routine municipal road, water, and wastewater projects from requiring an environmental assessment to better align assessment requirements with potential environmental impact. These exemptions were intended to reduce duplication and streamline the process for municipal projects, while maintaining strong environmental oversight and protection. The changes do not essentially affect the planning and assessment for this project and the process has been undertaken and documented to address the requirements for a Schedule C project.

2.2 Impact Assessment Act, 2019

The *Impact Assessment Act, 2019* (IAA) is a federal act intended to provide a process for assessing the environmental, health, social and economic effects of designated projects with a view to preventing certain adverse effects and fostering sustainability. Additionally, the Act serves to:

- promote cooperation and coordinated action between federal and provincial governments with respect to environmental assessments,
- ensure that impact assessments of designated projects consider all effects — both positive and adverse — that may be caused by the carrying out of designated projects, and
- to promote communication and cooperation with Indigenous peoples of Canada with respect to impact assessments, amongst others

Under Section 82 of the *Impact Assessment Act,* 2019:

“An authority must not carry out a project on federal lands, exercise any power or perform any duty or function conferred on it under any Act of Parliament other than this Act that could permit a project to be carried out, in whole or in part, on federal lands or provide financial assistance to any person for the purpose of enabling that project to be carried out, in whole or in part, on federal lands, unless (a) the authority determines that the carrying out of the project is not likely to cause significant adverse environmental effects; or (b) the authority determines that the carrying out of the project is likely to cause significant adverse environmental effects and the

Governor in Council decides, under subsection 90(3), that those effects are justified in the circumstances."

As federal lands may be required for various phases of project completion, an Environmental Effects Analysis of all the physical activities proposed on federal lands is required, under Section 82 of the IAA, 2019. No approvals from the NCC under the *National Capital Act* can be issued before these obligations are fulfilled. An Environmental Effects Analysis of a proposed project will determine the need to eliminate or mitigate adverse effects, to modify the project or to recommend further assessment requirements based on detailed design.

Section 84 of the Act notes that an authority's determination regarding whether the carrying out of the project is likely to cause significant adverse environmental effects must consider the following factors:

a) any adverse impact that the project may have on the rights of the Indigenous peoples of Canada recognized and affirmed by section 35 of the *Constitution Act, 1982,*

b) Indigenous knowledge provided with respect to the project,

c) community knowledge provided with respect to the project,

d) comments received from the public under subsection 86(1), and

e) the mitigation measures that are technically and economically feasible and that would mitigate any significant adverse environmental effects of the project that the authority is satisfied will be implemented.

The proposed project may also require approval through the Federal Land Use, Design and Transaction Approvals (FLUDTA) process under the *National Capital Act*. In addition to the NCC other federal authorities that may have an interest in the project include Fisheries and Oceans Canada (DFO) and Environment and Climate Change Canada (ECCC). This EA was prepared in consultation with the NCC and is intended to form the basis for the Impact Assessment when the Federal EA requirements are undertaken.

In October of 2023, the Supreme Court of Canada found that the IAA was unconstitutional. As a result, the Act will need to be amended to more specifically focus on federal jurisdiction and identification of environmental effects within federal jurisdiction. An amended version of the IAA will need to be focused on federal jurisdiction and effects within federal jurisdiction. This report takes into consideration the impacts on the federal lands within the Study Area but is not intended to meet the requirements or seek approval under the IAA. Any future approvals/permissions with respect to federal land or requirements will need to take in to account the requirements of legislation and policies in effect at the time.

3. CONSULTATION

This Section of the Report documents the consultation undertaken for the Project in accordance with the requirements for a Schedule C Project under the MCEA Process (**APPENDIX A**).

The project Study Team involved in consultation included personnel from the City of Ottawa and technical representatives from Morrison Hershfield, Momentum Planning and Communications, Alta Planning and Design, Golder Associates, Gradient Wind Engineering (GWE), and CSW Landscape Architects.

Consultation involved stakeholders, City Advisory Committees, community groups, property owners, businesses, approval agencies, Indigenous peoples, and special interest groups. Early in the study process, stakeholders were identified through consultation with Ward Councilors. The consultation strategy consisted of meetings with key stakeholders through an Agency Consultation Group (ACG), a combined Public and Business Consultation Group (P/BCG), and the general public.

3.1 Consultation Groups

3.1.1 Agency Consultation Group

An ACG was formed to address a range of technical issues and to comment on all the special studies required to fully assess the various alternatives for the project. The ACG has also ensured that the City followed the agencies' procedures, legislation and has addressed appropriate policies. Members included City staff, representatives from government agencies and approval bodies. The ACG met at key stages throughout the study. Direct one-on-one consultation with other Agency groups occurred as necessary as related to specific issues that arose during the study. In particular one of the key landowners affected, additional meetings were held with the NCC. ACG meeting and member details are available in (**APPENDIX A**).

3.1.2 Public/Business Consultation Group

A combined P/BCG was formed to enable community groups,special interest groups, the City's Advisory Committees, Ward Councillors, and businesses to provide direct input to the study, advising and commenting on local issues and concerns. The P/BCG met at key stages throughout the study. P/BCG meeting and member details are available in (**APPENDIX A**).

3.2 National Capital Commission

Collaboration between the NCC and City of Ottawa was and continues to be needed for the NCC-owned Greenbelt lands required for the Project. Additional meetings with the NCC were held in follow-up to materials introduced and presented at the ACG meetings. Meeting notes and documentation related to the NCC specific meetings and correspondence are available in the project Consultation Report (**APPENDIX A**).

3.3 Indigenous Peoples Consultation

The Study Team ensured appropriate co-ordination and consultation with Indigenous peoples in accordance with the requirements of the MCEA and City of Ottawa policies and procedures.

As part of this project, Indigenous groups were contacted to provide information on the project and opportunities for input. Outreach occurred by email at four key points in relation to the Brian Coburn Boulevard Extension/Cumberland Transitway EA. Details of this outreach are available in (**APPENDIX A**).

3.4 Project Website

A proactive and flexible approach to public consultation was adopted to ensure the interests of stakeholders and the community were taken into consideration. Consultation and the exchange of information was undertaken throughout the EA process using a variety of consultation and engagement methods.

To enhance the community engagement program, the City created a project specific webpage to facilitate communication of key project milestones. Notification of Public Open Houses were posted on the City of Ottawa's website, with materials posted as described in (**APPENDIX A**). Project communications were available online in English (htttp://www.ottawa.ca/briancoburn) and French (http://www.ottawa.ca/boulbriancoburn). The web information conforms to the *Accessibility for Ontarians with Disabilities Act*.

3.5 Public Consultation

In addition to the specific stakeholder groups noted above, the varied interests of the surrounding community have been considered through the study processes and have assisted in verifying the existing conditions; the development of design alternatives; and the refinement of the preferred design.

Three specific public consultation opportunities were organized at key points in the study process as described in the Sections below and detailed in the Consultation Report for the project (**APPENDIX A**).

3.5.1 Public Consultation Opportunity No. 1

The first Public Open House was held on May 17, 2018, in the gymnasium at Rendez-vous des aînés francophones d'Ottawa (3349 Navan Road, Orléans). The Public Open House was held to provide the public with an opportunity to review and comment on the public consultation process, existing conditions, project objectives, alternative designs, and next steps. It is estimated that over 100 people attended the Public Open House that consisted of a formal presentation and informal display board viewing and discussion. A total of nine comment sheets were received with an additional, 60 plus e-mails/letters/telephone correspondence received after the event. Greater detail on the format and responses provided are available in (**APPENDIX A**).

3.5.2 Public Consultation Opportunity No. 2

The second Public Open House was held on November 19, 2019 in the gymnasium at Rendez-vous des aînés francophones d'Ottawa (3349 Navan Road, Orléans). In addition to providing an update on the BCBE study, the second Public Open House provided preliminary information on the Blair Road Transit Priority Corridor EA study. Over 80 people signed into the Public Open House that consisted of a formal presentation and informal display board viewing and discussion. In addition, a large map of the study area offered attendees a visual aid to point to areas of concern and identify where they may like to see changes. Thirteen comments were documented in the mapping exercise and a further ten (10) comment sheets were received at the Public Open House. In addition, over 100 e-mails/letters/telephone correspondence were received after the event. Greater detail on the format and responses provided are available in (**APPENDIX A**).

3.5.3 Public Consultation Opportunity No. 3

Due to public health guidelines for the COVID-19 pandemic, the third/final public consultation involved a recorded presentation made available in English and French on the City of Ottawa webpages www.ottawa.ca/briancoburn and www.ottawa.ca/boulbriancoburn respectively. The recorded presentations were made available online for a period of three weeks, from Monday, June 28 to Friday, July 16, 2021. The final public consultation period presented Option 7 as the technically preferred ultimate design and presented a recommended interim design. The interim design has since been documented under its own Environmental Study Report.

The Study Team also measured public engagement online through the Facebook and Twitter advertisements, views of the recorded presentation on YouTube, and online survey submissions. Details of the engagement metrics, survey results and comments received are available in (**APPENDIX B**).

3.6 City of Ottawa Transportation Committee

A presentation was made to the City's Transportation Committee on Wednesday, March 2, 2022. When in-person meetings cannot be held, the meeting may be broadcast live on YouTube for the public (https://youtube.com/playlist?list=PLfltBIlh0Dr5tdYOI567tTAIVBmKu1jiV). All contacts maintained on the project's contact list were notified of the meeting by email, mail, or phone call.

The outcomes of the meeting included:

- Motions from the Transportation Committee to Council that:
  - The Minister Responsible for the National Capital Commission be requested to direct the NCC to strike a joint committee with the City to try and resolve the impasse on the BCBE EA, with a deadline to report back to the Minister and the Mayor within 100 days.
  - Planning Staff be directed to convene a summit with the Greater Ottawa Home Builders Association (GOHBA) and major developers in Orléans to discuss strategies for mitigating the impact of development approvals while the impasse remains.
  - Planning, Real Estate & Economic Development (PRED) staff be directed to bring a report to Planning and Transportation Committees outlining options for short term solutions.
  - Staff be directed to fund any Professional services from accounts: 910610 2022 Rapid Transit EA Studies and 908210 2016 EA Arterial Road Studies.
- Motion to approve the functional design for the Brian Coburn/Cumberland Transitway Extension (Navan Road to Blair Road at Innes Road) for the Ultimate Road and Transitway Plan, Option 7 is carried.
- Motion to approve the functional design for the Interim Transit Priority Measures is carried.
- Motion to finalize the ESR and undertake the 30-day public review period according to Ontario Municipal Class EA process is to be deferred until after the completion of the 100 days.

3.7 Memo to City Council

The Council meeting of Wednesday, March 23, 2022 confirms the amended list of recommendations from the March 2, 2022 Transportation Committee meeting with all recommendations being carried.

4. PROJECT NEED & OPPORTUNITIES

Phase 1 of the Municipal Class EA Planning and Design Process requires the identification and description of the existing and/or projected problems or opportunities related to a proposed undertaking. This section of the report will focus on the undertaking as identified in the Transportation Master Plan, as well as the project need and ability to address opportunities in the Study Area. Supporting documents are provided in (**APPENDIX C**).

4.1 Transportation Master Plan

The City of Ottawa's 2013 Transportation Master Plan (TMP) identified the new four lane Brian Coburn Boulevard section from Navan Road to the Blackburn Hamlet Bypass (listed in the TMP as the Blackburn Hamlet Bypass Extension) as part of the *2031 Affordable Road Network* (**Figure 4-1**).

Other roadway projects are included in the TMP's *2031 Road Network Concept* (**Figure 4-2**) but not in the *2031 Affordable Road Network*. These include the Blackburn Hamlet Bypass widening from 4 to 6 lanes, the new Innes-Walkley-Hunt Club Link (4 lane road with initial 2 lane phase), OR 174 widening to 6 lanes, and Navan Road widening south of Brian Coburn Blvd. to 4 lanes.

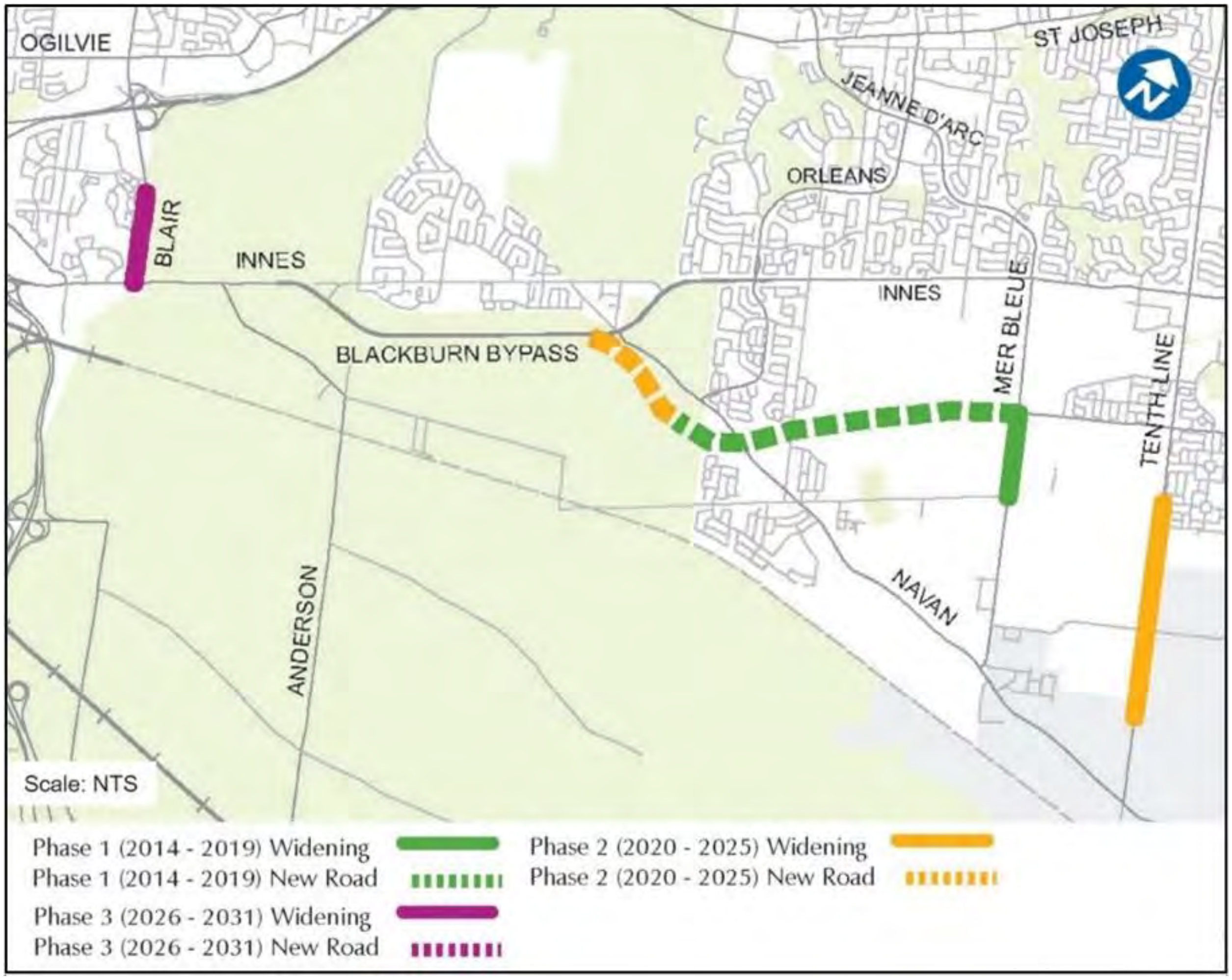

Figure 4-1: 2031 Affordable Road Network (City of Ottawa 2013) TMP

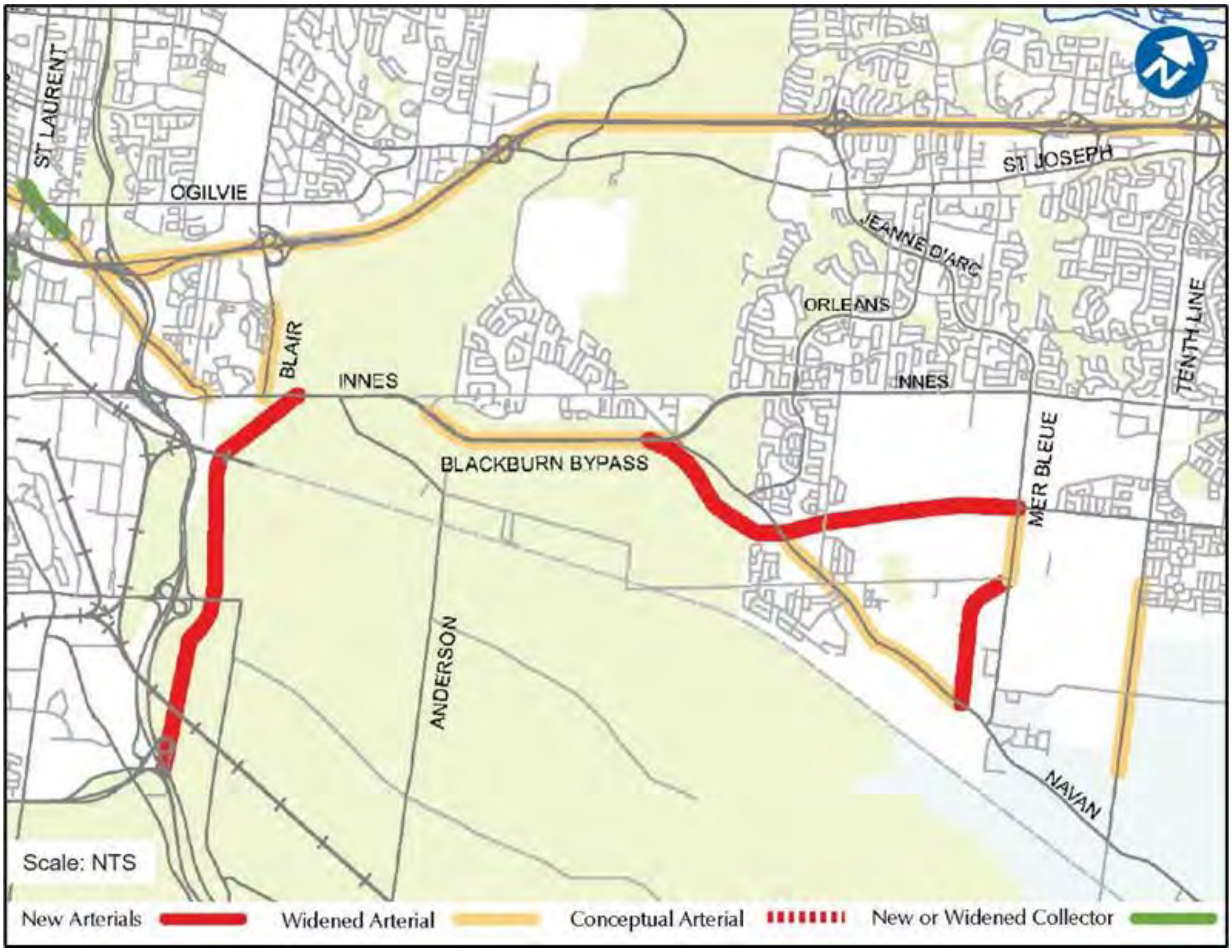

Figure 4-2: 2031 Road Network Concept (City of Ottawa 2013) TMP)

The 2013 TMP includes the Cumberland Transitway as a fully exclusive transitway between Blair Station and Frank Kenny Road as part of the *2031 Transit Network Concept* (**Figure 4-3**) but not as part of the *2031 Affordable Transit Network* (**Figure 4-4**) which indicates that it is expected to be constructed after the 2031 horizon.

Other transportation improvements planned to serve the east urban area outside the Greenbelt include the expansion of Ottawa's Light Rail Transit (LRT). Originally, the TMP included an LRT extension from the Blair Station to Orléans Town Centre, however, recent planning and funding opportunities have enabled the City to extend the LRT to Trim Road as part of the Stage 2 LRT system, scheduled for operation by 2025. The *2031 Affordable Transit Network* also includes Transit Priority Corridors (either Continuous Lanes or Isolated Measures) on Blair Road, Innes Road, the BHBP, Brian Coburn Blvd. and the BCBE (BHBP to Navan) within the study area.

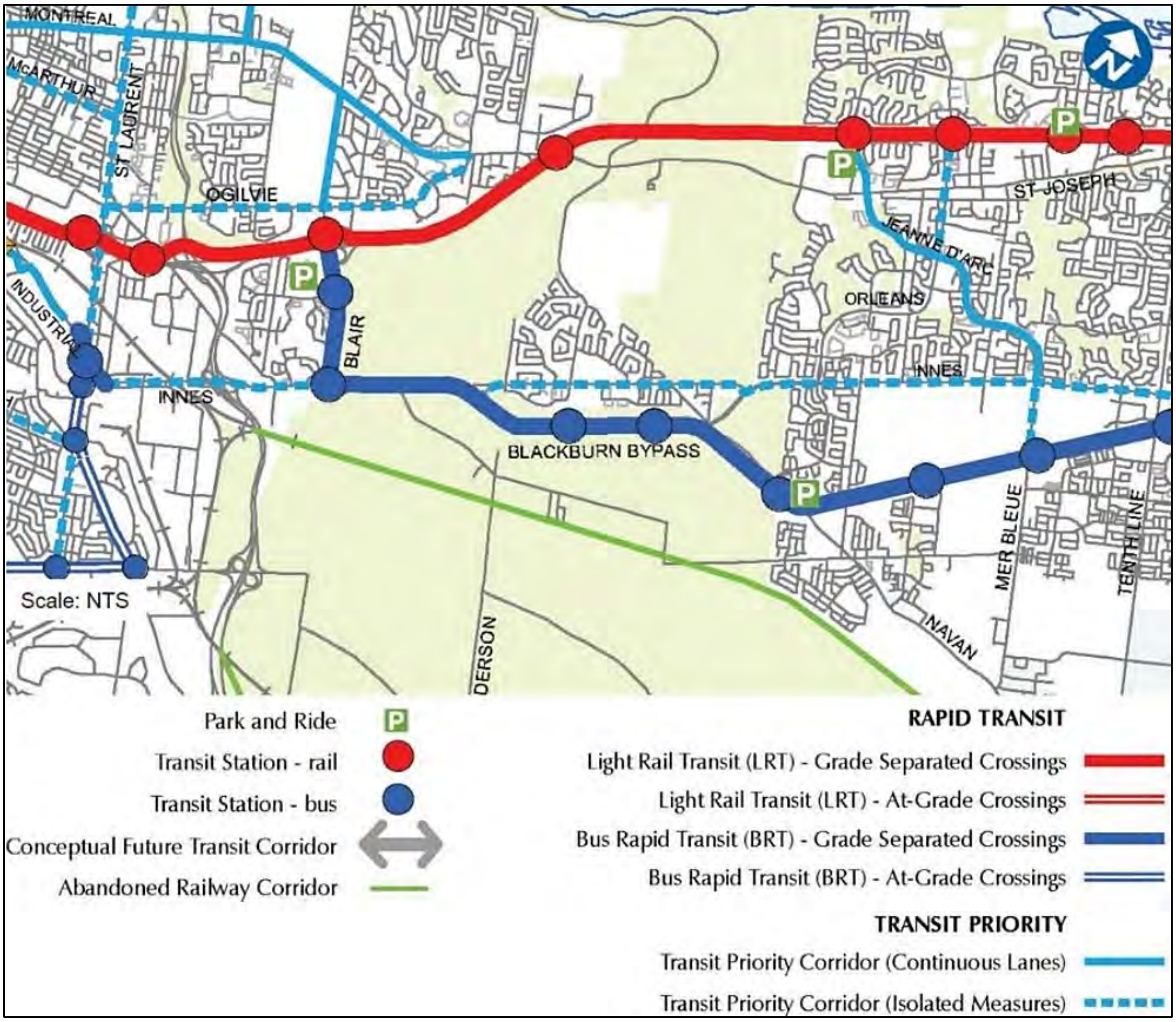

Figure 4-3: 2031 Network Transit Concept (City of Ottawa 2013) TMP

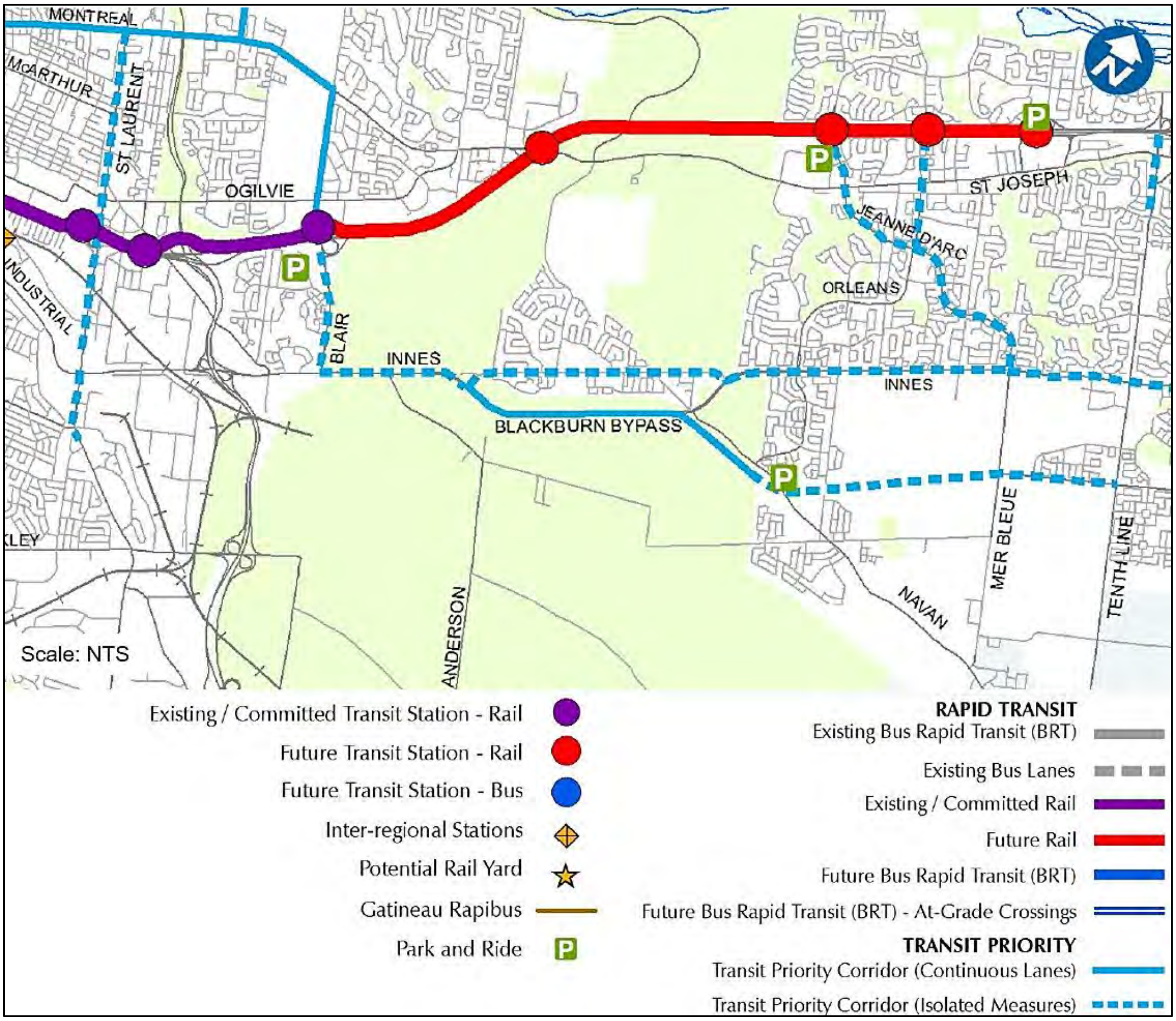

Figure 4-4: 2031 Affordable Transit Network (City of Ottawa 2013) TMP

4.2 Need for the Project

A re-examination of the need and a confirmation of the preferred alternative solution was undertaken as part of this study to confirm the 2013 TMP assumptions and conclusions. Supporting documents for the study are provided in **APPENDIX C**. The review examines the future roadway needs associated with the TMP's Affordable Network and Network Road Concept scenarios and includes the following key mobility improvements in the study area:

- Affordable Road and Transit Networks:
  - The widening of Blair Road to 4 lanes (Innes to Meadowbrook)
  - Transit priority measures throughout the study area

    - Completion of Stage 2 LRT easterly extension
- Network Concept Road and Transit Networks:
    - The widening of Navan Road to 4 lanes (south of Brian Coburn Boulevard)
    - The Innes-Walkley-Hunt Club Road link
    - The widening of OR 174 to 6 lanes
    - Completion of Stage 2 LRT easterly extension
    - Completion of the Cumberland Transitway BRT

4.2.1 Travel Demands

An efficient transportation network accommodates all modes of travel including transit, active transportation (AT) modes (cyclists and pedestrians), automobiles and large/heavy vehicles.

The City of Ottawa employs the EMME travel demand model to assist in the determination of the need for transportation infrastructure. The EMME model uses specific inputs related to population and employment, land use, modal share values and other factors to assist in the identification of existing and future traffic demands. A key metric in the EMME model relates to the population and employment projections in various areas across the City. The 2013 TMP Update indicated the following 2011 and 2031 population and employment values across the City (**Figure 4-1**).

Table 4-1: Population & Employment: 2011 & 2031

	POPULATION			EMPLOYMENT		
AREA	**2011**	**2031**	**Growth & Distribution**	**2011**	**2031**	**Growth & Distribution**
Inner Area	97,200	116,400	19,200 (9%)	170,600	201,800	31,200 (23%)
Inner Suburbs	432,500	459,300	26,800 (13%)	287,400	355,300	67,900 (49%)
Kanata/Stittsville	105,200	162,000	56,800 (27%)	51,300	62,500	11,200 (8%)
Barrhaven	71,200	107,400	36,200 (17%)	11,100	21,800	10,700 (8%)
Riverside South/Leitrim	15,900	35,800	19,900 (9%)	4,000	7,800	3,800 (3%)
Orléans	***108,200***	***143,400***	***35,200 (16%)***	***20,600***	***33,000***	***12,400 (9%)***
Rural Ottawa	91,400	111,700	20,300 (9%)	20,000	20,900	900 (1%)
Total	***922,000***	***1,135,900***	***213,900 (100%)***	***564,900***	***703,200***	***138,100 (100%)***

Table 4-1 indicates that population in the city will increase by a total of 213,900 persons while employment will increase by 138,100 jobs. The Orleans area (highlighted) is projected to add 35,200 persons and 12,400 jobs; these values respectively represent 16% and 9% of the projected population and employment growth in the entire City of Ottawa.

Table 3 illustrates the current (2011) and projected (2031) modal shares, a key metric related to the number of persons using transit in the peak periods.

Table 4-2: 2011 & 2031 Transit Mode Shares (AM Peak/2013 TMP)

Trips to → / Trips from ↓		Inner Area	Inner Suburbs	Orléans	Riverside South / Leitrim	Barr-haven	Kanata/ Stittsville	Rural Ottawa	Gatineau	*All Areas*
Inner Area	2011	15%	28%	28%	9%	5%	31%	1%	29%	***20%***
	2031	20%	35%	30%	15%	15%	35%	2%	32%	***22%***
Inner Suburbs	2011	49%	16%	12%	5%	8%	13%	1%	30%	***24%***
	2031	54%	22%	16%	18%	12%	15%	2%	33%	***28%***
Orléans	***2011***	***61%***	***19%***	***8%***	***4%***	***10%***	***6%***	***0%***	***27%***	***24%***
	2031	***65%***	***22%***	***11%***	***7%***	***12%***	***7%***	***0%***	***30%***	***26%***
Riverside S./ Leitrim	2011	36%	7%	0%	0%	0%	0%	0%	0%	***9%***
	2031	40%	16%	2%	10%	10%	5%	2%	13%	***16%***
Barrhaven	2011	62%	16%	5%	0%	5%	1%	0%	53%	***20%***
	2031	70%	20%	7%	5%	10%	6%	2%	55%	***26%***
Kanata/Stittsville	2011	53%	12%	6%	0%	3%	5%	2%	36%	***15%***
	2031	56%	20%	6%	4%	4%	10%	2%	40%	***21%***
Rural Ottawa	2011	31%	4%	3%	0%	2%	1%	1%	7%	***6%***
	2031	39%	8%	10%	2%	3%	3%	1%	8%	***11%***
Gatineau	2011	47%	13%	0%	0%	0%	3%	0%	-	***32%***
	2031	50%	14%	7%	3%	5%	7%	1%		***33%***
All Areas	***2011***	***42%***	***16%***	***9%***	***2%***	***6%***	***6%***	***1%***	***31%***	
	2031	***44%***	***21%***	***13%***	***9%***	***11%***	***11%***	***2%***	***32%***	

4.3 Project Opportunities

The communities at the eastern limits of the city are projected to experience continued growth in both population and employment over the next several decades (City of Ottawa, 2003a). This growth will require appropriate and targeted transportation infrastructure (for transit, auto and active transit modes) to accommodate this projected growth. The existing road network is currently at capacity and this condition will deteriorate unless improvements are made (see discussion of projected demands in the following section).

There are opportunities for the following multi-modal elements:

- Development of a staged transit system including short-term measures such as on-road transit lanes and transit priority measures and Park and Ride sites (e.g., Chapel Hill Park and Ride).
- Ultimately, the transit network should consist of a fully separate, dedicated Bus Rapid Transit (BRT) system with potential links to the future light rail transit (LRT) along Ottawa Road (OR) 174.
- In conjunction with the network improvements identified in this EA, the provision of appropriate AT facilities which encourage non-auto modes of travel.
- The provision of appropriate connectivity between the various modes of travel including effective and convenient access to the transit service.
- The development of roadway and transit options should consider, where feasible, opportunities to mitigate or eliminate existing neighbourhood traffic issues (e.g., Chapel Hill South, Bradley Estates).

Consistent with the City's TMP and OP, the transportation analysis, and the development of solutions for the study area will address the following key objectives as listed in the City's TMP:

- Reduce automobile dependence - give priority to public transit in accommodating future travel demand:
    - Make walking and cycling more attractive than driving for short trips.
    - Motivate sustainable travel choices through education, promotion, incentives, and automobile disincentives.
    - Encourage shorter trips and travel alternatives like telework.
- Meet mobility needs:
    - Provide an integrated system of multimodal facilities and services.

  - Aim to provide an acceptable level of service for each mode.
  - Balance mobility and accessibility needs in higher and lower density areas.
  - Balance the needs of public transit customers, pedestrians, cyclists, and motor vehicle users when resolving conflicts.
  - Provide barrier-free transportation facilities and services.
- Integrate transportation and land use:
  - Build communities that are accessible by active transportation.
  - Provide rapid transit and other quality transit services to community cores and employment areas.
  - Foster transit-oriented development in transit nodes and corridors.
  - Support intensification where transit, walking and cycling can be made most attractive.

The City's TMP and OP place considerable emphasis on transit. The TMP states that enhanced transit service elements will be provided as early as possible. These may take the form of surface transit routes with accelerated frequencies, accompanied by transit priority measures. While the City is protecting the eventual opportunity for complete grade-separation of all elements of the rapid transit network (i.e., intersections where rapid transit corridors intersect with streets, or pedestrian crossings at rapid transit stations), where practical, it will defer the costs of grade-separation by using transit priority measures that reduce delay and improve service reliability by isolating transit from mixed traffic.

The TMP indicates that the majority of Ottawa's transit service is delivered on roads, where traffic congestion increases delay and reduces the reliability and efficiency of transit services. Transit priority can improve the competitiveness of transit by reducing travel times and improving service reliability, while allowing more transit service to be delivered with the same resources. Transit priority measures (e.g., dedicated bus lanes, transit signal priority treatments, bus queue jumps, special bus stop arrangements, and traffic management techniques such as queue relocation) are intended to eliminate delay to transit services caused by congestion, and to minimize delay caused by traffic signals. Equipping road corridors with a set of coordinated transit priority measures can substantially improve the quality of service enjoyed by transit customers without incurring the costs of a fully grade-separated rapid transit corridor" (City of Ottawa, 2013). As stated, the transportation analysis and the development of solutions will be undertaken in a manner that prioritizes the implementation of transit in the study area.

The 2013 TMP/OP also supports the increased use of other non-auto modes including walking and cycling:

- **Walking:** The City of Ottawa's Pedestrian Charter establishes the vision, goals and objectives for walking. The Charter articulates a commitment to creating a city where people walk because they want to and defines a series of guiding principles to create a supportive urban environment. The *Ottawa Pedestrian Plan* (2013) contains a number of policies and actions for the City to implement. They address land use, walking network development, street and pedestrian facility design, maintenance, safety programs, information, promotion, stakeholder engagement, interjurisdictional cooperation, and performance measurement.

- **Cycling:** The *Ottawa Cycling Plan* (2013) contains a number of policies and actions to increase the safety, convenience and comfort of cycling in Ottawa. These include land use, cycling network development, street and cycling facility design, bicycle parking, cycling-transit integration, funding, maintenance, safety programs, wayfinding assistance, information, promotion, stakeholder engagement, inter-jurisdictional cooperation, and performance measurement.

The study area includes lands within the City and the National Capital Commission (NCC) Greenbelt. Appropriate pedestrian and cycling facilities will be provided along all new infrastructure in accordance with City's planning documents and where appropriate, NCC policies and guidelines. This will include linkages with the existing pathway network (i.e., City and NCC pathways) and linkages with adjacent communities such as Chapel Hill South and Bradley Estates.

Table 4-2 indicates increased transit use in virtually all areas including Orléans. For example, it is projected that travel from Orléans to Ottawa's downtown will increase from 61% in 2011 to 65% by 2031. Transit improvements will be required to achieve this increase in modal share.

Using the population and employment data and the modal share values, roadway, and transit improvements (i.e., per the TMP Affordable Network and Network Concept arrangements) were identified in the 2013 TMP Update. Travel demands are typically assessed at screenlines[1]. Within the study area, there are three screenlines: Screenline 16 (SL16), Screenline 6 (SL6), and Blackburn Hamlet Screenline. Screenline SL16 is located along the existing Greens Creek corridor while Screenline SL6 is located along the western periphery of the East Urban Community (i.e., abuts the NCC Greenbelt). The Blackburn Hamlet Screenline extends from the Village to south of Renaud Road. **Figure 4-5** illustrates the three screenlines.

[1] A screenline is defined as an imaginary line that crosses all major transportation facilities in a corridor, typically drawn along a feature (such as a river or railway) having a limited number of crossing points (Annex 3: Glossary, City of Ottawa Transportation Master Plan, 2013d).

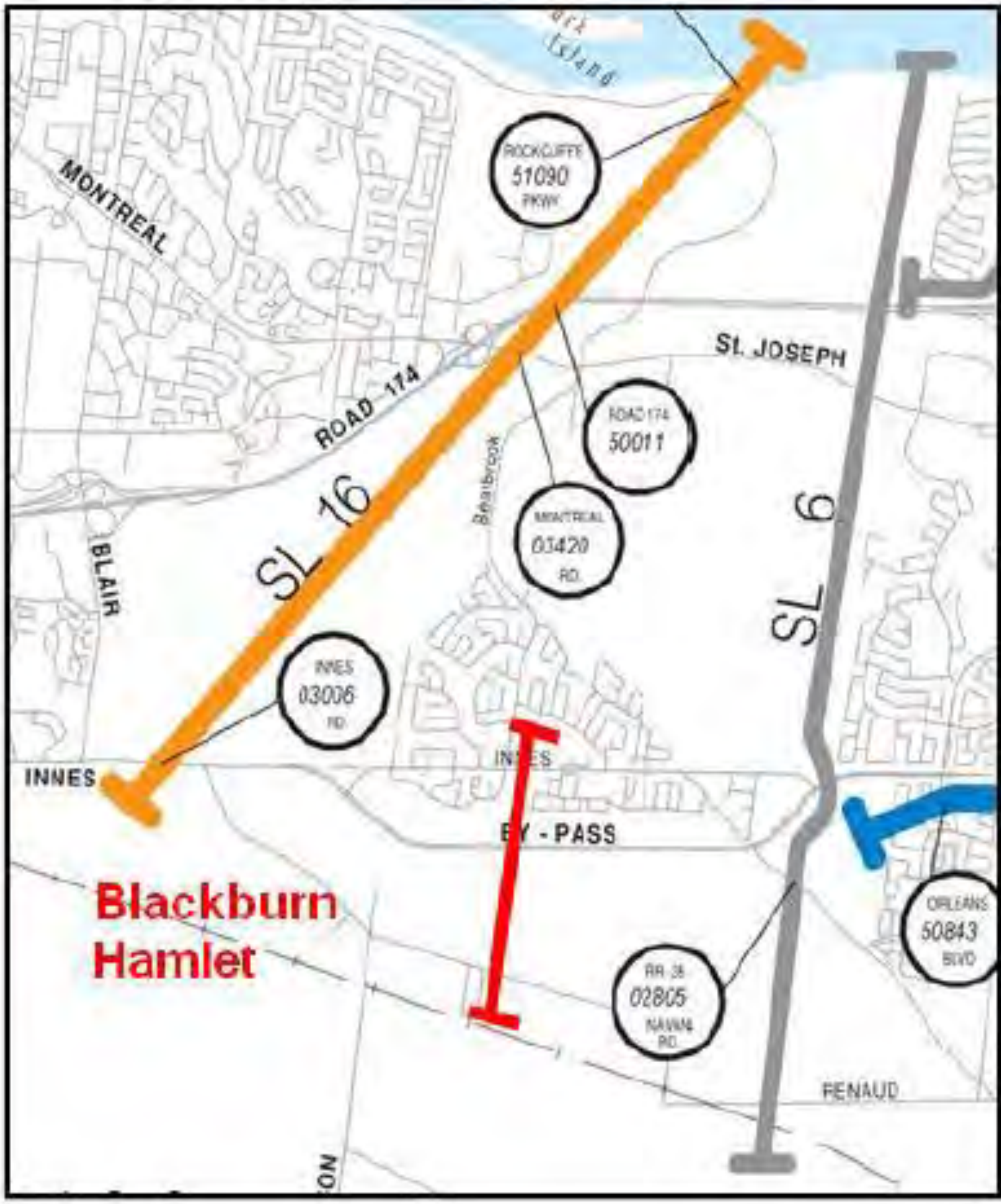

Figure 4-5: Study Area Screenlines

The existing roadways in the study area which service east/west travel demands range from multi-lane, high speed freeways (e.g., OR 174) to arterial roadways (e.g.,. Innes Road) to single lane facilities (e.g. Sir George-Étienne Cartier Parkway and

Renaud Road). Each facility has a finite capacity - the number of vehicles that can be serviced in a lane in each hour. The current and projected traffic volumes are then applied to this capacity of the roadway and the quality of performance is determined. Roadway performance is typically expressed in terms of the Volume to Capacity (V/C) ratio, whereby a V/C ratio that exceeds 0.90 is typically considered "at or over capacity" and improvements are generally warranted. In terms of transit use, the 2011 transit (or non-auto) modal share is estimated at 37% at the Greens Creek Screenline (SL 16); the projected 2031 TMP modal share is 43% (i.e., value used in the EMME model).

The 2017 EMME update included the following adjustments (when compared to the original 2013 version):

- Updated 2031 land use projections.
- Transit routes update (related to Stage 2 LRT).
- Road network modifications:
  - Highway 417 weaving section coding changes.
  - Network assumptions fixed for Leitrim EA project.
- Updated transit features including the extension of LRT to Trim Road by 2023.

The 2011 and 2031 traffic demand values used for this study were developed consistent with updated City policies regarding the analysis of roadway performance.

4.3.1 Current (2011) Travel Demand

Table 4-3 illustrates the 2011 Peak Period/Peak Direction Traffic Volume to Road Capacity (V/C) Ratio for the key network roads. Any volume/capacity levels that exceed "1.0" indicates a roadway that is exceeding its capacity.

Table 4-3: Roadway Capacity

	Volume	# Lanes (per Direction)	Lane Capacity (Per Direction)	Total Capacity (Per Direction)	V/C Volume/ Capacity
Screenline 16					
Sir George-Étienne Cartier Parkway	580	1	800	800	0.72
OR 174	3608	2	1,800	3,600	***1.00***
St. Joseph Boulevard	1778	2	1,000	2,000	0.89
Innes Road (West of BHBP)	2620	3	800	2,400	***1.09***
SCREENLINE TOTAL	**8585**	**8**		**8,800**	**0.98**
Screenline 6					
OR 174	3608	2	1,800	3,600	***1.00***
St. Joseph Boulevard	1929	2	1,000	2,000	***0.96***
Innes Road (East of BHBP)	1673	2	800	1,600	***1.05***
Navan Road	663	1	800	800	0.83
Renaud Road	474	1	800	800	0.59
SCREENLINE TOTAL	**8,346**	**8**	**5,200**	**8,800**	**0.95**
Blackburn Hamlet Bypass Screenline					
Innes Road (in Blackburn Hamlet)	117	1	600	600	0.20
BHBP	1980	2	1,000	2,000	***0.99***
Renaud Road	474	1	800	800	0.59
SCREENLINE TOTAL (ALL)	**2,572**	**4**	**2,400**	**3,400**	**0.76**
SCREENLINE TOTAL (NO INNES)	**2,454**	**3**	**1,800**	**2,800**	**0.88**

Based on analysis, the following conclusion can be made:

- numerous locations exhibit over-capacity conditions.
- virtually all *major* arterial roads crossing Screenlines SL6 and SL16 are functioning with a V/C ratio that exceeds 0.90.
- the overall V/C for Screenlines SL6 and SL16 respectively exhibit values of 0.95 and 0.98 suggesting that the demand is nearing the available capacity.
- At the Blackburn Hamlet Screenline, the BHBP is essentially at capacity (i.e., V/C of 0.99).
- the remaining minor roads (Innes Road in the Village and Renaud Road) are under-capacity; however, these roads are less well suited

for the movement of traffic (i.e., both are located in or pass through existing residential neighbourhoods).

4.3.2 Future (2031) Travel Demand

Table 4-4 illustrates the V/C for each key roadway at the three screenlines considering *average* 2031 peak direction auto volumes (am peak inbound), based on the Affordable Network. These volumes were generated by increasing the peak hour demand by 2.05 (to peak period) and dividing the peak period values by 2.5 to develop an average peak hour volume. The values are based on the City's EMME model and include updated transit routes commensurate with the introduction of Stage 1 LRT in early 2019 and Stage 2 LRT in 2023.

The analysis supports the need for 1 lane of additional roadway capacity at each screenline (includes the capacity provided by the Brian Coburn Boulevard Extension). All screenlines exceed a total V/C of 0.90 (generally considered the capacity of a roadway link); while most individual roads have V/C ratios well in excess of 0.90 with numerous locations exhibiting V/C ratios of more than 1.0.

The 2031 roadway performance considering the Network Concept arrangement, indicates the need for widening Innes Road, (west of Old Innes Road west leg intersection) beyond the existing 6-lane configuration (Screenline 16).

At Screenline 6, all roadways are generally functioning acceptably including the new BCBE. At the Blackburn Hamlet Screenline, widening of the BHBP is required to provide adequate roadway capacity to 2031, however, shortly after 2031 the BHBP will be at capacity. As stated, the BHBP Screenline includes two relatively minor roads (Old Innes Road in the Village and Renaud Road in the area of Bradley Estates). However, unlike OR174, Innes Road and other available east/west facilities, both collector roads are not well suited for the movement of large volumes of traffic as both are located in residential neighbourhoods.

Table 4-4: 2031 Average AM Peak Hour/Peak Direction Auto Volume & V/C Affordable Network

	Average Peak Hour Volume	# Lanes (per Direction)	Lane Capacity (Per Direction)	Total Capacity (Per Direction)	V/C Volume/ Capacity
Screenline 16					
Sir George-Étienne Cartier Parkway	622	1	800	800	0.78

	Average Peak Hour Volume	# Lanes (per Direction)	Lane Capacity (Per Direction)	Total Capacity (Per Direction)	V/C Volume/ Capacity
OR 174	3927	2	1800	3,600	***1.09***
St. Joseph Boulevard	1867	2	1000	2,000	***0.93***
Innes Road (West of BHBP)	3218	3	800	2,400	***1.34***
SCREENLINE TOTAL	**9,634**	**8**	**4,400**	**8,800**	**1.09**
Screenline 6					
OR 174	3927	2	1,800	3,600	***1.09***
St. Joseph Boulevard	2053	2	1000	2,000	***1.03***
Innes Road (East of BHBP)	1582	2	800	1,600	***0.99***
BCBE[1]	*1286*	*2*	*800*	*1,600*	**0.80**
Renaud Road	790	1	800	800	***0.99***
SCREENLINE TOTAL	**9,638**	**9**	**5,200**	**9,600**	**1.00**
Blackburn Hamlet Bypass Screenline					
Innes Road (in Blackburn Hamlet)	308	1	600	600	0.51
BHBP	2280	2	1,000	2,000	***1.14***
Renaud Road	790	1	800	800	***0.99***
SCREENLINE TOTAL (WITH INNES/In Hamlet)	**3,378**	**4**	**2,400**	**3,400**	***0.99***
SCREENLINE TOTAL (NO INNES/In Hamlet)	**3,070**	**3**	**1,800**	**2,800**	***1.10***

1 Widening is assumed (per 2013 TMP)

2 Locations where V/C exceeds 0.90

4.3.3 Transit

The projected average am peak period transit demand (i.e., transit person trips) at each screenline was developed in the City's EMME model. The developed peak period transit person trips include surface transit operations, future LRT along OR 174 and future BRT facilities such as the Cumberland Transitway.

Transit performance is a function of the type of service currently provided or the type of service that will be provided in the future. Existing transit services which operate in mixed use conditions with automobile traffic will be subject to the same performance issues encountered by automobiles. Better transit performance is projected where transit priority measures or dedicated lanes are provided (e.g., currently provided on sections of OR 174) or will be provided.

A dedicated transit facility such as the Cumberland Transitway or the approved LRT system in the OR 174 corridor provides the highest level of performance.

Transit is considered an integral element in addressing the mobility needs of the study area and beyond. In the City's TMP the Cumberland Transitway is planned for implementation sometime after 2031 and transit priority measures are proposed as a method of facilitating transit use before the BRT facility is built.

4.3.4 Roadway Lane Requirements

Notwithstanding the increased use of transit, additional roadway capacity will be warranted within the study area. The added lane requirements that are needed to satisfy the projected 2031 average auto demands are:

- **SCREENLINE 6:** 1 Lane/Direction
- **SCREENLINE 16:** 1 Lane/Direction
- BLACKBURN HAMLET SCREENLINE: 1 Lane/Direction

The identified lane requirements confirm the recommendations from the City's TMP related to roadway capacity improvements. The development of roadway and transit options should also consider, where feasible, opportunities to mitigate or reduce neighbourhood traffic issues (e.g., Chapel Hill South and Bradley Estates). Additionally, any future roadway options should be developed in a manner that minimizes cut-through traffic in existing and future neighbourhoods.

5. EXISTING ENVIRONMENTAL CONDITIONS

This section documents the baseline conditions for the study area against which the potential environmental effects of the alternatives can be assessed. The findings of the studies, investigations and policy review undertaken to document the existing conditions within the study area include environmental conditions for the natural, social, cultural, built, and economic environments.

Overall, the baseline data was collected and analyzed for key environmental parameters to:

- Provide an understanding of existing conditions.
- Allow for predictions of how the proposed project may cause these environmental conditions to change and how those changes can be mitigated.
- Provide a basis for designing monitoring programs.

The following sub-sections describe the study area boundaries and the existing ecological, social, cultural, built environment and economic conditions within the general study area. Once a preferred corridor is selected, a detailed update to existing conditions will occur, as applicable, localized to that corridor.

Some areas within the study area have been previously evaluated during other environmental assessments. These previous studies have been used to inform the documentation of the existing conditions report. Where information gaps exist, new content will be added to the work that has been done to date.

5.1 Study Area

5.1.1 Physical Boundaries

The study area for existing conditions may vary depending on the environmental features which were investigated. The study area boundaries are not rigidly defined and remain flexible to accommodate the extent of the particular environmental feature being described. This is because some potential environmental effects may be localized, such as noise, whereas others, like the movement of people may have broader implications outside of a restricted geographical boundary. Where broader study area boundaries have been used, they have been identified in context.

In general, the study area falls within the boundaries identified on Figure 5-1.

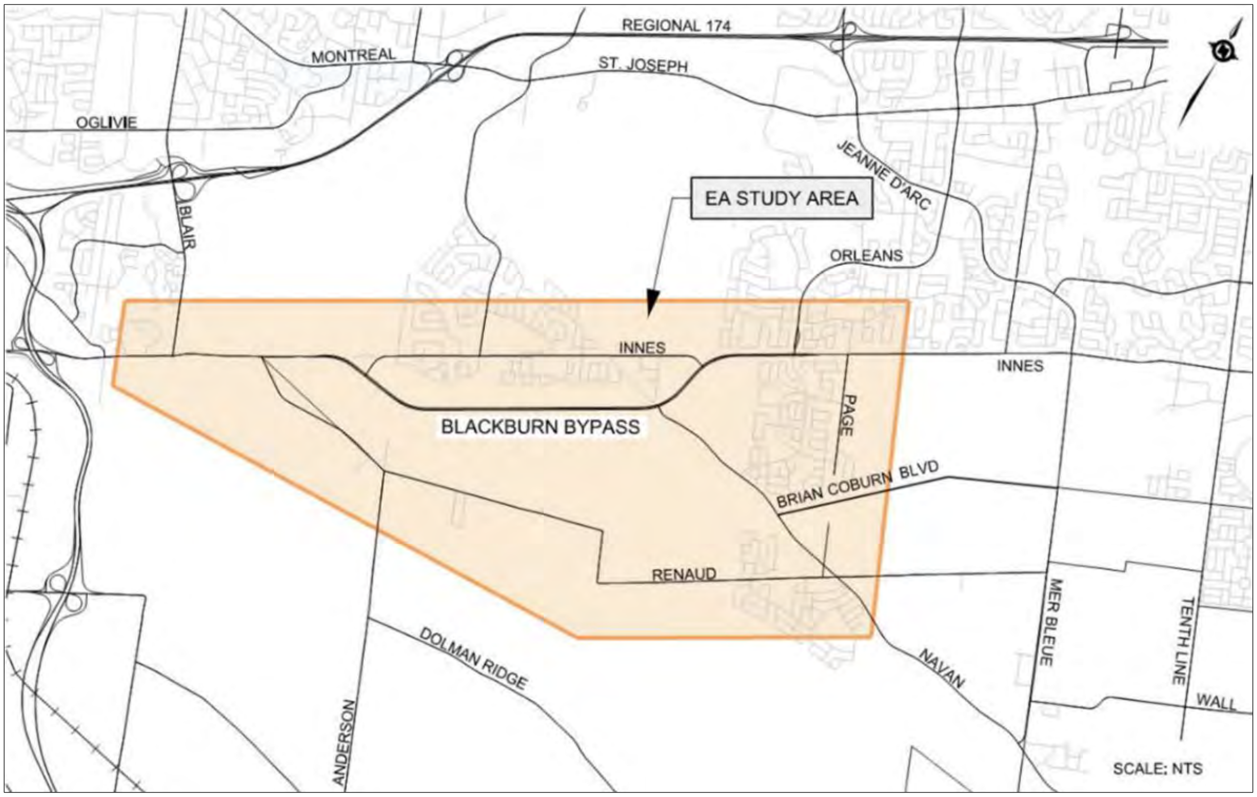

Figure 5-1: Study Area Boundaries

The EA study area covers approximately 18 km^2 with geographical boundaries that extend from:

- West Limit: Approximately 500 m west of Blair Road.
- North Limit: Parallels Innes Road approximately 500 m to the north.
- East Limit: Approximately 500 m east of Pagé Road.
- South Limit: Approximately 500 m south of Renaud Road connecting to Innes Road west of Blair Road.

Due to the introduction of potential northerly BRT routes to connect directly to the LRT along OR 174 north of Blackburn Hamlet, the documentation of existing conditions was expanded to include key features to the north and along portions of the Blair Road corridor.

5.1.2 Temporal Boundaries

The temporal boundaries of the study will encompass all phases of the project implementation including planning and design, construction, and operation/maintenance.

5.2 Natural Environment

The natural environment includes the physical and ecological/biological components that are essential to our health, quality of life and survival. Many environmental features have a variety of ecological, recreational, and/or aesthetic features and functions that are highly valued from both an environmental and social context. This section of the report will present an overview of the biological/ecological and physical elements of the study area with detailed reports available in **APPENDIX D**.

5.2.1 Aquatic Environment

The study area falls within the jurisdictional boundaries of the Rideau Valley Conservation Authority (RVCA) and Ministry of Northern Development, Mines, Natural Resources and Forestry (NDMNRF) Kemptville District. Most of the study area is located within the NCC's Greenbelt.

The study area is located primarily within the Greens Creek watershed. Greens Creek flows north for approximately 5 km from the study area before draining directly into the Ottawa River. The Greens Creek watershed encompasses a number of subwatersheds within the study area: Black Creek subwatershed and Mud Creek Subwatershed. Each of these Creeks discharge into Greens Creek. The headwaters of Mud Creek and Black Creek originate from the Mer Bleue Bog, a provincially significant and internationally recognized wetland that exists within the southeast portion of the study area.

5.2.1.1 Surface Water

Mud Creek

Mud Creek originates at the Mer Bleue Bog located at the southern extent of the study area, which provides much of the headwater flow with additional flow arising from drainage of adjacent agricultural and residential land uses. One named drainage feature, the James Blais Municipal Drain, contributes to flow for one of the Mud Creek tributaries and is located within the Chapel Hill South residential area along the north side of Renaud Road and Navan Road. The outlet of Mud Creek to Greens Creek is located approximately 0.65 km north of Innes Road. Mud Creek has experienced anthropogenic changes, such as road crossings, shoreline/instream modifications and little to no riparian buffer, however, nearly 50% of the creek has remained unaltered (RVCA, 2012b). Most of the remaining unaltered/natural reaches of the creek exist within 4 km upstream of the confluence with Greens Creek (i.e., middle and lower reaches).

Black Creek

The main-stem of Black Creek is located approximately 1.2 km south of Mud Creek and flows parallel to Mud Creek in a westerly direction before draining into Greens Creek. The confluence at Greens Creek is approximately 200 m east of Cyrville Road, which is located near the southwest limit of the study area. Black Creek also originates at the Mer Bleue Bog as this wetland is the primary headwater feature for the creek. Part of the Black Creek main-stem channel is a municipal drainage feature, the Lacroix Drain, which is located within the Mer Bleue Bog east of Anderson Road. The City Stream Watch program surveyed Black Creek in 2012 between Anderson Road and the confluence with Greens Creek. Through this stream survey, it was determined that most of Black Creek has been subject to anthropogenic changes that have altered the Creek's natural features resulting in approximately 8% of the Creek remaining unaltered (RVCA, 2012a). This can likely be attributed to the agricultural land uses present throughout much of the Black Creek subwatershed. Overall, there is limited residential development along Black Creek.

Greens Creek

The Greens Creek watershed is an important link between the Mer Bleue Bog wetland and the Ottawa River, where it outflows approximately 0.8 km downstream of the Sir George Etienne Parkway. In addition to the Mer Bleue headwaters, drainage from four (4) primary tributaries including Borthwick Creek, Black Creek, Mud Creek and Ramsay Creek contribute to flows within Greens Creek. The Greens Creek main-stem channel meanders through deeply incised channels due to the predominant leda clay-based substrates giving rise to highly unstable slopes. Frequent occurrences of slope failure and landslides, primarily between St. Joseph Blvd. and Innes Rd. have occurred within this section of the Greens Creek watershed. Nonetheless, Greens Creek has maintained a relatively high percentage of natural riparian buffer within the watershed compared to other urban streams within the City of Ottawa as more than 70% of the 13.4 km stream length surveyed by City Stream Watch possesses a buffer width of 30 m or greater (RVCA, 2016). The extensive natural features retained within the Greens Creek watershed is further exemplified by the limited percent of anthropogenic alteration along the main stem of the channel. Based on the 2016 City Stream Watch assessment along Greens Creek, approximately 69% of the channel has remained either unaltered or natural (RVCA, 2016).

Voyageur Creek

The Voyageur Creek watershed consists of a relatively short watercourse (approximately 6 km long) that is a direct tributary of the Ottawa River. Voyageur Creek originates near Orléans

Boulevard and flows north through the Chapel Hill North neighborhood. The creek upstream of St. Joseph Boulevard consists of branched channels within forested ravines, however, from OR 174 to the Ottawa River the creek is piped underground. Due to the urban location of the Voyageur Creek headwaters, the watershed receives uncontrolled runoff which results in flooding and erosion (RVCA, 2013). The forest ravines of Voyageur Creek have maintained a quality riparian buffer of the headwater reaches and approximately 50% of the creek upstream of OR 174 has remained unaltered (RVCA, 2013).

5.2.1.2 Fisheries

Generally, fish species found within the watercourses that flow through the study area are reflective of the watercourse's specific thermal regimes (i.e., warmwater, coolwater) (**Figure 5-2**).

Mud Creek

The thermal regime of Mud Creek has been classified as warmwater and is known to support a diverse bait/forage fish community. Based on fish community sampling completed by the City Stream Watch program in 2012, many fish species including pumpkinseed (*Lepomis gibbosus*), Creek Chub and Northern Redbelly Dace were captured along Mud Creek within the limits of the study area. In addition to fish and fish habitat surveys completed through the City Stream Watch Program, fisheries investigations at various tributaries and drainage features of Mud Creek were also conducted. These surveys were completed in 2009 as part of the Hospital Link/Cumberland Transitway Connection EA. Of the eight (8) reaches that were surveyed, fish were captured at five (5) reaches and no additional species were identified. Overall, the species inventory list shows the diversity and range of species (i.e., bait/forage fish and recreational species) increases within Mud Creek closer to the outlet to Greens Creek.

Black Creek

Although the main-stem of Black Creek falls outside of the study area, tributaries of Black Creek extend north to within the study limits. City Stream Watch thermal regime assessments indicate that Black Creek is classified as a coolwater system. Fish community sampling conducted in 2007 and 2012 during the City Stream Watch assessments have resulted in the capture of a number of fish species upstream and downstream. The species list indicates the primary fish community present within Black Creek includes coolwater bait/forage fish species along with a few coarse fish species including Brown Bullhead and Burbot.

Greens Creek

Results of the 2016 City Stream Watch assessment indicate that Greens Creek is primarily a warmwater system with cooler temperatures observed within the upper reaches. The fish community within Greens Creek consists of a wide range of species from bait/forage fish to recreational species, however, the recreational fish species have predominantly been captured near the outlet to the Ottawa River. With respect to the study area, RVCA was able to provide background information from fish community sampling that was carried out in 2010 and 2016 immediately downstream of Innes Road.

The fish community within the study area and the downstream reaches primarily consists of diverse bait/forage fish species who prefer warmwater and coolwater conditions, as well as recreational species with similar thermal regime preferences. A small proportion of the fish species identified within the study area, including Burbot and Trout-Perch, prefer coldwater conditions.

A fish community and freshwater mussel community sampling was completed by Morrison Hershfield Limited (MH) at the Greens Creek Ottawa Road (OR) 174 culvert crossing as part of the Ottawa Light Rail Transit (LRT) Stage 2 Preliminary Design Study in 2016 through 2018. The survey captured young-of-year (YOY) Burbot. The freshwater mussel sampling resulted in the capture of (3) species not previously known within the creek including Eastern Elliptio (*Elliptio complanata*), Cylindrical Papershell (*Anodontoides ferussacianus*), and Fragile Papershell (*Leptodea fragilis*). The distribution of the freshwater mussels throughout the upper reaches within the study area are not well known.

Voyageur Creek

Based on the results of City Stream Watch assessments along Voyageur Creek, this tributary has been classified as a coolwater system (RVCA, 2013). Through fish community sampling efforts, only two (2) coolwater species of bait/forage fish have been documented within Voyageur Creek, including Brook Stickleback (*Culaea inconstans*) and Creek Chub (*Semotilus atromaculatus*). The limited fish community within Voyageur Creek is likely a result of the extensive piped segment between OR 174 and the Ottawa River as this presents a potential barrier to upstream fish passage.

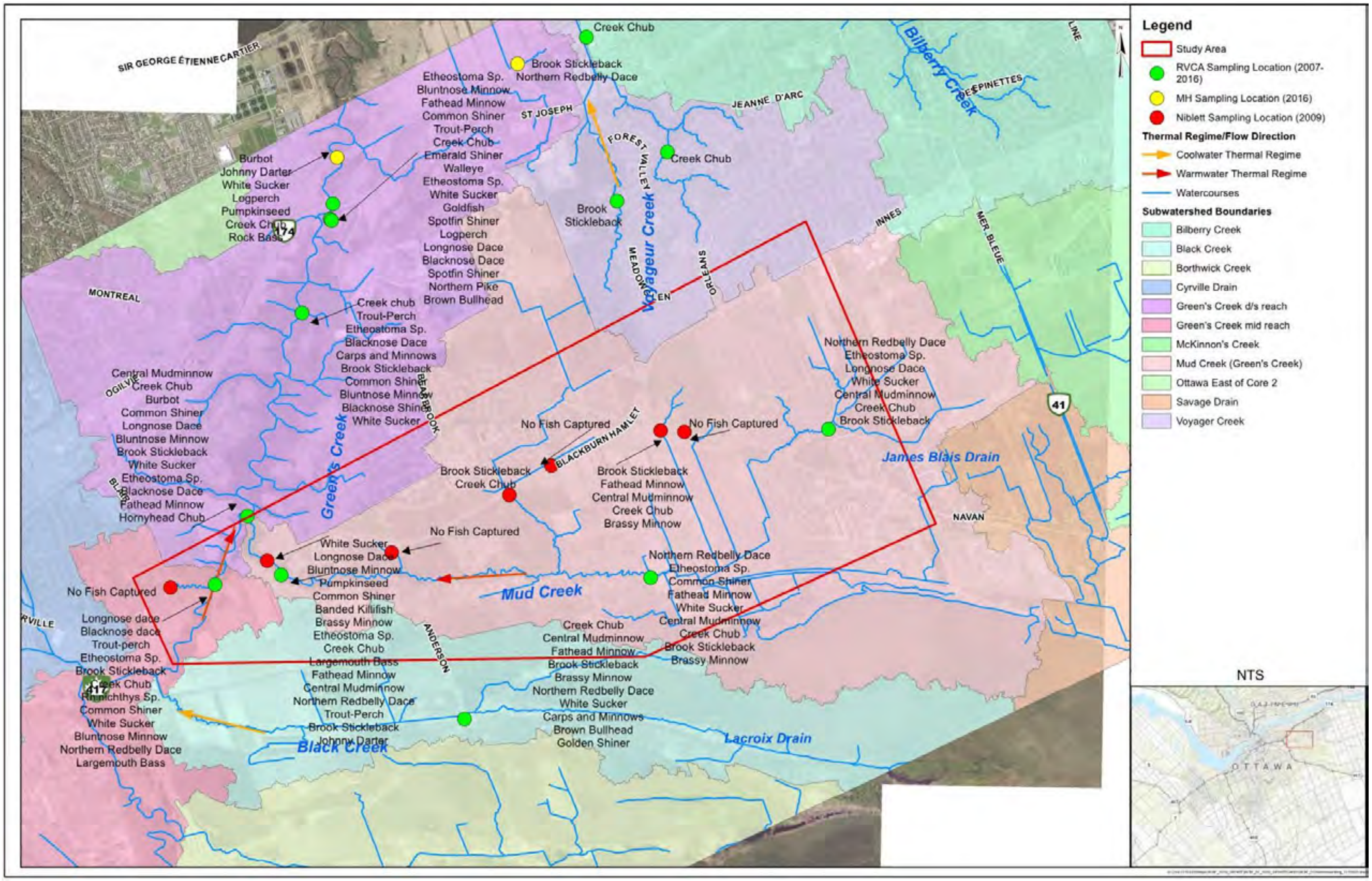

Figure 5-2: Fish & Fish Habitat

5.2.1.3 Aquatic/Fisheries Species at Risk

Based on the review of relevant background information, there have been no recorded aquatic Species at Risk (SAR) (provincially and federally) in the reaches of Mud Creek, Black Creek, and Greens Creek within and adjacent to the study area.

Field surveys were conducted to ground-truth the background information collected as well as to expand upon the knowledge of aquatic environment existing conditions within the study area to the extent possible. Field investigations completed within the EA area were limited to observations collected from publicly accessible lands (ex: roadside rights-of-way). Details of the aquatic/fisheries field survey, completed on October 29, 2020, are available in **APPENDIX D.1**.

5.2.2 Terrestrial Environment

Existing conditions of the terrestrial environment were evaluated in 2017 and involved undertaking a review of existing background information compiled from a variety of sources, including NDMNRF, the City of Ottawa, Committee on the Status of Endangered Wildlife in Canada (COSEWIC), ECCC and LIO. In addition, reviews of aerial photography and direct communication with NDMNRF have been undertaken.

A screening of potential SAR and SAR habitat was completed by confirming if the ranges of the species' habitat overlapped with the study. This was completed by referring to the full list of SAR that occur within the City of Ottawa, produced by the City of Ottawa (2019), and then reviewing observations records with more specific locations. As well, an information request was sent to the MECP on November 4, 2020, for any further information on SAR to confirm what was publicly available and to obtain specific information on SAR occurrences from their internal information. A response was received on December 3, 2020, confirming that the list provided to them was accurate. When a species was potentially present or confirmed to be present, and suitable habitat was available for the SAR, it was included for further review.

Field surveys were conducted to ground-truth the background information collected as well as to expand upon the knowledge of terrestrial SAR and SAR habitat existing conditions within the study area to the extent possible. Field investigations completed within the EA area were limited to observations collected with binoculars from publicly accessible lands (ex: roadside rights-of-way). Areas to the east of Navan Road were completely inaccessible to the survey team during the field surveys as they were under active construction and operation.

Details of the terrestrial field survey, completed on October 29, 2020, are available in APPENDIX D.2.

5.2.2.1 Natural Heritage Features

Designated Natural Areas are defined by resource agencies, municipalities, the government and/or public, through legislation, policies, or approved management plans, to have special or unique value. Such areas may have a variety of ecological, recreational, and/or aesthetic features and functions that are highly valued. There are a number of natural heritage areas within the study area (**Figure 5-3**).

<u>Areas of Natural & Scientific Interest (ANSIs): Life Science</u>

Blackburn Hamlet Department of National Defence Forest

Located at the northern boundary of the study area the Blackburn Hamlet Department of National Defence (DND) Forest is situated on a highland area of deep sand which drains through small rivulets north and westward to Greens Creek. This Forest is dominated by mature and submature Sugar Maple, American Beech, and Eastern Hemlock. Ground flora contains a relatively large number of regionally uncommon species. Such sand forests are rarely found in a natural or near-natural state in the site district. This area is vulnerable to urban development (AECOM, 2015).

Greens Creek Conservation Area

Greens Creek Conservation Area is situated in the northwest of the study area and forms part of the NCC's Greenbelt. The Greens Creek catchment supports a variety of provincially and regionally rare species. Its geology is unique due to the presence of two (2) types of leda clay, which create inherent slope instability (RVCA, 2016). The slope instability is exacerbated by increased flows due to adjacent development and agriculture (RVCA, 2016). The forest cover is a complex of deciduous and mixed woodland, with young to mature Sugar Maple, Trembling Aspen, Eastern Hemlock, White Spruce, and Eastern White Pine on drier slopes. White Pine and White Cedar are common on the Creek's steep, eroding slopes along with deciduous thicket swamps.

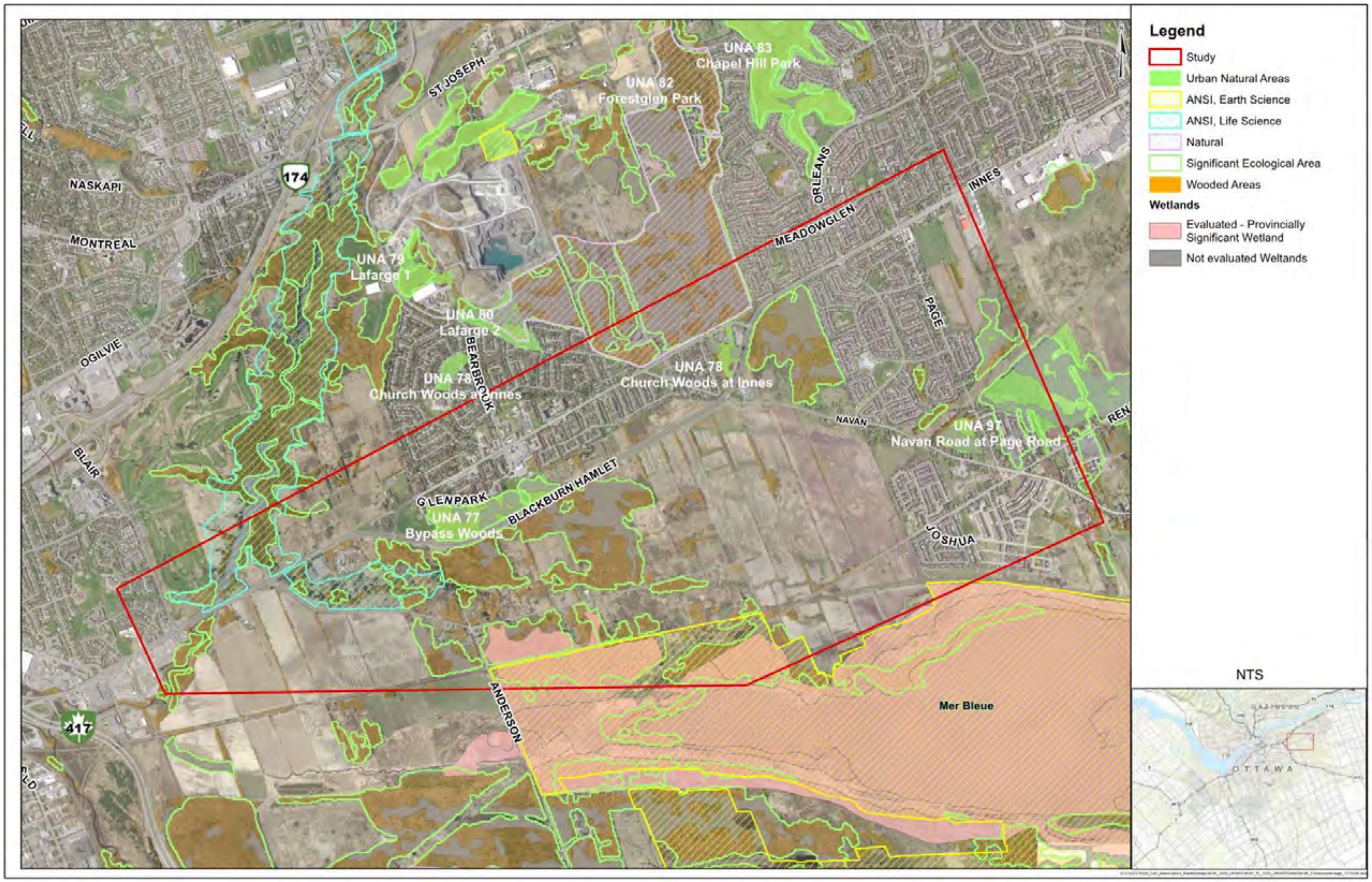

Figure 5-3: Natural Features

ANSIs: Earth Sciences

Francon Quarry

This area is located north of the study area. Francon Quarry has dawsonite-rich carbonatite sills having a rather unique mineralogy, not found anywhere else in the region (AECOM, 2016). It is currently called the Bearbrook Quarry and is operated by Lafarge Canada. This area is labelled as a 'Special Study Area' under the NCC Greenbelt Master Plan.

'Special Study Areas' consist of privately-owned lands that have attributes of importance to key Greenbelt natural environment lands located immediately adjacent to them. Within the Master Plan, the NCC proposes to explore options that would protect key environmental characteristics within the Special Study Areas and achieve complementary recreational opportunities, and to work with partner agencies and landowners to identify protection options.

Candidate ANSI/Natural Area (NDMNRF)

DND Forest (Part of RCMP Technical & Protective Operations Facility)

The Blackburn Hamlet DND Forest area is located northeast of the Blackburn Hamlet Community. It is a sand-based forest with mixed canopies due to a high-water table resulting in subtle topographic variation between upland and lowland forest. The upland forest cover is dominated by White Birch-Trembling Aspen, Green Ash and Red Maple with scattered Bur Oak and Basswood supporting a variety of the typical and uncommon sand-based ground flora (AECOM, 2016).

City of Ottawa: Urban Natural Areas (UNA)

There are a total of eight (8) urban natural areas located within the study area (Muncaster Environmental Planning Inc. & Brunton Consulting Services, 2005):

- Bypass Woods (UNA 77)
- Church Woods at Innes (UNA 78)
- Lafarge 1 (UNA 79)
- Lafarge 2 (UNA 80)
- Forest Glen Park (UNA 82)
- Chapel Hill Park (UNA 83)
- Navan Road at Pagé Road (UNA 97)

- Centre Park (UNA 76)

Significant Woodlands

Significant Woodlands are mapped on Annex 14 of the City of Ottawa's Official Plan to be within the eight (8) UNAs noted above. Potentially Significant Woodlands are found throughout the study area, within the Official Plan Natural Heritage Areas noted above and within ANSIs and Provincially Significant Wetlands (PSW), as well as in the forested areas south and north of the Blackburn Hamlet Bypass.

Significant Wetlands

The *Provincial Policy Statement* (PPS) 2020, prohibits development and site alteration in PSWs.

Mer Bleue Bog

There is one designated PSW within and immediately surrounding the study area - Mer Bleue Bog. It is located south of the project area and is designated as an Area of Natural and Scientific Interest (Life Science). Mer Bleue Bog is a 7,700-year-old wetland which provides habitat for many regionally rare and significant plants, birds and other wildlife and is managed by the NCC. In addition to being recognized as a PSW, the Mer Bleue Bog is also a wetland of international importance under the Ramsar Convention on Wetlands.

5.2.3 Wildlife

The Study Area has been identified as potentially containing:

- Specialized Habitat for Wildlife: Amphibian Woodland and Wetland Breeding; Bald Eagle and Osprey Nesting, Foraging and Perching; Deer Yarding; Colonial Nesting Bird (Tree/Shrub, Watercourse Banks); Turtle Wintering and Nesting; Raptor Wintering and Nesting; Area Sensitive Forest Bird Breeding; Waterfowl Staging and Nesting; and Bat Maternity Colony.

- Potential habitat for Special Concern species within the Study Area include Monarch butterfly, Eastern Wood-pewee, Wood Thrush, eastern milksnake, eastern ribbonsnake, snapping turtle, and Eastern Musk Turtle Vegetation and Insect Species of Conservation Concern.

Species of Conservation Concern includes species that may be locally rare or in decline, but that have not yet reached the level of rarity that is normally associated with "Endangered" or "Threatened" designations under the Ontario *Endangered*

Species Act. This information is from the Natural Heritage Information Centre (NHIC) data and presented in **Table 5-1**.

Table 5-1: Vegetation & Insect Species of Conservation Concern

Species of Conservation Concern			Rank/ Status
Species Group	**Common Name**	**Scientific Name**	
Plants and Lichens	Woodland Pinedrops	*Pterospora andromedea*	S2
	Blistered Jellyskin	*Leptogium corticola*	S2
	Black-foam Lichen	*Anzia colpodes*	SH, THR
	Cupped Fringe Lichen	*Heterodermia hypoleuca*	S2
	Large Purple Fringed Orchid	*Platanthera grandiflora*	S1
	Southern Twayblade	*Neottia bifolia*	S1
Insects	Arrowhead Spiketail	*Cordulegaster obliqua*	S2

Status Ranks

SH: Only known from historical occurrences

S1: Critically imperiled (territory/province)

S2: Imperiled (territory/province level)

THR: Threatened (COSEWIC status)

5.2.3.1 Rare Vegetation

Vegetation information was taken from: the *Urban Natural Areas Environmental Evaluation Study*. Ottawa. Annex A – UNA 77 (Appendix –Vascular Flora observed Table) (Muncaster Environmental Planning Inc. and Brunton Consulting Services. 2005), and UNA 78 (Appendix –Vascular Flora observed).

UNA 77: Bypass Woods

- Provincially Significant Plants: *Carex folliculate (S3 Rank), Carex novae-angliae (S3 Rank)*
- Regionally Rare: *Hieracium kalmii* (var. *fasciculatum)* in swamp forest habitat
- There are four (4) Regionally Uncommon plants (as documented in the Appendix – Table from UNA 77 Bypass Woods) including: Bearded Shorthusk (*Brachyelytrum erectum*)*,* Interrupted Fern (*Osmunda claytoniana*)*,* Brownish Sedge (*Carex brunnescens*)*,* and American Black Elderberry (*Sambucus canadensis*) plant species in swamp forest habitat.
- One (1) plant was classified as Regionally Rare: Wherry Dowell's Woodfern (*Dryopteris x dowellii*)

UNA 78: Church Woods at Innes

- Regionally Significant: American shinleaf (*Pyrola americana*)
- Regionally Uncommon plant species in swamp forest habitat; - Bearded Shorthusk (*Brachyelytrum erectum*), Hay-scented Fern (*Dennstaedtia punctilobula*), Hickey's tree club-moss (*Lycopodium hickeyi*), Interrupted Fern (*Osmunda claytoniana*), and New York fern (*Thelypteris noveboracensis*).

UNA 82: Forest Glen Park

- Regionally Significant species: Golden Saxifrage (*Chrysosplenium americanum)* in Eastern Hemlock swamp habitat, and Marsh Pennywort (*Hydrocotyle americana*)
- There are seventeen (17) Regionally Uncommon plant species in upland and lowland Eastern Hemlock Habitats including: Slender false foxglove (*Agalinis tenuifolia*), False Nettle (*Boehmeria cylindrica*), and Eastern Rough Sedge (*Carex scabrata*)

UNA 83: Chapel Hill Park

- Three (3) Regionally Significant Species: Drooping Sedge (*Carex prasina*), Manna Grass (*Glyceria melicaria)*, Golden Saxifrage (*Chrysosplenium americanum*) in Coniferous Swamp Forest habitat in seasonal swales
- Twenty-two (22) Regionally Uncommon plant species including: Fireweed (*Erechtites hieracifolia*), Spotted St. Johnswort (*Hypericum punctatum*), and Ground Pine (*Lycopodium obscurum*)

Greens Creek Conservation Area

- Nine (9) Regionally Significant Species, two (2) of which are Provincial Conservation Concern Species: Witch Hazel (*Hamamelis virginiana*), Floating Bur-reed (*Sparganium fluctuans*), Cat-tail Sedge (Carex typhina) (S2), Small Bellwort (*Uvularia sessifolia*), Spotted Coralroot (*Corallorhiza maculata*), Grove Sandwort (*Moehringia lateriflora*), Climbing Poison-Ivy (*Toxicodendron radicans*), One-flowered Wintergreen (*Moneses uniflora*), Pinesap (*Pterospora andromedea*) (S3).

Mer Bleue Conservation Area

Over 64 Regionally Significant Species, of which two (2) are additionally Provincial Conservation Concern Species – Twinned

Bladderwort (*Utricularia geminiscapa*) (S3) and Downy Goldenrod (*Solidago puberula*) (S2).

DND Woods

- Five (5) Regionally Significant Species: Forest Meadow Grass (*Poa saltuensis*), Onion Sedge (*Carex prasina*), Round-leaved Orchid (*Platanthera orbiculata*), Three-leaved Snakeroot (*Sanicula trifoliata*), and Figwort (*Scrophularia lanceolata*).

5.2.3.2 Animal Movement Corridor

Animal movement corridors are elongated areas that are used by wildlife to move from one habitat to another habitat (MNRF, 2015b). The following animal movement corridors are potentially located in the study area:

- Amphibian Movement Corridors (Terrestrial): Movement corridors for amphibians moving from their terrestrial habitat to breeding habitat can be extremely important for local populations.
- Deer Movement Corridors: Corridors important for deer to be able to access seasonally important life-cycle habitats or to access new habitat for dispersing individuals by minimizing their vulnerability while travelling.

5.2.3.3 Terrestrial Species at Risk

The following species at risk, as specified under the Endangered Species Act, 2007 (ESA) or the Species at Risk Act (SARA) either have been identified as present, or they may potentially be found within the study area. The list of species is present in the Table below (**Table 5-2**).

Table 5-2: Terrestrial Species at Risk

Species		Designations*		Legislation**	
Common Name	Scientific Name	Federal (SARA)	Provincial (SARO)	Federal	Provincial
Butternut	*Juglans cinerea*	END	END	SARA	ESA
Flooded Jellyskin	*Leptogium rivulare*	SC	NAR	SARA	-
Pale-bellied Frost Lichen	*Physconia subpallida*	END	END	SARA	ESA
Monarch Butterfly	*Danaus plexippus*	SC	SC	SARA	FWCA, ESA
Blanding's Turtle	*Emydoidea blandingii*	END	THR	SARA	FWCA, ESA

Species		Designations*		Legislation**	
Common Name	**Scientific Name**	**Federal (SARA)**	**Provincial (SARO)**	**Federal**	**Provincial**
Eastern Milksnake	*Lampropeltis triangulum*	SC	NS	SARA	FWCA, ESA
Eastern Ribbonsnake	*Thamnophis sauritus*	SC	SC	SARA	FWCA, ESA
Northern Map Turtle	*Graptemys geographica*	SC	SC	SARA	FWCA, ESA
Snapping Turtle	*Chelydra serpentina*	SC	SC	-	FWCA, ESA
Western Chorus Frog	*Pseudacris triseriata*	THR	NS	SARA	-
Eastern Musk Turtle	*Sternotherus odoratus*	SC	SC	SARA	FWCA, ESA
Eastern Hog-nosed snake[2]	*Heterodon platirhinos*	THR	THR	SARA	ESA
Bank Swallow	*Riparia*	THR	THR	MBCA, SARA	ESA
Barn Swallow	*Hirundo rustica*	THR	SC	MBCA, SARA	ESA
Bobolink	*Dolichonyx oryzivorus*	THR	THR	MBCA, SARA	ESA
Chimney Swift	*Chaetura pelagica*	THR	THR	MBCA, SARA	ESA
Eastern Meadowlark	*Sturnella magna*	THR	THR	MBCA, SARA	ESA
Eastern Wood-pewee	*Contopus virens*	SC	SC	MBCA, SARA	ESA
Henslow's Sparrow	*Ammodramus henslowii*	END	END	MBCA, SARA	ESA
Wood Thrush	*Hylocichla mustelina*	THR	SC	MBCA, SARA	ESA
Least Bittern	*Ixobrychus exilis*	THR	THR	MBCA, SARA	ESA
Common Nighthawk	*Chordeiles minor*	SC	SC	MBCA, SARA	ESA
Little Brown Myotis	*Myotis lucifugus*	END	END	SARA	FWCA, ESA

[2] This reptile was recorded in square 18VR53 from NHIC database in February 2015 and will need to be verified by NDMNRF as an observation of a snake during the winter months is unlikely and this is outside of the species natural range.

Species		Designations*		Legislation**	
Common Name	**Scientific Name**	**Federal (SARA)**	**Provincial (SARO)**	**Federal**	**Provincial**
Northern Myotis	*Myotis septentrionalis*	END	END	SARA	FWCA, ESA
Tri-colored Bat	*Perimyotis subflavus*	END	END	SARA	ESA
Eastern Small Footed Myotis	*Myotis leibii*	-	END	-	FWCA, ESA

* **Designations:** **END:** Endangered **NAR:** Not at Risk **NS:** No Status **THR:** Threatened

** **Legislation:** **SARA:** Species at Risk Act **SARO:** Species at Risk Ontario **ESA:** Endangered Species Act **FWCA:** Ontario Fish and Wildlife Conservation Act **MBCA:** Migratory Bird Conservation Act

Potential SAR habitat was identified based on review of 2014 aerial photography for the study area. **Figure 5-4** identifies the potential for bird, bat and amphibian SAR habitat based on the 2020 federal and provincial species listings and 2014 aerial photography, as determined by the study team. It is noted that actual conditions may differ from those illustrated and grasslands are currently under mostly active agricultural activities.

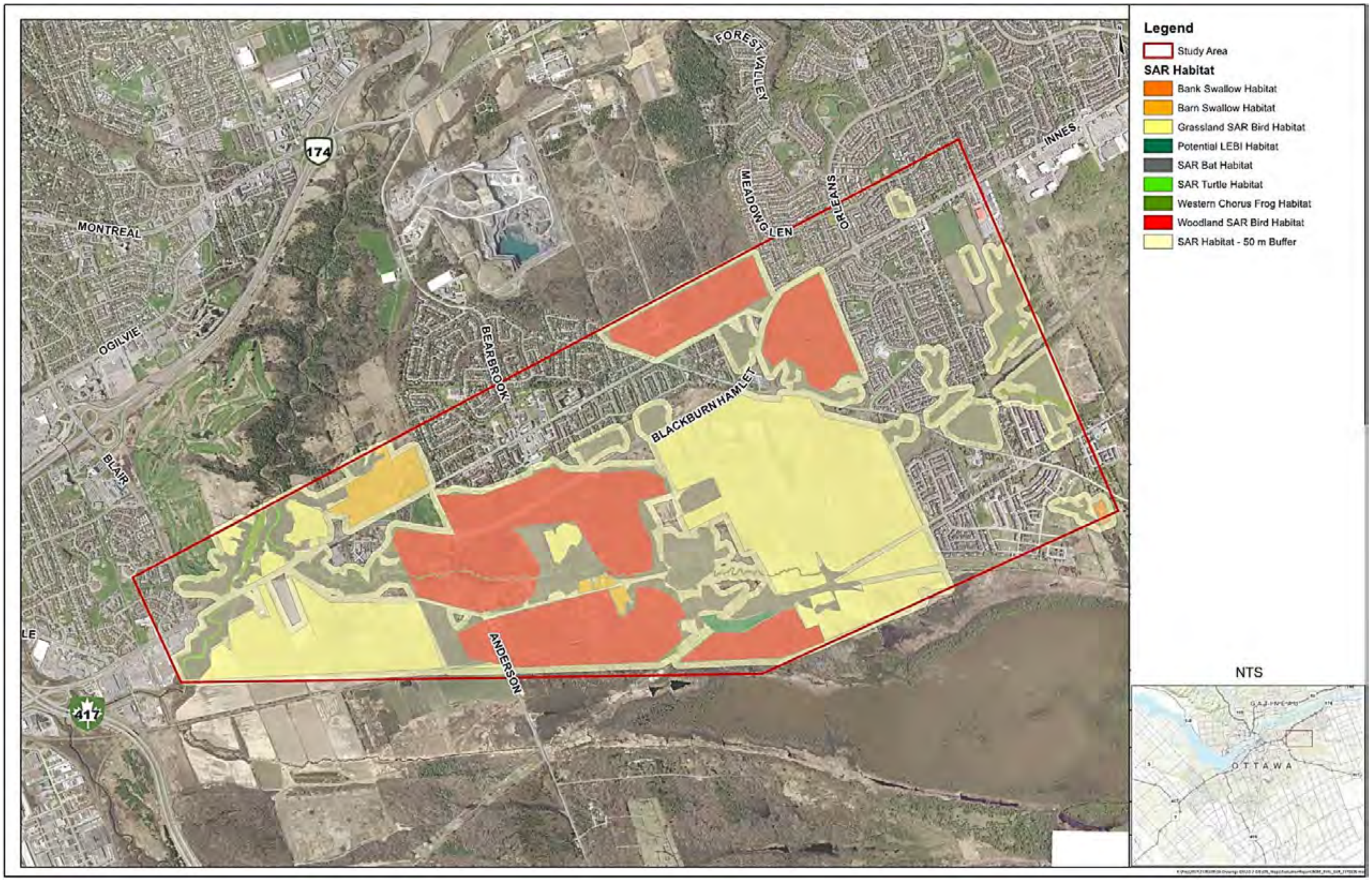

Figure 5-4: Potential Species at Risk Habitat (Desktop Review)

5.2.4 Geological Environment

The geologic subsurface conditions were established based on a review of the Published Geologic Survey of Canada (GSC) mapping; past geotechnical reports undertaken within the study area by Golder Associates Ltd. (Golder) and McRostie Genest St-Louis and Associates; and reports published in the MTO GEOCRES Library (Golder, 2018a). Golder documented findings in a Technical Memorandum (2018a), which are summarized in the sections below and available in **APPENDIX D.3**.

5.2.4.1 Bedrock Geology

Depths to bedrock range from 25 to 50 metres over most of the study area with the exception of the extreme west and east ends where the bedrock elevation rises west of Anderson Road and east of Navan Road. The study area bedrock consists primarily of shale (Billings Formation) and limestone (Lindsay, Bobcaygeon and Gull River Formations) (**Figure 5-5**). Bedrock outcrops were only encountered in the far northwest portion of the study area at the crossing of Greens Creek at Innes Road and along Beaverpond Drive, and the far northeast portion of the study area (west of Orléans Boulevard, just north of Innes Road).

5.2.4.2 Surficial Geology

The study area is within the physiographic region known as the Ottawa Valley Clay Plain characterized by an extensive deposit of marine clay deposited within the Champlain Sea basin, interrupted by sand or bedrock ridges. Subsurface conditions consist of a thick deposit of weak and compressible marine silty clay, which is often overlain with a relatively thin sand cap. No significant or extensive fill layers were found to exist within the study area, with sporadic filling, including pavement structures from the existing roadways encountered at some locations. Throughout most of the study area, thin organic topsoil deposits were encountered with thicker and peaty organic soils (up to approximately 2 metres) found in isolated areas south of Blair Road and near Pagé Road. Thick peat and organic deposits are also expected in the area of the Mer Bleue bog. Alluvial sand deposits exist on the western and central portions of the study area with depths upwards of 6 metres encountered in the most western portion of the study area. East of Bearbrook Road, sand deposits with thicknesses up to 4 metres were encountered. However, the sand cap was not encountered at all locations and is considered to have been eroded sporadically. The sand tends to be in a generally loose to compact state (**Figure 5-6**).

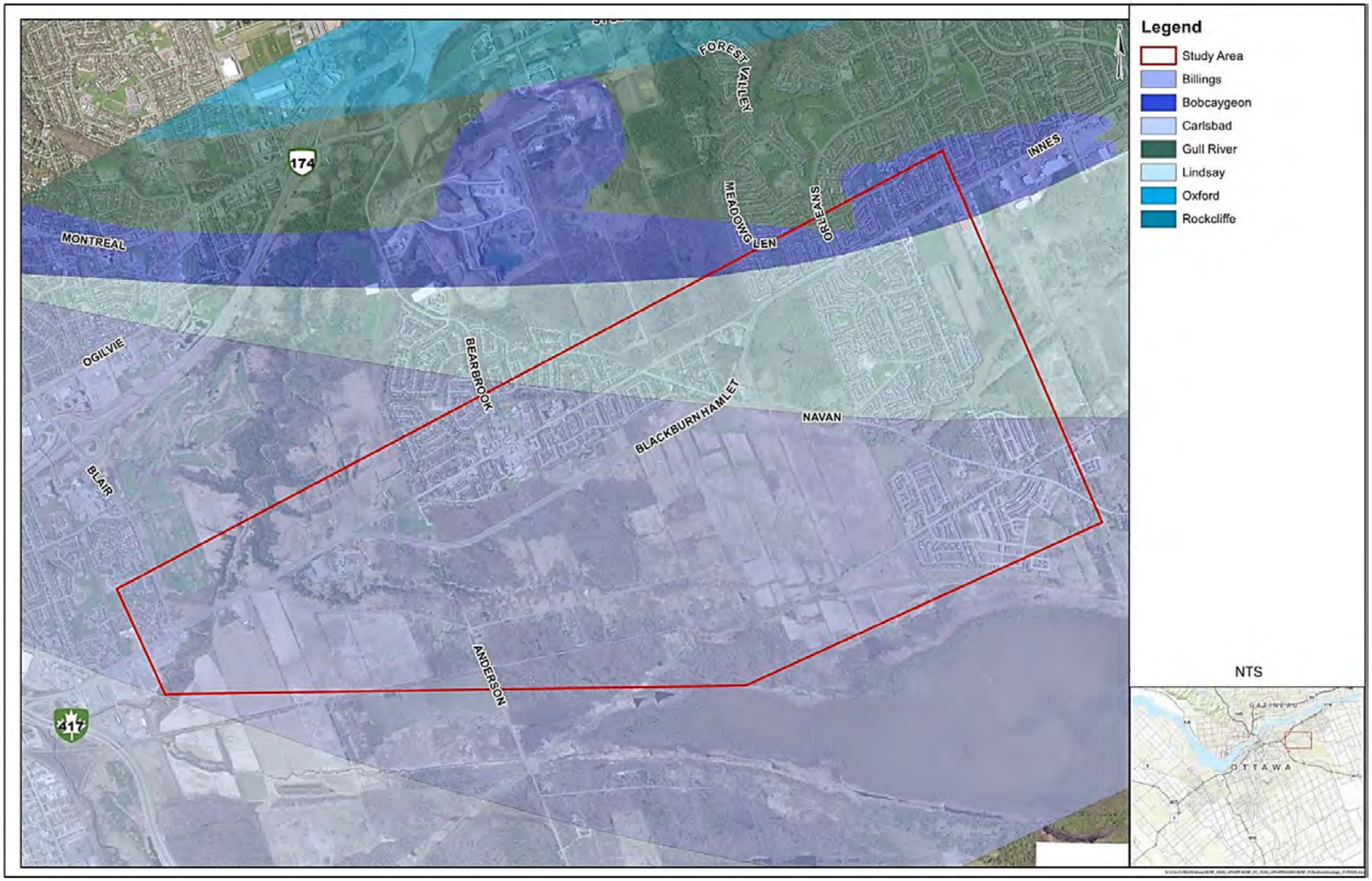

Figure 5-5: Bedrock Geology

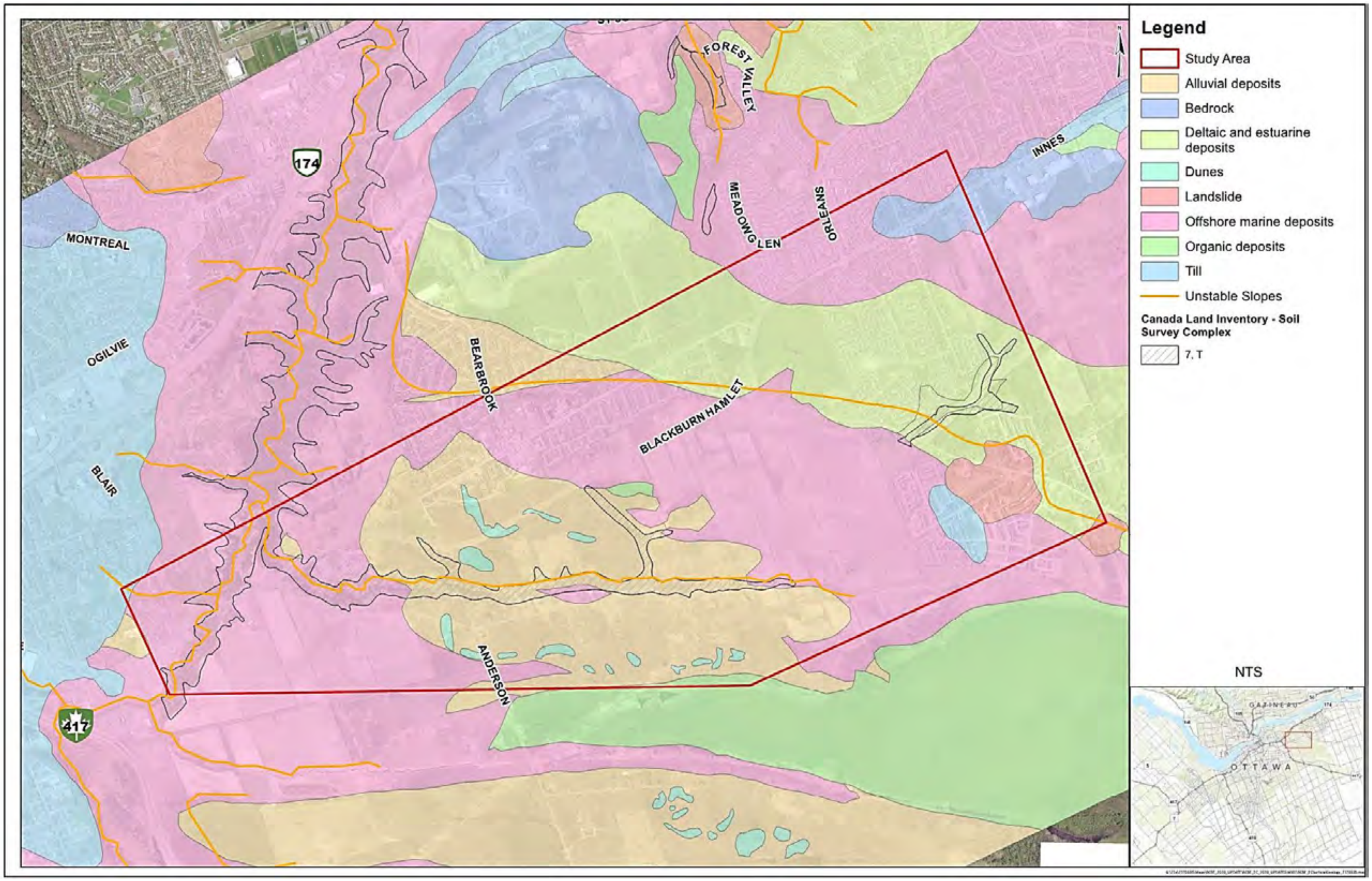

Figure 5-6: Surficial Geology

Silty Clay

A thick deposit of sensitive and compressible silty clay is found below the fill, sand cap and organic matter, where present. Weathered grey-brown crusts with generally stiff to very stiff consistency are found in areas of thick silty clay deposits and present singularly in areas where the silty clay deposits are thinner (in the vicinity of Renaud Road and east of Blair Road). Depths of the weathered zone vary from approximately 1 to 4.5 m based on previous geotechnical borehole information.

The silty clay depths range up to 30 m between about Anderson Road to the eastern limits of the study area with layers of approximately 3 to 9 m thickness in the southeast corner of the study area and absent in the area surrounding Blair Road. Below the weathering, the silty clay is grey with deeper layers having occasional black mottling and containing silt, fine sand seams and clayey silt layers. Typically, the silty clay deposit has a firm consistency with shear strengths generally increasing with depth. Throughout the study area, the silty clay varies from soft to stiff with soft portions (i.e., shear strengths equal or less than 25 kilopascals) located mainly in the eastern half of the study area; and firm to stiff clay in the western portion. The deposit is indicated to be a sensitive to extra sensitive/quick clay.

Glacial Till

Underlying the silty clay is glacial till with the exception of some localized areas, where silty clay was not encountered. At such sites, glacial till is found at the ground surface or immediately below any surficial fill or the sand cap (area west of Anderson Road and southeastern portion of study area). Glacial till depths range in thickness from about 1 to 4 m generally; and consist of gravel, cobbles, and boulders in a matrix of sandy silt and silty sand with a trace to some clay. Generally, the glacial till is expected to be compact to dense.

5.2.4.3 Slopes & Ravines

The Canada Land Inventory (CLI) is an interpretative system for assessing the effects of climate and soil characteristics as they relate to agriculture. The system classifies mineral soils into seven groups according to their potentials and limitations, with the first three classes (Classes 1-3) capable of sustained production of cultivated field crops and are considered prime agricultural land resources (OMAFRA, 2020). The seventh class (Class 7) has no agricultural capability and includes marsh, rockland and soil on very steep slopes (OMAFRA, 2020). Various soil subclasses further identify any limitations of the soils on agriculture. As it relates to steep slopes, Subclass T - Topography denotes limitations due to slope steepness and length (OMAFRA, 2020). As depicted in **Figure 5-6**, soils classified as 7-T are located within the study area, indicating steep and/or long slopes.

Schedule K of the City's Official Plan identifies unstable slopes within the study area, which are predominantly found along Greens Creek and Mud Creek.

Greens Creek

The Greens Creek main-stem channel meanders through deeply incised channels due to the predominantly clay-based substrates. This characteristic of highly unstable slopes within the Greens Creek watershed has led to frequent occurrences of slope failure and landslides, primarily between St. Joseph Blvd and Innes Rd (RVCA, 2016). Just upstream of Innes Road, the Greens Creek valley system is approximately 5 m in height. This height increases significantly downstream of Innes Road

Mud Creek

Stream bank erosion is widespread along the Mud Creek valley due to both the undercutting of the toe of the slope and high groundwater levels during the spring. The Mud Creek valley exhibits the potential for retrogressive flow slides (JTB Environmental Systems Inc. and J.F. Sabourin & Associates Inc., 2009).

A slope stability hazard assessment was completed by Golder Associates Ltd. in 2015 for Mud Creek (Golder, 2015). The assessment evaluates the stability of the creek and conducts qualitative assessments for the uncontrolled erosion along Mud Creek between Renaud Road and Innes Road.

As part of the above work, two site visits were conducted in the summer of 2012 by Golder personnel to observe the creek bank conditions, visible signs of previous slope failures, and exposed outcrops of native soil. A total of 16 locations were identified by Golder where there was evidence of previous slope instability. The identified slope failures ranged from relatively recently exposed silty clay slopes to areas of observed slope (Golder, 2015).

Golder determined that the valley slope height ranges from approximately 9 m near Renaud Road, to approximately 18 m near Innes Road. Valley slopes are generally inclined from horizontal at angles ranging from approximately 20 to 40 degrees. Golder further determined, that, based on the measured undrained shear strength values, the valley slopes are not considered to be susceptible to retrogressive earthflow sliding, in the event of a slope failure.

Within the upper reach of the Mud Creek valley, Golder has determined (2015):

- the setback distance to the Limit of Hazard Lands ranges from 13 to 28 m between Renaud Road and Weir Road. For planning purposes, a general setback distance of 30 m is recommended.

- the setback distances to the Limit of Hazard Lands range up to about 47 m below Weir Road to the tributary stream that joins Mud Creek. For planning purposes, a general setback of 50 m is recommended for planning purposes.

Golder (2015) notes that the results are applicable to the general sections of slope only, and site-specific studies are required for the detailed evaluation needed for the design of any development adjacent to individual or specific slopes. Project specific slope stability and meander setback investigations were completed for the preferred alternative corridor and are further described as Design Considerations in **Section 7.1** of this report.

5.2.4.4 Groundwater

Groundwater levels within the silty clay deposit were measured at approximately ground surface to about 5 m in depth, and more generally about 2 to 3 m depth. Within the glacial till and bedrock, groundwater levels were generally lower (from approximately 1 to 8 m in depth). Groundwater levels are expected to fluctuate seasonally with higher groundwater levels in spring (Golder, 2018a).

5.3 Social Environment

5.3.1 Federal Planning

5.3.1.1 National Capital Act

The Parliament of Canada passed the *National Capital Act* in 1985. This Act established the NCC, a Crown corporation whose responsibility is “to prepare plans for and assist in the development, conservation and improvement of the National Capital Region in order that the nature and character of the seat of the Government of Canada may be in accordance with its national significance.” (R.S.C. 1985, c. N-4, s. 10.1).

The 2013 Greenbelt Master Plan, which sets out the planning policies for the use and development of all Greenbelt lands, is one of the plans that has been prepared to fulfill this requirement. Additionally, the NCC is mandated to “coordinate the development of public lands in the National Capital Region (NCR)”, which includes reviewing all changes of land, use, construction, demolition, or other works on federal lands in the region. The NCC carries out this function through its Federal Land Use and Transaction Design processes.

5.3.1.2 Plan for Canada’s Capital: 2017 – 2067

The renewed mandate of the NCC, implemented in 2017, has brought into focus the importance of successful long-term planning and decisive stewardship actions to ensure that the Capital is worthy of its important national role. The Plan for Canada’s Capital (PFCC) is the preeminent planning document of the NCC and its Capital Planning Framework.

The PFCC outlines a framework for the continued evolution of the Capital to ensure it remains a welcoming and beautiful place, and that it makes Canadians proud.

The PFCC notes that in 2067, the Greenbelt will remain a fundamental part of the region’s vast network of natural spaces, in the midst of an urbanized region. The projected population increase will have an impact on the Greenbelt, as those green open lands will become more of a rarity. Much of the growth within the City of Ottawa could take place in communities adjacent to the Greenbelt. Key policy directions for the Greenbelt are identified in the PFCC for the next 50 years, and include:

- Where new infrastructure must cross the Greenbelt since it is demonstrated that there is no other viable alternative, the NCC will encourage clustering of the infrastructure in corridors to avoid further fragmentation of the land base. Any proposed new transportation infrastructure must be evaluated through the cumulative effects assessment process the NCC has jointly established with the City of Ottawa.

With regards to policy directions related to the Capital and the regional economy over the next 50 years the PFCC states that:

- Changes to federal accommodations will include locating facilities near readily available transit, and retrofitting or replacing buildings with more energy efficient design will contribute to regional sustainability and reduce environmental impacts; and

- In all aspects of its mandate, the NCC will support the use and development of smart technologies, and the sharing and exchange of information through partnerships with other federal agencies and the municipalities, when appropriate.

5.3.1.3 National Capital Commission Sustainable Development Strategy

The NCC's Sustainable Development Strategy aims to foster environmental protection within Canada's Capital Region. The current Sustainable Development Strategy (2018-2023) aims to protect the natural and cultural heritage, as well as contribute to the improved health and well-being of all residents and visitors in the National Capital Region (NCC, 2018). The NCC recognizes that creating sustainable communities requires collaboration across political and geographical boundaries and has identified thirty-six actions within development with a goal of completion by 2023. The goals and a sample of defined actions are summarized below:

1. **Effective Action on Climate Change:** The NCC commits to working with its partners to better understand climate impact, vulnerability and risk to increase the region's resiliency. This goal includes the promotion of sustainable transportation and mobility within the National Capital Region.

2. **Low Carbon Government:** The NCC will ensure that its future investments reduce greenhouse gas emissions, resulting in overall cost savings. This includes investing in measures to support low-carbon forms of transportation to reduce emissions from employee commuting and business travel.

3. **Modern and Resilient Infrastructure:** The NCC notes that long-term planning and stewardship functions with respect to federal lands, as well as through the federal land use, design and transaction approval process is vital in working toward more climate resilient infrastructure.

4. **Clean Energy:** The NCC recognizes that energy conservation is linked to public health and environmental well-being.

5. **Pristine Lakes and Rivers:** The NCC aims to continue protecting shoreline vegetation zones within leased properties and prioritize restoring degraded shorelines to improve ecosystem integrity.

6. **Sustainably Managed Lands and Forests:** As actionable goals the NCC aims to promote connectivity of ecosystems and habitats, control the spread of invasive plant species, and implement a forest management strategy with consideration

for natural and cultural heritage values and a focus on urban tree protection.

7. **Healthy Wildlife Populations:** Actionable goals include but are not limited to acquiring and analyzing ecological land classification data, creating a pollinator habitat landscape program, and developing guidelines to minimize wildlife mortality on roadways.

   Sustainable Food: The NCC supports sustainable food production on its lands. The NCC aims to enhance the conservation and quality of soil and water resources.

8. **Connecting Canadians with Nature:** The NCC aims to promote greater accessibility of Capital parks and greenspaces by public transit, and collaboration with partners to install new bike share locations in the NCC urban greenspaces.

9. **Safe and Healthy Communities:** The NCC applies environmental standards to operations and practices on its lands to prevent the pollution of lands, groundwater and surface water. It additionally manages a decontamination program for contaminated sites on NCC lands.

5.3.1.4 National Capital Commission 2013 Greenbelt Master Plan

The PFCC is the high-level strategic plan for all federal lands in the Capital, while the master plans such as the Greenbelt Master Plan (GMP) provide more specific policy direction to guide area planning, development, and management decisions. The 1996 GMP established land use strategies to provide recreation and attractive landscapes, to improve damaged and abandoned lands, to secure natural spaces and to support agriculture and forestry. The 2013 GMP considers the extent to which the Greenbelt is presently meeting these objectives and looks ahead to where the Greenbelt could be in 2067.

The GMP takes an integrated land use planning approach that incorporates ecological, economic, and social factors in Plan proposals and policies. The GMP sets policies for:

- Protected ecologically significant habitats
- A connected system of natural lands
- Sustainable farming

- Capital experiences, achieved through completion of a recreational pathway system and offering of visitor features such as trails, protected views and interpretation areas
- Greenbelt profile and environmental leadership, and
- Federal and non-federal facilities which respect the Greenbelt roles of Natural Environment, Sustainable Agriculture and Capital Experiences and Recreation and which demonstrate sustainable design and operations.

Transportation infrastructure, including both roads and transit, within the GMP framework is identified in Section 6.7 of the GMP. The Plan notes that this infrastructure has considerable impacts on the Greenbelt environment, including noise, visual nuisance, habitat loss and fragmentation, and pollution of air, water, and land. Devaluation of the landscape and of natural areas in terms of their recreation and tourism value can also be a significant economic factor. The NCC is committed to achieving sustainable transportation that complies with environmental conservation best practices in the Greenbelt, through collaboration with partners and stakeholders. The NCC will promote and give preference to sustainable, safe, and active transportation infrastructure that is consistent with the vision, roles and goals of the Greenbelt and is in accordance with the following policies:

a) Future transportation infrastructure projects that are proposed to be located within or adjacent to the Greenbelt will be considered according to the categories determined through the Cumulative Effects Assessment Study.

b) Work with the City of Ottawa, and other authorities to ensure that projects listed, are planned from the earliest stage to ensure early consultation and collaboration with, and consideration of the input of the NCC.

c) Apply the “No net loss” ecological principle to transportation infrastructure projects, through identification and implementation of appropriate mitigation measures. Off-site restoration may be sought where on-site restoration cannot be achieved.

d) Required, of proponents of any future new transportation infrastructure or improvement to existing transportation infrastructure, a thorough assessment of the loss in environmental value resulting from any such proposal(s), such assessment to include a cumulative effects component.

e) Work with the City of Ottawa and other jurisdictions with the aim of closing unopened road allowances and existing low volume roads in the Greenbelt.

f) Give priority to transport demand management measures when assessing new infrastructure proposals that respond to increasing demand for access to and within the Greenbelt.

g) Apply context sensitive design best practices to transportation infrastructure projects that aim to conserve Greenbelt natural and visual resources. Take landscape ecology principles into account in order to achieve ecological connectivity and wildlife safety. Include measures that seek to “blend” the infrastructure project into the Greenbelt landscape and protect views. Require the incorporation of wildlife-friendly designs and crossing facilities, where appropriate, in transportation infrastructure projects that affect natural areas on the Greenbelt.

h) Work with proponents of transportation infrastructure projects to ensure the provision of a symbolic and distinctive sense of place and arrival, to and through the Greenbelt.

i) Discourage Park-and-Ride facilities from locating within the Greenbelt.

j) Identify and implement measures to mitigate the deficiencies of existing transportation corridors and other structures and their impacts upon terrestrial and aquatic habitat.

k) Encourage the reduction or elimination of unnecessary lighting along transportation routes and at facilities in the Greenbelt to help achieve a night sky quality, without compromising safety.

l) Work with stakeholders to monitor and evaluate the extent of fragmentation caused by transportation projects and determine the effectiveness of mitigation measures.

m) Maintain and enhance the continuity of recreational pathways and natural links in the planning, design, and function of transportation infrastructure.

The study area is located within the Mer Bleue Sector as defined in the Greenbelt Master Plan. The Sector is characterized by the Mer Bleue designated wetland and the farmlands south of Blackburn Hamlet. **Figure 5-7** highlights the various sector designations including:

- H – Mud Creek Core Natural Area
- K – Innes, Navan, Renaud Road Farms
- M – Visual Quality
- N – Chapel Hill South
- O – Blackburn Station

- Q – Blackburn West Institutional-Commercial Node

Sector specific policies and considerations relate to the tiered framework and mitigation approaches developed through the Joint Cumulative Effects Assessment Study to prevent significant adverse environmental effects on the Greenbelt. Additionally, it is recommended that development have regard for the existing NCC studies, particularly those addressing erosion control thresholds.

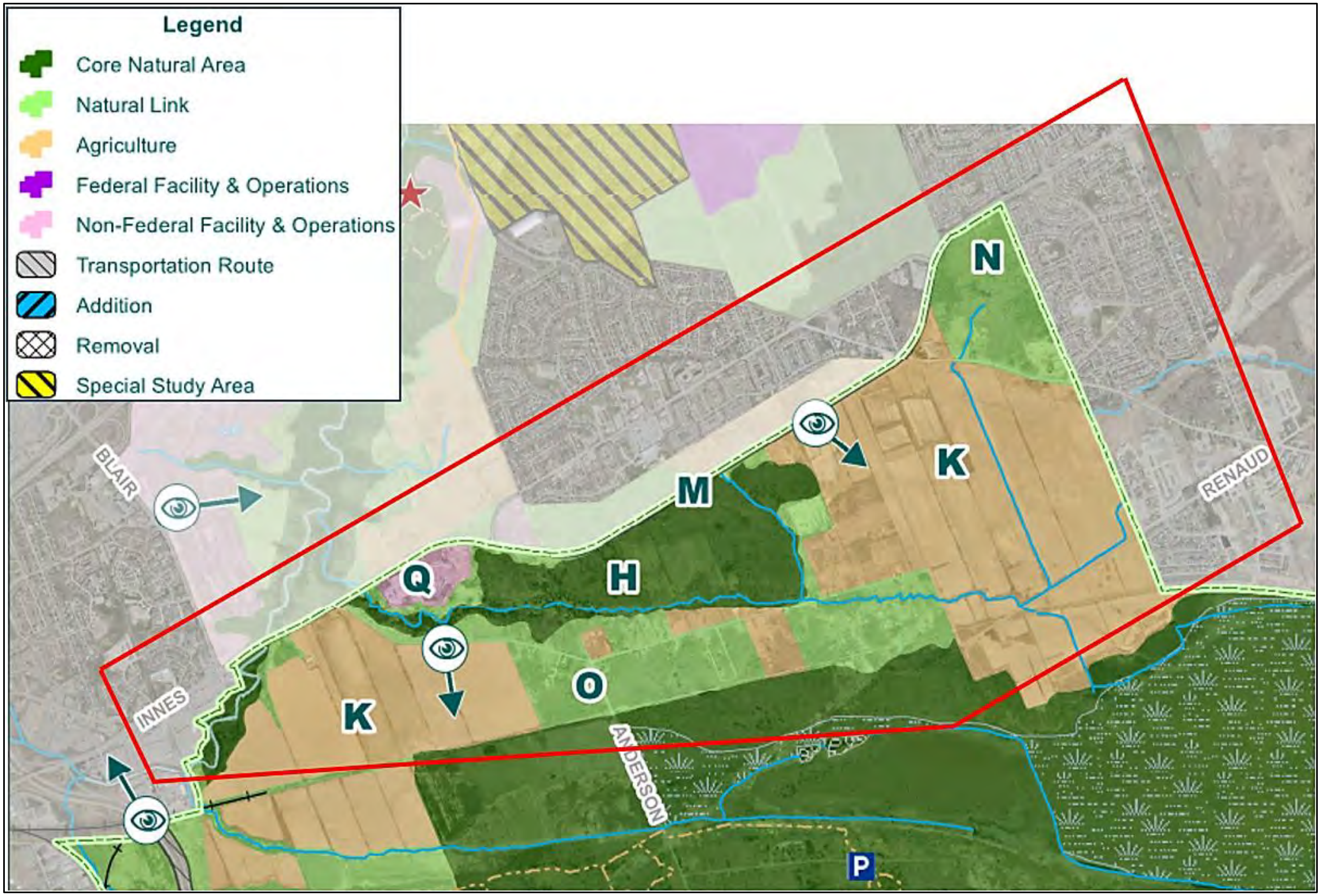

Figure 5-7: Mer Bleue Sector, Greenbelt Master Plan

5.3.1.5 Assessment of Cumulative Effects of Transportation Infrastructure on the National Capital Greenbelt

The *Joint Study to Assess Cumulative Effects of Transportation Infrastructure on the National Capital Greenbelt* (2012) was undertaken in partnership by the NCC and the City of Ottawa to identify projects within the TMP and other transportation projects that could have an impact on the environmental integrity of the federal Greenbelt lands.

The Study developed and implemented a cumulative effects framework and made recommendations for the study of future transportation projects. Thirty projects (transit and roads) within and/or adjacent to the Greenbelt were identified over the planning horizon to 2031.

Two categories of projects (Category 1 and Category 2) were defined, with Category 1 projects having the greatest potential contribution to cumulative effects, especially within Core Natural Areas and Natural Area Linkages.

The Cumberland Transitway (OR 174 to Navan Road) and the Blackburn Hamlet Bypass Widening were approved by the NCC "with conditions". The Brian Coburn Boulevard (Blackburn Hamlet Bypass) Extension and Chapel Hill Park and Ride Lot were approved by the NCC subject to standard review and approval processes. Blair Road Widening was not identified within the list of the thirty transportation projects included in the cumulative effects assessment.

The "approved" projects are included in the Greenbelt Master Plan and will be subject to standard design, review and review processes and mitigation will be determined by the necessary EA. The "approved with conditions" projects to be included in the Greenbelt Master Plan are subject to measures to minimize, compensate or offset contributions to cumulative effects on the Greenbelt, with the possibility of a designation "Not Include" in cases where specific mitigative conditions cannot be implemented satisfactorily.

5.3.1.6 Pathway Network for Canada's Capital Region: 2006 Strategic Plan

The 2006 Pathway Network Strategic Plan is a comprehensive strategy and vision for the planning, management, and expansion of the Capital pathway network. The 2006 Strategic Plan, prepared by the NCC in partnership with the City of Ottawa and the Ville de Gatineau, complements the NCC's Plan for Canada's Capital, and sets out a clear and common vision for the integrated network of pathways within Canada's Capital Region. While the Strategic Plan does not identify projects for implementation, it does include objectives, strategies, and policies to promote the safety and enjoyment of the pathways and ensures that the potential of the network is optimized.

5.3.2 Provincial Planning

5.3.2.1 Provincial Policy Statement

The Provincial Policy Statement (PPS), 2020, is authorized under Section 3 of the Planning Act, R.S.O. 1990. It contains policies relating to a wide range of areas of Provincial interest. Of relevance regarding the study, are policies that relate to recreation, transportation systems and infrastructure, long-term economic prosperity, and the protection of natural, cultural, and built heritage. In particular, the PPS promotes:

- Healthy and active communities by facilitating active transportation and community connectivity,
- The planning for and protection of corridors and rights-of-way for transportation infrastructure and transit to meet current and projected needs,
- Providing safe, efficient, cost-effective, and reliable multimodal transportation systems that facilitate the movement of people, are integrated with adjacent systems and are appropriate to address projected needs,
- Maintaining or restoring the diversity and connectivity of natural features in an area, and the long-term ecological function and biodiversity of natural heritage systems and recognizing linkages between and among natural heritage features and areas, surface water features and ground water features,
- Restricting development and site alteration in or adjacent to significant natural areas unless it has been demonstrated that there will be no negative impacts on the natural features or their ecological functions,
- Restricting development and site alteration in habitat of endangered or threatened species except in accordance with provincial and federal requirements,
- Restricting development and site alteration in or near sensitive surface or groundwater features such that their features and related hydrological functions will be protected, improved, or restored, and
- Conserving heritage and significant cultural heritage landscapes.

5.3.3 Municipal Planning

5.3.3.1 City of Ottawa Official Plan (2013)

The City of Ottawa Official Plan (OP) provides a vision for the future growth of the city and a policy framework to guide the city's physical development to the year 2031. It is a legal document that addresses matters of provincial interest defined by the Planning Act and the Provincial Policy Statement. The City of Ottawa's OP was adopted by City Council in May 2003 and approved by the Minister of Municipal Affairs and Housing in November 2003. Two major updates to the OP were adopted as part of a comprehensive review of the City's Official Plan completed in 2013. On November 26, 2013, Ottawa City Council unanimously approved the Official Plan Amendment #150 (OPA#150); the plan was approved by the Minister of Municipal Affairs on April 24, 2014, although appeals are still pending. Policies contained within the approved plan update are still considered council policy pending appeals.

The purpose of OPA#180 is to make changes to the various parts of the Official Plan to implement changes recommended by the Employment Land Review, the LEAR Review for Agricultural Land and the extension of the planning horizon for the Official Plan to 2036. This amendment constitutes part of the comprehensive 5-year review undertaken by the City in 2013 and as required by Section 26 of the *Planning Act*. Official Plan Amendment 180 was adopted by By-law 2017-19 on January 25th, 2017, and forwarded to the Ministry of Municipal Affairs and Housing for provincial approval.

5.3.3.2 City of Ottawa Official Plan (2022)

The City of Ottawa's new Official Plan (OP) was adopted by City Council on November 24th, 2021, and approved by the Ontario Ministry of Municipal Affairs and Housing on November 4th, 2022. The City's new OP is an update from the previous 2003 OP and directs the City's growth to 2046. The OP positions Ottawa to be a flexible and resilient city where people want to live, work and play.

The Strategic Directions in the OP outlines five policy areas, referred to as 'Big Moves,' to guide the City towards the goal of becoming the most livable mid-sized city in North America over the next century. They include:

- Achieve, by the end of the planning period, more growth by intensification than by greenfield development.

- By 2046, most trips in the city will be made by sustainable transportation.

- Improve our sophistication in urban and community design and put this knowledge to the service of good urbanism at all scales, from the largest to the very small.
- Embed environmental, climate and health resiliency and energy into the framework of our planning policies.
- Embed economic development into the framework of our planning policies.

There are several different Transect Areas identified in the OP including a Greenbelt Transect. The OP land use policies for the relevant areas are supported by designations by illustrating the distribution of transportation, road and cycling networks, priority development areas, protected areas, and other constraints to inform development across the City. This is referred to as the Schedule C Series and identifies the key transportation facilities in our study area as outlined in the table and graphics below.

Table 5-3: Table C Series Transect Designations

C-Series Schedule	Designation	Location within the Study Area
C2 – Transit Network (Ultimate)	Transitway – Grade Separated Crossings	Blackburn Hamlet Bypass
	Transit Priority Corridor	Innes Road
C3 – Active Transportation Network (Urban – Major Pathways)	Major pathway	Tauvette Street, across Innes and Blackburn Hamlet Bypass, extending south towards Renaud Road
C4 – Urban Road Network	Arterial – Existing	Blackburn Hamlet Bypass
	Arterial – Future (alignment defined)	*New Road off Navan Road
	Major Collector – Existing	Innes Road
	Collector - Existing	Renaud Road
C7-A – Design Priority Areas – Urban	Corridor- Mainstreet within Design Priority Area	Innes Road
C11-C – Natural Heritage System (East)	Natural Heritage System Core Area	Mer Bleue Conservation Area
	Natural Heritage Features Overlay	
C12 – Urban Greenspace	Open Space	Greenspace between Glen Park Drive/Orient Park Drive and Blackburn Hamlet Bypass
	Greenbelt Natural Area	Green's Creek Sector, Mer Bleue Sector

C-Series Schedule	Designation	Location within the Study Area
	Greenbelt Natural Linkage	Green’s Creek Sector, Mer Bleue Sector
	Significant Wetlands	Mer Bleue Conservation Area
	Park	Tauvette Park, Orient Park, Michael Budd Park, Innes Park
C15 – Environmental Constraints	Unstable Slopes	Green’s Creek Sector, northern Mer Bleue Sector
C16 – Road Classification and Rights-of-Way Protection	Blackburn Hamlet Bypass (Innes)	G to 86.2m
	Innes Road (between Blair and Backburn Hamlet Bypass (west end))	45.7 to 118.8m
	Innes Road (between Rondel and Blackburn Hamlet Bypass (east))	26m
	Brian Coburn (from Blackburn Hamlet Bypass to Trim)	40m
	Renaud (between Greenbelt Boundary and Fern Casey)	26m

Overall the 2022 OP provides an overall policy direction recognizing that land use and transportation are fundamentally connected. *Planning for transportation looks beyond moving people and goods, to also guide city-building objectives such as growth management and economic development (Section 4.1).*

The Transportation policy in the Plan reflects Council's commitment towards more equitable, safe and healthy communities and climate change action. This project recognizes the City will direction to rely primarily on space- and cost-efficient modes of transportation to accommodate the projected population growth and intensification targets of this Plan. This project has a deliberate approach to the allocation of space for automobiles and includes both public transit and active transportation. The design also incorporates a Safe Systems Approach to reduce the frequency and severity of collisions for all road users through traffic management and intersection design.

Related to the Promotion of healthy 15-minute neighbourhoods and as part of new road construction and road reconstruction projects this project considers:

- sidewalks on both sides
- cycling facilities
- feasible connections to active transportation facilities
- transit service along Corridors and in areas targeted for intensification and new growth including greenfield areas

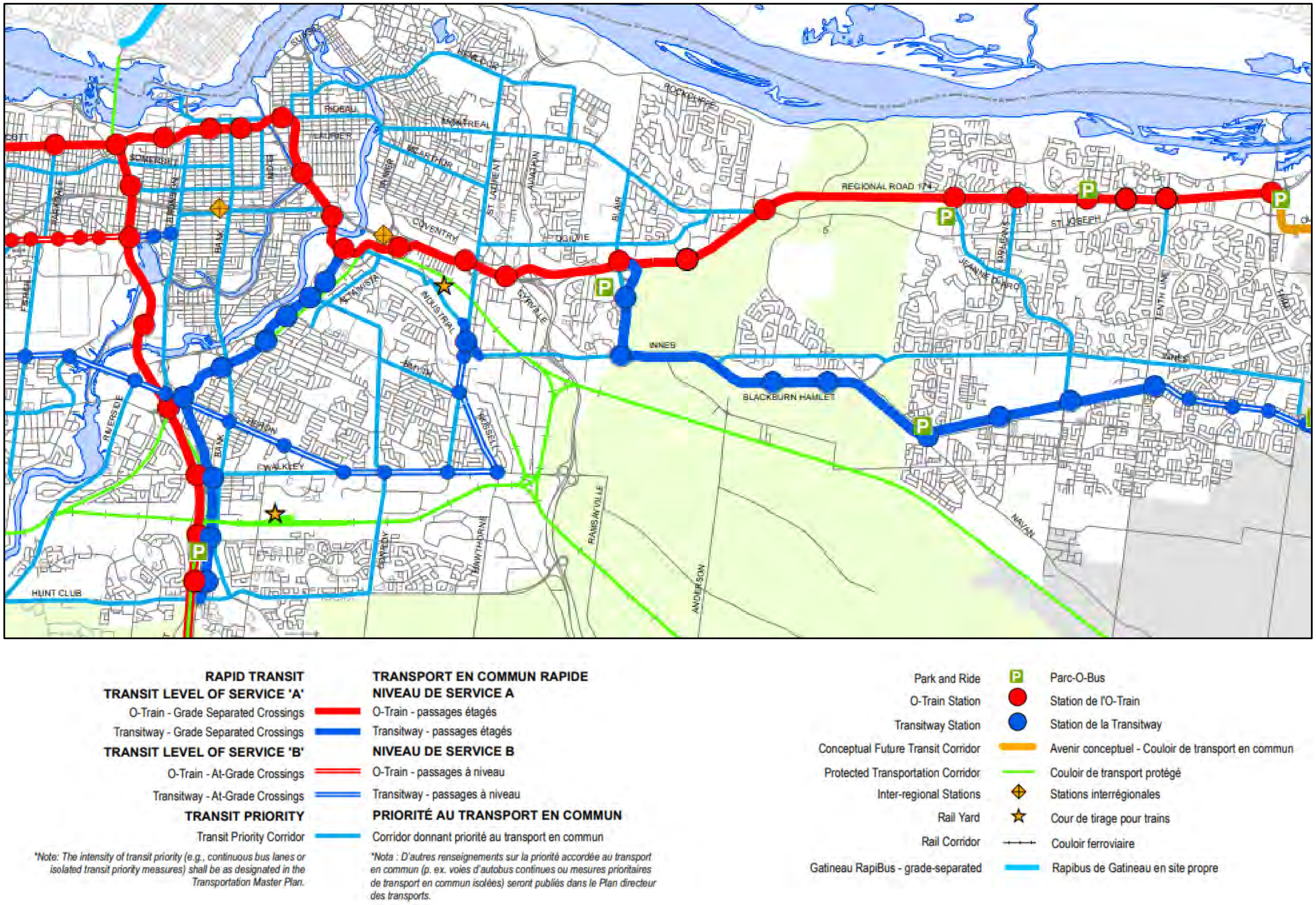

Figure 5-8: Transit Network (City of Ottawa 2022) OP

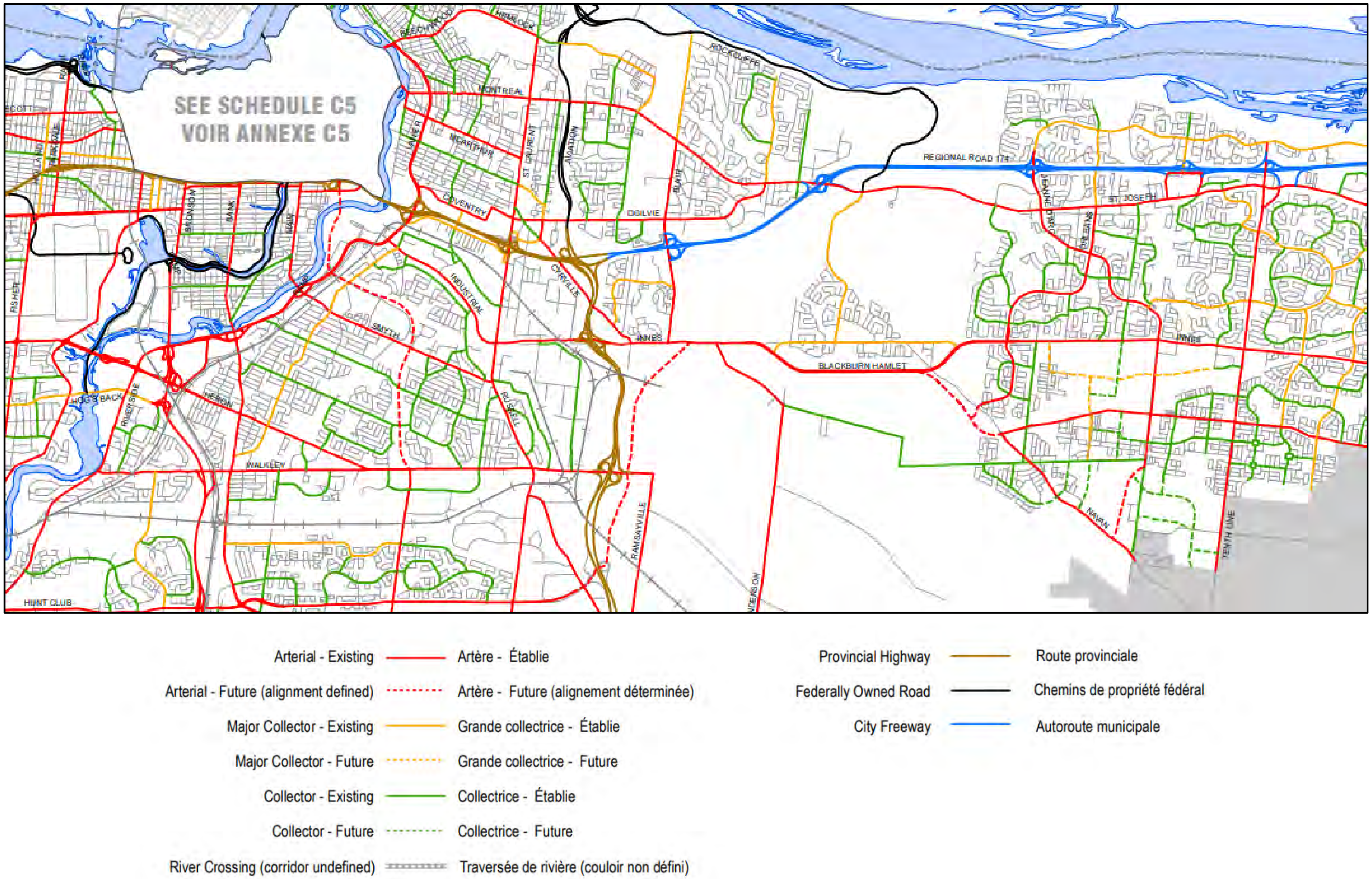

Figure 5-9: Schedule C4 – Urban Road Network (City of Ottawa 2022) OP

5.3.3.3 City of Ottawa Transportation Master Plan (TMP)

To implement the transportation policies expressed in the OP, City Council has adopted a Transportation Master Plan (TMP) that identifies facilities and services that the City intends to put in place over the next two decades to meet the travel needs of residents and businesses in Ottawa and to support the development pattern identified in the OP.

The City's TMP and OP place considerable emphasis on transit. The TMP states that enhanced transit service elements will be provided as early as possible. These may take the form of surface transit routes with accelerated frequencies, accompanied by transit priority measures. While the City is protecting for grade-separation of most of the rapid transit network (i.e., intersections where rapid transit corridors intersect with streets, or pedestrian crossings at rapid transit stations), where practical it will defer the costs of grade-separation by using transit priority measures that reduce delay and improve service reliability by isolating transit from mixed traffic.

The TMP indicates that most Ottawa's transit service is delivered on roads, where traffic congestion increases delay and reduces the reliability and efficiency of transit services. Transit priority can improve the competitiveness of transit by reducing travel times and improving service reliability, while allowing more transit service to be delivered with the same resources. Transit priority measures (e.g., dedicated bus lanes, transit signal priority treatments, bus queue jumps, special bus stop arrangements, and traffic management techniques such as queue relocation) are intended to eliminate delay to transit services caused by congestion, and to minimize delay caused by traffic signals. Providing road corridors with a set of coordinated transit priority measures can substantially improve the quality of service enjoyed by transit customers without incurring the costs of a fully grade-separated rapid transit corridor. As stated, the transportation analysis and the development of solutions will be undertaken in a manner that prioritizes the implementation of transit in the study area. The 2013 TMP/OP also supports the use of non-auto modes including walking and cycling:

Walking: The City's Pedestrian Charter establishes the vision, goals, and objectives for walking. It articulates a commitment to creating a city where people walk because they want to and defines a series of guiding principles to create a supportive urban environment. The Ottawa Pedestrian Plan contains a number of policies and actions for the City to implement. They address land use, walking network development, street and pedestrian facility design, maintenance, safety programs, information, promotion, stakeholder engagement, interjurisdictional cooperation, and performance measurement. The City requires that that planning processes such as Community Design Plans, Transit Oriented Design plans, and Environmental Assessments for transportation projects include the prescribed pedestrian facilities found within the 2013 Pedestrian Plan.

The City of Ottawa 2013 Pedestrian Plan contains mapping of the proposed network (Exhibit 3.2) as well as an outline of the prioritization process that was undertaken to determine the links that are deemed affordable that would be built during the planning horizon of the 2013 Pedestrian Plan. The plan does not identify any proposed connections within the Blair Road, Innes, Navan or Blackburn Hamlet corridors.

Cycling: The Ottawa Cycling Plan (OCP) contains policies and actions to increase the safety, convenience, and comfort of cycling in Ottawa. These include land use, cycling network development, street and cycling facility design, bicycle parking, cycling-transit integration, funding, maintenance, safety programs, wayfinding assistance, information, promotion, stakeholder engagement, inter-jurisdictional cooperation, and performance measurement. The existing study area includes on road cycling facilities (generally on-road bicycle lanes/paved shoulders) and off-road facilities (e.g., Prescott-Russell Trail).

The OCP 2013 notes that cyclists are permitted on all City roadways except major divided highways. The OCP identifies a complete network of cycling routes covering the entire City. While this Ultimate Network Concept (UNC) has no targeted completion date, it serves as a framework for prioritizing projects within the planning horizon. The OCP 2013 notes that the second important role of the UNC map is to allow for coordination when roadworks or developments are being reviewed.

Cross-Town Bikeways are defined in the OCP 2013 as those facilities that will include both on-road and off-road facilities to provide a consistently high level of comfort for their entire length and be the main priority of the cycling network for maintenance. Geo Ottawa, as referenced in the OCP, highlights the UNC. The following routes have been identified within the UNC as highlighted on Geo-Ottawa (2020) and in **Figure 5-10**:

- **Spine Routes:** Blair Road, Navan Road and Innes Road
- **Local Routes:** Anderson Road and Renaud Road connecting to the Montreal and Ottawa Rail Corridor Major Pathway
- **Major Pathways:** Prescott-Russell Trail, Blackburn Hamlet Bypass and various routes not along an existing major transportation corridor.

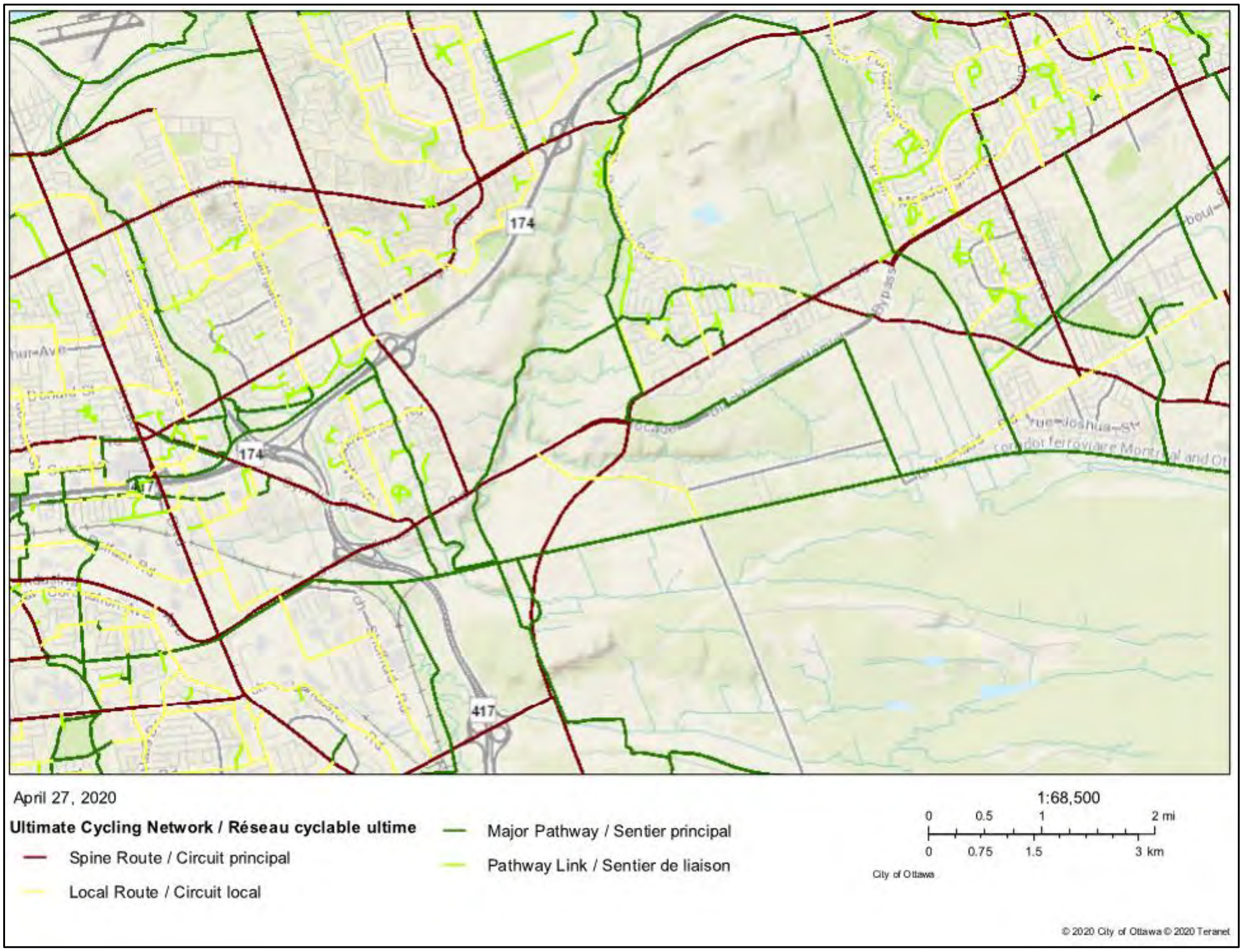

Figure 5-10: Ultimate Cycling Network (Geo-Ottawa 2019)

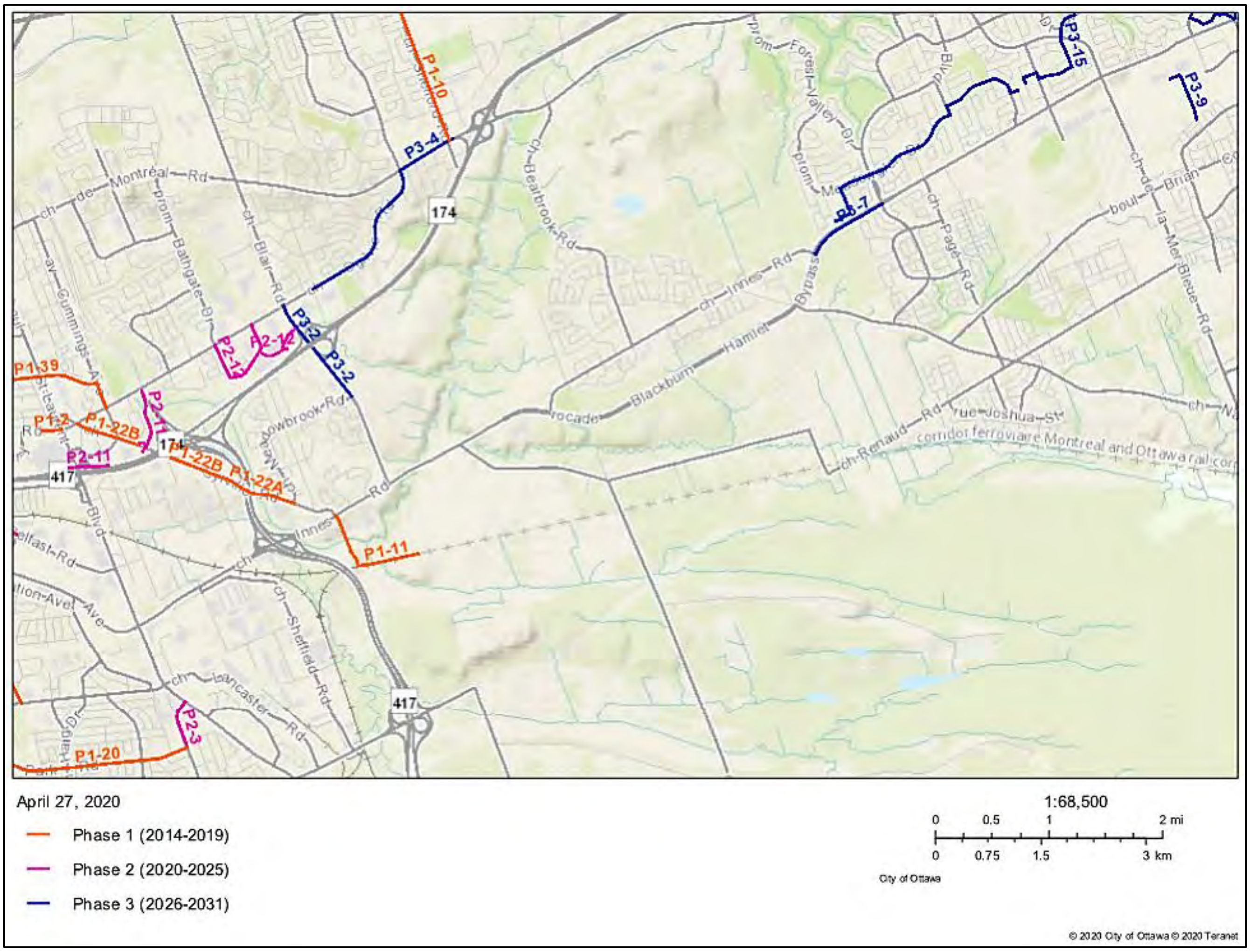

Figure 5-11: City of Ottawa Cycling Plan – Phased Projects (Geo-Ottawa 2019)

The OCP (2013) has established targets and budget requirements for the 2031 planning horizon, with implementation over three time frames:

- Phase 1 projects to be implemented between 2014 and 2019
- Phase 2 projects to be implemented between 2020 and 2025
- Phase 3 projects to be implemented between 2026 and 2031

As indicated in **Figure 5-11**, bike lanes (or other cycling improvements) are identified as a Phase 3 project for the Blair Road corridor from Ogilvie Road to Meadowbrook Road as part of the TOD development (P3-2).

5.3.3.4 City of Ottawa Transportation Master Plan Update 2023

The City of Ottawa's population is growing, with projections for 1.4 million people by 2046. Sustainable transportation and walkable "15-minute neighbourhoods" have been emphasized as priorities for the City's development. The TMP is a critical document in the development and implementation of this vision for the City as it strives to become North America's most livable mid-sized city. The vision for the TMP is: "*In 2046, Ottawa's transportation network will be flexible, dependable, safe and efficient in meeting the evolving needs of residents and businesses across the city, while enabling the City to meet its climate goals. The network will provide travel options for people regardless of their income, identity, or ability.*"

The Transportation Master Plan is currently being updated. Part 1 was approved at the City Council meeting of April 26, 2023. Part 1 included the TMP Policies, Active Transportation Projects and Networks, and Transit and Road Project Prioritization Frameworks for TMP Part 2, development of the Capital Infrastructure. The next step is the development of the TMP Capital Infrastructure Plan, including additional public engagement on travel patterns and trends, transit and road projects, and network investment scenarios.

Part 1 re-enforces the City commitment towards: investing in safe and healthy "complete streets"; expanding and connecting the City's pedestrian and cycling networks, including a focus on major barriers; and attracting and retaining residents by providing safe, convenient, and sustainable transportation options

5.3.3.5 Climate Change Master Plan (2020)

On April 24, 2019, Ottawa City Council declared a climate emergency, joining a growing global movement calling for urgent action to avert the climate crisis. The City of Ottawa's Climate Change Master Plan (CCMP) provides a framework for how the City can mitigate and adapt to climate change over the next three decades (2020a). The CCMP sets guiding principles, goals, greenhouse gas (GHG) emission reduction targets, and priority actions for the next five years (2020-2025). The CCMP identifies a total of eight priority actions for the City over the next five years (2020-2025):

1. Implement Energy Evolution: Ottawa's Community Energy Transition Strategy.
2. Undertake a climate vulnerability assessment and develop a climate resiliency strategy.
3. Apply a climate lens to the new Official Plan and its supporting documents.
4. Apply a climate lens to asset management and capital projects.
5. Explore community and corporate carbon budgets.
6. Explore options for carbon sequestration methods and the role of green infrastructure.
7. Encourage private action through education, incentives, and municipal support.
8. Develop a governance framework to build corporate and community capacity, align priorities, and share accountability in tackling climate change.

The CCMP is not a standalone document, and must be coordinated with other municipal planning documents, such as those described in **Section 5.3.3** of this report. The CCMP provides the framework for actions that address both climate mitigation and climate resilience/adaptation.

As one of the priorities identified in the CCMP, applying a climate lens to asset management has been identified as a critical area to be explored and developed in the short-term to achieve the long-term vision. Specifically, risk management and asset resiliency are core principles of asset management. The City of Ottawa commits to increasing climate considerations into the Capital Asset Management Plan.

5.3.3.6 Secondary Plans, Community Design Plans, TOD Guidelines

The East Urban Community (EUC) of the southeast Orléans area is a 570-hectare parcel of relatively urban land that has been designated as a Developing Community within the City of Ottawa Official Plan (OP). The proposed plan for the entire EUC area includes an addition of 6,700 residential units, accommodating 18,110 new residents (CH2M, 2018) (**Planning and Environment Committee, June 7, 2005)** .

There are three City of Ottawa *Secondary Plans* within the land use planning study area:

Mer Bleue Expansion Area Secondary Plan (2017)

The study area is located within the Mer Bleue Sector as defined in the Greenbelt Master Plan. The Sector is characterized by the Mer Bleue designated wetland and the farmlands south of Blackburn Hamlet. The Mer Bleue Expansion Area Secondary Plan sets out a series of policies that relate to creating a mix of densities, forms and uses, establishing small-scale commercial sites, providing for a hierarchy of neighborhood parks, improving pedestrian, and cycling facilities, preserving natural heritage features, and creating a well-designed street and block network. The Mer Bleue Expansion Area is that area as outlined in the Community Design Plan (**Figure 5-12**).

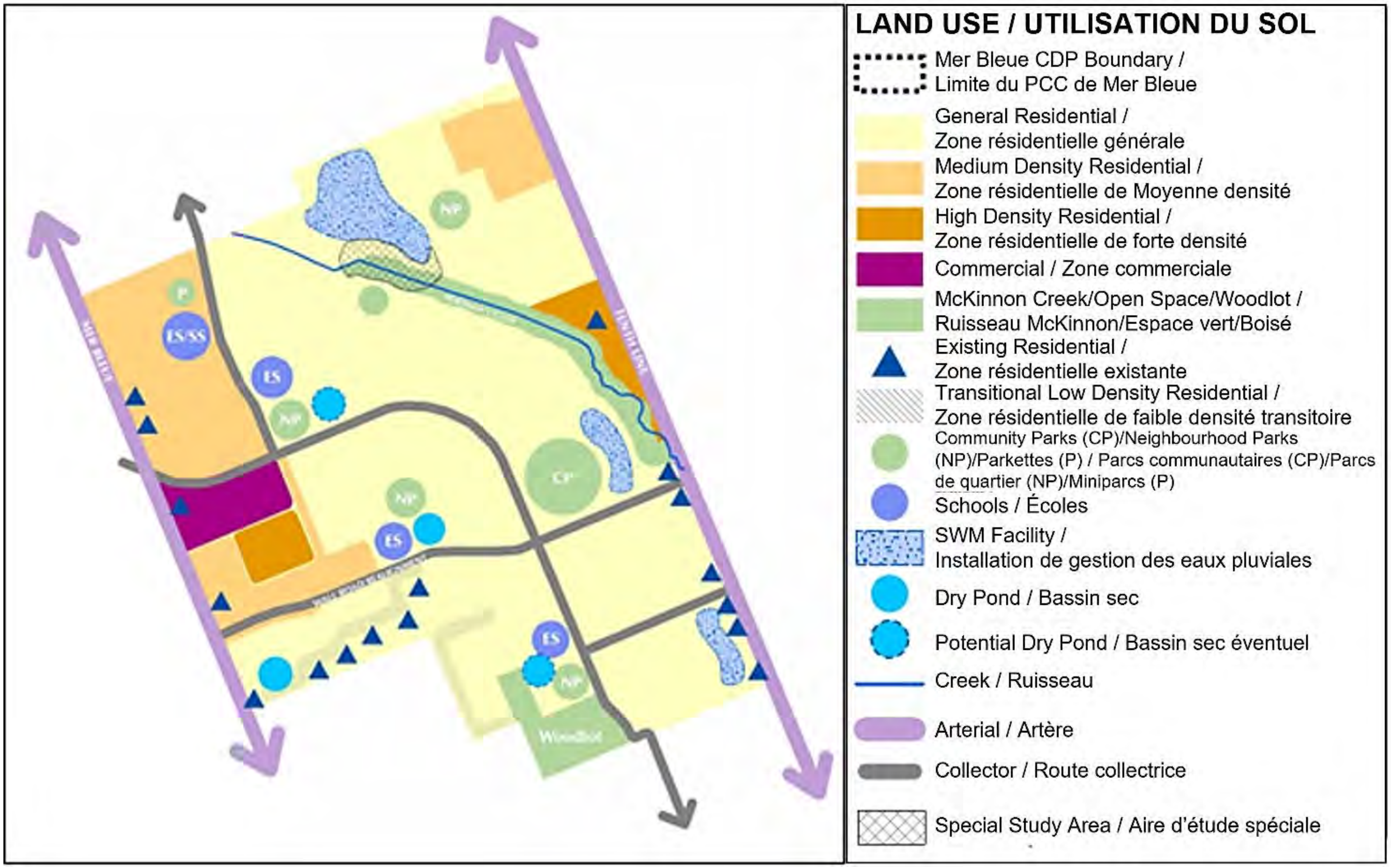

Figure 5-12: Mer Bleue Secondary Plan, Urban Expansion Area Boundaries

Blair Secondary Plan (2015)

The Blair Secondary Plan (**Figure 5-13**) provides direction on maximum building heights and minimum densities within the planning area identified within the Blair Transit-Oriented Development Plan to prioritize development intensification that is transit oriented and accessible to pedestrians, cyclists and vehicles. The Transit-Oriented Development (TOD) area is defined as an area within an approximate 800 m walk from a transit station.

Consolidated Villages Secondary Plan

The Notre-Dame-Des-Champs Village, located in the southeastern portion of the study area, is part of the City of Ottawa's Consolidated Villages Secondary Plan (**Figure 5-14**). The Village is bound by Mer Bleue Road to the east, the Wall Road homes at the northern extent, the Grand Pre neighbourhood south of Navan Road, and extends east to encompass the lots on Turquoise. The goal of this plan is to preserve the rich cultural heritage that exists in these distinct areas of Ottawa while providing a framework for future development that is compatible with their character and identity. Specific goals have been created for the Notre-Dame-Des-Champs Village, which includes:

- Ensuring that development is environmentally responsible,
- Developing a pedestrian-friendly village,
- Preserving the village identity, and
- Conducting a future comprehensive planning study to consolidate the Village and the urban parts of the Notre-Dame-Des-Champs community.

The listed CDPs implement the policies of the Official Plan and Secondary Plans, including their goals and objectives related to land use, intensification, transit, and employment opportunities.

A significant amount of commercial development will be concentrated in the EUC Mixed-Use Center as well as within Phase 2 lands, generating increased employment opportunities. At least 5,000 new jobs will be accommodated in the Mixed-Use Center, as directed by the OP. The Mer Bleue CDP proposes the development of 3,000 new residential units of various housing types and at least 5,000 new office, institutional, and commercial employment opportunities. The Mer Bleue Expansion Area 10 CDP (City of Ottawa, 2017a) envisions a community of 3,500 units and 10,000 residents (CH2M, 2018).

5.3.3.7 City of Ottawa 2036 Population Projections (2017)

The City expects a 31% increase in total population from 921,000 residents in 2011 to 1,214,000 million residents in 2036 (OPA #180, 2017).

The East Urban Community, Mer Bleue CDP and expansion area, and the Orléans Industrial Park contribute to an 812% population increase and 157% employment increase from 2012 to 2031. In the west end of the study area, the Blair TOD contributes significantly to the growth for this region as well, with a population increase of 179% and an employment increase of 22% from 2012 to 2031. Most other areas within the study limits are mature and established neighborhoods where growth is significantly less, even decreasing in some neighborhoods. For example, population decreases in the Pineview community by 13% from 2012 to 2031 and by 6% in Blackburn Hamlet. In general, the broader study area is expected to experience significant growth over the remainder of the planning horizon due primarily to Community Design Plans that have set ambitious targets for increasing population and employment opportunities in this region of Ottawa (City of Ottawa, n.d.b).

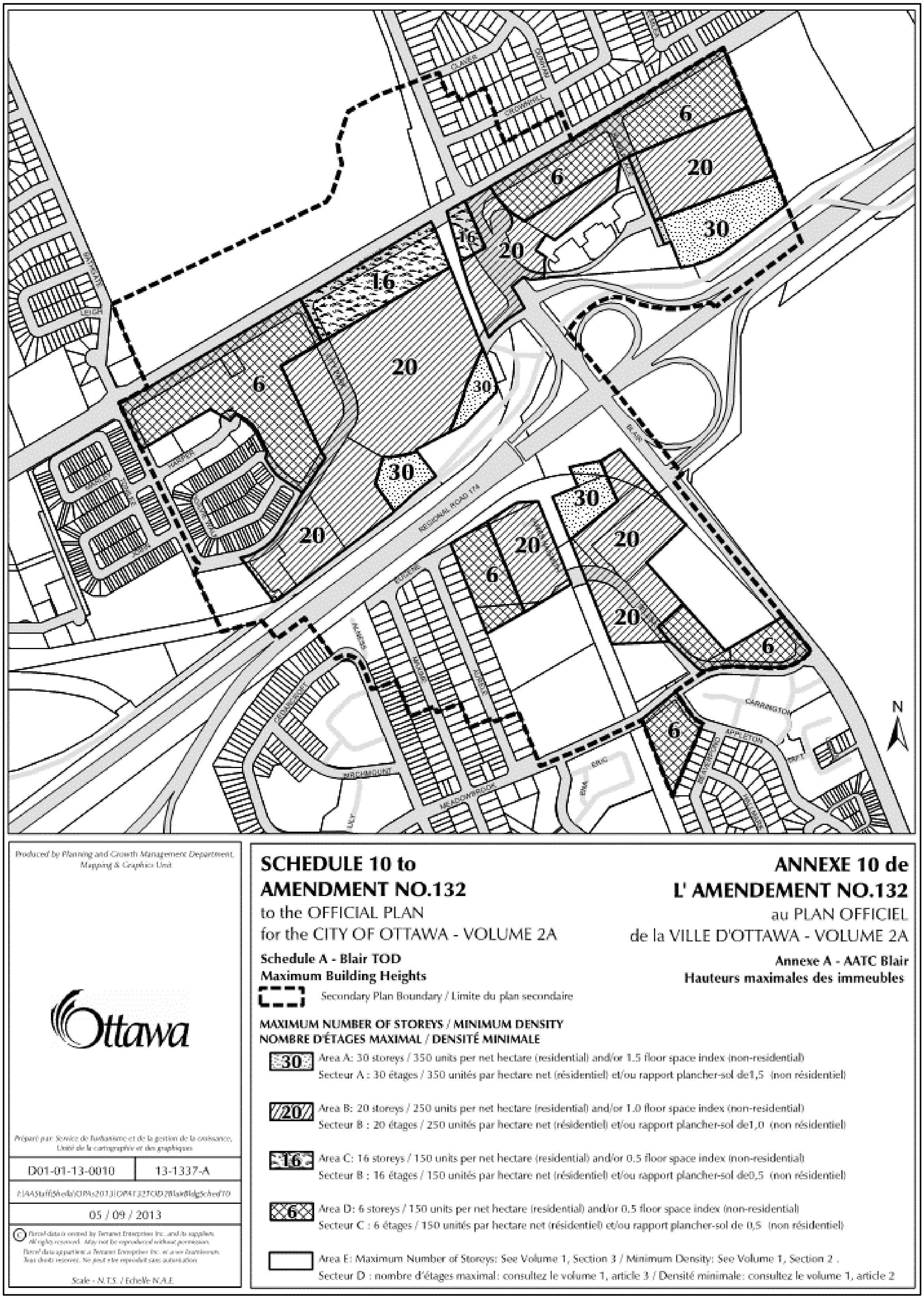

Figure 5-13: Blair Secondary Plan

Figure 5-14: Consolidated Villages Secondary Plan - Notre Dame Des-Champs

Other *relevant City of Ottawa plans* that guide development within the study area include:

Blair Transit-Oriented Development (TOD) Plan (2014)

The interim eastern terminus for the City of Ottawa's Light Rail Transit (LRT) Confederation Line is located at the meeting point of Ottawa Road 174 and Blair Road. As a primary exchange point for the transfer between light rail and buses, this area has been identified by the OP as a Transit Oriented Development (TOD) priority site. The TOD area is 119 hectares in size and includes properties within an 800 metre walk from the station platform. It is divided into three sectors: the northwest sector is located north of Highway 174 and west of Blair Road; the northeast sector is east of Blair Road and north of Highway 174 and the south sector is located south of Highway 174.

The Plan calls for creating new and improved street, cycling and pedestrian connections to increase accessibility to Blair Station. There are close to 8,700 jobs and residents combined in the Blair TOD study area (2014). Over the next 20 years, current projections foresee the addition of approximately 2,300 jobs and residents combined over this time period. Over the longer-term, well beyond the next 20 years, there is capacity for close to 28,900 jobs and residents combined if fully built to transit-supportive densities. This long-term scenario is expected to include over 2,200 residential units – most of which would be condominium or rental apartments.

Orléans Industrial Park Land Use & Design Study (2003)

On the south side of Innes Road north of the hydro corridor, and between Pagé Road and Tenth Line Road is the Orléans Industrial Park. A Land Use & Design Study was initiated for this area to create a long-term plan for its future development and growth. Designated an Arterial Mainstreet, Innes Road has been experiencing increasing development pressures. As a designated Employment Area, the projection is for 6,700 jobs to be created within the Orléans Industrial Park by 2021. A small portion of this site is also designated as Mixed-Use Center, supporting a live-work environment. To facilitate this future intensification and subdivision of land, a collector road network has been established in the Plan and includes extending both Belcourt Boulevard and Vanguard Drive as the primary north-south and east-west corridors.

5.3.3.8 City of Ottawa Zoning Bylaw No. 2008-250

The City of Ottawa's Comprehensive Zoning By-law 2008-250 implements the overall policies and objectives for growth and development that are identified in the City of Ottawa Official Plan through specific regulatory provisions.

"Section 87, Rapid Transit Network" stipulates that the provisions of the Zoning by-law do not apply to the rapid transit network and to land used for the construction, staging and repair works to support the rapid transit network. Further, any related construction, staging or repair works to support this network are permitted in all zones.

5.3.4 Land Use

Existing land uses within the study area include natural, residential, recreational, agricultural, institutional, retail commercial, industrial and hydro corridors. **APPENDIX E.1** contains the CH2M inventory of existing land uses within the study area (CH2M, 2018). The main residential neighbourhoods include Blackburn Hamlet, Pineview, Chapel Hill and Chapel Hill South, Orléans Village, Village of Navan. There are public parks located within each neighbourhood that serve as recreational facilities for residents. City of Ottawa municipal land use designations are illustrated on **Figure 5-15**, while the federal NCC Greenbelt land use designations are depicted on **Figure 5-16**.

The study area falls within the Mer Bleue and Greens Creek Sectors of the National Capital Greenbelt (discussed in **Section 5.3.1**). The Greenbelt consists of 20,000 hectares of greenspace and includes a comprehensive trail network that is easily accessible to residents in the area. Other recreational uses within the Greenbelt include the Pine View Golf Course; the Mer Bleue Golf, Driving Range & Miniputt; the Louis Riel Dome; Superdome Sports Centre; and the Hornet's Nest (an outdoor facility with 11 soccer fields located on Bearbrook Road just north of Blackburn Hamlet).

Agricultural lands with active farmland tenants are found within the Greenbelt to the north and south of Blackburn Hamlet. Institutional uses within the study area include schools, churches, retirement homes, libraries, and the Ottawa Regional Detention Centre.

Retail commercial uses are predominantly concentrated along major urban roadways such as Innes Road, St. Joseph Boulevard, and Jeanne D'Arc Boulevard.

Industrial land uses include a mineral extraction use (Bearbrook Quarry, forming part of the Greenbelt), sand and gravel suppliers (located in the northeastern portion of the study area). A 70-hectare landfill and recycling center is located on the south side of Navan Road outside of the study area. A hydro corridor with high voltage transmission lines cuts through the southern portion of the study area.

The many active development applications in the study area provide for approximately 4,027 additional residential units, multiple commercial blocks, retail units and industrial sites (CH2M, 2018). These proposed developments are primarily concentrated within the East Urban Community, the Orleans Business Park, and the Mer Bleue CDP area at the eastern portion of the study area. There are also several developments underway in the Blair Transit Oriented Development (TOD) area (CH2M, 2018).

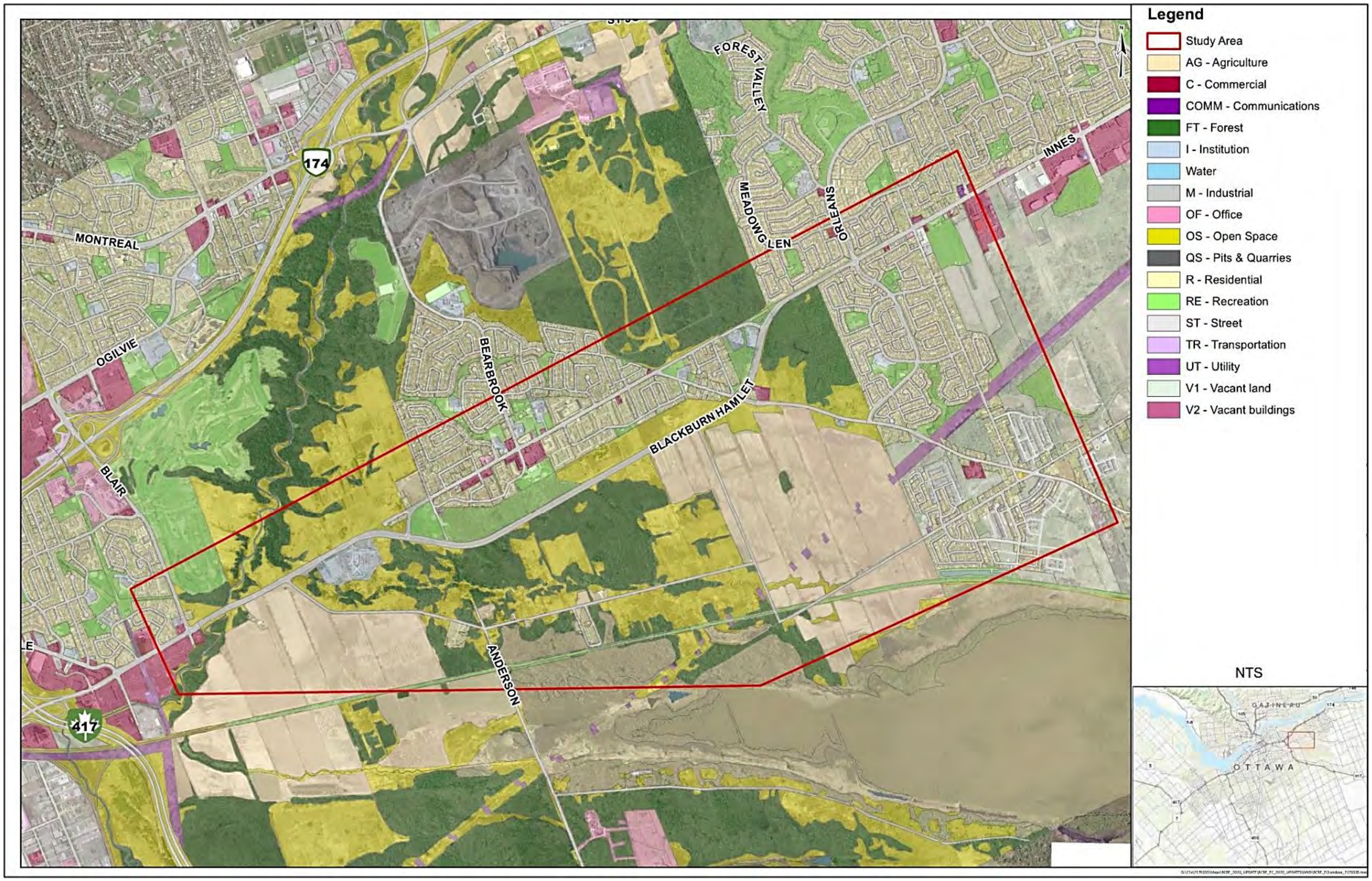

Figure 5-15: Existing Official Plan Land Use Designations

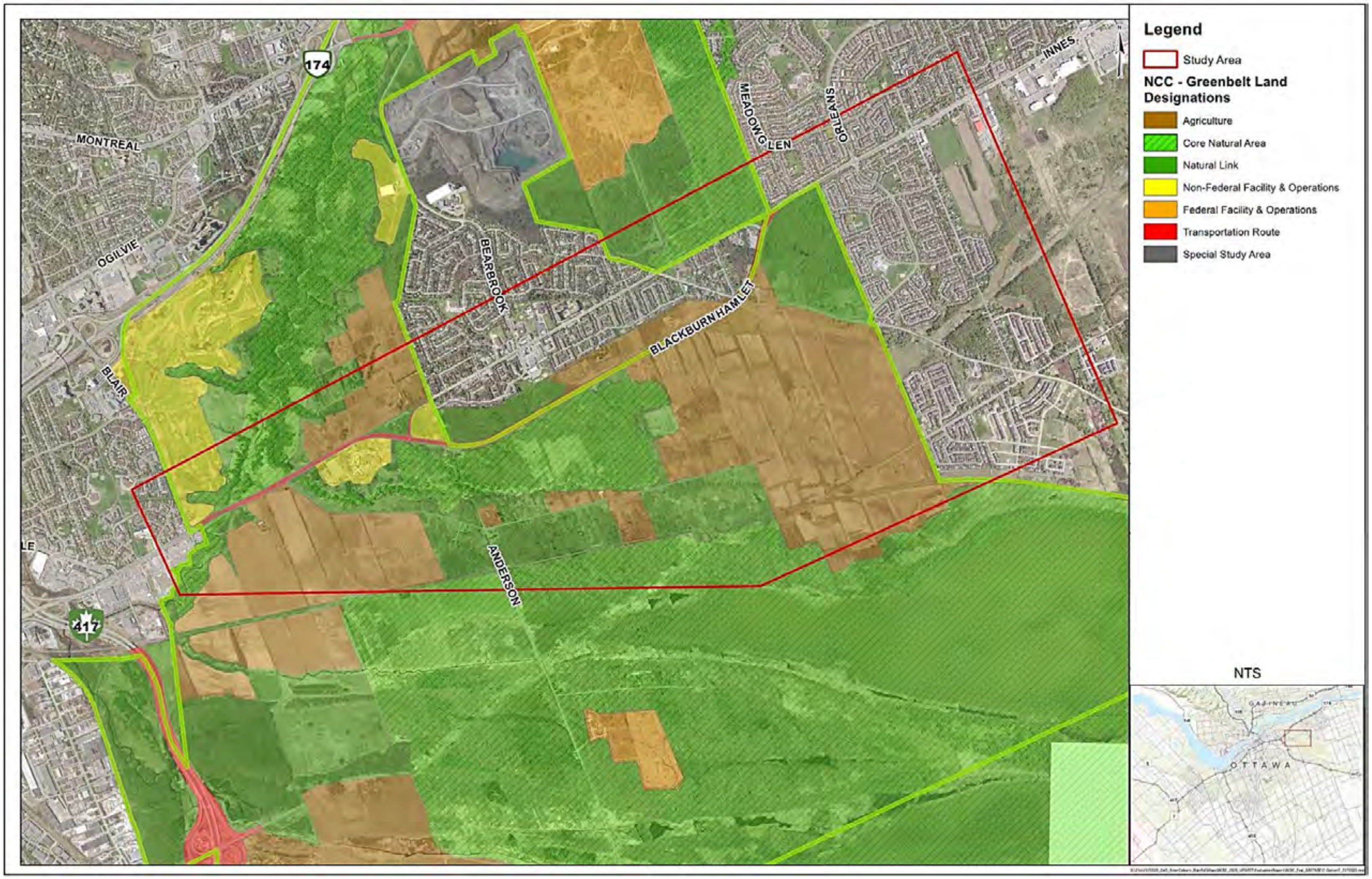

Figure 5-16: Existing Greenbelt Land Use Designations (NCC)

5.3.4.1 Land Ownership

More than 50% of the lands within the Study Area are owned by the NCC and form part of the NCC's Greenbelt (**Figure 5-17**). Other major landowners include the Federal Government (Department of National Defence) and the City of Ottawa (including Parks and Open Space Network and Natural Environment lands). The remainder of the land parcels are in private ownership.

5.3.5 Landscape Character

Analyses of the natural and built environment provides input on land uses (**Figure 5-18**), connectivity (**Figure 5-19**), important views (**Figure 5-20**), and landscape character. The study area has been broken into descriptive roadway spans. The roadway spans begin at Blair Station in the west, continue east to Brian Coburn Boulevard, and then are directed south to the Greenbelt's Mer Bleue Sector.

Blair Station: Innes Road

Views along the eastern side of Blair Road, overlooking Pine View Golf Course, extend from Innes Road to OR 174. The views of the golf course contribute to a rural aesthetic. Most residential homes back onto Blair Road, with setbacks that have trees and mown turf. With homes oriented away from the roadway this span of Blair Road feels separate from the community.

Innes Road: Blackburn Hamlet Bypass

The span of Innes Road, beginning from Blair Road and continuing until Blackburn Hamlet Bypass, is within the NCC Greenbelt. Rural zones comprise the majority of land-uses, which contributes to a rural feel. There are views of agricultural and open fields, as well as forested areas which surround both Mud Creek and Greens Creek.

Fast moving, heavy vehicular traffic may deter cyclists from using the existing on-road bicycle lane. Bicycle lane widths are reduced during winter months due to incomplete snow-removal.

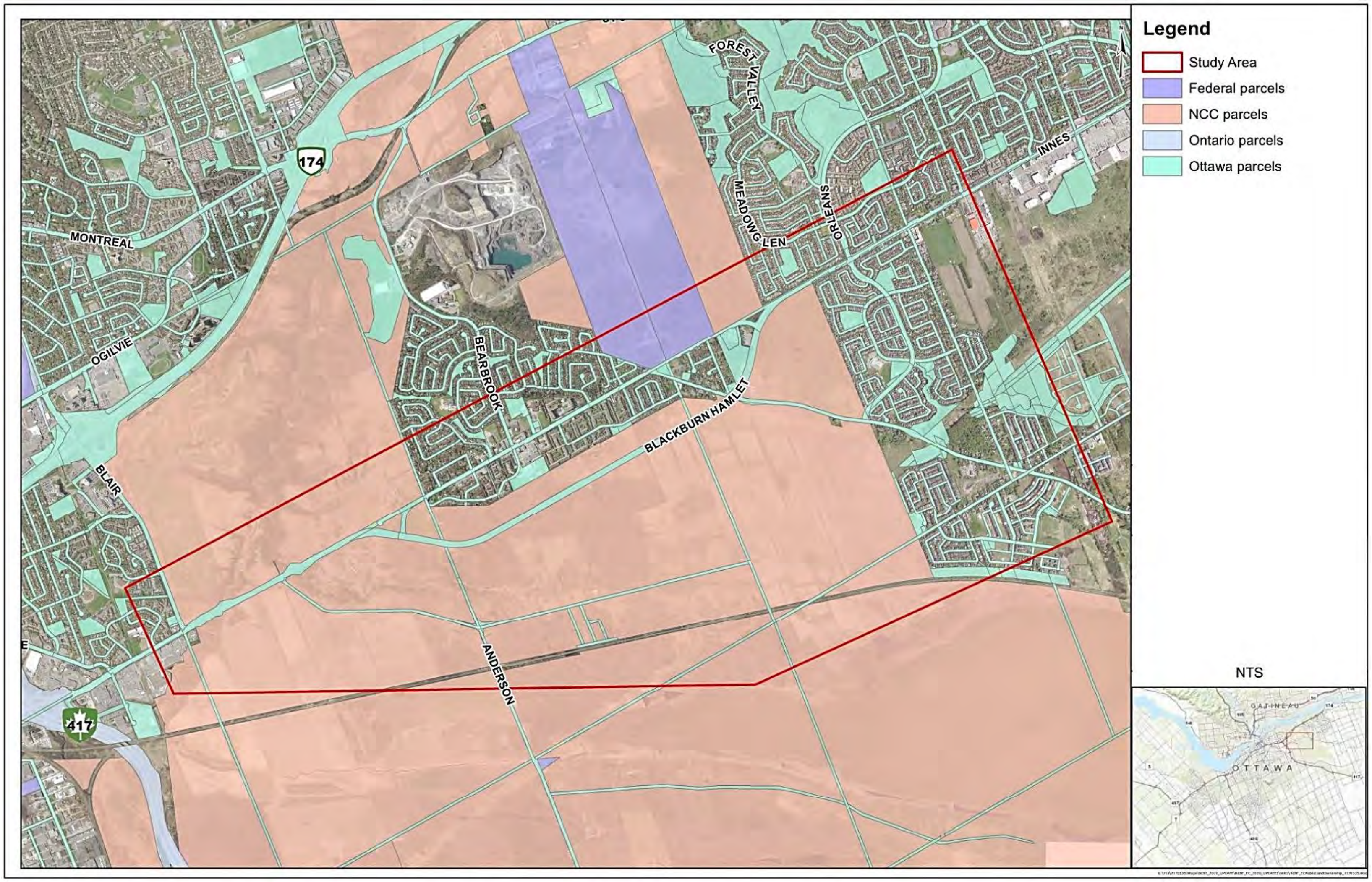

Figure 5-17: Public Land Ownership

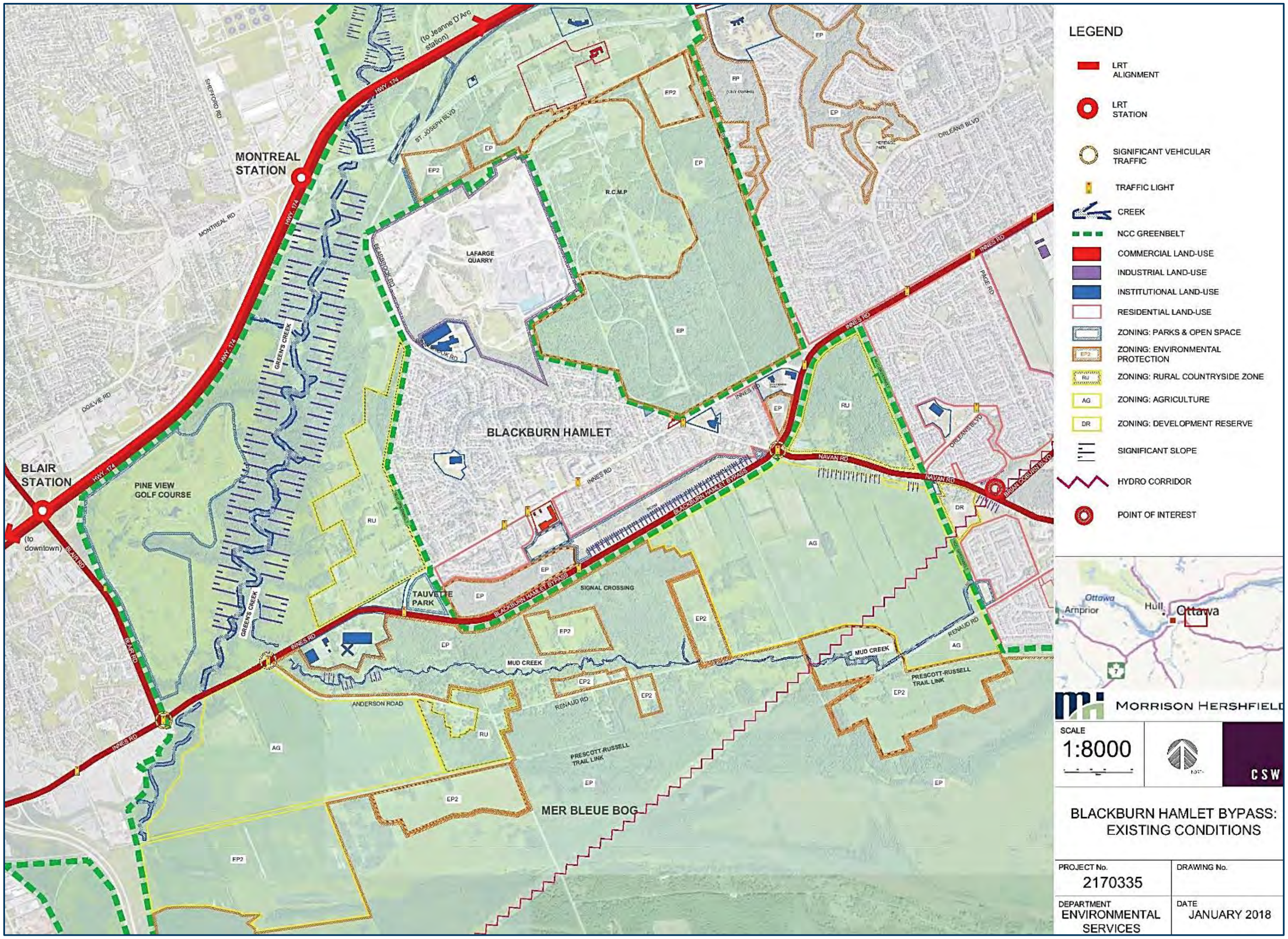

Figure 5-18: Existing Land Use Zone Designations

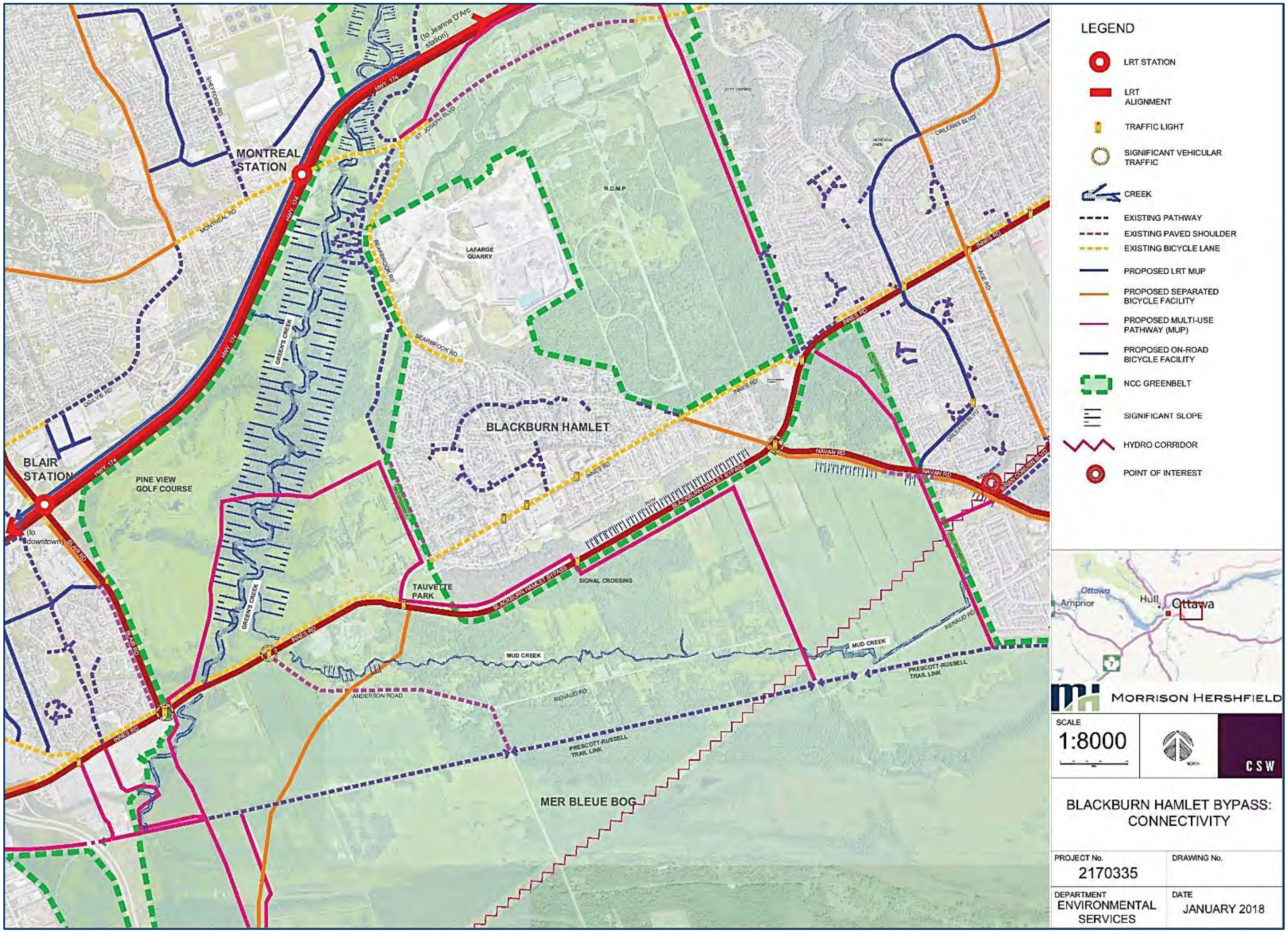

Figure 5-19: Multi-Modal Transport Connectivity

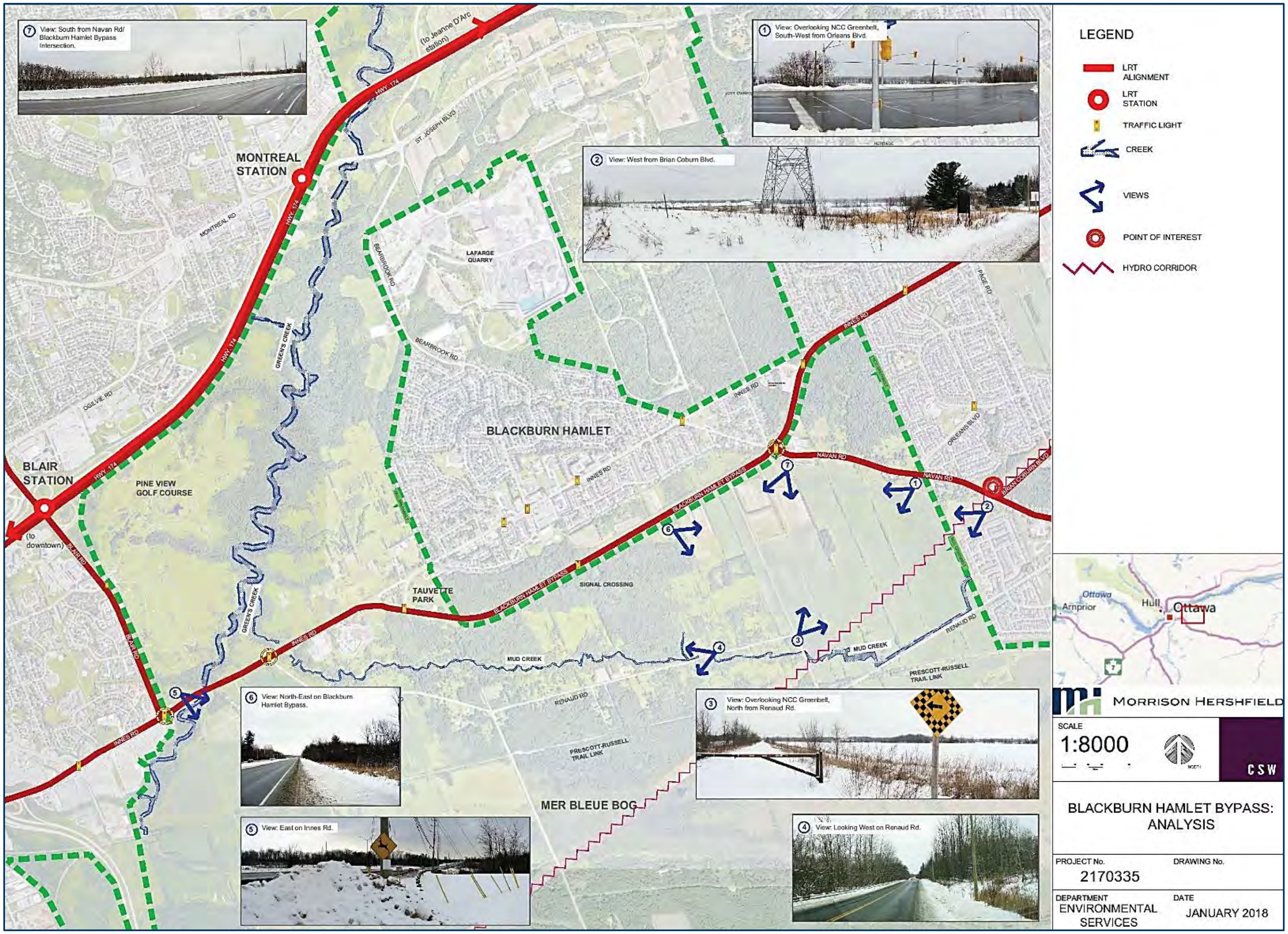

Figure 5-20: View and Vistas

Blackburn Hamlet Bypass: Navan Road

The Blackburn Hamlet Bypass is an efficient route for vehicular traffic. Aligned between the NCC Greenbelt and Blackburn Hamlet, the Bypass has good views of forested areas and agricultural lands. A proposed multi-use pathway (MUP) will allow cyclists to commute to and from Blair Station. The proposed alignment runs parallel to the Blackburn Hamlet Bypass.

Navan Road: Brian Coburn Boulevard

Proposed separated bicycle facilities along Navan Road will effectively link south Orléans to Blackburn Hamlet (**Figure 5-21**).

This span of Navan Road is aligned parallel to an escarpment within the NCC Greenbelt. Looking south offers excellent views of agricultural lands within the NCC Greenbelt. Within the Greenbelt, both sides of Navan Road are considered Environmental Zone (I) which indicates more land-use opportunities than environmental protection zones.

Greenbelt: Renaud Road

Renaud Road and Anderson Road are aligned through the Greenbelt's Mer Bleue sector. Environmental protection zoning surrounds Mer Bleue Bog, Mud Creek, and forested core-natural areas. These areas are important natural features within the Greenbelt. The views of agricultural lands, farmhouses, and forested areas contribute to a rural feel.

The Prescott-Russell Trail Link and paved shoulders on Anderson Road are currently appropriate for cycling. Proposed MUPs will increase connectivity to Blair Station by directing cyclists north to Navan Road and Blackburn Hamlet Bypass. With narrow unpaved shoulders and an 80 km/h speed limit, Renaud Road is not currently an effective cycling route.

5.3.6 Air Quality, Noise & Vibration

GWE completed a qualitative report describing the existing conditions relating to air quality, noise, and ground vibrations (**APPENDIX E.2**) (**Figure 5-21**). Current major sources of air quality and noise emissions in the area are the existing road networks, including Ottawa Road 174, Blackburn Hamlet Bypass, St. Joseph Boulevard, Navan Road, Anderson Road, Bearbrook Road, Innes Road and Orléans Boulevard. Ottawa Road 174 is also a source of minor ground vibrations and ground-borne noise, mainly due to heavy vehicles passing over uneven surfaces (GWE, 2018).

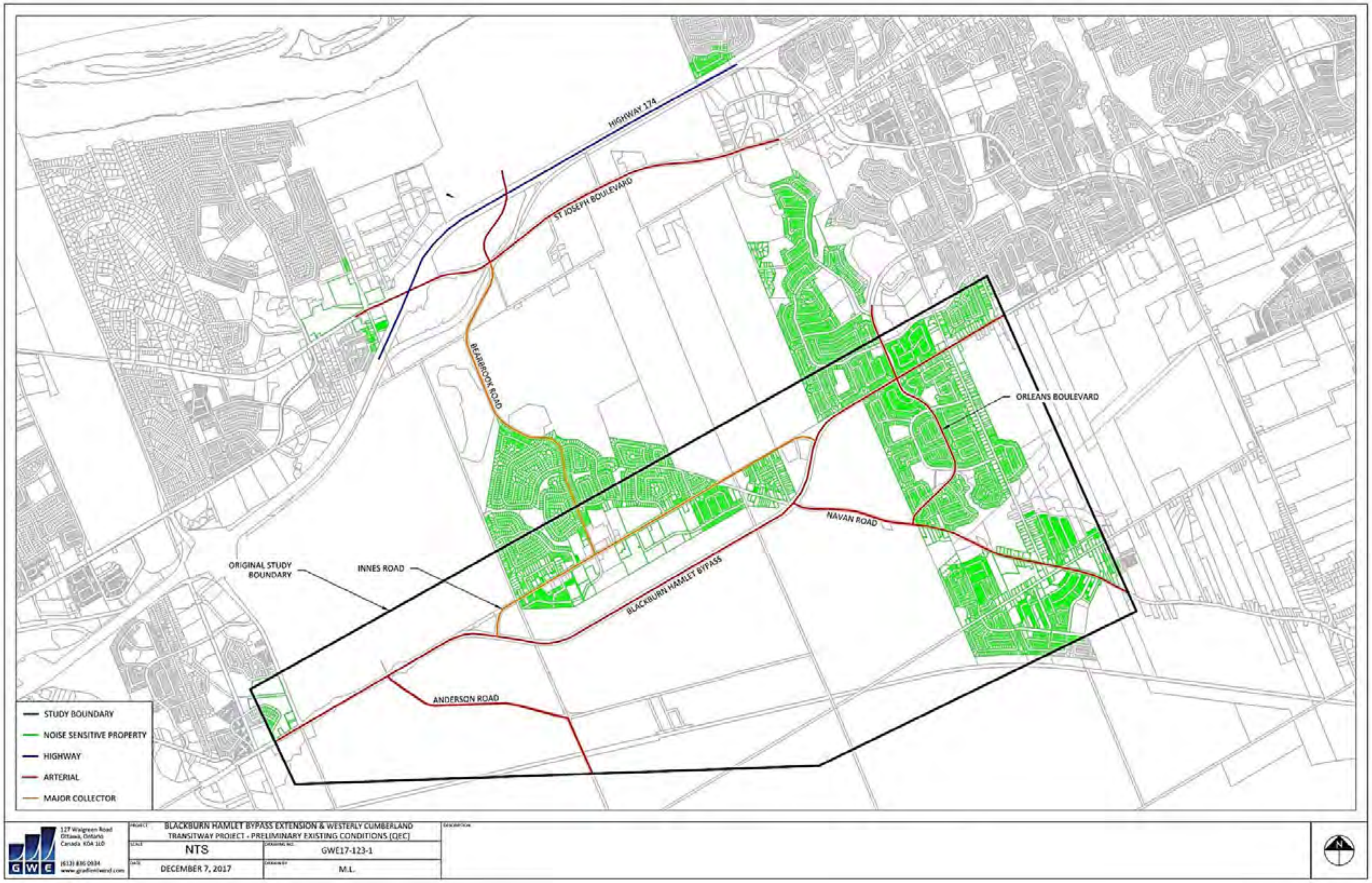

Figure 5-21: Noise Sensitive Receptors

5.4 Cultural Environment

5.4.1 Aboriginal Land Claims

The City of Ottawa is within the land claim area of the Algonquins of Ontario. The land claim is in the process of negotiation and currently, an Agreement-in-Principle has been prepared as a first step toward an eventual signed Treaty between the Algonquins of Ontario, the Province of Ontario, and the Government of Canada (2016). The Agreement-in-Principle contains Maps of Proposed Settlement Lands, including a "Proposed Settlement Lands in the City of Ottawa" (Algonquins of Ontario, Government of Ontario, Government of Canada, 2016). None of the lands within the Study Area encompass any Proposed Settlement Lands.

5.4.2 Archaeological Potential

A Stage 1 Archaeological Assessment of the Study Area has been undertaken to ensure preservation and management of any property that may hold an archaeological interest, in keeping with the requirements of Section VI of the Ontario Heritage Act, RSO 1990, c.0.18. As part of the data collection, historic maps as well as relevant archaeological, historical, and environmental documentation were reviewed. Over the past twenty years, fifteen archaeological assessments were completed for properties contained within the study area with an additional fourteen assessments completed within the nearby vicinity. Additionally, a property inspection was conducted on November 15, 2017. The Stage 1 Archaeological Assessment, as completed by Golder (2018b) is presented in **APPENDIX F.1**.

The archaeological potential of the study area has been impacted by the bedrock stone quarry located east of Bearbrook Road as well as the building footprints, infrastructure, and landscaping associated with the residential developments within Gloucester, Blackburn Hamlet, Chapel Hill, and Chapel Hill South.

Archaeological potential is not present in areas where previous Stage 2 Archaeological Assessments were conducted following the establishment of the 2011 MHSTCI Standards and Guidelines (**Figure 5-22**).

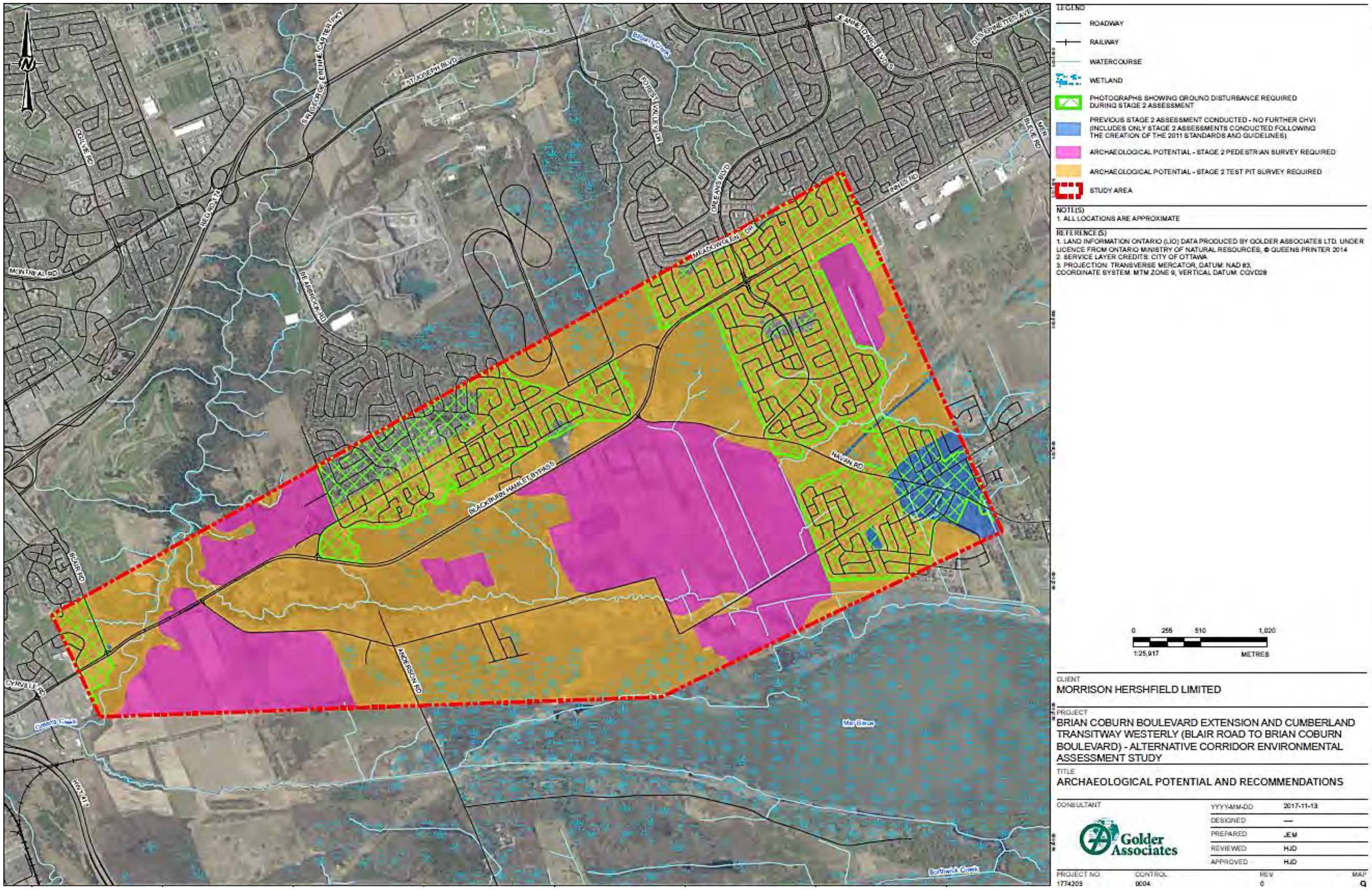

Figure 5-22: Archaeological Potential

5.4.2.1 Identified Archaeological Resources

One registered archaeological site was identified within the study area. The Mer Bleue site (BiFv-22) is in the southeast corner of the study area and is described as ‘a pre-contact lithic scatter consisting of quartz, chert-like, and slate flakes covering a 20 metre-diameter area’ (Golder, 2018b). The Ministry of Heritage, Sport, Tourism and Culture Industries ’s (MHSTCI) archaeological site database indicates the site remains unexcavated and still of cultural heritage value or interest. Though within the project study area, the registered site is not located within the immediate project area.

Potential for Archaeological Resources

Areas identified within the study area as having “potential for archaeological resources” are based on the following indicators (**Figure 5-22**).

Historic Euro-Canadian Settlement Patterns: All areas that fall within 100 m of early transportation routes and 300 m of early Euro-Canadian settlement.

Pathways of Historic Roadways/Transportation Routes: Montreal Road and St. Joseph’s Boulevard in the north, Innes Road, Anderson Road, Renaud Road, and Navan Road follow paths of historic roadways. In addition, some 19th century historic roads that have been altered or are no longer in use represent areas of archaeological potential.

Pre-Contact Archaeological Potential Areas: The Mer Bleue site (BiFv-22), is deemed of cultural heritage value or interest (Note that the MHSTCI’s archaeological site database contains no record of a Stage 3 site specific assessment).

Areas within 300 m of all Watercourses and Secondary Water Sources: Includes areas found within 300 m of the following primary water sources: Greens Creek, Mud Creek, other small watercourses, the northern portion of the Mer Bleue Bog and several wetlands.

5.4.3 Cultural Heritage Resources

Federal, provincial, and municipal heritage registers, inventories, and databases were reviewed to identify known cultural heritage resources in the Study Area (Golder, 2018b). This included a review of the Canadian Register of Historic Places; the Government of Canada’s Directory of Federal Heritage Designations; Ontario’s Heritage Trust Online Plaque

Database; Ontario's Heritage Trust Places of Worship Inventory; Ontario Ministry of Government and Consumer Services (OMGCS) Database of Registered Cemeteries; the City of Ottawa's Heritage Register and Heritage Resources Inventory; and aerial photographs from 1976 and contemporary aerial photos and satellite imagery. Golder has completed a summary of findings in a Technical Memorandum, available in **APPENDIX F.2**.

In addition, stakeholder consultation included contact with the City of Ottawa Heritage Planner regarding cultural heritage resources in the Study Area. They advised that no properties designated under Part IV of the Ontario Heritage Act and no properties listed on the Heritage Register are in the Study Area. However, eight properties are included on the City's Heritage Reference List. No protections or restrictions are placed on properties included on the Heritage Reference List. Lastly, the MTCS's checklist for *Criteria for Evaluating Potential for Built Heritage Resources and Cultural Heritage Landscapes* (2016) was completed for the Study Area.

Protected Cultural Heritage Resources

None of the properties identified in the Study Area are protected cultural heritage resources.

Cultural Heritage Landscapes

The NCC has identified a combination of distinct landscape features and man-made structures as components of the cultural heritage landscape. These include landscape features that visually express land stewardship, ecological diversity, and the history of the Capital; buildings structures and features of cultural and heritage value that celebrate the Capital's rural history; and rural cultural heritage. Characteristics of the rural cultural heritage landscape in the Study Area include the pattern of fields and ditches, ongoing agricultural activity and the remaining rural roads with soft shoulders and open ditches.

Heritage Reference List Properties

The following eight properties were identified on the City of Ottawa's Heritage Reference List: 1873 Innes Road (Mrs. Emerson Woodburn House); 1691 Blair Road; 2090 Innes Road/2170 Anderson Road (original Woodburn property); 2567 Navan Road (William Purdy House); 2750 Navan Road (St. Mary the Virgin Anglican Church & Cemetery); 2871 Navan Road (H. Lemieux House); 3143 Navan Road (Louis Perrault Farm); and 6211 Renaud Road (D. & E. Robinson House).

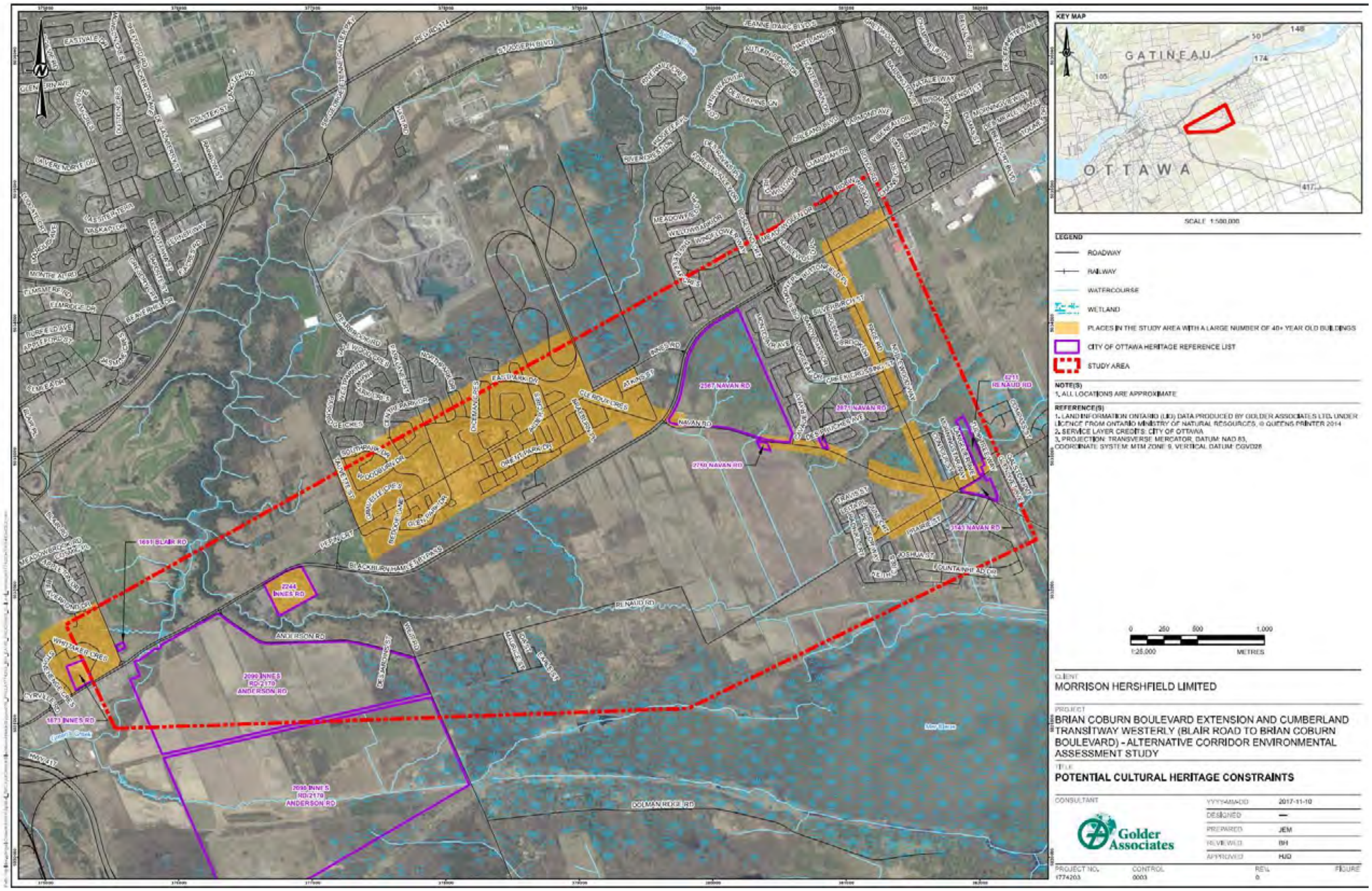

Figure 5-23: Potential Cultural Heritage Constraints

The *Criteria for Evaluating Potential for Built Heritage Resources and Cultural Heritage Landscapes* includes consideration of buildings or structures that are over 40 years old to be considered as having potential cultural heritage value or interest. Within the study area, such buildings are located along the major roads and Blackburn Hamlet is a mid-century modern residential development and planned community from the late 1960s and early 1970s.

Figure 5-23 illustrates the location of the eight properties on the City's Heritage Reference List, as well as the land areas deemed to have potential cultural heritage value with properties over 40 years old.

5.5 Bulit Environment

5.5.1 Transportation

Section 2.3.1 of the City's Official Plan describes the City's transportation system as one which emphasizes the use of public transit, and wherever possible reduces the reliance on private automobiles. The single biggest transportation issue the City currently faces is accommodating the movement of people during the morning and evening peak periods. Therefore, a key strategy in the OP is to expand the rapid transit network to serve more of the urban area. However, despite encouraging increased transit use through infrastructure improvements, on-going improvements to the road infrastructure network are also needed to accommodate projected traffic volumes. This includes road widenings and extensions. These improvements are designed and maintained in coordination with the City of Ottawa's Transportation Master Plan's *"Complete Streets Policy*", which plans for transportation infrastructure that prioritizes the needs of pedestrians and cyclists and ensures safety, comfort, and convenience to users of all ages and abilities.

Along with protecting corridors for the development of the transit network and acquiring lands for transit rights-of-way (ROW), Section 2.3.1 also stipulates that it will protect rights-of-way for the future development of the road transportation network. A right-of-way establishes allowances for a new road, major widening of an existing road, or minor widening of an existing road.

Section 3.5 of the OP provides a transportation infrastructure policy for lands designated as Greenbelt. This policy stipulates that "roads and other infrastructure will be designed to maintain the rural character of the Greenbelt to minimize the fragmentation of farmland and natural areas. Combining infrastructure in a limited number of corridors and utilizing existing rights-of-way wherever possible can help achieve this end. Transportation infrastructure, including lighting, will be designed to a rural standard.

5.5.2 Transit Network

The proposed future Bus Rapid Transit corridor (BRT) travels along Innes Road from Blair Road and continues east along the Blackburn Hamlet Bypass. As part of the future Cumberland Transitway, it will continue through the Greenbelt southwest of Navan Road to the newly constructed Brian Coburn Boulevard then continue further east to Tenth Line Road.

The BRT also travels north from Innes Road along Blair Road to Ottawa Road 174. There are several proposed transitway stops within the study area as well as two park and ride facilities in the vicinity of the study area: proposed Chapel Hill and Blair. In addition to the proposed BRT route, there are also a number of additional local OC Transpo routes that run through the study area.

Current transit network modifications within the study area include the extension of the Light Rail Transit (LRT) line beyond the Stage 1 Confederation Line that will end at Blair Road, which recently opened in September 2019. Stage 2 LRT will include an extension east to Trim Road along Ottawa Road 174 with construction currently underway and completion expected in 2024. Innes Road and Jeanne D’Arc Boulevard are planned to be established as Transit Priority Corridors.

In terms of transit use, the 2011 transit (or non-auto) modal share is estimated at 37% at the Greens Creek Screenline (SL16). The projected 2031 TMP transit modal share is 43%.

5.5.3 Road Network

The road-based transportation system within the study area is a network of provincial highways, municipal freeways, arterial roads, collector roads, and local roads. The existing roadways which service east/west travel demands range from multi-lane, high speed roadways (such as OR 174) to single lane, lower speed operations (such as Sir George-Étienne Cartier Parkway).

The major network includes:

Highway 417: This provincially owned Highway 417 is a six lane, divided highway that runs east west along the northwestern border of the study area. At the Aviation Parkway/Highway 417/ Ottawa Road 174 major interchange, Highway 417 becomes a north south, four lane highway with an interchange located at Innes Road.

Ottawa Road 174: This municipally owned freeway is a four lane, divided freeway that runs east west along the north border of the study area east of the Highway 417 interchange.

Arterial roads located within the study area include Innes Road, Blair Road, the Blackburn Hamlet Bypass, Anderson Road, Brian Coburn Boulevard, and Orléans Boulevard. Navan Road is designated in the City's TMP as an arterial road. Renaud Road is designated as a collector roadway.

5.5.4 Structures

Structures within the study area include bridges and culverts with spans greater than 3 metres, which are termed "bridge-culverts." There are thirteen (13) such structures within the original and expanded study areas (**Table 5-4**).

Table 5-4: Existing Structures Within the Study Area

Structure	Photograph
The **Renaud-Anderson Road Culvert** (SN 224610), located on Renaud Road, 1.64 km east of Anderson Road. The culvert is a Reinforced Concrete Pipe measuring 750 mm in diameter. It is nearing the end of its service life, slated for in-kind replacement.	
The **Greens Creek Bridge** (SN 227130), located on Innes Road about 0.32 kilometres east of Blair Road, is a concrete rigid frame structure with long concrete retaining walls along the sides of the creek. It was constructed in 1989 and is currently rated in generally fair condition.	

Structure	Photograph
The **Mud Creek Bridge-Culvert** (SN 227160) is located under Innes Road about 0.13 km east of Anderson Road. Constructed in 1989, it is a concrete box culvert with high fill cover, with concrete head walls and wing walls. It is currently rated in generally fair condition.	

Structure	Photograph
The **Beaudoin Bridge-Culvert** over Mud Creek (SN 227040), located under Renaud Road about 1.35 km east of Anderson Road, is a corrugated steel plate (CSP) arch structure with open bottom built in 1965. It features gabion basket wing walls and is currently in fair condition.	
The **Kemp Road Culvert** (SN 228160) is located under Renaud Road about 1.45 km east of Ida Street. It is a CSP open bottom structure, built in 1999, with gabion head walls and wing walls. It is in generally good condition according to City records.	
The **Renaud Road Culvert** (SN 228180) is located 1.80 km west of Navan Road. It is a CSP pipe constructed in 1975 and is currently in poor condition. The road embankment side slopes in this area are also showing signs of instability and erosion.	
The **Navan Road Culvert** (SN 228111) is located 1.25 km southeast of the Blackburn Hamlet Bypass. It is a CSP pipe that has been re-lined with another CSP pipe, located under high fill cover. It was constructed in 1996 according to City records and appears to be in fair to good condition, with some corrosion of the invert.	

Structure	Photograph
The **Pagé Road Storm Retention Pond Culvert** (SN 228115) is located under Pagé Road, just north of Brian Coburn Blvd., about 0.50 km northeast of Navan Road. It is a precast concrete box structure built in 2011. It features concrete inlet and outlet structures.	
The **Brian Coburn Bridge-Culvert** (SN 227450) is a twin-cell precast concrete pipe culvert under the new Brian Coburn Boulevard extension, located 0.20 km southeast of the Pagé Road/Montpelier Place intersection. It includes concrete headwalls and wing walls as well as long precast concrete block retaining walls on the south side. It was built in 2015.	 
The **Ottawa Road 174 Greens Creek Bridge-Culvert** (SN 227110) is a four-barrel CSP arch crossing constructed in 1958. It is located about 0.75 km east of Montreal Road. The easternmost barrel has been re-lined with a CSP culvert and the barrels each feature tapered CSP wing walls. The culvert is currently rated in generally poor condition and is nearing the end of its service life, slated for repairs by the City. As part of the Stage 2 LRT construction project, the culverts are in the process of being relined.	

Structure	Photograph
The **Chapel Hill Creek Culvert** (SN 228150-1 and SN 228150-2) is a culvert for the east leg of Chapel Hill Creek, passing under St. Joseph Boulevard. It features a CSP and concrete pipe run, both built in 1991 and currently rated in good condition. The inlet features extensive gabion basket retaining walls and slope protection. The culvert is located 0.45 km west of Jeanne D'Arc Boulevard. Chapel Hill Creek converges to a single stream between St. Joseph and Youville Drive. The western leg goes under Forest Valley Drive and St. Joseph Blvd. through a sewer.	
The **Youville Drive Bridge** (SN 227300) is a twin-cell concrete box bridge-culvert with gabion wing walls. It was constructed in 1980 and is currently in fair to poor condition. The structure features an outfall directly downstream where two storm sewers also outlet. It is located about 0.50 km west of Jeanne D'Arc Blvd.	

5.5.5 Pedestrian & Cycling Networks

The study area includes pedestrian and cycling facilities within the City and the NCC's Greenbelt. Innes Road has a dedicated bike lane which extends from the western to eastern border of the study limits and is referred to as a Cross-Town Bikeway within the City's Official Plan (OPA #150, 2014a). There are also a series of existing bike paths, paved shoulders, pedestrian walkways, and multi-use pathways throughout the study area. In addition to the City and NCC trail network, informal trails and accessways also exist and form important connections within the multi-modal network.

The Prescott-Russell Trail is a City of Ottawa Rural Shared-Use Pathway that extends eastward from the greenbelt near Blair Road through the Village of Navan to the Prescott-Russell Trail at Canaan Road. **Figure 5-24** highlights the existing pedestrian and cycling networks.

5.5.6 Sewage, Water & Stormwater

5.5.6.1 Water Distribution System

There are watermains located within the residential areas of Blackburn Hamlet and Chapel Hill South (

Figure 5-25). There is a large backbone 1200 mm water pipe located on St Joseph Boulevard, a 400 mm water pipe on Innes Road and a 300 mm water pipe located on Navan Road. The 1200 mm water pipe is connected to the Orléans Reservoir and the Forest Ridge pumping station located in the northeast corner of the study area.

Water wells are located within the rural areas of the study area, including within the Greenbelt and around Mud Creek (

Figure 5-25). It is likely that some of the domestic and agriculturally designated water wells that are not in proximity to the City's water distribution system are currently in use.

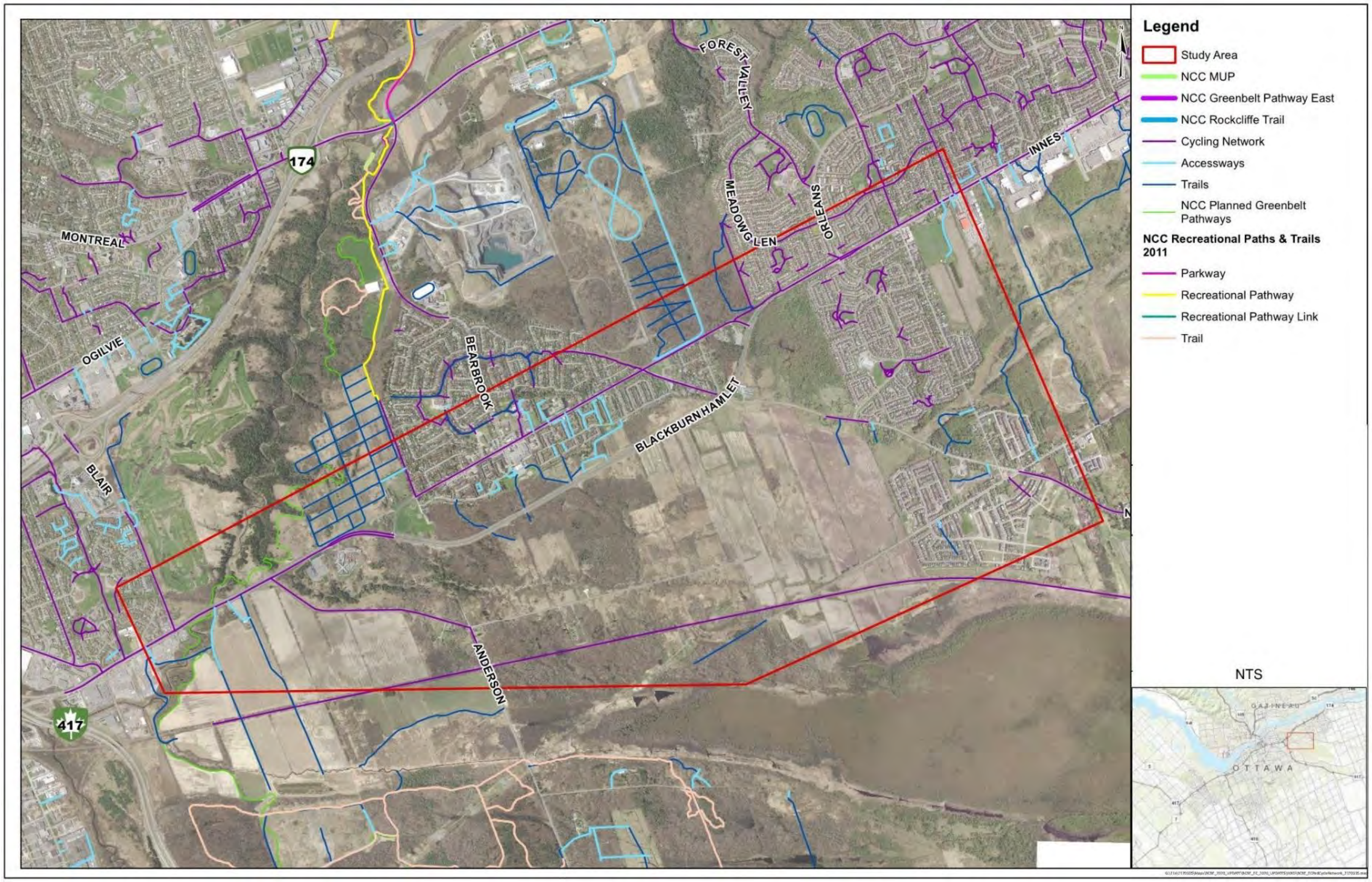

Figure 5-24: Cycling & Pedestrian Networks

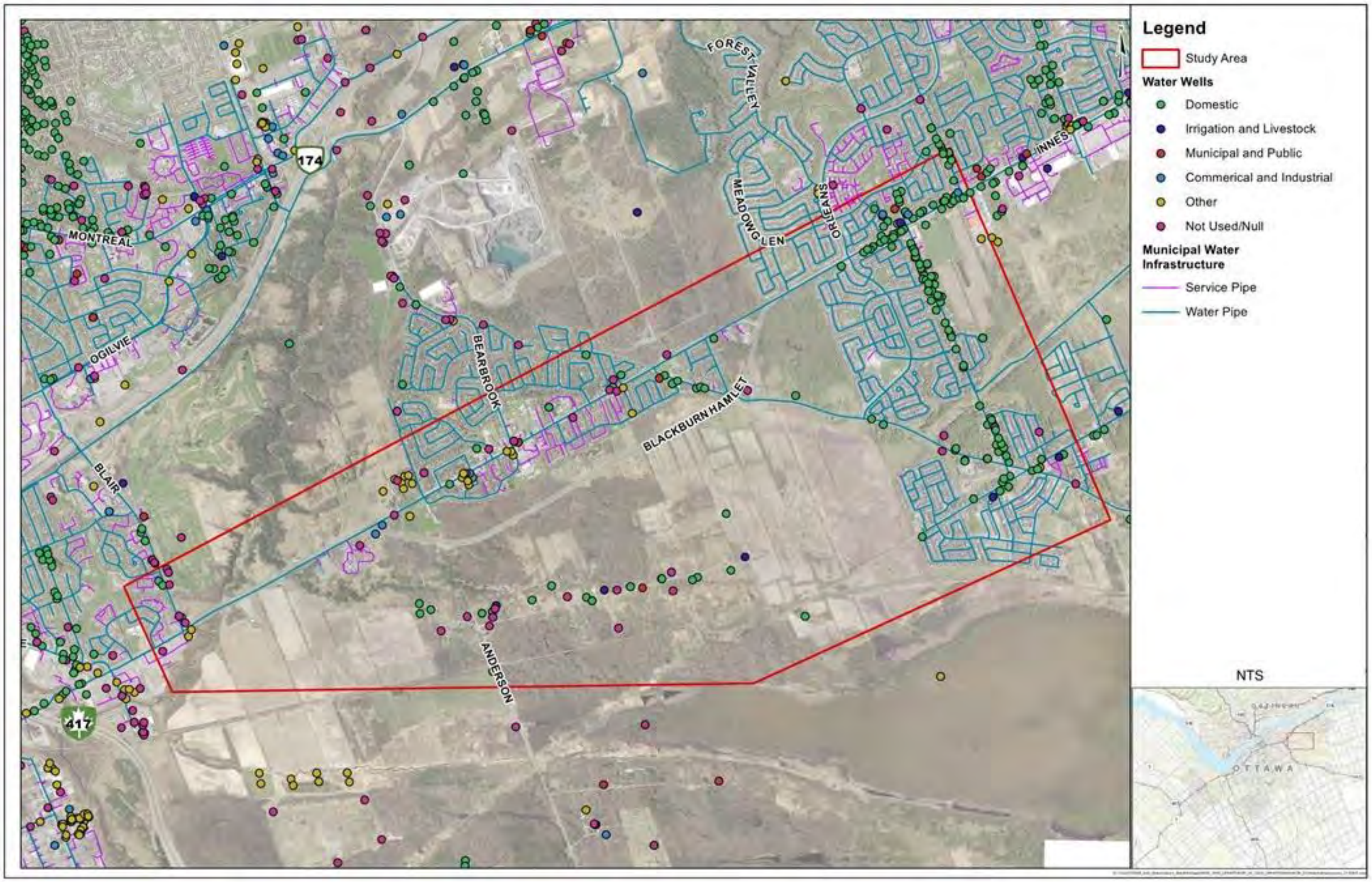

Figure 5-25: Water Infrastructure

5.5.6.2 Sanitary Sewers

Local sanitary sewers service the residential neighbourhoods. These local sewers feed into the four trunk sewers located in the project area. There is the 900 mm Forest Valley trunk sewer located on Forest Valley Drive/Orléans Boulevard. There is the 525 mm Innes Road Trunk located on Innes Road west of Blackburn Hamlet. On the western edge of the study area are the 2700 mm South Ottawa Tunnel and the 1650 mm North Greens Creek Collector. Sewer infrastructure is illustrated on **Figure 5-26**.

5.5.6.3 Storm Drainage

The largest diameter storm sewers are typically located along arterial roads, including Innes Road (1350 mm), Brian Coburn Boulevard (1200 mm), Orléans Boulevard (1650 mm), and Blair Road (1350 mm).

The 2013 study *Establishing Static and Unit Thresholds for Erosion, Mud and McEwan Creeks* by JTB Environmental Systems Inc. (JTBES), recommends unit thresholds be applied to new or increased discharges to Mud Creek to prevent further erosion to the creek.

Two stormwater management facilities are located within the study area. The first, servicing the Bradley Estates community, is located south of Keith Crescent. The second services Chapel Hill South and Trails Edge communities and is located on either side of Brian Coburn Boulevard at Pagé Road. Both facilities outlet to tributaries of Mud Creek.

5.5.6.4 Municipal Drains

There is one municipal drain in the study area: the James Blais Drain, located east of Pagé Road. The drain outlets to a stormwater management pond located at the intersection of Brian Coburn Boulevard and Pagé Road.

5.5.7 Utilities

5.5.7.1 Hydro One & Hydro Ottawa

The entire study area is within the Hydro Ottawa service area (**Figure 5-27**). There is an aerial Hydro line located on Bearbrook Road. This line is located on the west side of the road south of the Hornet’s Nest Soccer Park and on the east side north of the park. There is an aerial Hydro line located on Innes Road and the majority of this line is located on the north side of Innes Road. Another pole line is located on the north side of the Blackburn Hamlet Bypass. This pole line continues down the east side of Navan Road. Hydro One Transmission has a high voltage transmission line consisting of two parallel tower lines that crosses the southern end of the study area.

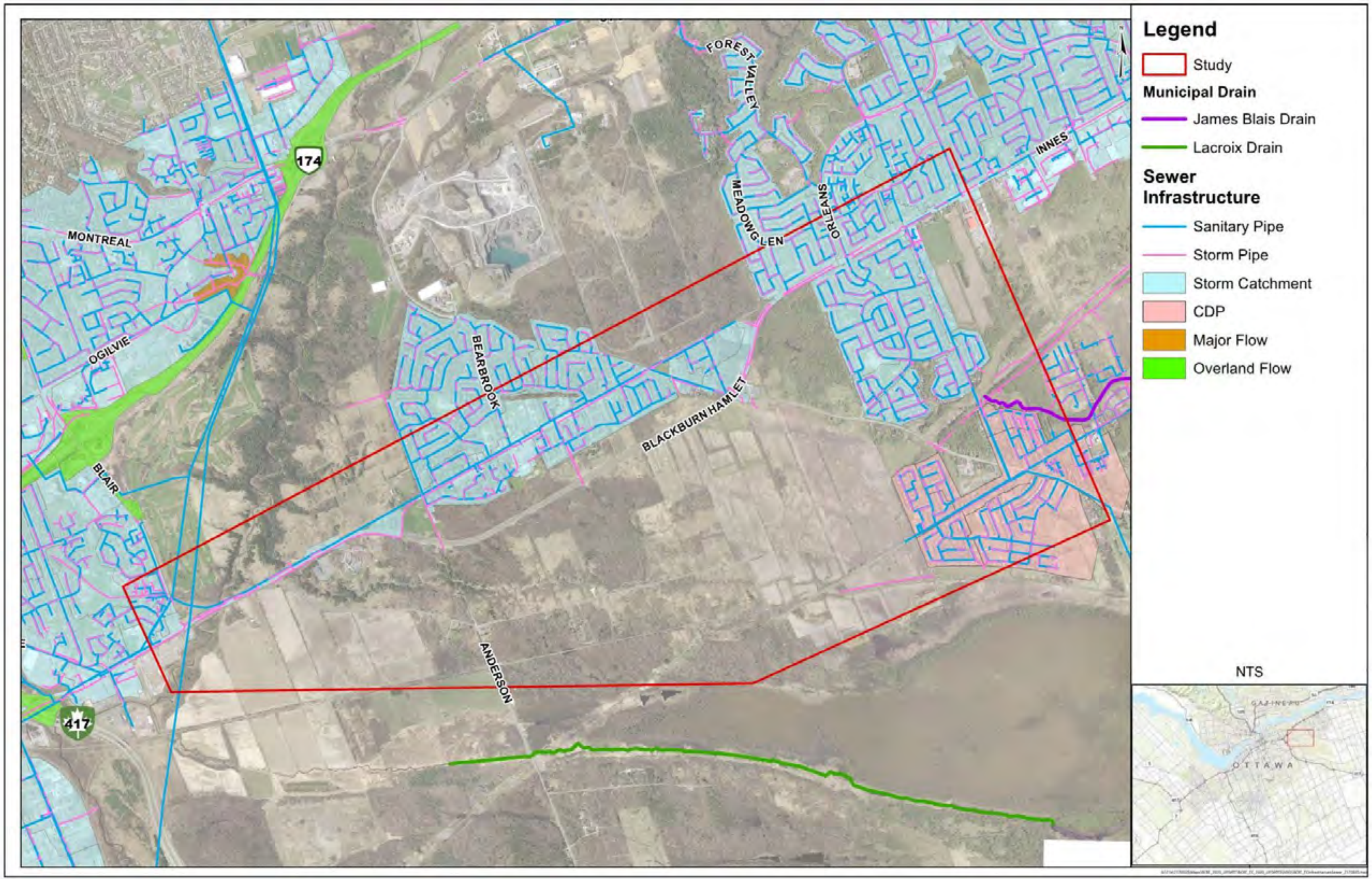

Figure 5-26: Sewer Infrastructure

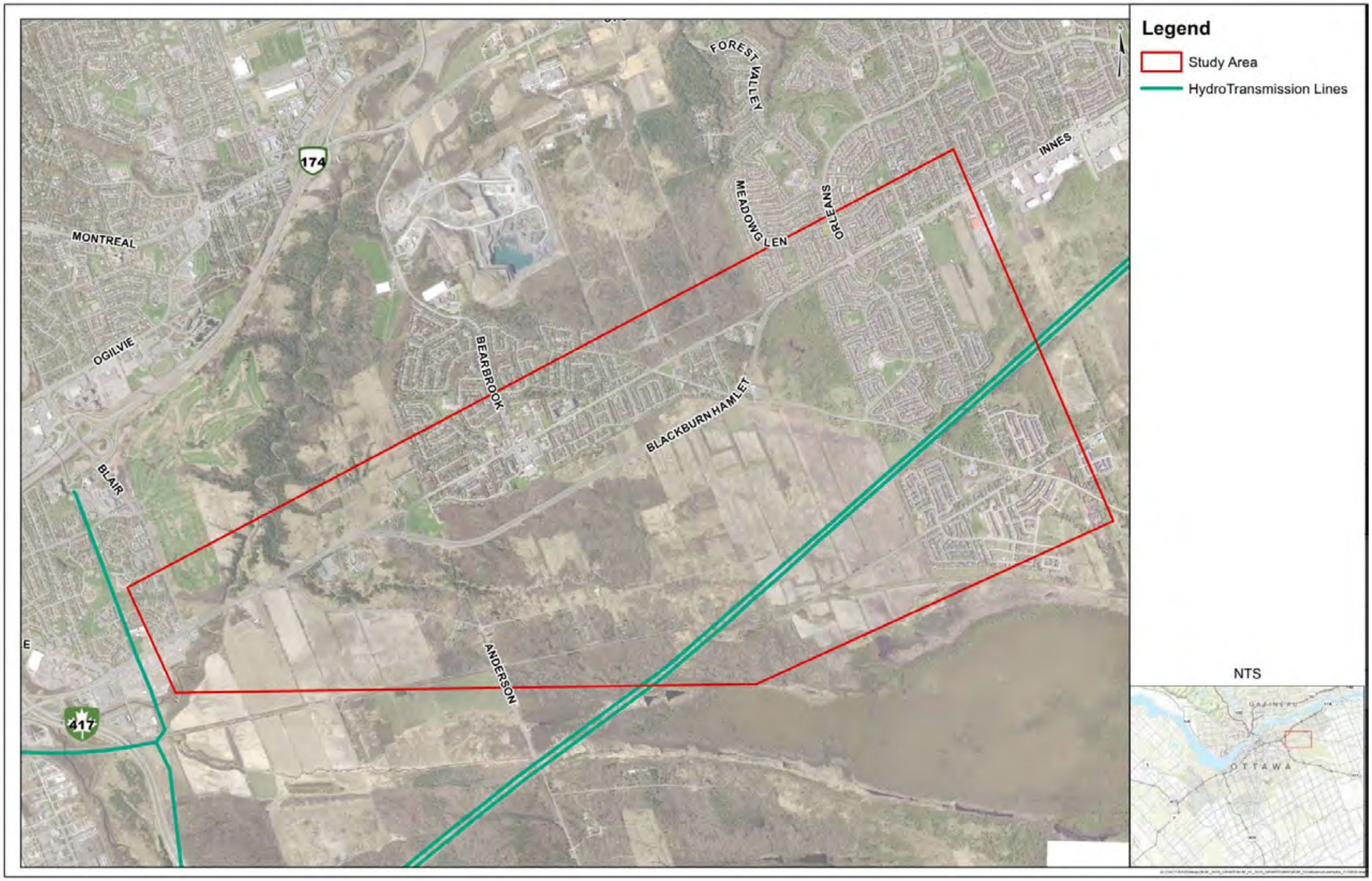

Figure 5-27: Hydro Infrastructure

5.5.7.2 Telecommunications

The majority of the telecom infrastructure in the study area is located on Hydro poles. There are Bell conduits on Innes Road and Blair Road crossing the study area and there are Bell pole lines on Navan Road and Renaud Road.

5.5.7.3 Natural Gas

On the east side of the study area there is a 500 mm interprovincial transmission main that borders the east edge of the RCMP property located on St Joseph Boulevard. There is a major junction point located at the eastern intersection of Innes Road and the Blackburn Hamlet Bypass. From this junction there is a 200 mm gas main on Innes Road and a 400 mm gas main located on the Blackburn Hamlet Bypass.

There are 300 mm and 150 mm diameter gas mains which run along the south side of Innes Road. In addition, there is an NPS 16 (400mm) diameter vital gas main which runs through the corridor on the south side of Anderson Road/Renaud Road from Innes Road to the north-south section of Renaud Road. There are large valve boxes for the vital gas main in the existing Anderson Road/Renaud Road roundabout. The vital gas main has three access points for inspection, two are in front of 2126 and 2170 Anderson Road and the third is located south of the Innes Road and Anderson Road Intersection. The rest of the developed area is served by local gas mains.

5.5.7.4 Other Utilities

There is street lighting on most of the roads in the study area. There are also traffic conduits at the major intersections in the area.

5.5.8 Contamination & Hazardous Materials

Former and current activities within the Study Area have the potential to impact the soil and/or groundwater along the proposed alignment section. A Phase I Environmental Site Assessment was undertaken to identify actual or potential issues of environmental concern within the Study Area. The identification of issues was based on readily available information and did not include an intrusive investigation.

The Phase 1 Environmental Site Assessment, undertaken by Golder (2020), included a site visit (7 November 2017) and a review of the following records:

- The City of Ottawa's Historic Land Use Inventory (HLUI).
- Federal, provincial, and private sector databases[3] which included Certificates of Approval, List of Expired Technical **Standards** and Safety Authority (TSSA) Facilities, Fuel Storage Tank, Ontario Regulation 347 Waste Generators Summary, TSSA Incidents, Private and Retail Fuel Storage Tanks, Scott's Manufacturing Directory and Ontario Spills.
- Past and currently available aerial photographs, for various specific years within the period spanning the years 1945 to 2014.

5.5.8.1 Areas of Potential Environmental Concern

Given the large size of the Study Area, several areas of potential environmental concern were identified within the Phase 1 Environmental Site Assessment. These areas were described based on their tendency to potentially impact the soil and/or groundwater. Golder (2020) classified a number of **"**noteworthy records" that included:

- Various former and current commercial/light industrial land uses such as gas stations/garages, a printing shop, a dry cleaner, nurseries with greenhouses, a hydro substation, construction company sites, an area of dumping/waste storage,
- The Ottawa-Carleton Detention Centre,
- Locations with records of minor spills, and
- The Department of National Defence's Former artillery range.

An additional Phase I Environmental Site Assessment was completed by Golder (2020) for this project as described below. The 2020 study was conducted to incorporate the Blair Road Transit Priority Environmental Assessment Study Area, and adjacent to the current study area.

[3] For a complete description of each of the databases searched for the Phase 1 Environmental Site Assessment, refer to Appendix B of Golder's (2020) Phase 1 Environmental Site Assessment Report.

Historic Land Use Inventory (HLUI)

The HLUI data provided by the City, included approximately 80 records for the Study Area. Noteworthy records for the Study Area included retail fuels outlets, two automotive garages, two construction companies, dry cleaning facilities, a transit facility, and a Department of National Defense bombing range (Golder, 2020).

ESRIS Reports

Various environmental concerns were noted through the ESRIS review, including Certificates of Approval (various uses), fuel storage tanks, expired TSSA facilities, various waste generation sites, TSSA incidents, private and retail fuel storage tanks, Scott's Manufacturing Directory listings and various spills as reported to Ontario (Golder, 2020).

Agricultural Land, Developed Areas & Transportation Facilities

In addition to the full List of "noteworthy" issues (List Numbers 1 to 36) described in Golder's Phase I Environmental Site Assessment (2020), there are numerous agricultural fields within the Study Area that have persisted for at least 70 years. Golder (2020) identified such agricultural fields as potential issues of environmental concern given that pesticides and fertilizers may have been applied to crops on these fields. Usage of pesticides and fertilizers may have resulted in shallow soil impacts.

A review of aerial photography indicates that the Study Area was developed prior to 1945. Today, lands within the NCC's Greenbelt primarily consist of agricultural fields with some farm and/or residential properties located along Innes Road, Renaud Road, Maurice Street, Riel Street and Navan Road. The Ottawa-Carleton Detention Centre located just west of Blackburn Hamlet Bypass at 2125 Anderson Road (2244 Innes Road) was constructed between 1965 and 1976.

Reviews of aerial photography indicated that residential development was observed to have occurred between the early 1950s and 1965, primarily near and along Innes Road within the communities that are now known as Blackburn Hamlet and Pineview Village. Between 1965 and 1999, aerial photos indicated further development, primarily consisting of residential and commercial development, within Blackburn Hamlet and Chapel Hill South. By 1991, these neighbourhoods were developed as they are today. Ongoing development (again primarily residential with some commercial) has taken place within Chapel Hill South, Chapel Hill North and Orléans Village between the years 1965 to 2014.

For parcels of land within the Study Area that were developed prior to the 1940's, Golder (2020) reports that such land may show the potential for the presence of former and/or existing heating oil tanks.

It is also noted that residual salt may be present along the roadways within the Study Area. The presence of residual salt is due to de-icing agents having been, and presently being, applied for the purpose of road maintenance.

5.6 Climate Change

Climate Change Projection Data

Climate change projection models used for this study were primarily sourced from an international body referred to as the Intergovernmental Panel on Climate Change (IPCC). The IPCC was established by the United Nations and World Meteorological Organization in 1988 to review information on climate change. The IPCC has since been preparing Assessment Reports that, among other things, aggregate global climate models and projection data. The latest such report, the Fifth Assessment Report (AR5), included projection information from forty Global Climate Models (GCMs).

For this climate change risk assessment, projected changes for various climate elements were computed through the GCMs from AR5 using historical climate data from Environment and Climate Change Canada. This was accomplished using the Climate Change Hazards Information Portal (CCHIP), a climate analysis tool developed by Risk Sciences International (RSI).

AR5 also uses the concept of Representative Concentration Pathways (RCPs) to denote scenarios of various climate change intensities. Each scenario is named after 'radiative forcing values', a measure of the rate of energy change per unit area of the globe, measured in watts per square metre.

The scenario with the lowest projected change, or 2.6 W/m^2, is represented by RCP 2.6, while the highest projected change, or 8.5 W/m^2, is represented by RCP 8.5. The two RCPs used in this risk assessment were RCP 4.5 (moderate future emissions), and RCP 8.5 (highest future emissions).

The historical climate data used in the computation of climate projections comes from the Ottawa CDA meteorological station, located at the Central Experimental Farm, which has over 100 years of data.

In addition to CCHIP, historical trends and climate projections were identified through the review of past climate change risk assessments from the Ottawa area and academic papers from the field of climate science.

Daily Average Temperature Temperatures in the Ottawa area are projected to increase in future. Overall, annual daily average, maximum, and minimum temperatures are projected to increase at similar rates. All three variables are projected to increase on average between 2.4 and 3.1 degrees by 2050, and between 3.3 and 5.8 degrees by 2080.

Extreme Heat Days

Along with an increase in average daily temperatures, an increase in extreme temperatures is projected for the study area under the RCP 4.5 and 8.5 climate scenarios. Projections for the number of days with daily maximum temperatures above 30ºC, show a possible increase from an annual average of 12 days, historically, to between 33 and 37 days in 2050 and to between 42 and 69 days in 2080.

Precipitation

According to current projections under the RCP 4.5 and 8.5 climate scenarios:

- Total annual precipitation would increase; and
- Extreme precipitation would increase at a faster rate than total annual precipitation.

The total annual precipitation is projected to increase by up to 11% in 2080, the average maximum 24hr precipitation is expected to increase by 17% in that same time frame. The 11% increase in total annual precipitation would predominantly occur in the form of extreme rain events.

Average Snowfall Trend

A downward trend can be identified in the historical data for the Ottawa CDA station, and this generally aligns with projections for annual increases in temperature.

Freeze-thaw Cycles

The ensemble of projections for both the moderate and high concentration pathways (RCPs) show a noticeable decrease in the number of days with freeze-thaw cycles in 2050 and 2080. The months of April and October may see 62% to 95% fewer freeze-thaw cycles on average under the RCP 4.5 and 8.5 climate scenarios. December, January, and February are projected to see an increase in freeze-thaw cycles. The month of March would continue to see the most days with freeze-thaw cycles in 2080.

Freezing Rain

An Environment and Climate Change Canada study by Cheng et. al. (2007) concluded that freezing rain events are very likely to increase in northern, eastern, and southern Ontario in the coming century. The study concluded that eastern Ontario is likely to see a 60% and 95% increase in freezing rain event frequency by 2050 and 2080, respectively, during the months of December, January, and

February. The study projected that the frequency of freezing rain events would remain unchanged for the months of November, March, and April.

Wind

One Environment and Climate Change Canada study by Cheng et. al. (2012) looked at projected increases in daily and hourly wind gusts for various regions of Ontario, including eastern Ontario. The results suggest modest increases in wind gusts are likely in the coming decades. Wind gusts over 70 km/h may see the highest increase in frequency, occurring 23% to 46% more often than current conditions.

Water Balance

Water deficits exist when potential evapotranspiration is greater than actual evapotranspiration. Results from CCHIP for the RCP 4.5 and 8.5 climate scenarios show that water surplus in the region would increase during the winter months (December to March), while water deficits will increase from May to October, with pronounced deficits in July and August.

Rainfall Intensity Duration Frequency

Intensity Duration Frequency (IDF) relates rainfall intensity with its duration and frequency and is used for flood forecasting and drainage design. For this parameter, the IDF_CC tool, developed by Western University, was used to project the change in total 24-hour precipitation for various design return periods. The results project a 19-22% increase in the 5-year, 24-hour rainfall amount, and a 17-30% increase in the 100-year, 24-hour rainfall amount.

5.6.1 Climate Projections Report, 2020

Climate Projections for the National Capital Region were prepared by CBCL Ltd. in June 2020, as a joint venture between the City of Ottawa and the NCC. The projections for climate changes and extremes documented in the 2020 Projection Report illustrate a similar trend to those noted in **Section 5.6**.

The Climate Projections Report further notes that climate change is expected to impact both transportation infrastructure and operations (CBCL Ltd., 2020). Potential opportunities to the transportation sector such as longer construction seasons or reduced winter snow clearing may also result from a changing climate.

Strategies to manage uncertainty in climate modeling include (CBCL Ltd., 2020):

- Where practical, use a low-regret approach that accounts for the full range of climate projections.

- Plan/design for the most probable climate conditions over the intended lifetime.
- Include flexibility and/or additional safety factors for alternative courses of action.
- Monitoring climate conditions and project performance over time.
- Opting for adaptations that provide a clear financial or social benefit.
- Implementing design and construction modifications in response to observed changes.

5.7 Sustainability & Resilience

The City of Ottawa, in partnership with the City of Gatineau and the National Capital Commission have completed *A Plan for Sustainability and Resilience in Canada's Capital Region* (HB Lanarc Consultants Ltd., 2012). The plan identifies a long-term vision and set of goals speaking to all dimensions of sustainability—economic, social, cultural, and environmental. The plan outlines a set of strategies with broad guidelines to achieve these goals over the long term. A Risk Prevention and Mitigation Plan was created as a sub-plan to combine sustainability planning with long-term risk management. This sub-plan assesses the effects of long-term risks on communities and describes how the Sustainability and Resilience Plan can mitigate or prevent them.

The Sustainability and Resilience Plan developed a set of 10 strategies that form the core of the plan. The strategies most relevant to this project and the study area include:

- Manage Growth and Development:
  - Maintain a compact region
  - Protect the integrity of rural areas
  - Encourage design excellence
- Encourage Sustainable Mobility
  - Integrate land use and transportation systems
- Protect and Restore Green and Natural Systems
  - Continue to conserve large natural areas and strengthen connections between them
  - Promote habitat restoration and species recovery
  - Control the spread of invasive species
- Support Local Food and Agriculture
  - Control the spread of invasive species

The Plan notes that to curb the use of private automobiles, walking, cycling, and transit need to become more efficient and attractive forms of transportation. The Plan indicates that a region utilizing smart growth (compact, mixed, transit-oriented development) tends to reduce public infrastructure and service costs and reduces direct and indirect transportation costs. The plan indicates that by 2060, most population growth may occur within the urban boundary. Around rapid transit stations, there will be an increased intensification of residential land and decrease in single-detached housing when compared to historic trends.

6. IDENTIFICATION & EVALUATION OF ALTERNATIVE SOLUTIONS

This evaluation follows the work done to define problems and opportunities in the study area. The communities in the eastern areas of the City of Ottawa are projected to experience continued growth in both population and employment over the next several decades. This growth will require appropriate and targeted transportation infrastructure (for transit, automobiles, and Active Transportation (AT) modes).

6.1 Multi-Modal Objectives

The existing road network is currently at or close to capacity and this condition will deteriorate unless improvements are made. The identified problems and opportunities were used to generate alternative solutions (options) and multi-modal transportation solutions for the corridor. Options considered the role of transportation demand management to reduce single occupancy vehicle traffic (alternative modes such as transit, cycling and walking). The presented Alternative Solutions included expanded/enhanced transit service; expanded/enhanced pedestrian/cycling; travel demand management; and expanded roadway capacity. The Future Do-Nothing Alternative was also considered.

6.2 Development of Alternatives

A Preliminary Workshop was held on October 4, 2017, with Study Team members and City Staff who had previous project/area specific information on the project. The purpose of the half-day workshop was to gain insights and provide context to this study. The Workshop included review of past work; lessons learned; objectives and constraints; and development of preliminary alternative corridors for transit and roadways.

The Workshop (**APPENDIX B**) identified a range of potential new or expanded roadway and rapid transit corridors in addition to those identified in the City's TMP. The options as identified in the workshop are illustrated in **Figure 6-1**. Building off the Workshop results, the Study-Team identified a long-list of alternative road and transitway corridors, as discussed further in **Section 6.3**.

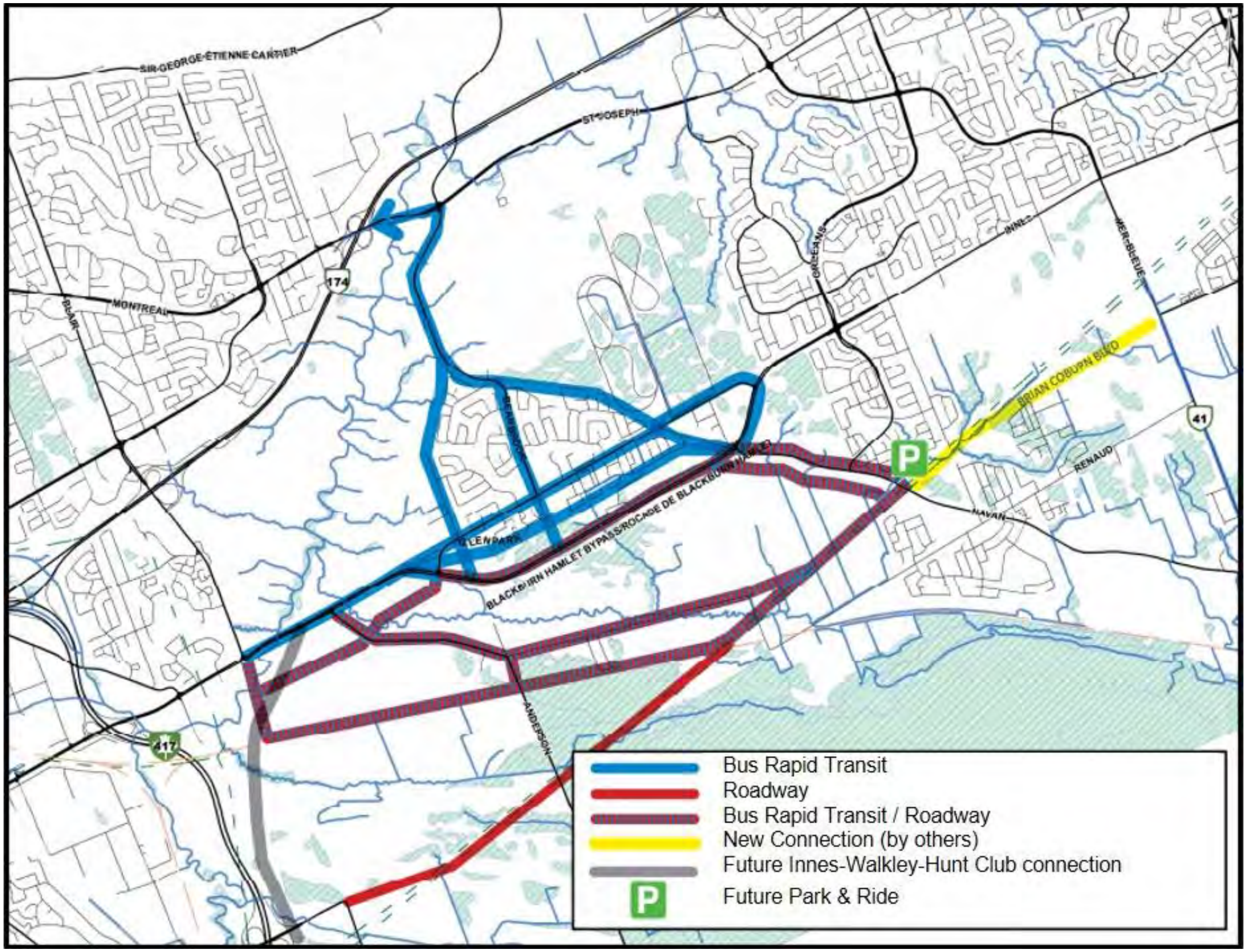

Figure 6-1: Initial Transit & Roadway Corridors

6.3 Long List of Alternative Corridors

The study developed a long list of road and transit corridor options covering a broad area within and even to the north and south of the study area. These options were assessed at a high level considering the natural, social, and cultural environments, as well as transportation and cost. The long list of alternative corridors was initially examined as separate groups of roadway and transit alternatives (**Figure 6-2** and **Figure 6-3**).

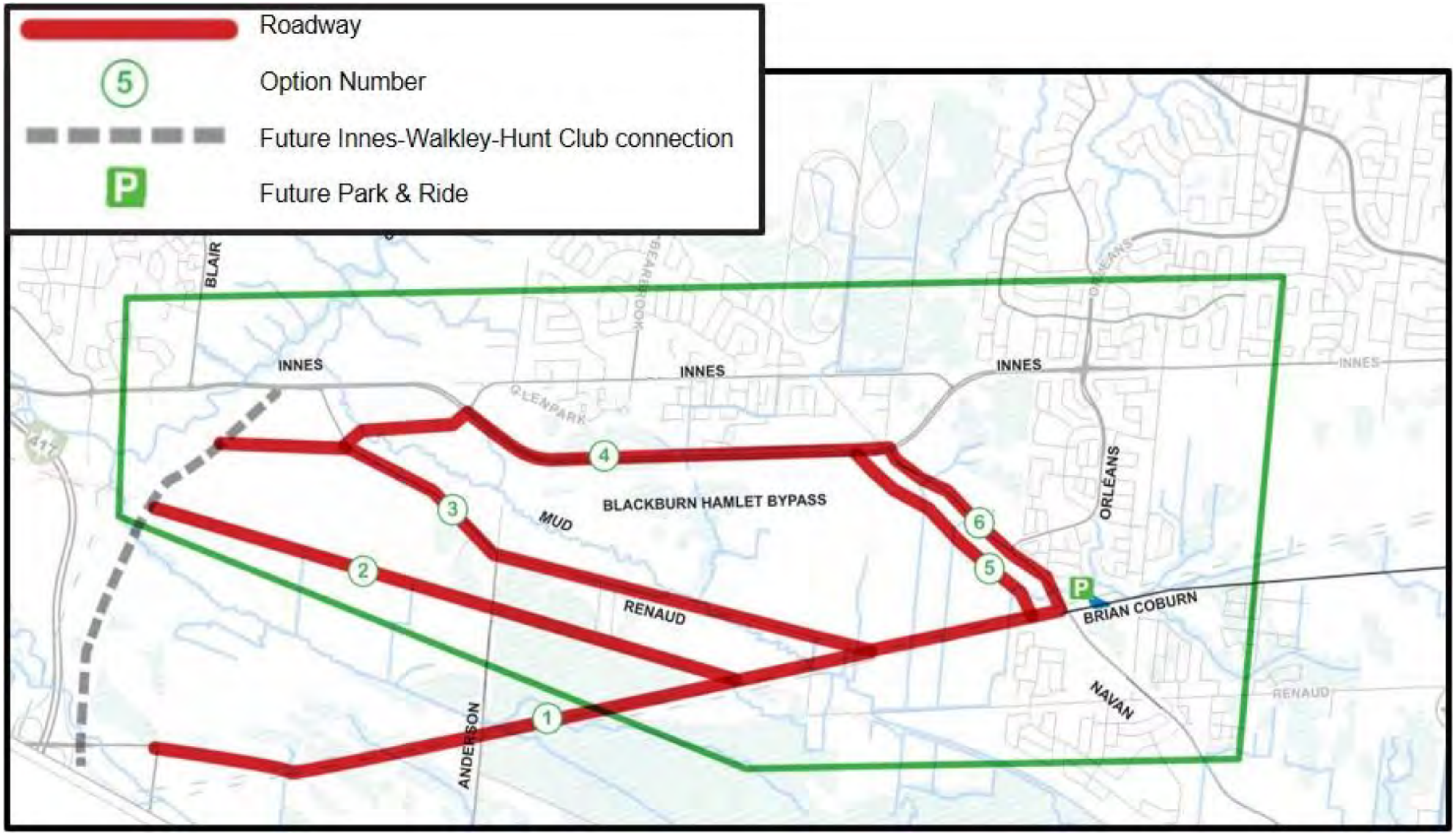

Figure 6-2: Long List of Alternative Roadway Corridors

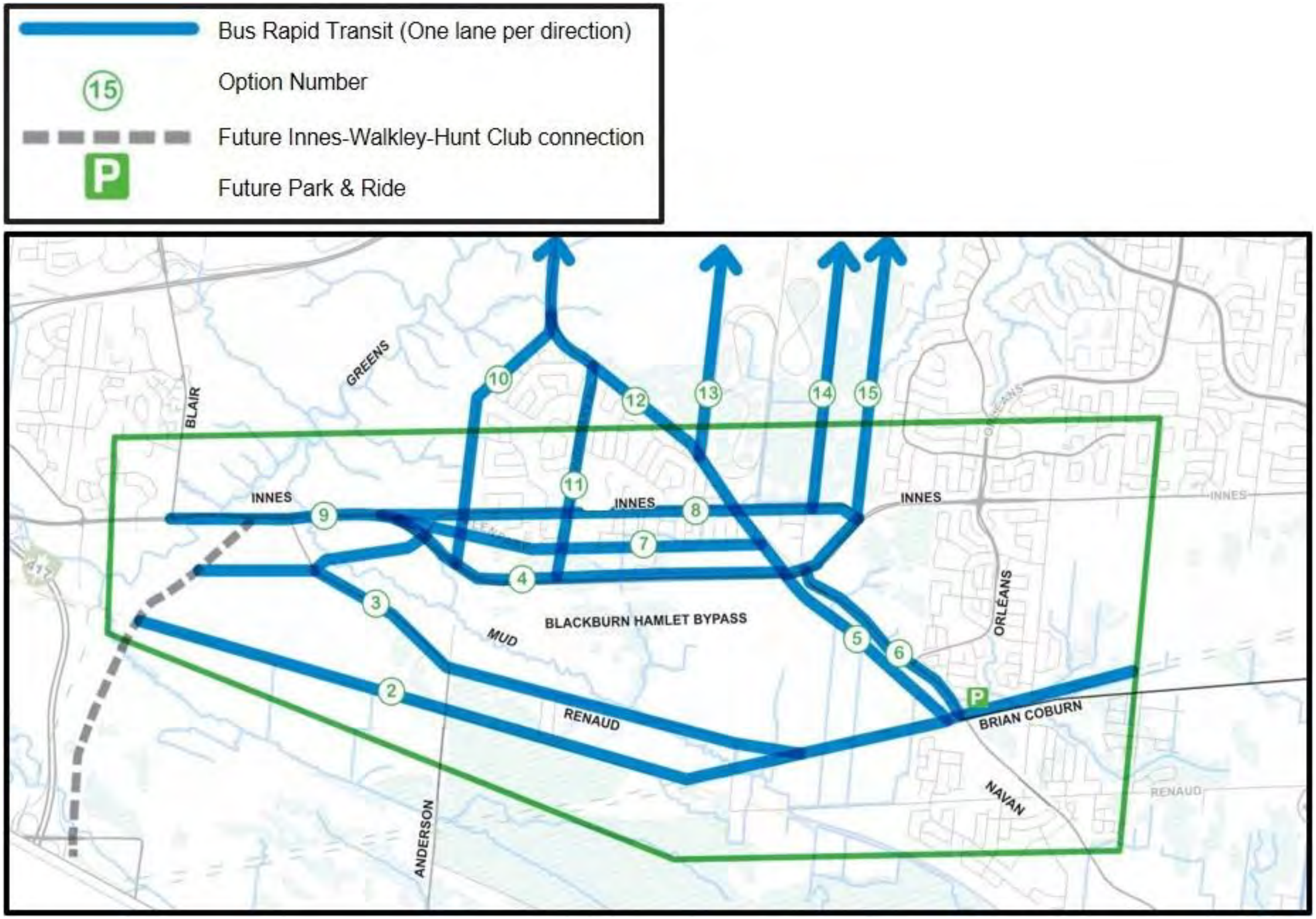

Figure 6-3: Long List of Alternative Transitway Corridors

Shown in **Figure 6-2** is the long list of six road corridor options some of which could be combined together. The six road corridor options included:

1. Extend a new 4 lane Brian Coburn Boulevard (BCB) directly west from Navan Road and follow the Hydro corridor to Walkley Road.

2. Extend a new 4 lane BCB directly west from Navan Road along the Hydro Corridor, then continue along the Prescott Russell Trail to the future Innes-Walkley-Hunt Club (IWHC) link.

3. Extend a new 4 lane BCB directly west from Navan Road to a widened 4 lane Renaud Road and along a widened 4 lane Anderson Road to connect to the future IWHC link.

4. Option 4 combines with either Option 5 or 6 and involves a widening of the Blackburn Hamlet Bypass (BHBP) from 4 to 6 lanes, a new 2 (or 4) lane road extending southwest from the Innes Road/BHBP west intersection across Mud Creek and connecting to the future IWHC link.

5. As per the 1999 EA for the BHBP Extension, Option 5 extends BCB with 4 lanes down the escarpment, which then turns north following west of Navan Road in the Greenbelt to connect to Option 4 on the BHBP.

6. Option 6 is a widening of Navan Road to 4 lanes, which would then connect to Option 4 on the BHBP.

Shown in **Figure 6-3** is the long list of 15 transit corridor options. The transit corridor concept options included:

1. Figure 1 was considered but applies to the road corridor options only.

2. Extends the transitway west from Navan Road down the escarpment following the Prescott Russell Trail, where it then connects to the future IWHC link.

3. Extends the transitway west from Navan Road down the escarpment towards Renaud Road, following Renaud Road, then continuing along Anderson Road, before connecting to the future IWHC link.

4. As per the 2011 EA for the Hospital Link and Cumberland Transitway Westerly, Option 4 combines with either Option 5 or 6. The transitway takes over the existing westbound lanes of the BHBP, then drops down to pass under Innes Road on a structure before rising back up to grade to the planned transit station at Blair Road and Innes Road.

5. As per the 1999 Cumberland Transitway EA Study, Option 5 extends the transitway from Navan Road down the escarpment, then extends west of Navan Road in the Greenbelt heading north to connect to the transitway in Option 4 via a grade separated structure at the BHBP.

6. Option 6 extends the transitway along the north side of Navan Road to connect to the transitway as per Option 4 via a grade separated structure at the BHBP.

7. Option 7 combines with either Option 5 or 6 and runs parallel to and in between Innes Road and the BHBP before connecting to Option 9.

8. Option 8 combines with Option 5 and follows Innes Road before connecting to Option 9.

9. Option 9 combines with either Option 4, 7 or 8 and is as per the 2011 EA for the Hospital Link and Cumberland Transitway Westerly. From the grade separated structure at Innes Road and the BHBP, the transitway continues along the north side of Innes Road at grade to the planned transit station at Blair Road and Innes Road.

10. Option 10 is located to the west of the Blackburn Hamlet community, destined to the Montreal Road LRT Station.

11. Option 11 runs adjacent to Bearbrook Road before connecting to the Montreal Road LRT Station.

12. Option 12 is located to the east of the Blackburn Hamlet community, destined to the Montreal Road LRT Station.

13. Option 13 swings north from Option 12 to a new potential LRT station.

14. Option 14 swings north from Option 8 and through the RCMP property to a new potential LRT station.

15. Option 15 swings north from Option 8 and through the RCMP property further east of Option 14 to a new potential LRT station.

6.3.1 Preliminary Screening Criteria

The following Screening Criteria groups were used to assess the long list of roadway and transit corridors all on a qualitative basis:

- **Natural Environment:** Potential effects of the alternative corridors on the natural environment. Consideration given to watercourse crossings; impacts on natural heritage features, wildlife, natural vegetation, and key natural features.

- **Social Environment:** Assess opportunities to promote healthy communities and protect enjoyment of the outdoor environment. Consideration given to impacts to existing community facilities/uses, agricultural capability, businesses.

- **Cultural Environment:** Assess effects on cultural resources. Consideration given to heritage, archaeology, cultural landscapes.

- **Transportation/Transit System:** Effectiveness of the alternatives to contribute to the success of the planned transportation systems. Consideration given to transit catchment potential, connectivity, capacity, operations.

- **Cost:** Consideration given to construction cost, operating cost, property and utility costs, affordability.

6.3.2 Preliminary Screening Results

The preliminary screening of the long list of road and transit corridor options resulted in a short list of six combined road and transit corridor options that were then carried forward for further consideration. The screening results are presented in **Table 6-1** and **Table 6-2**.

Table 6-1: Long List of Alternative Roadway Corridors & Screening Results

#	Factor					Recommendation
	Natural Environment	Social Environment	Cultural Environment	Transportation	Cost	
1	×	~	~	✓	~	Do Not Carry Forward
2	×	~	~	✓	~	Do Not Carry Forward
3	~	~	~	✓	~	Do Not Carry Forward
4&5	~	~	~	✓	~	**Carry Forward**
4&6	~	~	~	✓	~	**Carry Forward**

Table 6-2: Long List of Alternative Transit Corridor & Screening Results

#	Factor					Recommendation
	Natural Environment	Social Environment	Cultural Environment	Transportation	Cost	
1	Not Applicable – Road Corridor Only					
2	×	~	~	×	~	Do Not Carry Forward
3	~	~	~	×	~	**Carry Forward**
4+5 +9	~	~	✓	✓	~	**Carry Forward**

#	Factor					Recommendation
	Natural Environment	Social Environment	Cultural Environment	Transportation	Cost	
4+6 +9	~	~	✓	✓	~	Do Not Carry Forward
7	~	×	✓	✓	~	Do Not Carry Forward
8	✓	×	✓	~	×	Do Not Carry Forward
10	×	×	~	✓	~	Do Not Carry Forward
11	~	×	✓	✓	×	Do Not Carry Forward
12	~	×	~	✓	~	Do Not Carry Forward
13	~	~	~	✓	~	Do Not Carry Forward
14	×	~	~	✓	~	Do Not Carry Forward
15	×	×	~	✓	~	Do Not Carry Forward

6.4 Alternative Corridors

Following the high- level screening exercise, as described above, a short list of six combined road and transit corridor options were then carried forward for further consideration.

6.4.1 Option 1: New Road & BRT off Navan

Option 1 is a combination of road widening, new road, and new BRT facilities, primarily west of Navan Road and along the Innes Road corridors, as illustrated in **Figure 6-4**. Note that all figure options also illustrate some proposed future road widenings and transit corridor extensions per the TMP that are not part of the current study including: Navan Road south of Brian Coburn Boulevard widened from 2 to 4 lanes; Brian Coburn Boulevard east of Navan Road widened from 2 to 4 lanes; Blair Road north of Innes Road widened from 2 to 4 lanes; new/expanded Park and Ride facilities and a transit station would be provided in the northeast corner of the Navan Road/ Brian Coburn Boulevard intersection; and, a new Cumberland Transitway BRT provided east of Navan Road and north of Innes Road along Blair Road.

For Option 1, a new 4-lane road would be provided from north of Brian Coburn Boulevard and west of Navan Road through the Greenbelt to the Blackburn Hamlet Bypass. The Bypass would be widened from 4 to 6 lanes. West of the Innes Road/Blackburn Hamlet Bypass west intersection, a new 2 lane roadway would be provided west to Anderson Road, and a new 4 lane roadway would be provided from Anderson Road to the future Innes-Walkley-Hunt Club Connection. The Anderson Road connection between the new roadway and Innes Road would be removed. The connection to the future Innes-Walkley-Hunt Club Connection is needed as the 6 lane section of Innes Road between the Blackburn Hamlet Bypass and Highway 417 is already at capacity and the proposed Innes-Walkley-Hunt Club Connection provides alternate access to Highway 417 and to key east-west arterial roadways (Walkley Road and Hunt Club Road) which help to distribute and accommodate east-west travel demand.

The new BRT would travel along Brian Coburn Boulevard, cross Navan Road, and run adjacent to the new roadway west of Navan Road to the Bypass. A grade separated intersection would enable the BRT to cross the Bypass. The BRT would then follow the Bypass west to Innes Road and follow Innes Road to Blair Road. BRT stops would be provided at the Park and Ride, 2 on the Blackburn Hamlet Bypass and at the Blair/Innes Intersection.

6.4.2 Option 2: 4 Lane Off Navan/BRT on Navan

Similar to Option 1, Option 2 is a combination of road widening, new road and new BRT facilities, primarily along or near to the Navan Road, Bypass and Innes Road corridors, as illustrated in **Figure 6-4**. North of Brian Coburn Boulevard, a new 4-lane road would be provided to the west of Navan Road along the Greenbelt edge to the Blackburn Hamlet Bypass. The Bypass would be widened from 4 to 6 lanes. West of the Innes Road/ Blackburn Hamlet Bypass intersection, a new 2 lane roadway would be provided west to Anderson Road, and a new 4 lane roadway would be provided from Anderson Road to the future Innes-Walkley-Hunt Club Connection. The Anderson Road connection between the new roadway and Innes Road would be removed.

The new BRT would extend north along the existing Navan Road to the Bypass with a grade separated intersection at Orleans Boulevard. A grade separated intersection would enable the BRT to cross the Bypass. The BRT would then follow the Blackburn Hamlet Bypass to Innes Road, crossing via grade separated intersection and continue to Blair Road. BRT stops would be provided at the Park and Ride, 2 on the Blackburn Hamlet Bypass and at the Blair/Innes Intersection.

6.4.3 Option 3: Widen & BRT on Navan

Option 3 is a combination of road widening, new road, and new BRT facilities, primarily along the Navan Road, Bypass and Innes Road corridors, as illustrated in **Figure 6-4**. This option widens Navan Road from 2 lanes to 4 lanes from Brian Coburn Boulevard north to the Blackburn Hamlet Bypass. The Bypass would be widened from 4 to 6 lanes. West of the Innes Road/ Blackburn Hamlet Bypass Intersection, a new 2 lane roadway would be provided west to Anderson Road, and a new 4 lane roadway would be provided from Anderson Road to the future Innes-Walkley-Hunt Club Connection. The Anderson Road connection between the new roadway and Innes Road would be removed.

The new BRT would extend north along the existing Navan Road to the Bypass, with a grade separated intersection at Orleans Boulevard. A grade separated intersection would enable the BRT to cross the Bypass. The BRT would then follow the Blackburn Hamlet Bypass to Innes Road, crossing via grade separated intersection and continue to Blair Road. BRT stops would be provided at the Park and Ride, 2 on the Blackburn Hamlet Bypass and at the Blair/Innes Intersection.

6.4.4 Option 4: Widen Navan/BRT off Navan

Option 4 is a combination of road widening, new road, and new BRT facilities, primarily along or near to the Navan Road, Bypass, and Innes Road corridors, as illustrated in **Figure 6-7**. This option widens Navan Road from 2 lanes to 4 from Brian Coburn Boulevard north to the intersection with the Blackburn Hamlet Bypass. The Bypass would be widened from 4 to 6 lanes. West of the Innes Road/Blackburn Hamlet Bypass intersection, a new 2 lane roadway would be provided west to Anderson Road, and a new 4 lane roadway would be provided from Anderson Road to the future Innes-Walkley-Hunt Club Connection. The Anderson Road connection between the new roadway and Innes Road would be removed.

The new BRT would travel along Brian Coburn Boulevard and cross Navan Road with a grade separated intersection. New BRT facilities would be provided west of the existing Navan Road along the Greenbelt edge to the Blackburn Hamlet Bypass. A grade separated intersection would enable the BRT to cross the Bypass. The BRT would then follow the Blackburn Hamlet Bypass to Innes Road, crossing via grade separated intersection and continue west to Blair Road. BRT stops would be provided at the Park and Ride, 2 on the Blackburn Hamlet Bypass and at the Blair/Innes Intersection.

6.4.5 Option 5: Renaud Extension & BRT off Navan

Option 5 is a combination of road widening, new road and new BRT facilities, as illustrated in **Figure 6-8**. A new 4 lane roadway would be provided to connect Brian Coburn Boulevard at Navan Road to Renaud Road. Renaud Road would be widened from 2 to 4 lanes west to Anderson Road. The Anderson Road connection between the new roadway and Innes Road would be removed. A new 4 lane road would connect the new/widened road to the future Innes-Walkley-Hunt Club connection.

New BRT facilities would be provided west of the existing Navan Road between Brian Coburn Boulevard and the Blackburn Hamlet Bypass. A grade separated intersection would enable the BRT to cross the Bypass. The BRT would then follow the Blackburn Hamlet Bypass to Innes Road, crossing via grade separated intersection and continue west to Blair Road. BRT stops would be provided at the Park and Ride, 2 on the Blackburn Hamlet Bypass and at the Blair/Innes intersection.

6.4.6 Option 6: Renaud Extension & BRT on Navan

Option 6 is a combination of road widening, new road, and new BRT facilities, as illustrated in **Figure 6-9**. A new 4 lane roadway would be provided to connect Brian Coburn Boulevard to Renaud Road. Renaud Road would be widened from 2 to 4 lanes to Anderson Road. The Anderson Road connection between the new roadway and Innes Road would be removed. A new 4 lane road would connect the new/widened road to the future Innes-Walkley-Hunt Club connection.

The new BRT would travel along the existing Navan Road to the Blackburn Hamlet Bypass, with a grade separated intersection at Orleans Boulevard. A grade separated intersection would enable the BRT to cross the Bypass. The BRT would then follow the Blackburn Hamlet Bypass to Innes Road, crossing via grade separated intersection and continue west to Blair Road. BRT stops would be provided at the Park and Ride, 2 on the Blackburn Hamlet Bypass and at the Blair/Innes intersection.

6.4.7 Option 7: Renaud Extension & BRT on Renaud

During the first Open House, the participants proposed a 7th option. The option would consist of a road and transit expansion follow Brian Coburn extension (connecting Brian Coburn to second S curve to link up with Anderson). Participants indicated the development of a 7th option would maintain a connection between Bradley Estates and CHS/Innes Road; provide Bus Rapid Transit serving the Bradley Estates community; address growth in the south; require less grade separations; and leaves Navan Road As is for local traffic. Based on the feedback received, an Option 7 was developed and included in the evaluation.

Option 7 is a combination of road widening, new road, and new BRT facilities, as illustrated in **Figure 6-10**. A new 4 lane roadway would be provided to connect Brian Coburn Boulevard to Renaud Road. Renaud Road would be widened from 2 to 4 lanes west to Anderson Road. The Anderson Road connection between the new roadway and Innes Road would be removed. A new 4 lane road would connect the new/widened road to the future Innes-Walkley-Hunt Club connection.

Option 7 additionally sees the BRT extend from Brian Coburn Boulevard to Innes Road via the Renaud Road corridor. Bus stops would be provided at the corner of Brian Coburn Boulevard and Navan Road and at the corner of Innes Road and Blair Road. Grade separations would be provided at Navan Road and Brian Coburn Boulevard, the BRT/Innes Road crossing and east of the Mud Creek crossing for active transportation and agricultural equipment.

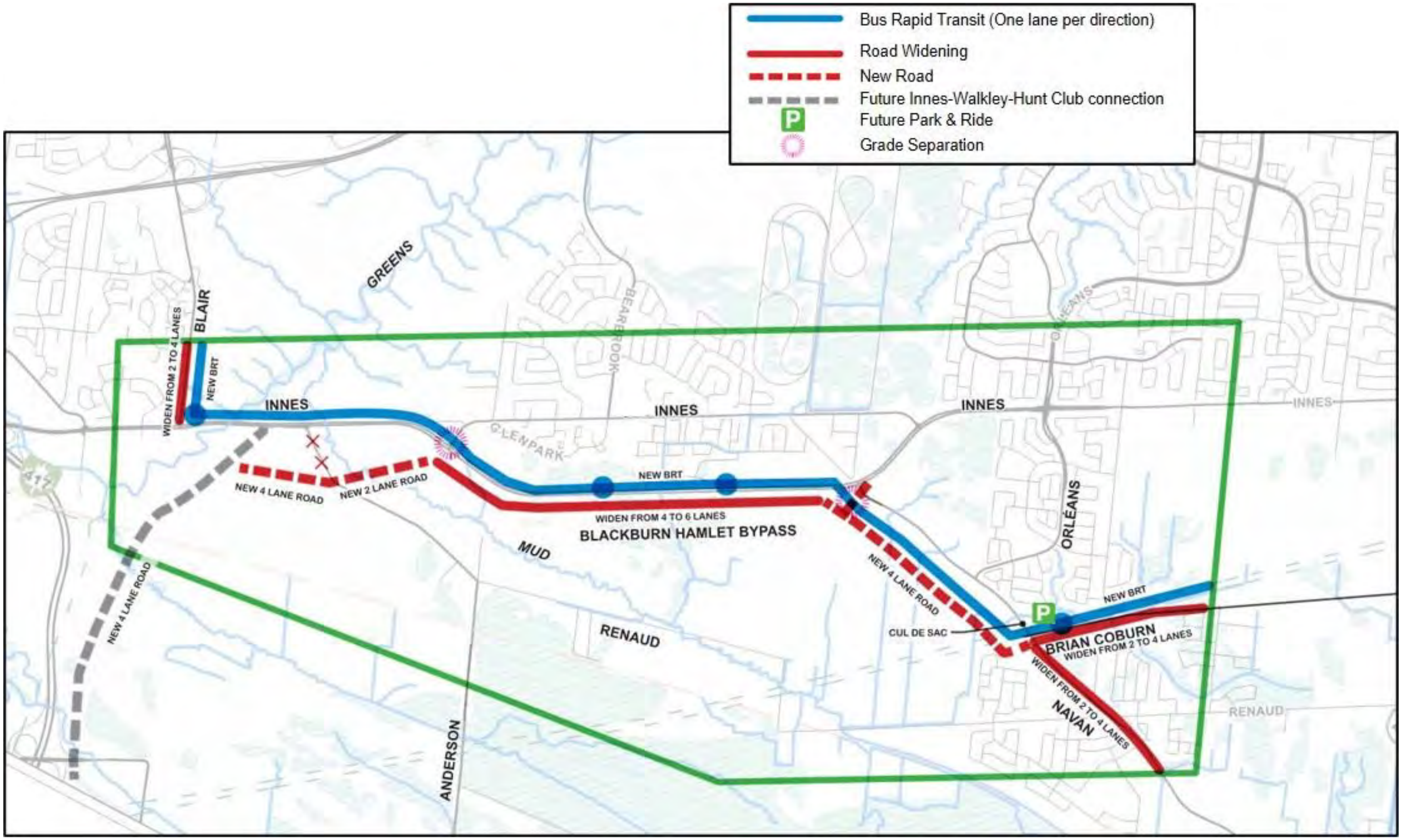

Figure 6-4: Option 1 - New Road & BRT off Navan

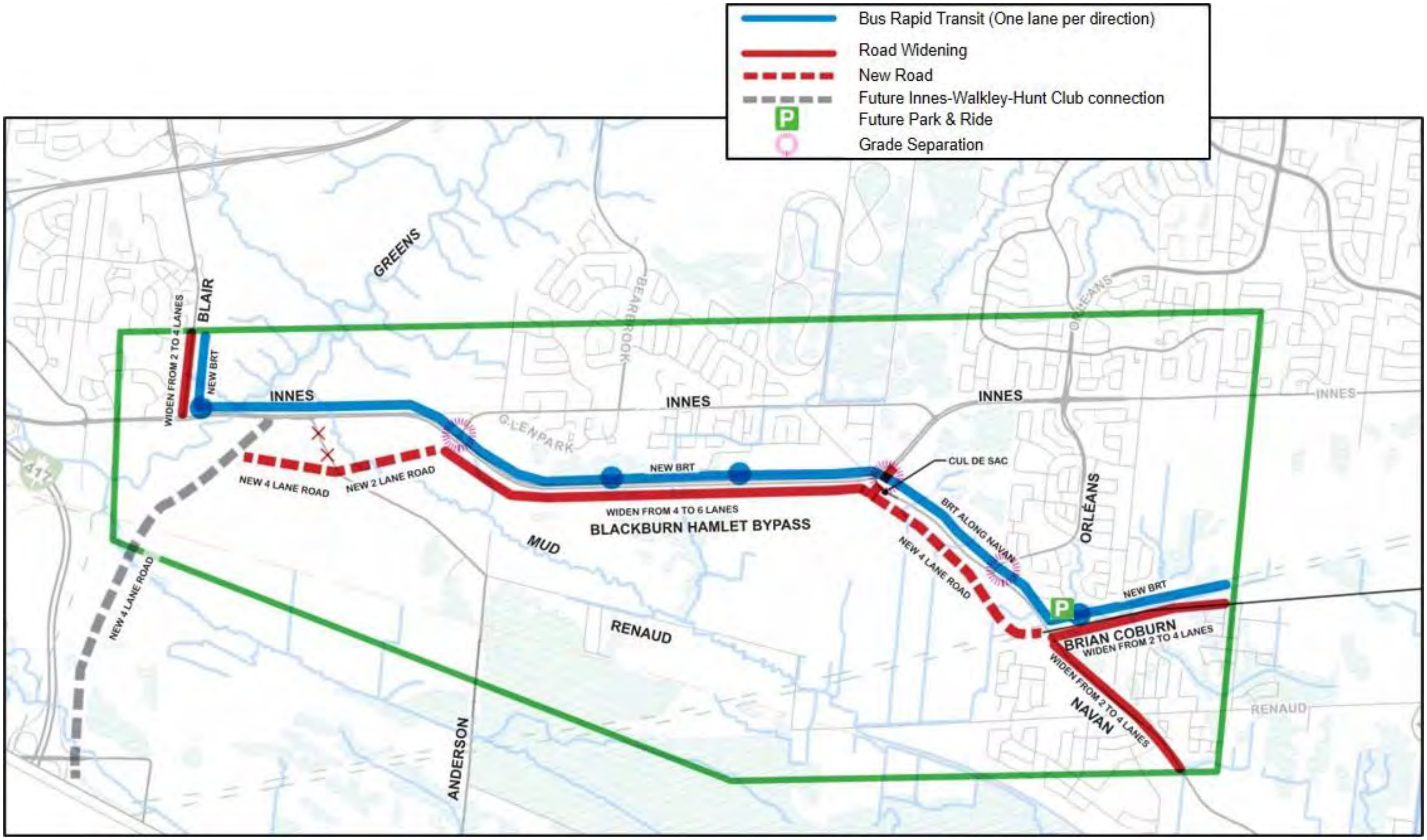

Figure 6-5: Option 2 - 4 Lane Off Navan/BRT on Navan

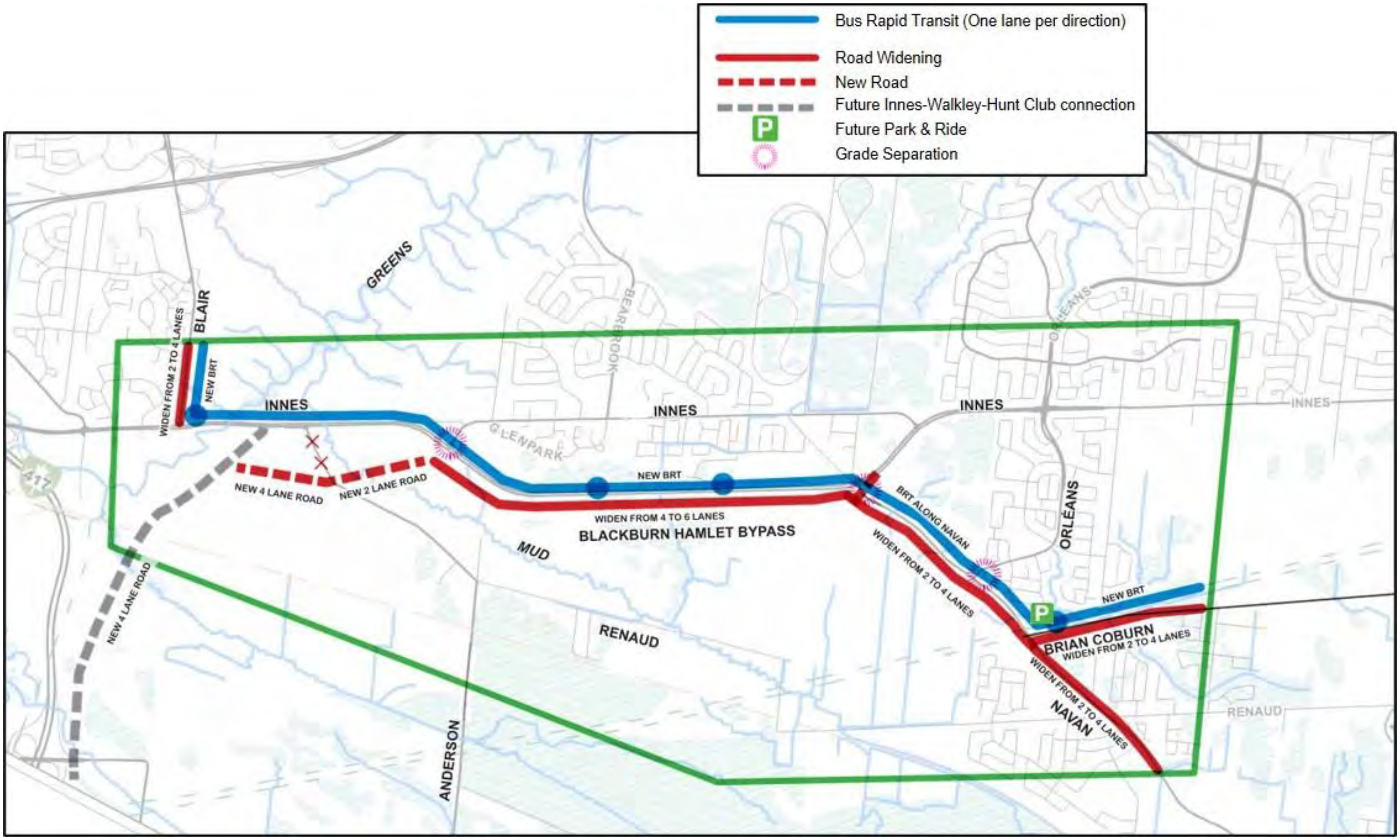

Figure 6-6: Option 3 - Widen & BRT on Navan

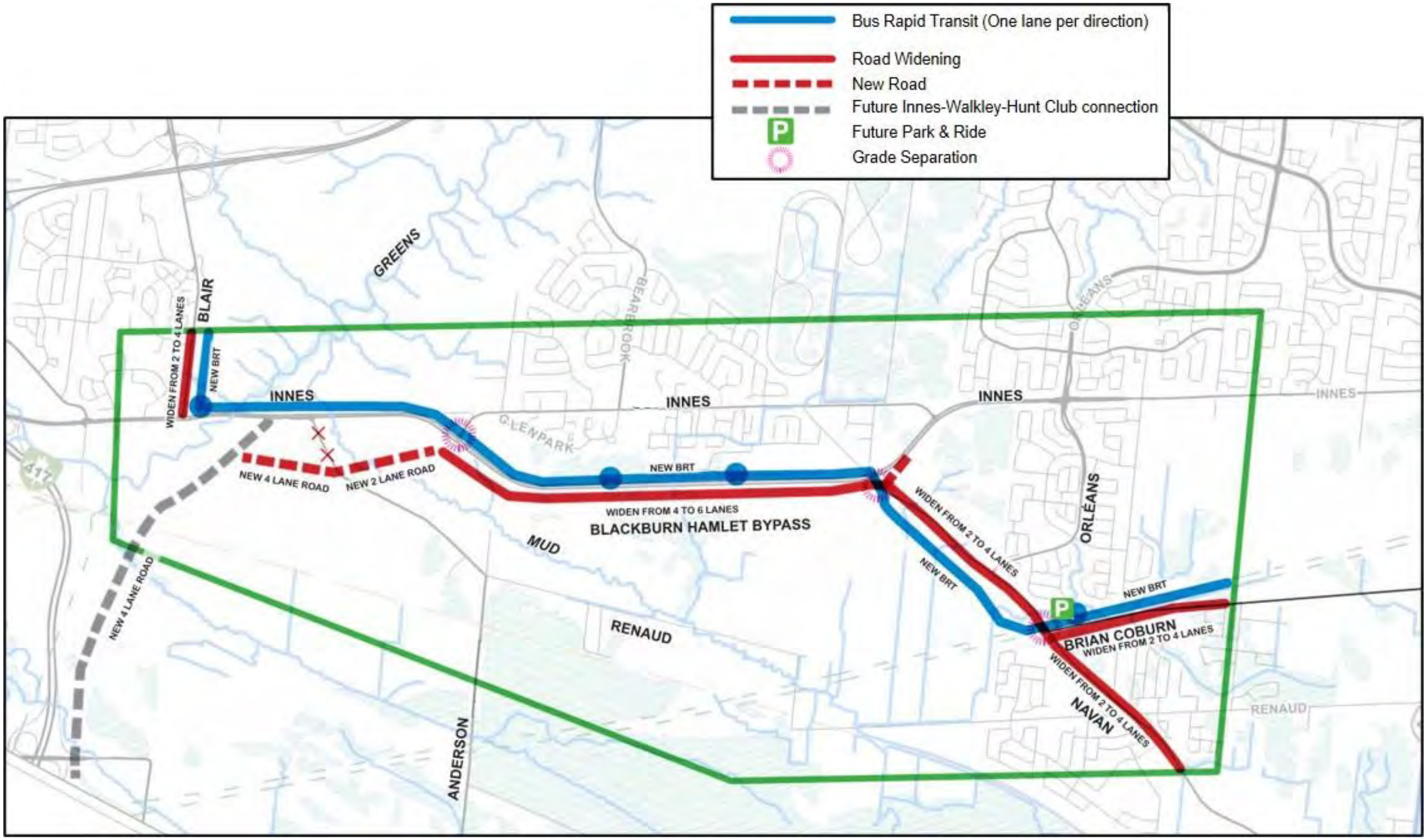

Figure 6-7: Option 4 - Widen Navan/BRT off Navan

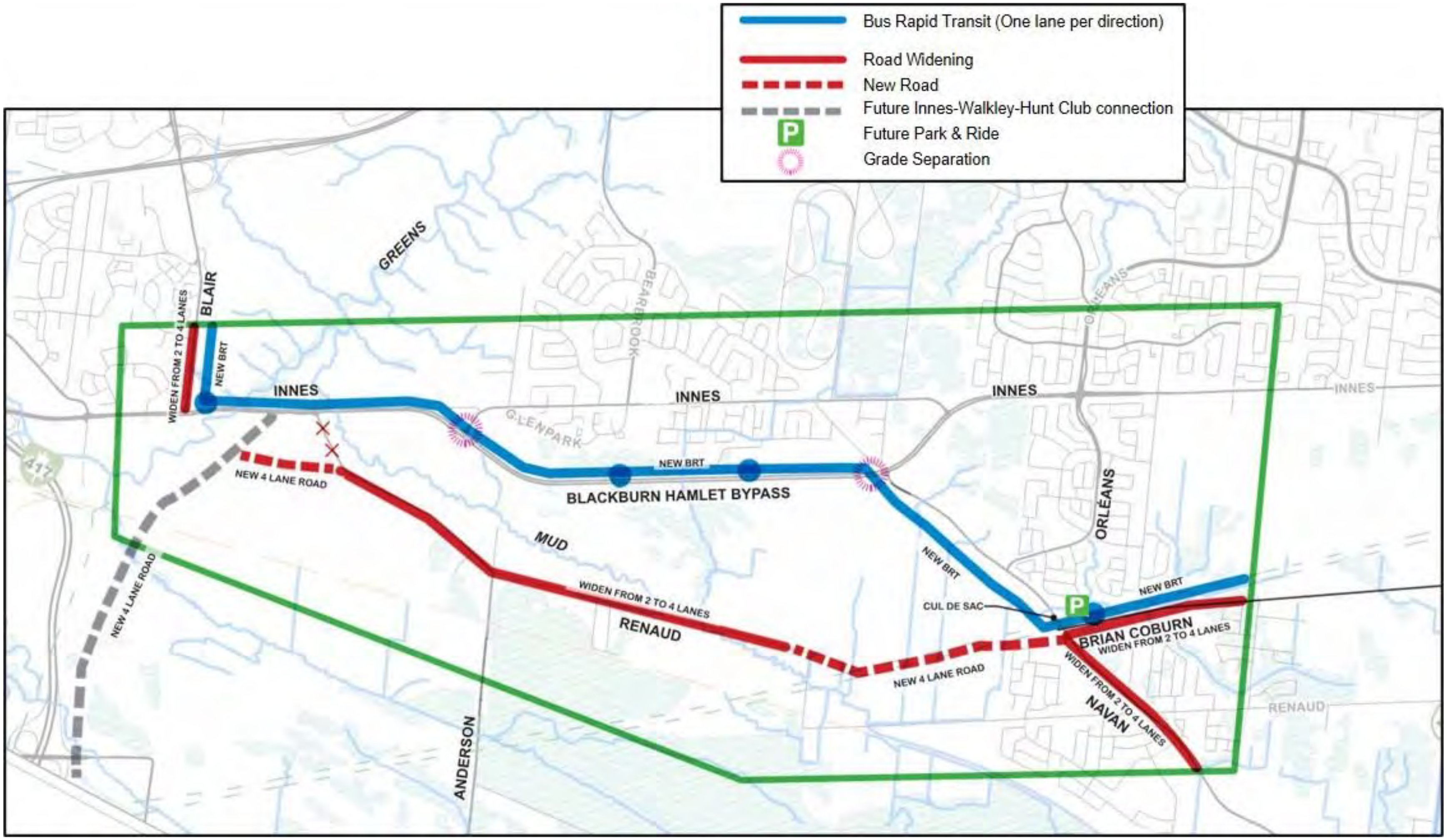

Figure 6-8: Option 5 - Renauld Extension & BRT off Navan

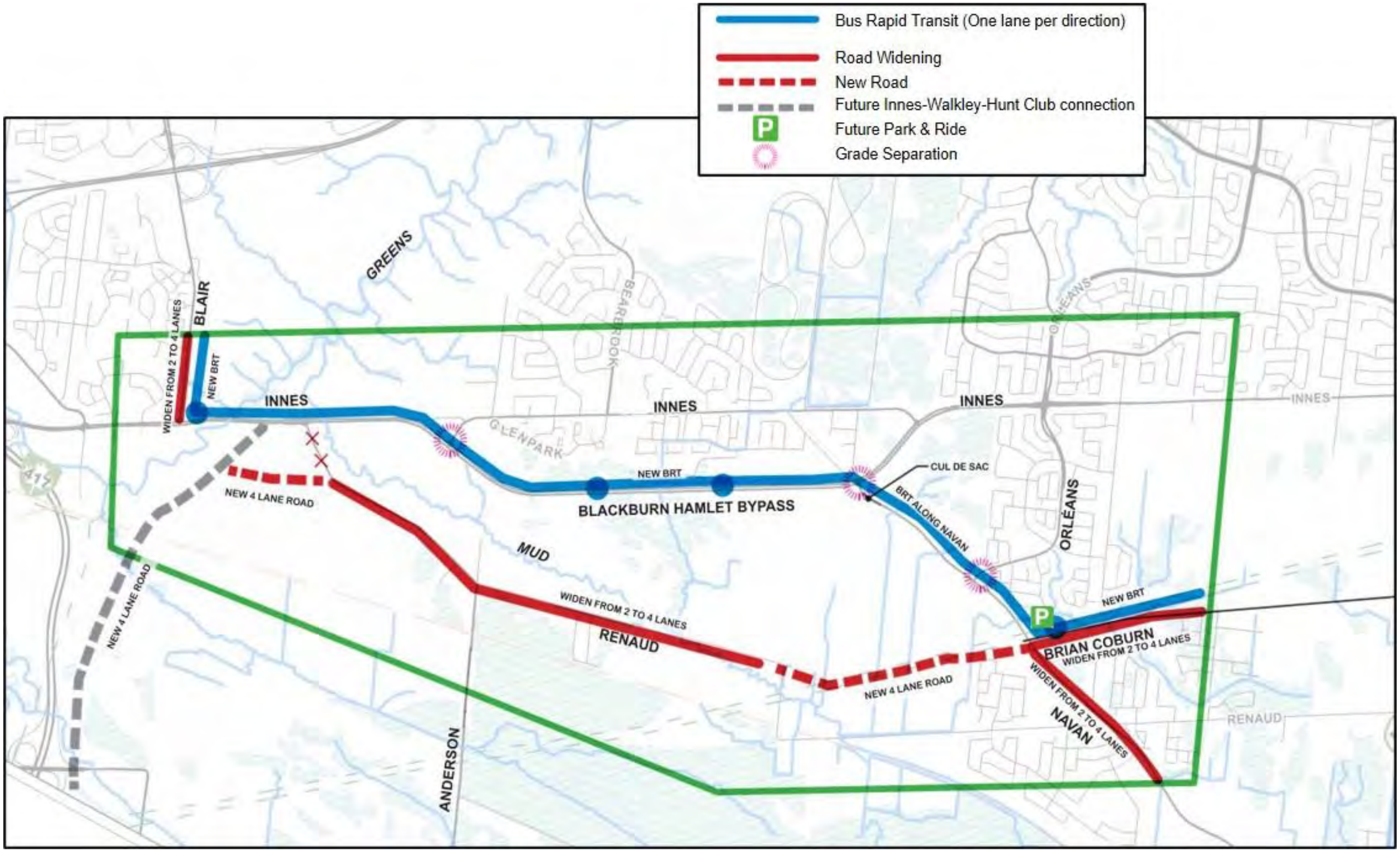

Figure 6-9: Option 6 - Renaud Extension & BRT on Navan

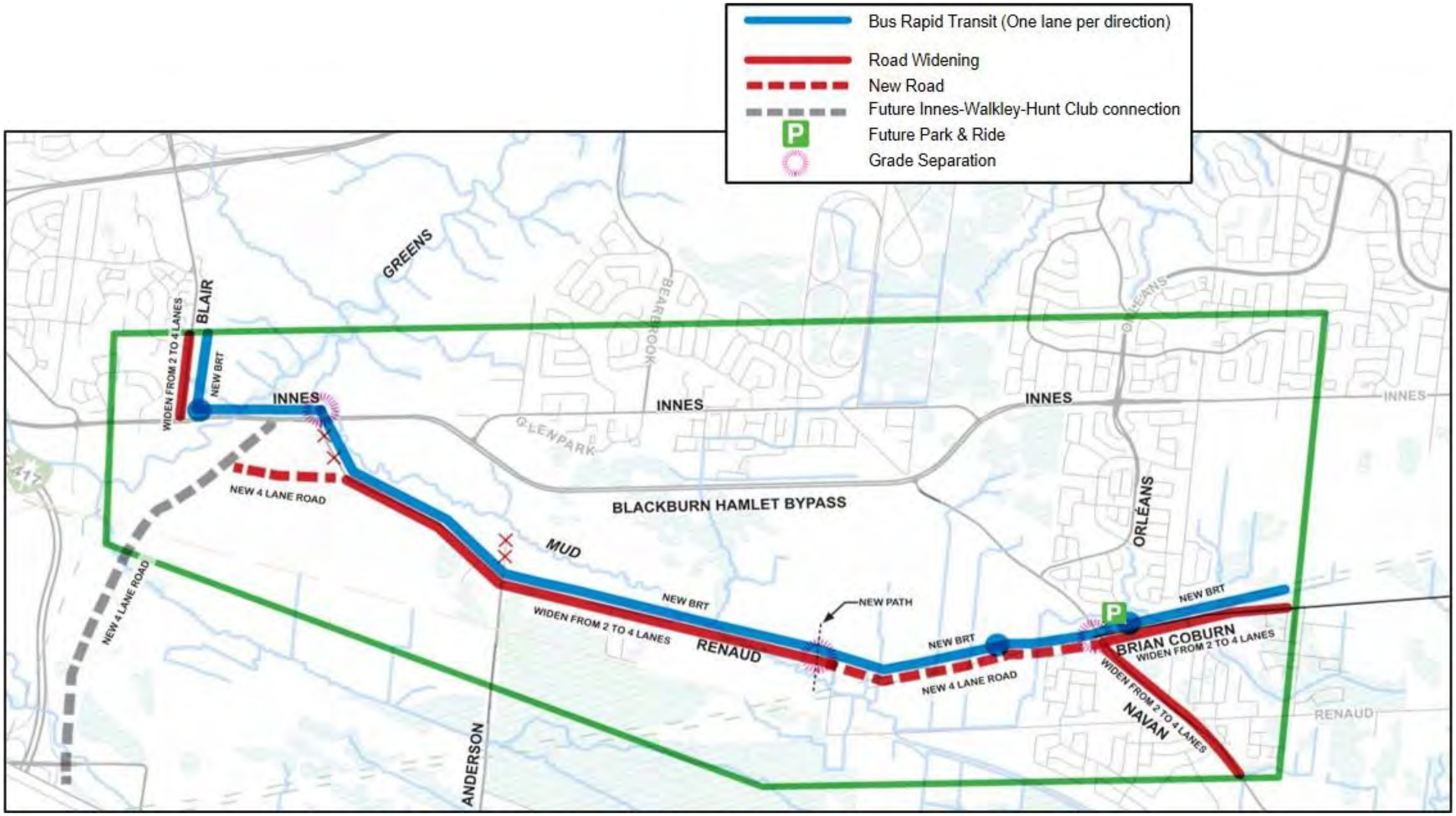

Figure 6-10: Option 7 - Renaud Extension & BRT on Renaud

6.5 Alternative Corridor Preliminary Screening

The following Screening Criteria groups were used to assess the Long List of combined Road and Transit Corridor Options:

- **Natural Environment:** Potential effects of the alternative corridors on the natural environment. Consideration given to watercourse crossings; impacts on natural heritage features, wildlife, natural vegetation, and key natural features.

- **Social Environment:** Assess opportunities to promote healthy communities and protect enjoyment of the outdoor environment. Consideration given to impacts to existing community facilities/uses, agricultural capability, businesses.

- **Cultural Environment:** Assess effects on cultural resources. Consideration given to heritage, archaeology, cultural landscapes.

- **Transportation/Transit System:** Effectiveness of the alternatives to contribute to the success of the planned transportation systems with consideration given to transit catchment potential, connectivity, capacity, operations.

- **Cost:** Consideration given to construction cost, operating cost, property and utility costs, affordability.

6.5.1 Option 1: New road & BRT off Navan

Of the seven Long List options, during the high-level screening Option 1 has a relatively high impact to the Greenbelt Core Natural Areas along the Blackburn Hamlet Bypass and at the new watercourse crossing of Mud Creek. There are relatively low social impacts along Navan Road, however some impacts are anticipated along the north edge of Bradley Estates. This Option severs tile drained active agricultural lands and may have impacts to areas of archaeological potential. Option 1 accommodates the anticipated Travel Demand for moderate costs.

6.5.2 Option 2: 4 Lane off Navan/BRT on Navan

Option 2 has relatively high costs, though it is anticipated to accommodate the travel demand. This option has relatively high impact to the Greenbelt Core Natural Areas along the Blackburn Hamlet Bypass and at a new crossing at Mud Creek. There are higher social impacts anticipated along Navan Road with the BRT bridge at Orléans Blvd., and community impacts anticipated along the north edge of

Bradley Estates. Option 2 severs tile drainage for active agricultural land and has potential increases of noise and vibrations at sensitive receiver locations. This Option may impact property that has a high potential to be of cultural heritage value or interest (church and cemetery on Navan Road) and has impacts to areas of archaeological potential.

6.5.3 Option 3: Widen & BRT on Navan

Option 3 has relatively high impact to the Greenbelt Core Natural Areas along the Blackburn Hamlet Bypass and at a new watercourse crossing at Mud Creek. The highest social impacts are along Navan Road, associated with a widening to 6 lanes and BRT bridge structure at Orleans Blvd. This Option avoids the community impacts along the north edge of Bradley Estates, though there is a potential for an increase in noise and vibration to sensitive receptors. Option 3 may impact areas of archaeological potential and has the potential to impact a property of cultural heritage value or interest. Option 3 has high costs, though it does accommodate travel demand.

6.5.4 Option 4: Widen Navan/BRT off Navan

Option 4 resulted in relatively high impact to Greenbelt Core Natural Areas along the Blackburn Hamlet Bypass and at a new watercourse crossing at Mud Creek. Some social impacts can be expected with this Option, including along the north edge of Bradley Estates. There is a potential for increases in noise and vibration levels to some sensitive receptors. This Option additionally severs tile drained agricultural lands. This option impacts areas of archaeological potential and has potential impact to a property of high cultural heritage value or interest. Option 4 accommodates travel demand for moderate costs.

6.5.5 Option 5: Renaud Extension & BRT off Navan

Option 5 has higher associated costs due to an additional BRT grade separation at Navan and the associated geotechnical work required. Travel demand is accommodated in this Option. Option 5 has impacts to the Greenbelt and Core Natural Areas along the Blackburn Hamlet Bypass and the Mer Bleue Wetland from two separate corridors, and requires two new watercourse crossings at Mud Creek, though the Core Nature Area and deeper Mud Creek valley are avoided. Option 5 is anticipated to have less social impact on the community along Navan Road, though there is the potential for an increase in noise and vibration levels to sensitive noise receptors. Community impacts are anticipated along the north edge of

Bradley Estates, though less cut through traffic is expected within the community. Impacts to areas of archaeological potential are anticipated.

6.5.6 Option 6: Renaud Extension & BRT on Navan

Option 6: Renaud Extension and BRT on Navan would require the extension of two existing watercourse crossings (Mud Creek tributaries), though it avoids crossing the deeper Mud Creek valley (Core Natural Areas). This Option would have impacts to the Greenbelt from two corridors, though the impact is anticipated to be less than that of Option 5. Higher social impacts along Navan Road with a BRT bridge structure at Orléans Blvd are associated with this Option. This Option has anticipated social impacts along the north edge of Bradley Estates, though less cut-through traffic is expected within the community. Though Option 6 accommodates travel demand, it severs tile drained active agricultural lands and may create an increase in noise and vibration levels to sensitive noise receptors. Option 6 is likely to impact areas of archaeological impact and may potentially impact a property that has high potential to be of cultural heritage value or interest. This option has high costs and associated geotechnical work.

6.5.7 Option 7: Renaud Extension & BRT on Renaud

Option 7 focuses new infrastructure in a single route through the Greenbelt with lower impacts to Core Natural Areas but with potential impacts associated with the wider Renaud corridor in closer proximity to the Mer Bleue Wetland. This Option requires the extension of two existing watercourse crossings (Mud Creek tributaries) but avoids crossing the deeper Mud Valley Creek in the Core Natural Area. This option has the least anticipated impact to the Navan Road community, though some social impacts along the north edge of Bradley Estates are expected. Option 7 can expect less cut-through traffic within Bradley Estates. The corridor may sever some tile drained active agricultural lands. Impacts to areas of archaeological potential are anticipated. Though this option accommodates travel demand, it may have somewhat lower transit ridership potential. Costs are moderate to high for this option but lower than other options.

6.5.8 Preliminary Screening Results Summary

A screening exercise was completed to generate a short list of viable alternative solutions (Options) that were subject to a more in-depth evaluation process. Results of this high-level screening are presented in **Table 6-3**. Four short listed options were carried forward for further assessment and evaluation.

Table 6-3: High Level Screening Summary (From 7 to 4 Short Listed Options)

Option	Natural Environment	Social Environment	Cultural Environment	Transportation	Cost	Recommendation
1. New Road and BRT off Navan	—	✓	—	✓	—	**CARRY FORWARD**
2. 4 Lane off Navan/BRT on Navan	—	×	×	✓	×	*Do not carry forward*
3. Widen and BRT on Navan	—	×	×	✓	×	*Do not carry forward*
4. Widen Navan/ BRT off Navan	—	—	—	✓	—	**CARRY FORWARD**
5. Renaud Extension and BRT off Navan	×	✓	—	✓	—	**CARRY FORWARD**
6. Renaud Extension and BRT on Navan	×	×	×	✓	×	*Do not carry forward*
7. Renaud Extension and BRT on Renaud	×	✓	—	✓	✓	**CARRY FORWARD**

Note: × = Poor — = Average ✓ = Good

6.6 Short Listed Alternative Corridors

The four short listed alternative corridors were refined based on public and stakeholder feedback, gathered through the consultation process (**Section 3**). Refinements included modified connections with the existing or proposed transportation network, such as the connection to the Innes-Walkley-Hunt Club Connection for Options 1 and 4. A summary of each option, including refinements used in the Evaluation of Alternatives is presented below.

6.6.1 Option 1: New Road & BRT off Navan

Option 1 provides a connection between Navan Road and the Blackburn Hamlet Bypass, with an extended Brian Coburn Boulevard roadway and co-located BRT along the Greenbelt edge. A grade separated crossing of Navan Road was added. Community connections were added from the bus stations along the Blackburn Hamlet Bypass. The proposed BCBE roadway intersection to the future Walkley-Innes-Hunt Club connection was shifted to the south.

6.6.2 Option 4: Widen Navan/BRT off Navan

Option 4 provides a connection between Brian Coburn Boulevard and Blackburn Hamlet Bypass, with widened Navan Road. A new BRT connection between Brian Coburn Boulevard and the Blackburn Hamlet Bypass would be via a new transitway corridor, west of Navan Road. Community connections were added from the bus stations along the Blackburn Hamlet Bypass. The proposed BCBE roadway intersection to the future Walkley-Innes-Hunt Club connection was shifted to the south.

6.6.3 Option 5: Renaud Extension & BRT off Navan

Option 5 includes a new 4 lane roadway connecting Brian Coburn Boulevard to Renaud Road. A new BRT facility would connect the existing Brian Coburn Boulevard with Blackburn Hamlet Bypass in a new BRT facility, located west of Navan Road which would extend west to Blair Road. A grade separated crossing of Navan Road was added. Community connections were added from the bus stations along the Blackburn Hamlet Bypass.

6.6.4 Option 7: Renaud Extension and BRT on Renaud

Option 7 includes a new roadway extending Brian Coburn Boulevard to Renaud Road, co-located with a new BRT facility and the existing hydro facilities in the eastern extent of the study area. The initially contemplated BRT station northwest of Bradley Estates was removed.

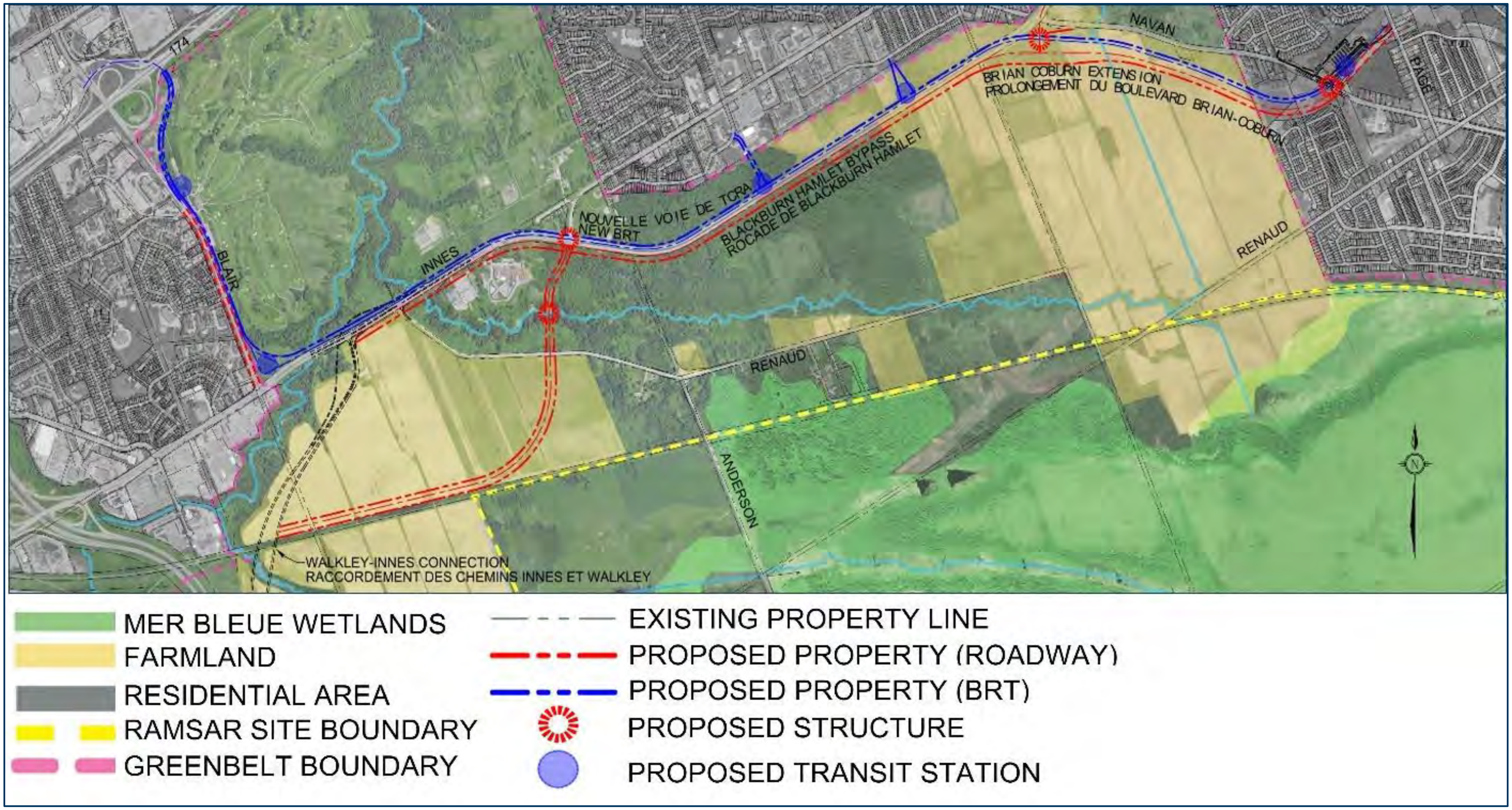

Figure 6-11: Short Listed Option 1

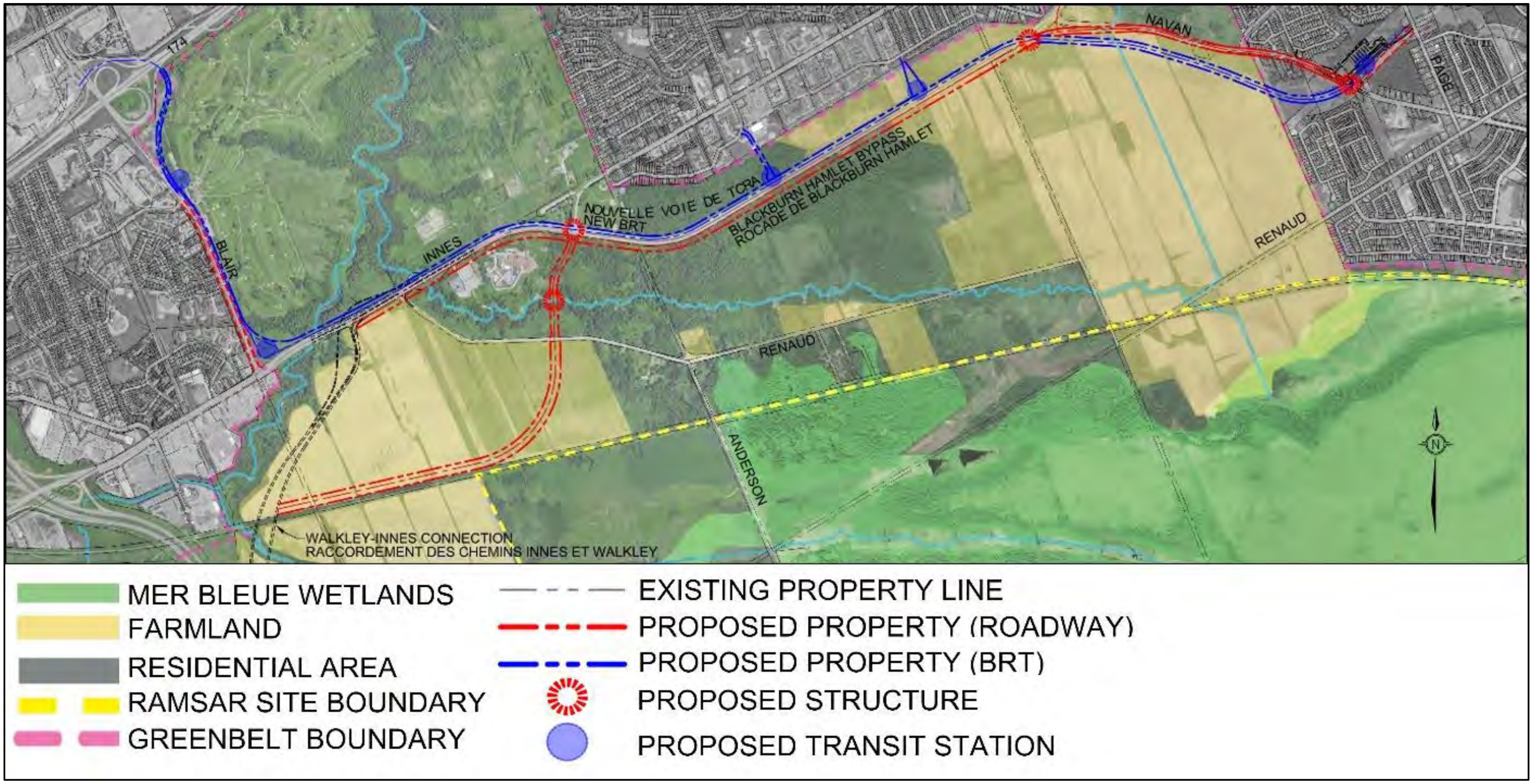

Figure 6-12: Short Listed Option 4

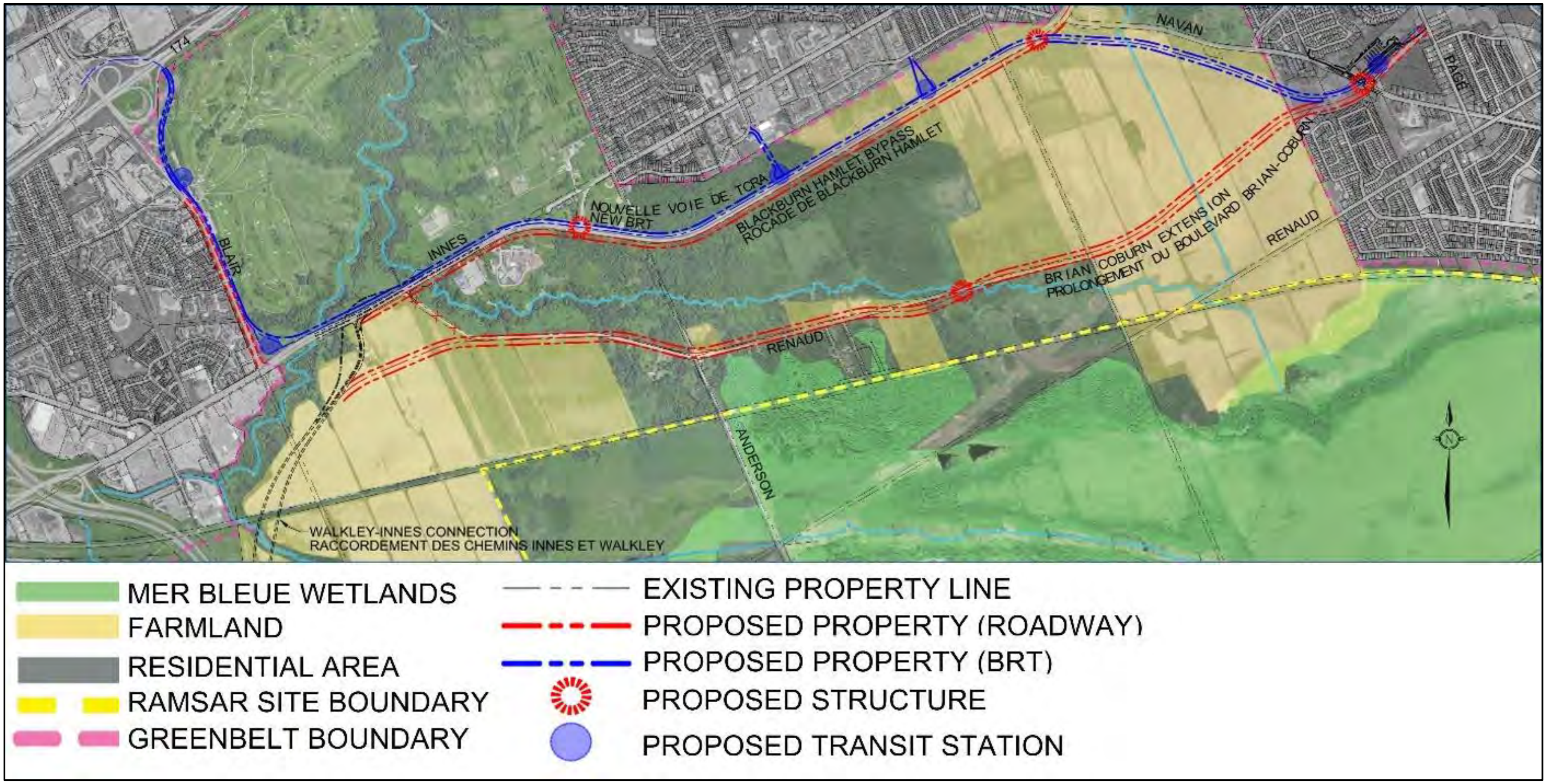

Figure 6-13: Short Listed Option 5

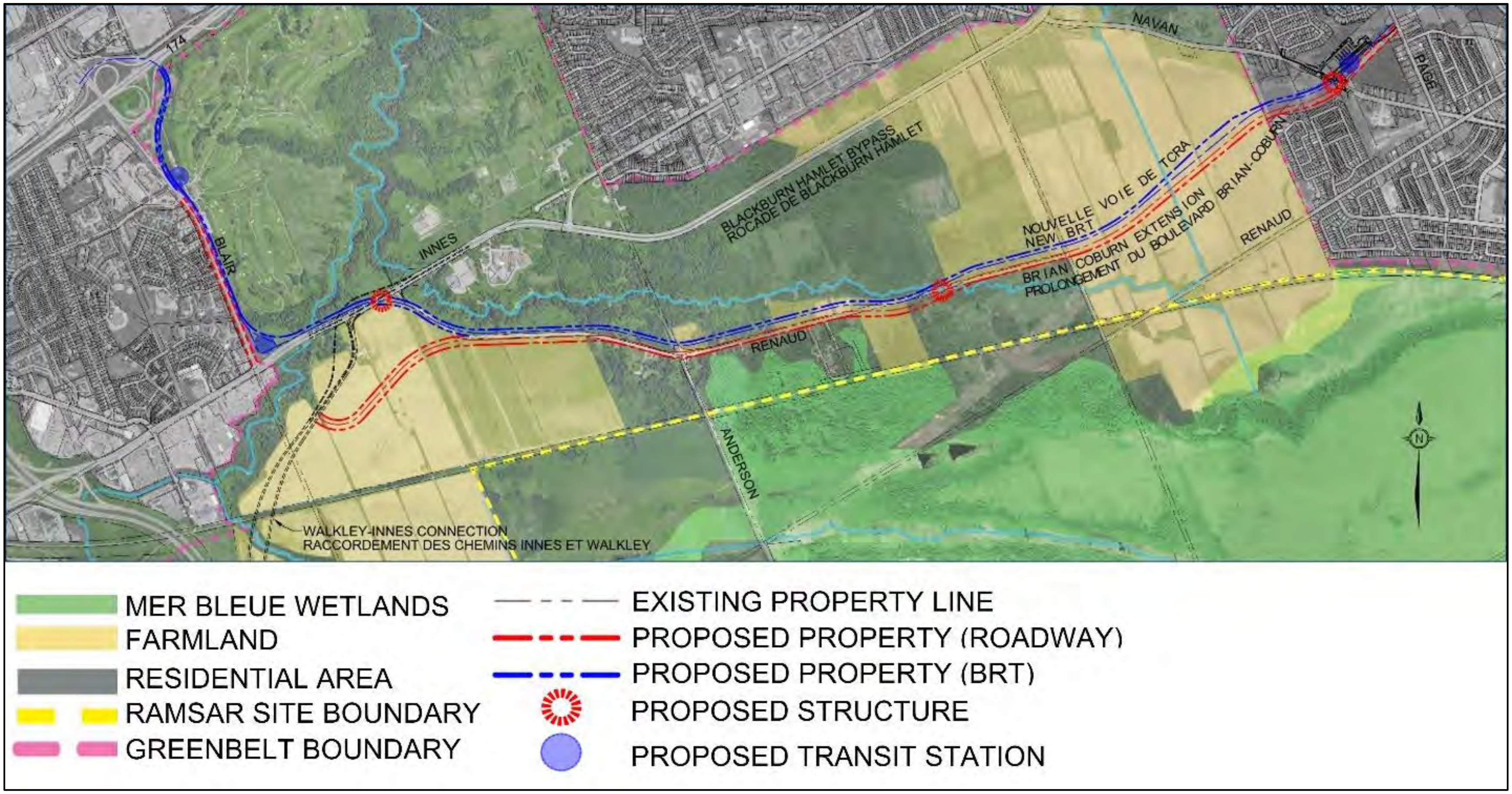

Figure 6-14: Short Listed Option 7

6.7 Corridor Evaluation Methodology

Following the screening to the 4 short listed options, each option was further developed to gain an understanding of the footprint and impacts on the environment. Since the four short listed options are located within the NCC Greenbelt lands, the evaluation criteria were developed in consultation with NCC staff to reflect the importance of the Greenbelt and to ensure a comprehensive assessment of potential impacts. The evaluation was based on four broad criteria groups and 31 associated criteria, some of which were based on multiple indicators. Quantitative and/or qualitative measurements were obtained for each option, which were then used to rank each option from least to most preferred.

The four short listed alternative corridors (Options) as determined in the preliminary screening (presented in **Table 6-3**) were evaluated using a Relative Performance Method. In general, this method involves ranking options according to defined indicators and measurements. The 1st ranked Option receives 4 Points, 2nd receives 3 Points, 3rd receives 2 Points and 4th receives 1 Point. Relative performance was determined as the overall number of ranked points divided by the overall points available for the Criteria Group.

Where Options were ranked within 10% of one another by relative performance (percentage), it was considered a tie and those Options were assigned the same overall score, with the next Option receiving the next available consecutive score (For example, if two Options were ranked 1st (tie), the third option would rank 3rd).

The evaluation process consisted of the following steps:

Step 1: Confirm Existing Conditions (available under separate cover)

Step 2: Identify Alternatives/Options

Step 3: Identify Evaluation Criteria Groups, Indicators and Measurements

Step 4: Analyze Impacts of each Alternative Solution (Option)

Step 5: Apply Evaluation Method (including carrying out Sensitivity Analyses)

Step 6: Review Evaluation Results and Select Preliminary Preferred Alternative (Option)

Where possible, spatial data was used by the Study Team to provide a quantitative analysis for relative performance comparison, as described in greater detail and specific to relevant criteria below.

Environmental effects were predicted by the specialists considering the relevant phases of the project. The evaluation considers the anticipated project footprint and future traffic operations as well as the physical impacts that could occur during construction and operation of the road corridor. The acquisition of land, which is part of the pre-construction phase, is also considered as an evaluation criterion.

Measurements with a quantitative assessment were assigned a measurement unit such as distance, travel time, traffic volumes, area or another number quantifying a specific characteristic of the Option. For each measurement, quantities were calculated and used for comparing the Options. In most cases, the grading limits for each option were used to indicate where impacts may occur. Grading limits refer to the extent of cut slopes and fill slopes on either side of the road and so reflect the limit of disturbance. For those measurements requiring a qualitative assessment, specific terms were used to reflect the qualitative judgment of the impacts for each option. These terms, as described in **Table 6-4**, relate to the degree of impact or the benefit related to the indicator/measurement.

Table 6-4: Qualitative Assessment Terms & Conditions

Terms Used	Definition
Poor	The impact exists and has an effect that is relatively large or has the least beneficial impact when compared to the other options in the table.
Fair	The impact exists and is of relatively low magnitude, but enough to have a measurable effect or contribution.
Good	The impact exists and has an effect that is of a moderate beneficial magnitude or provides a moderate beneficial contribution.
Very Good	The impact exists and has a positive effect that is relatively large or has the most beneficial impact when compared to other options in the table.

The Options were ranked for each measurement individually. Given its high potential impact on the NCC Greenbelt and to test the rigour of the results, a sensitivity analysis was performed, as detailed in **Section 6.11**.

6.8 Corridor Evaluation Criteria

The following four groups of evaluation criteria were developed with input from the public and agencies and built upon the screening criteria used to determine the short list of alternative corridors. These criteria were used to evaluate the relative preference of each Option:

- Transportation and Transit
- Natural Environment
- Social/Cultural Environment
- Cost

Within each of the above Criteria Groups, indicators and measurements were identified/selected to assess the characteristics of each Option. **Table 6-5** lists the criteria groups and indicators, the rationale for their selection, and the measurements developed for each indicator, and are discussed in greater detail below.

Table 6-5: Evaluation Factors, Criteria, Indicators & Rationale

Criteria Group	Factor	Criteria	Rationale	Indicator	Measurements
Transportation and Transit	Active Transportation (AT)	Support for Active Transportation	Maximize Active Transportation (Pedestrian, Cycling) opportunities	• Maximize connections to existing and build new AT facilities • Maximize access to communities and trails/pathways	Qualitative
	Transit Ridership and Service	Maximizing Transit Ridership	Maximize transit ridership as part of the Ultimate Network Transit Plan (Post 2031)	• # of Bus Rapid Transit (BRT) stations • Population within 600m of stations • EMME Traffic Model Ridership Projections for 2031 AM Peak Hour East of Blair • Transit travel time from Chapel Hill Park & Ride to Blair/Innes	Qualitative and Quantitative
	Park and Ride Access	Access to and Use of Chapel Hill Park and Ride Lot	Maximize access to Park and Ride (P&R) for all modes	• Maximize access to P&R for all modes	Qualitative
	Traffic Operations	Neighbourhood Traffic	Minimize neighbourhood cut-through traffic	• Minimize neighbourhood cut- through traffic	Qualitative
		Traffic Operations	Accommodates east-west roadway level of service	• AM Volume/ Capacity ratio accommodates future traffic demands	Quantitative
			Traffic on Anderson (after Innes-Walkley Connection)	• Minimize 2-way AM Peak Hour Traffic versus Base Case (No Project)	Qualitative

Criteria Group	Factor	Criteria	Rationale	Indicator	Measurements
	Emergency Vehicle Access	Maintain/Enhance Emergency Vehicle and Service Access	Maintain/enhance emergency vehicle and service access	• Maintains/ enhances emergency access and connections to communities	Qualitative
	Construction Staging and Phasing	Construction Staging	Minimize traffic disruption/delays during construction	• Minimize/avoid construction detours and lane closures	Qualitative
		Phasing and Flexibility	Maximizing flexibility for incremental implementation	• Maximize ability to phase construction	Qualitative
Natural Environment	Fisheries & Aquatic Habitat	Effects on Aquatic Habitat Type, Quality and Function	Avoid disruption and minimize effects on aquatic habitat, type, quality and function.	• Minimize # of new bridge watercourse crossings • Minimize # of new culverts • Minimize km of road alignment running alongside water courses	Quantitative
	Terrestrial habitat	Habitat Quality – Invasive Species	Avoid disruption of habitats by minimizing encroachment of invasive species	• Minimize new edge conditions created within the Greenbelt	Quantitative
	Wetlands	Effects on Wetlands	Minimize impact on wetland functions	• Least amount of area (Ha.) within a wetland • Least amount of area (Ha) within 120m of a wetland.	Quantitative
	Terrestrial At-Risk and Sensitive Species	Provincially or Federally listed potential Species at Risk (SAR) habitat	Minimize impact on SAR habitats	• Area (Ha.) within SAR habitat. • Proximity to SAR habitat (km).	Quantitative
	Greenbelt Core Natural Area	Encroachment on Core Natural Area	Minimize encroachment on Greenbelt Core Natural Areas	• Encroachment area (Ha)	Quantitative

Criteria Group	Factor	Criteria	Rationale	Indicator	Measurements
	Greenbelt Natural Link	Encroachment on Natural Link	Minimize encroachment on NCC Greenbelt Natural Link Areas	• Encroachment area (Ha)	Quantitative
	Habitat Fragmenting	Infrastructure in Shared Corridor	Minimize new infrastructure corridor in Greenbelt	• New corridor length (km)	Quantitative
	Natural Heritage Features (Municipal)	Encroachment on municipal natural heritage features	Minimize encroachment on municipal natural heritage features	• Encroachment area (Ha)	Quantitative
	Slope Stability	Areas with Slope Stability Concerns	Minimize encroachment on areas with slope stability concerns	• Minimize area (Ha) within unstable slopes	Quantitative
	Climate Change Mitigation	Carbon Footprint	Avoid/minimize impact to carbon sinks (wetland, plants)	• Least amount of area (Ha) within wetland and vegetation	Quantitative
	Climate Change Adaptation	Potential Climate Change Risk on Infrastructure and Adjacent Land Use	Minimize area within creek meander zone	• Area within creek meander zone	Qualitative
			Minimize area with potential flood risk	• Area with potential flood risk	Qualitative
Social and Cultural Environment	Property Ownership	# of Properties Required	Minimize impact to property owners (private and federal)	• # of property owners affected/ isolated • # of buildings to be acquired	Quantitative
	Agriculture	Loss of Farmland	Minimize impact to agricultural lands/operations	• Farm area (ha) lost • # of farms affected • Area (Ha.) identified within Class 1-3 soils	Quantitative
	Business	Impacts to Business	Minimize impact to businesses including Agricultural	• # of businesses affected	Quantitative

Criteria Group	Factor	Criteria	Rationale	Indicator	Measurements
				• # of farms affected	
	Views and Vistas	Impact of Vistas/ Visual Aesthetics	Minimize impact on vistas/ visual aesthetics	• Minimize impact on established views	Qualitative
	Air Quality, Noise, Vibration	Proximity to Sensitive Land Uses	Minimize impact to sensitive land uses	• # of sensitive receptors	Quantitative
	Recreation	Access to/ Enjoyment of Recreation	Encourage recreation activity within the Greenbelt	• Lowest # of Greenbelt pathway crossings • Greater improved access to recreational features	Quantitative
	Greenbelt Experience	Greenbelt Experience	Minimize impact to Greenbelt experience	• Impacts to established views • # of grade separations	Quantitative
	Drinking Water Quality	Preserve Water Quality	Minimize/ avoid potential water quality impacts	• Potential # of private wells within 50 m	Quantitative
	Heritage Properties	Listed (Ottawa) Heritage Properties	Minimize potential encroachment on listed (Ottawa) heritage properties	• Potential # of heritage properties impacted	Quantitative
	Archaeological Potential	Water Resources/ Topography/Historic Settlement	Minimize impact to areas of archaeological potential	• Area (Ha.) within area of archaeological potential	Quantitative
		Registered Archaeological Sites/ Traditional Use Sites	Minimize potential impact on archaeological sites	• # of archaeological sites impacted	Not Applicable
Cost	Construction	Relative Construction Cost	Minimize construction cost	• Relative order of magnitude construction cost	Qualitative

6.8.1 Transportation & Transit Criteria

Section 2.3.1 of the City's Official Plan, as amended (City of Ottawa, 2003a) describes the City's transportation system as one which emphasizes the use of public transit, and wherever possible reduces the reliance on private automobiles. Nonetheless, improvements to the road infrastructure network are also needed to accommodate projected traffic volumes. This includes road widenings and extensions. These improvements are designed and maintained in coordination with the City's Transportation Master Plan (TMP), which plans for transportation infrastructure that prioritizes the needs of pedestrians and cyclists and ensures safety, comfort, and convenience to users of all ages and abilities (City of Ottawa, 2013d).

The various components of the short-listed Options were assessed to determine their impacts on the overall transportation system. Data sources used to evaluate the Transportation and Transit Criteria included the City of Ottawa and National Capital Commission existing cycling and pedestrian routes, and future active transport network plans, transportation modelling and projections, transit ridership, and other traffic related existing conditions.

6.8.2 Natural Environment Criteria

The natural environment encompasses both ecological and physical environmental components and contributes to the health, quality of life and survival of humans and all other species. Many environmental features have a variety of ecological, recreational, and/or aesthetic features and functions that are highly valued from both an environmental and social context. Biological and Physical Environment Criteria were developed for the evaluation of option specific anticipated impacts on various components of the natural environment.

Impacts to various components of the biological and physical environment were assessed to include aquatic, terrestrial, and semi-aquatic (i.e., wetland) habitats and the at-risk and sensitive species that use them. Consideration was also given to the extent of Greenbelt encroachment, habitat fragmentation, natural heritage feature encroachment, and potential limits on climate change mitigation. Likewise, impacts from the biological and physical environment on the proposed infrastructure were considered, including slope stability considerations and the potential for climate change related vulnerability and risk.

6.8.3 Social & Cultural Environmental Criteria

A significant portion of the study area is located within the NCC's Greenbelt. The Greenbelt is integral to the capital region's network of natural spaces and is comprised of sensitive natural areas, agriculture, viewpoints, and provides an area of opportunity for outdoor recreation and education. The Greenbelt Master Plan (GMP) notes that the facilities accommodated within it should operate and perform sustainably (NCC, 2013). The planning directives and policies outlined in the GMP take an integrative land use planning approach that incorporates ecological, economic, and social factors (NCC, 2013).

The social and cultural (socio-cultural) evaluation criteria and indicators were created with input from the NCC at various points throughout the evaluation process. Impacts to various components of the socio-cultural environment that were assessed included land use, land ownership, Greenbelt experience, recreational connections, and cultural heritage. Given the rural characteristics and agricultural land use designations, consideration was given to farmlands and associated agricultural features, as well as water wells for domestic and agricultural use.

Consideration was also given to the federal land ownership of a large portion of the study area and associated land use policy, such as consideration of impacts to established views and vistas. Potential impacts to sensitive residential land users were also considered using air quality, noise, and vibration indicators.

6.8.4 Cost Criteria

Order of magnitude construction costs were developed at a high level for corridor alternative evaluation purposes only based on initial concept plans for each of the four short listed options. Costs were developed for the separate roadway and BRT components and were based on length, with additional costs allocated for structures and stations, as appropriate.

6.9 Corridor Evaluation Results

6.9.1 Transportation & Transit Evaluation

Active Transportation

The evaluation determined that all the short-listed options would be designed to have some form of facility to accommodate active transportation, and all would provide linkages to trails and communities. Hence all the Options ranked equal for this indicator.

Transit Ridership & Service

The Cumberland Transitway, as described within the City's TMP Network Concept would pass through the study area. As part of that development, a BRT facility would be provided, as well as planned BRT stations between Chapel Hill Park and Ride and Blair Road, regardless of the selected option. The transit facility in the Innes Road corridor would serve the residential areas in Blackburn Hamlet. Approximately one half of the Hamlet would be located within 600 m of proposed stations for options 1, 4, and 5, placing them within the reasonable walking distance as recommended by the City's Transit-Oriented Development Guidelines (2007) referenced in the TMP. Option 7 provides the fastest travel time for westbound (WB) riders to Blair Station. All four short listed Options were forecasted as serving just over 1200 west-bound riders, and thus ranked equal for this indicator.

Park & Ride Access

Park and Ride parking lots are meant to encourage commuters from rural areas in and around Ottawa to park and use transit, reducing the need for additional road widening. Options were examined for their connectivity and access for all modes to the Chapel Hill South Park and Ride lot near the intersection of Brian Coburn Boulevard and Navan Road.

Access to the Park and Ride lot from both northbound and southbound Navan Road occurs via a new all-turn entrance at the west of the lot. Direct access from Bradley Estates (via Renaud Road and Navan Road) and Chapel Hill South (via Orléans Boulevard and Navan Road) provides further accessibility. It was determined that all options provide good access to Park and Ride facilities, and thus they have ranked equal.

Traffic Operations

A qualitative assessment was completed to assess the traffic operations and the potential to avoid cut-through-traffic in existing neighbourhoods. Options 5 and 7 ranked best for the anticipated reduction in traffic demand for the Bradley Estates area, combined with the potential reduction in cut-through traffic on Orléans Blvd. Option 4 ranked last due to the potential for increased traffic on Navan Road resulting from capacity enhancements. All options ranked equal for their ability to accommodate future traffic demands.

Emergency Vehicle Access

The various options were assessed for their ability to maintain/enhance emergency vehicle and service access to study area communities. All the Options ranked equally for the ability to enhance access to existing communities.

Construction Staging & Phasing

Road widening would require staging to maintain traffic during construction. Traffic delays and construction were considered factors, as was the flexibility for incremental implementation. The Construction Staging and Phasing evaluation was dependent on two indicators, including traffic disruption and delays during construction and a flexible and incremental implementation.

Option 7 had the least amount of traffic disruption/delays during construction and was thus ranked as the preferred for this indicator measurement. All Options ranked equally for their flexibility for incremental implementation.

6.9.1.1 Transportation & Transit Evaluation Summary

For Transportation and Transit, Option 7 ranked first for all eight (8) Criteria and received the maximum score of 32 points (100 %). Option 5 received the second highest score, followed by Option 1 and then Option 4. **Table 6-6** provides a summary of the ranking evaluation for the Transportation and Transit Criteria.

Some of the advantages of Option 7 in relation to the Transportation and Transit evaluation criteria include:

- Good flexibility for BRT north of Renaud,
- Enhanced access to Bradley Estates/Chapel Hill South,
- Reduced traffic demand in Bradley Estates area, and
- Potential reduction in cut-through traffic on Orléans Blvd.

Table 6-6: Summary of Ranking Evaluation: Transportation & Transit Criteria

	Option			
	1	4	5	7
Transportation & Transit Overall	29/32	28/32	31/32	32/32
	●	●	●	●
Relative Performance = Total Score/ Maximum Score*	91%	88%	97%	100%

* Maximum Score of 32 (Calculated as 8 Criteria x 4 Ranks)

6.9.2 Natural Environment Evaluation

Fisheries and Aquatic Habitat

The study area is located primarily within the Greens Creek watershed, which forms an important link between the Mer Bleue Bog (Provincially Significant Wetland and a recognized RAMSAR Wetlands of International Importance) and the Ottawa River. Greens Creek has maintained a relatively high percentage of natural riparian buffer within the watershed with more than 70% of the 13.4 km stream length surveyed by City Stream Watch possessing a buffer width of 30 m or greater (RVCA, 2016).

Several watercourses have been identified within the study area that will have the potential to be affected by the proposed Options, including Mud Creek and Greens Creek and their tributaries, and agricultural drains. Potential impacts to the aquatic environment were measured in three ways; the total number of major/bridge crossings, the total number of culvert/ minor watercourse crossings, and the total amount of roadway running within and adjacent to a watercourse within a defined limit of 30 m.

Watercourses were identified through a combination of aerial photographic interpretation and use of the City's spatial data (geographic information system) provided base layer for watercourses. For this evaluation, watercourses were defined as waterbodies containing or contributing to fish habitat. The spatial data base layers utilized were *Watercourses, Rivers, Municipal Drains, Urban Ditches*.

To determine the number of crossings, the aquatic assessment relied on the Option design details to obtain the number of major (bridge) and minor (culvert) crossings. Geographic Information System (GIS) analysis was used to determine the length of the Option that would be adjacent to a waterway within 30 m of the ROW. This calculation was for potential run-off impacts and did not include a crossing count, as that was evaluated separately. A 30 m buffer was applied to each Option, as measured from the outside of alternative polygon.

In all locations where a waterway runs alongside the road and within the 30 m applied buffer, the length of potential impact was included.

Options with fewer crossings and/ or less roadway running alongside a watercourse were preferred. Overall, Option 1 ranked first with four major water crossings, five minor crossings and 1.3 km of roadway running alongside watercourses. Option 7 ranked second as it has a potential Creek/Tributary realignment associated with it. Option 5 ranked last overall as it has the largest number of major and minor water crossings, and more roadway length running alongside watercourses than the preferred option.

Terrestrial Habitat

Terrestrial habitat refers to those places, on land, where various species can find food, shelter, protection, and mates for reproduction. Quality, quantity, and location of habitat is integral to terrestrial species survival. The terrestrial environment for the study area has been described within the Existing Conditions Report and evaluated by Morrison Hershfield Limited (MH) (Morrison Hershfield, 2020). The evaluation of Options involved undertaking a review of existing background information compiled from a variety of sources, including the Ministry of Northern Development, Mines, Natural Resources and Forestry (NDMNRF), the City of Ottawa, Committee on the Status of Endangered Wildlife in Canada (COSEWIC), Environment and Climate Change Canada and Land Information Ontario. In addition, reviews of aerial photography and direct communication with NDMNRF have been undertaken.

The original criteria included two indicators for the evaluation of anticipated impacts to terrestrial habitat. Given using the same methodology more than once for the same environmental component was a “double count”, “habitat quality and attributes” was removed from the evaluation, and “habitat quality – invasive species” was retained resulting in only one factor going through quantitative evaluation for “avoid disruption of habitats by minimizing encroachment of invasive species”, the measurement of which was the creation of a new edge condition within the Greenbelt.

Using spatial data (GIS), each potential solution and the anticipated new ROW was overlain with the existing designated Greenbelt area. New edge conditions within the Greenbelt were calculated by measuring and summing the “new” length of roadway within the Greenbelt, along both sides of the proposed roadway.

The option with the least amount of length was preferred (higher rank) while the most amount of length was least preferred (lowest rank). Options 1 and 7 were equally preferred based on potential impacts to terrestrial habitat. Option 5 was the least preferred option as it had the greatest amount of impact length associated with it.

Wetlands

Wetlands are important landscape features known to provide numerous benefits. Ecological benefits include protecting and improving water quality, providing fish and wildlife habitat, storing floodwaters, and maintaining surface water flow. Protection of these important ecological features is achieved via laws, regulations and policies that guide land use. In Ontario there is an evaluation system that distinguishes between more common wetlands and Provincially Significant Wetlands. All wetlands on federal lands are protected.

A GIS exercise was completed to calculate the impact of new ROW on wetlands. To determine the impact on both evaluated and unevaluated wetlands, the new ROW was overlain with the City of Ottawa wetlands data (EA geodatabase, hydrography subset). Areas were calculated for the resultant overlap between the new ROW and the wetlands, with the provincially significant wetland (PSW) areas being differentiated from the unevaluated wetland calculations.

Similarly, a 120 m buffer was applied to all evaluated and unevaluated wetlands. Where the Option ROW overlapped the 120 m buffer, the areas were calculated for the comparative evaluation. Options that had the least amount of adjacent and severed wetlands were preferred over those with a greater number of features potentially impacted. Options with the least amount of area within a wetland feature were preferred over those with a lesser amount of impact on wetland features (both unevaluated and PSW). Impacts on auto traffic on Anderson Road (post Innes-Walkley Connection implementation) were also considered - although all Options were found to provide a similar benefit.

Option 7 had the least overall impact to unevaluated wetlands and ranked second for the amount of area within the 120 m buffered area of the wetland. Options 1 and 4 were determined to be preferred overall given the greater distance between the potential ROW and the Mer Bleue PSW. Options 5 and 7 were less preferred given their proximity to Mer Bleue PSW and an encroachment of the ROW of approximately 0.2 Ha into the PSW.

At-risk and sensitive species, and their habitat, are protected under the Endangered Species Act, 2007 (ESA) and/or the Species at Risk Act (SARA). Background information, and the results of previous studies relevant to the study area were reviewed for records of occurrence. Sources used to determine terrestrial and sensitive at-risk species, and their habitat included the following:

- Natural Heritage Information Centre (NHIC) (2020d)
- NDMNRF – Kemptville District Office
- COSEWIC
- Committee on the Status of Species at Risk in Ontario (COSSARO)
- SAR Public Registry (Environment Canada, 2016)
- Natural Heritage Reference Manual for Policy 2.3 of the Provincial Policy Statement (MNRF 2010a)
- Significant Wildlife Habitat Technical Guide (MNRF 2000)
- Royal Ontario Museum (ROM) Biodiversity database,
- Atlas of the Breeding Birds of Ontario: 2001-2005 (Bird Studies Canada; BSC)
- Ottawa Bird Count
- eBird Canada
- Ontario Reptile and Amphibian Atlas (ORAA)
- Ontario Butterfly Atlas (OBA)
- Atlas of the Mammals of Ontario (Dobbyn, 1994)
- Land Information Ontario (LIO)
- GeoOttawa online mapping (City of Ottawa)

Aerial photography (Google Earth)

A quantitative assessment was conducted for comparison of anticipated impacts from the Options on the terrestrial SAR species identified as potentially occurring within the study area. To determine the length (km) of new ROW in proximity to SAR habitat, a 50 m buffer was applied to each habitat area within GIS. Though a 120 m buffer was initially applied, the routes were of similar enough quality for the criterion, that no differences were observed. The 50 m buffer was thus applied to each habitat to discern the differences between options. The proposed new ROW, with existing ROW removed, was then overlain with the SAR habitat. Where the roadway was directly adjacent to SAR habitat, regardless of if it was an intersection/ overlap or proximity based, the length of new ROW was summed and compared for the various options.

Options with a smaller area or lesser proximity to SAR habitat were preferred over those with greater potential impacts. Overall Option 4 was preferred, as it had the least amount of length adjacent to potential SAR habitat, and the least amount of direct area impact on potential SAR habitat. Option 1 ranked second, as it had a slightly increased amount of direct area impact on potential SAR habitat. Options 5 and 7 ranked last overall with the largest amount of length adjacent to potential SAR habitat, and the largest overall area of impact on potential SAR habitat, respectively.

Greenbelt Encroachment

The Greenbelt comprises 20,000 hectares of green space, including farms, forests and wetland and is primarily owned by the National Capital Commission (NCC) (2013). The NCC's Greenbelt Master Plan describes the purpose of the Greenbelt and outlines the values that should inform any decisions made pertaining it, including the connected system of natural lands; recreational pathway system; sustainable agriculture; and protected views.

Core Natural Area and Natural Link Areas

Areas within the Plan are classified according to their desired role (NCC, 2013). Core Natural Areas are defined as diverse, mature, and significant natural features, while the Natural Link designation is applied to natural and regenerating areas that connect the Core Natural Areas to each other (NCC, 2013). Spatial analysis using a GIS was completed to approximate areas impacted by each of the four Options. Greenbelt Designations data was provided in a GIS compatible file format by the NCC for this purpose. The Greenbelt Designations data identifies Greenbelt Core Natural Areas and Greenbelt Natural Link Areas.

Some greenbelt areas are already encroached on by existing ROW allotments from adjacent roads. To exclude already impacted areas from the calculation, the existing ROW for the City of Ottawa road network (EA geodatabase provided by the City) was overlain with each Option, and the existing ROW area removed from the area of impact calculation.

Once the impact area, excluding the existing ROW where applicable, was determined for each solution, the areas intersecting the various Greenbelt Designations were calculated. Option 7 ranked first for having the least encroachment in designated Core Natural Areas, followed by Option 5, then Options 1 and 4 tied with greatest potential impacts. Option 1 had the least amount of encroachment in designated Natural Link Areas, with Options 5 and 7 having the greatest areas of impact.

Habitat Fragmentation

Habitat fragmentation may have direct impact on all the species, their community structure, and the overall ecosystem within each of the fragments. It can result from both natural and anthropogenic causes, such as construction of a linear roadway through contagious habitat. Generally, best management practices encourage a reduction of habitat fragmentation and the creation of new edges.

Spatial analysis using a GIS was completed to approximate habitat fragmentation created by each of the four Options. Using a similar methodology to the Terrestrial Habitat category, the proposed ROW was overlain with the existing Greenbelt area using spatial analysis tools within the GIS platform. The existing Street and Transportation ROW were also displayed to determine existing infrastructure corridors. The “new” length of roadway within the Greenbelt was determined.

The option with the least amount of new road length outside of an existing infrastructure corridor was preferred (higher rank) while the most amount of length was least preferred (lowest rank). Option 7 minimized new infrastructure corridor created within the Greenbelt and was preferred, with the other options ranked equal as less preferred.

Natural Heritage Features

Natural Heritage Features are defined in the 2014 and 2020 Provincial Policy Statement (PPS) as “features and areas, including *significant wetlands*, *significant coastal wetlands*, other *coastal wetlands* in Ecoregions 5E, 6E and 7E, *fish habitat*, *significant woodlands* and *significant valleylands* in Ecoregions 6E and 7E (excluding islands in Lake Huron and the St. Mary’s River), *habitat of endangered species and threatened species*, *significant wildlife habitat*, and *significant areas of natural and scientific interest*, which are important for their environmental and social values as a legacy of the natural landscapes of an area” (Ontario Ministry of Municipal Affairs and Housing (MMAH), 2020, p. 47). The policy sets a framework for the protection of the defined features and areas within the municipal Official Planning process.

The City of Ottawa has completed studies to identify Urban Natural Areas (UNAs) within the City as part of its larger Natural Heritage System (Muncaster Environmental Planning Inc. & Brunton Consulting Services, 2005). Spatial analysis using a GIS was completed to approximate UNAs impacted by each of the four Options. The existing ROW was provided by the City of Ottawa and removed from each of the four Options, as a means of distinguishing those areas already disturbed. The remaining, undisturbed areas, per option, were overlain with the UNAs to calculate the potential area of impact (encroachment) per Option.

Options with the least amount of impact to the UNAs were considered preferred over those with greater impact (least preferred). Option 7 had the least amount of UNA impacted (0 Ha) and was thus determined to be the most preferred. The other Options were determined to have equal potential encroachment and were determined to be less preferred for this indicator.

Slope Stability

The Greens Creek main-stem channel meanders through deeply incised channels due to the predominant leda clay-based substrates giving rise to highly unstable slopes. Frequent occurrences of slope failure and landslides, primarily between St. Joseph Blvd. and Innes Rd. have occurred within this section of the Greens Creek watershed. Unstable slopes resulting from erosion hazards, may pose a risk to both human and infrastructure investment. The PPS (2020) refers to Erosion Hazard which may result in the loss of land, due to human or natural processes, posing a threat to life and property.

The Canada Land Inventory, as accessed through the Land Information Ontario (LIO) database, was used to determine the areas where there were unsuitable slopes within the study area. Class 7 soils are defined as those comprised of marsh, rockland and soil on very steep slopes (OMAFRA, 2020). “Subclass T – Topography” within the data set is defined as areas where the steepness of the surface slope and the frequency of slopes in different directions are topographic limitations and includes an increase in water erosion potential. Land Class 7, T was thus used to identify areas of potentially sleep slopes.

The digital dataset was filtered for the appropriate soil Class and Subclass (7,T) and the corresponding polygons were intersected with the proposed ROW for each of the options. Where the dataset overlapped the ROW, the intersecting area sums were calculated to determine an approximate area with the potential for slope stability concerns. Though the City of Ottawa maintains a digital slope database, the dataset is comprised of polylines rather than polygons. To use the City's data set a geotechnical analysis of each polyline would have to be undertaken to determine toe of slope and appropriate top of slope setbacks to determine a point specific setback and corresponding polygon intersection analysis. A geotechnical analysis was not completed as a part of this evaluation.

Options with the least amount of encroachment on areas with potential slope stability concerns were preferred, while those with the most encroachment are least preferred. Option 1 ranked first with the least amount of encroachment, followed by Options 4, 7 and 5, respectively.

Climate Change Mitigation

Climate change mitigation refers to the actions taken to limit the magnitude or rate of global warming and its related effects. Carbon sequestration is one method of climate change mitigation related to the carbon sinks identified within the carbon cycle (Association of State Wetland Managers, n.d.). All wetland systems are known carbon sinks and function to mitigate the effects of climate change.

Spatial analysis using a GIS was completed to approximate areas impacted by each of the four Options from a climate mitigation perspective. Each option, with existing areas of disturbance removed (ROW erased) was overlain with Natural Environment Systems Strategy Vegetation and wetland polygons to calculate potential areas of impact (ha). All wetlands, regardless of evaluation status were considered.

Options with the least amount of area (ha) impacting potential carbon sinks (wetlands/plants) were determined to be preferred, while those with the greatest area of impact (ha) are least preferred. Option 7 was preferred, as it had the least overall impact to potential carbon sinks, followed by Options 5, 1 and 4, respectively.

Climate Change Adaptation

Climate Change Adaptation refers to the process of adjusting behaviors, systems, and infrastructure to reduce the impact climate change has on our communities**.** Practitioners in Ontario have begun to assess the vulnerability of their assets, and in some cases, adapt their infrastructure and operations in preparation for changing climate conditions (Woudsma &

Towns, 2017). Considerations at the planning phase of infrastructure development can include avoiding areas with increased flood risk concerns.

For this evaluation, flood risk was determined to be a quantifiable comparable criterion relevant to climate adaptation within the study area. It should be noted that, at the time of evaluation, no floodplain modeling exists for the study area, and as such flood risk was determined based on review of topography, an area of concern identified by the RVCA, and the proposed number of watercourse crossings for each option. The potential flood risk area of concern is south of the Navan Road crossing of Mud Creek, where one side is sloped while the other side is flat and most likely to flood in a 1:100-year storm event (RVCA (2012b)). Options with the higher number of watercourse crossings, particularly the major crossings, are at greater risk of flooding. Options that run parallel to Mud Creek are more at risk of flooding due to the proximity to the watercourse. The evaluation notes that meander setback areas will need to be confirmed for the preferred option and that design mitigations may be required (such as shifting crossing locations slightly).

Options 5 and 7 both result in similar levels of flood risk largely due to proximity to Mud Creek. In Option 7 both corridors (BCBE and CTE) are located parallel to Mud Creek while Option 5 is less at risk in comparison to Option 7 as only one of the two corridors is located adjacent to the Creek. Option 7 is concluded to have the greater overall level of climate change risk based on fluvial characteristics/indicators, followed by options 5, 1 and 4.

6.9.2.1 Natural & Physical Environment Evaluation Summary

Option 1 ranked first overall and received the highest score with 36 points (82 %) for the various Criteria (**Table 6-7**). Option 7 received the second highest score, followed by Option 4, and then Option 5. When comparing using a relative performance indicator, Options 1, 4 and 7 score first as the preferred.

Some of the advantages and disadvantages of Option 1 as they relate to the Natural Environment evaluation criteria include:

- Least amount of encroachment in area of potential slope stability concerns
- Least amount of encroachment on NCC Greenbelt Natural Link Areas
- Least amount of area within a watercourse meander zone (climate adaptation)

Table 6-7: Summary of Ranking Evaluation: Natural Environment Criteria

	Option			
	1	4	5	7
Natural Environment Overall	36/44	31/44	23/44	32/44
Relative Performance = Total Score/ Maximum Score*	● 82%	● 70%	◔ 52%	● 73%

* Maximum Score 0f 44 (Calculated as 11 Criteria x 4 Ranks)

Notes:

1. *For each Factor/Criteria/Indicator the 1st ranked Option receives 4 Points, 2nd receives 3 Points, 3rd receives 2 Points and 4th receives 1 Point.*
2. *Ties (within 10%) receive the same Score and Aggregate Rank.*

6.9.3 Social & Cultural Evaluation

Property Ownership

Property ownership data is defined as: private; City of Ottawa; Provincial; or NCC/federal owned, for the purposes of this evaluation. For each of the options, the existing ROW was removed for the purposes of spatial analysis, as these road segments are subject to existing City ownership and agreements. An intersection of the Option area polygon (less the existing ROW) was overlain with the property ownership data to determine the areas of impact.

The Option with the least amount of private and/or federal property impact was preferred, with the Option potentially impacting the private and federal properties the greatest were least preferred. Overall, Options 1 and 7 ranked first for having the least amount of impact on private/federal landowners. Where Option 1 ranked first for having no building acquisition requirements, Option 7 ranked first for requiring fewer federal parcels of land. Both Options 1 and 7 ranked first for having comparatively less impact related to private property parcel impacts.

Agriculture

For the determination of potential agricultural impacts, various criteria were evaluated for each Option. Agriculture lands were determined using spatial data provided by the NCC, as it represents lands currently being leased for agricultural purposes. Using the ROW for each Option, the areas of intersection between the ROW and AOI were determined. The intersection represents the area (ha) of active farm lost for each Option.

The AOI GIS data was again used to determine the overall number of farms affected by each option, including severance of farmlands. The number of parcels as defined in the data set provided by the NCC were counted to determine the number of farms affected.

The Canada Land Inventory (CLI), Land Capability for Agriculture Canada Open Data illustrates the varying potential of a specific area for agricultural production. Classes of land capability for agriculture indicate the degree of limitation imposed by the soil. Characteristics of the soil is determined by soil surveys. For the purposes of this evaluation, CLI Classifications 1 to 3 have been included as "agricultural lands" (OMAFRA, 2020).

Class 1: Soils in this class have no significant limitations in use for crops.
Class 2: Soils in this class have moderate limitations that reduce

the choice of crops or require moderate conservation practices.

Class 3: Soils in this class have moderately severe limitations that reduce the choice of crops or require special conservation practices.

The Options with the least amount of potential agricultural lands/operations impacted were preferred. Options 4, 5 and 7 are equally preferred as it relates to the overall area of farmlands lost. Option 7 is preferred for affecting the fewest number of agricultural parcels, followed by Option 1. Options 4 and 5 are preferred for the least amount of impact in Class 3 soils. Overall, Option 4 is most preferred for least overall impact to agricultural indicators, while Option 1 is least preferred.

Businesses

To determine businesses that may be directly impacted by the various Options, Google Street View was utilized to gain a better understanding of existing conditions. Aerial photography was used, in addition to the street view function to determine where existing businesses may be impacted with regards to access changes which may result from project implementation. The total number of businesses included farms, given the farms require maintained access to their entire property.

Options with the lowest number of businesses potentially impacted were preferred over those with greater numbers of businesses potentially impacted, with the highest number of businesses potentially affected, ranking last. Option 7 is most preferred for minimizing the impact to businesses, including agriculture. The remaining options ranked equally less preferred.

View & Vistas

Qualitative impacts to the Views and Vistas were determined using professional judgement. Views identified within the Existing Conditions Report were examined with regards to their proximity to the alternative Options and where an impact was assumed to the existing viewpoints, it was included in the evaluation.

Similarly, grade separations and embankments were determined to have a potential impact on the overall Greenbelt Experience and negatively affect the existing vistas and view aesthetics. The design of each Option was examined for elevated structures within the proximity of existing views and vistas.

Qualitative rankings include *very good, good, fair* and *poor*, with "very good" having the least amount of impact and "poor" having the greatest impact and thus is least preferred. Option 7 ranked first for this indicator as it ranked "very good" with the least identified impacts to views and vistas. Options 1 and 4 were ranked to have a "fair" impact on views and vistas, while Option 5 ranked last with "poor" and having the greatest impact on views.

Air Quality, Noise & Vibration

Environmental noise typically produces subjective effects (annoyance, nuisance), and interference with activities including speech and sleep (California Public Utilities Commission, 2002). An assessment for potential noise impacts was undertaken using the existing noise sensitive receptor data, as documented in the Existing Conditions Report (Morrison Hershfield, 2020).

Existing noise sensitive receptor was overlain with the ROW footprint for each of the Options. Where the noise sensitive receptor property parcel overlapped with the Option footprint, potential noise impacts were assumed.

Options with fewer noise sensitive receptors (properties) were most preferred, while those with the most noise sensitive receptors (properties) were least preferred. Option 7 ranked first overall as it had the least number of overlaps with potential noise sensitive receptors. Option 5 ranked second for impact to sensitive land uses based on number of potential interactions, and Option 4 ranked last.

Recreation

The study area includes pedestrian and cycling facilities within the City and the NCC's Greenbelt. In addition to the formal trail network, informal trails and accessways also exist and form important connections within the multi-modal network.

Spatial analysis was conducted to determine the number of existing pathways, trails and accessways that may be affected by project implementation. The trail network system was overlain with each of the Option polygons to determine the number of recreational connections that may be broken/disturbed.

The Option with the fewest number of broken links was most preferred, while the Option with the greatest number of connections disturbed was least preferred. Option 7 ranked first for this indicator given the fewest intersections with existing and planned active transport trails and pathways. Option 5 ranked second overall, with Options 1 and 4 least preferred.

Greenbelt Experience

Views and vistas were determined to enhance the Greenbelt Experience, with lesser views and vistas potentially impacted preferred, over those with more potential impacts.

Elevated grade structures were determined to be detrimental to views and vistas, and thus a lesser number of elevated structures is preferred over a greater number of elevated structures. Option 7 ranked first overall given the lower number of grade separations (comparatively) and the least number of potential impacts to Greenbelt views. Option 4 ranked second overall with a low number of elevated structures (tied with Option 7) and potential impacts to Greenbelt views.

Drinking Water Quality

While the City of Ottawa provides municipally treated drinking water within the study area, potential exists for drinking water well impacts resulting from the project. Given the rural nature of parts of the study area, drinking water wells have been identified as present.

Water well data was compiled from the Groundwater Information Network (n.d.). To determine potential drinking water well impacts, it was determined that domestic wells would be included in the analysis. A 50 m buffer (zone of influence) was applied to each well, with those having an overlap with the Option ROW determined to have a potential impact.

The Option with the largest number of domestic and agricultural wells potentially impacted was least preferred, while the Option with the least number of wells potentially impacted was preferred. Option 1 was preferred for this indicator, given the least number of wells potentially impacted. Options 5 and 7 were least preferred given the likely interaction with a greater number of domestic and agricultural wells.

Heritage Properties

Eight heritage properties (City of Ottawa Reference List) have been identified by Golder (2018b) within the study area. A visual assessment was completed, comparing aerial photography with heritage properties identified, with those of the Option ROW polygons.

Options potentially affecting the greatest number of heritage properties are least preferred, while those potentially affecting the least number of heritage properties are most preferred. Option 7 is preferred given it is adjacent to the fewest heritage properties. All options ranked equal with some encroachment to heritage property anticipated.

Archaeological Potential

Archaeological potential was provided via spatial data as provided by the City (EA geodatabase). To complete the impact comparison, the existing street ROW was removed from each of the options, as this area is disturbed. Where the archaeological potential data overlapped with the various option polygon (less the existing ROW), an area of potential disturbance was calculated and summed. Those areas with the greatest area of disturbance were determined to be least preferred, while those with the least amount of disturbance to archaeological resources are preferred.

Registered Archaeological Sites were identified by Golder (2018c). Each option was evaluated based on proximity to and encroachment on registered archaeological sites. It is noted that none of the options are anticipated to directly affect a registered archaeological site.

Options with the greatest amount of potential impact on areas of archaeological potential were least preferred, while the option with the least amount of potential impact was most preferred. Option 4 is preferred overall, given the least amount of anticipated disturbance to areas of archaeological potential. Option 7 is least preferred with the greatest amount of potential for disturbance of archaeological resources.

6.9.3.1 Social & Cultural Evaluation Summary

For the evaluation of Socio-Cultural Environment Criteria, Option 7 ranked first overall and received the highest score with 38 points (86 %). The three remaining Options all ranked second, with overall relative performance rankings as outlined in **Table 6-8**.

Some of the advantages of Option 7 as they relate to the Socio-Cultural evaluation criteria include:

- Least amount of property impacts
- Least amount of total farmland and number of farms impacted
- Least amount of impact on the Greenbelt Experience
- Least amount of potential to impact built heritage resources

Table 6-8: Summary of Ranking Evaluation: Socio-Cultural Environmental Criteria

	Option			
	1	4	5	7
Socia-Cultural Environment Overall	30/44	29/44	28/44	38/44
Relative Performance = Total Score/ Maximum Score*	◕ 68%	◕ 66%	◕ 64%	● 86%

* Maximum Score 0f 44 (Calculated as 11 Criteria x 4 Ranks)

Notes:

1. *For each Factor/Criteria/Indicator the 1st ranked Option receives 4 Points, 2nd receives 3 Points, 3rd receives 2 Points and 4th receives 1 Point.*
2. *Ties (within 10%) receive the same Score and Aggregate Rank.*

6.9.4 Cost Estimate

6.9.4.1 Cost Evaluation Summary

For the Cost Evaluation Criteria Group, Option 7 ranked first overall and received the highest score with 4 points (100 %). The three remaining Options all ranked second, with overall relative performance rankings as outlined in **Table 6-9**. The BRT costs for Option 7 is less than the other alternative corridors due to the fewer stations, structures, and associated utility impacts along segments of the Blackburn Hamlet Bypass and Innes Road.

Table 6-9: Summary of Ranking Evaluation: Cost Criteria

	Option			
	1	**4**	**5**	**7**
Cost Criteria Overall	3/4	3/4	3/4	4/4
Relative Performance = Total Score/ Maximum Score*	75%	75%	75%	100%

* Maximum Score 0f 44 (Calculated as 1 Criterion x 4 Ranks)

Notes:

1. *For each Factor/Criteria/Indicator the 1st ranked Option receives 4 Points, 2nd receives 3 Points, 3rd receives 2 Points and 4th receives 1 Point.*
2. *Ties (within 10%) receive the same Score and Aggregate Rank.*

6.10 Corridor Evaluation Summary

Results of the Short Listed Alternative Corridor relative ranking evaluation are presented in **Table 6-10** and provided in **APPENDIX G.1**. The evaluation assumed an equal weighting for all four evaluation factor groups. Option 7 was determined to be the Preferred Alternative, based on relative rankings. A sensitivity analysis was subsequently performed on these results, as described below.

Table 6-10: Short Listed Options: Evaluation Summary

Evaluation Criteria Groups	Short Listed Option: Assessment of Alternatives				
	Option 1: New Road & BRT off Navan	**Option 4: Widen Navan/BRT off Navan**	**Option 5: Renaud Extension & BRT off Navan**	**Option 7: Renaud Extension & BRT on Renaud**	**Preferred Option(s)**
Transportation & Transit (8 Criteria)	29/32 (91%)	28/32 (88%)	31/32 (97%)	32/32 (100%)	**Option 7 (All Options Close)**

Natural Environment (11 Criteria)	36/44 (82%)	31/44 (70%)	23/44 (52%)	32/44 (73%)	**Option 1 (Option 4 & 7 Close)**
Social/Cultural Environment (11 Criteria)	30/44 (68%)	29/44 (66%)	28/44 (64%)	38/44 (86%)	**Option 7**
Cost (1 Option)	3/4 (75%)	3/4 (75%)	3/4 (75%)	4/4 (100%)	**Option 7**
Overall Ratings (All Criteria)					**Option 7**
*** Relative Ranking:**	**1st =**	**2nd =**	**3rd =**	**4th =**	

6.11 Sensitivity Analysis

Several sensitivity tests were conducted on the short listed corridor evaluation. Tests #1, #2 and #3 removed all criteria from the evaluation under, respectively, Natural Environment, Social/Cultural Environment and Cost. Option 7 ranked first under all three of these sensitivity tests with Option 1 scoring within 10% under test #3. Sensitivity test #4 determined that Natural Environment's weighting would have to increase from 25% (equally weighted) to 66% for the next closest option (Option 1) to have an equal score to the Option 7. Under test #5, where all individual criteria were weighted equally, Option 7 ranked first with Option 1 within 10%.

Table 6-11: Short Listed Options: Sensitivity Analysis

Sensitivity Test Description	Short Listed Option: Assessment of Alternatives				
	Option 1: New Road & BRT off Navan	Option 4: Widen Navan/BRT off Navan	Option 5: Renaud Extension & BRT off Navan	Option 7: Renaud Extension & BRT on Renaud	Preferred Option(s)
Sensitivity Test #1 Excluding Natural Environment	78%	76%	79%	95%	**Option 7**
Sensitivity Test #2 Excluding Social/ Cultural Environment	82%	78%	75%	91%	**Option 7**
Sensitivity Test #3 Excluding Cost	80%	75%	71%	86%	**Option 7 (Option 1 within 10%)**

Sensitivity Test #4 Natural Environment Weighted 66%	● 81%	● 72%	◔ 61%	● 81%	**Options 1, 7**
Overall Ratings (All Criteria)	● 79%	● 73%	● 69%	● 85%	**Option 7**
*** Relative Ranking:**	**1st =** ●	**2nd =** ◕	**3rd =** ◑	**4th =** ◔	

6.12 Preferred Alternative Corridor

Overall ranking and comparison of results were completed as described above. **Table 6-10** displays the overall ranking and comparison of results for the relative rankings based on Transportation, Natural Environment, Social/Cultural Environment and Cost factors groups.

Option 7 ranked first overall, with the evaluation outcome confirmed via completion of a series of sensitivity tests. Option 7 was preferred under the Social/Cultural Environment and Cost comparisons due to the lowest overall cost, and the best relative performance for various indicators including but not limited to greenbelt experience, recreation connections, and potential property impacts. Option 7 was also preferred from the Transportation perspective, though all of the options for this Criteria Group ranked relatively closely.

Comparatively speaking, benefits of Option 7 include:

Best relative performance under the Transportation and Transit Factor Group (ranked first for each of the indicators)

Least amount of:
ROW length running adjacent to watercourses and least number of minor watercourse crossings

New edge condition created within the Greenbelt

Area within unevaluated wetlands

Encroachment into Greenbelt Core Areas

New road corridor within the Greenbelt

Encroachment into Urban Natural Area

Area within wetland and vegetative areas (climate mitigation)

Least number of:

Private and federal land parcels potentially impacted

Farms and least amount of farm area potentially impacted

Heritage sites potentially impacted

Least potential impact on:

Views and vistas

The greenbelt experience

Lowest relative cost of construction.

- Option 7 has the greatest potential impacts, comparatively for the following:

Impact to areas of archaeological potential

Potential water quality impacts

Area with potential flood risk

Area within the creek meander zone

Encroachment on greenbelt natural link areas

Area within potential SAR habitat

Proximity to Mer Bleue Provincially Significant Wetland

7. IDENTIFICATION & EVALUATION OF ALTERNATIVE DESIGNS

7.1 Design Considerations

Various design alternatives were developed for the Preferred Corridor (Option 7). Given that the Preferred Corridor passes through important ecological and agricultural areas, consideration was given to avoiding and minimizing impact to the environment, where feasible. Additional environmental constraints that were considered throughout the development and evaluation of alternative designs included slope stability setbacks and meander risk setbacks along Mud Creek and Greens Creek.

Recommended Designs were developed to address the needs of the study area with consideration that the construction of the Preferred Corridor (Option 7) is likely beyond the 2031 TMP planning horizon based on its cost and affordability.

7.1.1 Geotechnical Conditions

Golder Associates completed a memo highlighting the functional design level geotechnical input for the preferred alignment alternative (**APPENDIX D.4**). Golder Associates provided key functional design considerations by segment. In general, key geotechnical considerations include the following elements:

- Tunnel at Innes Road
- Excavations and embankments
- Stability of Mud Creek
- Potential for creek infilling

7.1.2 Mud Creek: Slope Stability & Meander Risk Setbacks

Golder Associates completed a slope stability hazard assessment (**APPENDIX D.4**). The report notes that the valley slopes of Mud Creek range from about 9 metres high around Renaud Road, up to about 18 metres high within the lower reaches near Innes Road.

Slope Stability Setback refers to a measure of the distance required to ensure risk of slope failure is minimized to the extent possible. It is determined using the Ontario Ministry of Natural Resources (2002) *Technical Guide – River and Stream Systems: Erosion Hazard Limit*. For Mud Creek the Slope Stability Setback was calculated as the sum of the stable slope setback, toe erosion allowance, and top of bank allowance. The hazard line is offset from the base of the slope and not the bank or centreline of watercourse. The Slope Stability Setback for Mud Creek is notably more stringent than the Meander Risk Setback. It is noted that all design options should incorporate an additional 10-15 m buffer where possible.

Meander Risk Setback was determined for Mud Creek using existing meander patterns within each reach and incorporation of components from the Natural Hazards Technical Report (s7.2 Erosion Hazards) and Toronto Region Conservation Authority (TRCA) Meander Belt Assessment Protocol. It was calculated as the sum of the setback value, erosion factor and toe slope factor. A default of 30 m (15 m from top of bank on each side of watercourse) is used. The Meander Risk Setback is the 'total setback corridor' for the watercourse therefore the value must be halved and applied to each side of the watercourse.

Within the upper reach of the Mud Creek valley, between Renaud Road and Weir Road, the setback distance to the Limit of Hazard Lands ranges from 13 to 28 m. For planning purposes within this upper portion of study area, a general setback distance of 30 m is recommended. However, this 30 m setback value developed for planning purposes can be revised at a given location with a site-specific stability assessment.

7.1.2.1 2021 Functional Design Geotechnical Input

As part of this study, Golder completed a field investigation to support the assessment of the corridor alternatives and inform the development of the recommended plan (**APPENDIX D.4**). As described above, the subsurface conditions within the project area generally consists of fill overlying a thick deposit of firm to very stiff silty clay and groundwater levels are expected to fluctuate seasonally (Golder, 2021b). The silty clay beneath this site has a limited capacity to support additional stresses caused by foundation loads and/or grade raises.

Within the limits of the study area, Golder reports that the valley slope height ranges from about 9 m near Renaud Road, to about 18 m near Innes Road (2021b). The overall valley slopes are inclined from horizontal at angles ranging from about 20 to 40 degrees (Golder, 2021b). The risk of slope failures along Mud Creek has been relatively well studied/documented from a hydrological, geomorphological, and geotechnical perspective. Historically, slope failures are typically linked to erosion processes at the toe of existing slopes and current active erosive forces are highest along the upper reaches of Mud Creek (Golder, 2021b).

The stability of the slope within the study area was evaluated using 2-dimensional limit equilibrium methods and the commercially available SLOPE/W software. Detailed methods of evaluation, limitations and assumptions are available in **APPENDIX D.4**. Results indicate that the creek slopes near the crossing with existing Renaud Road are stable with factors of safety greater than 1.5 and 1.1 for static and seismic conditions, respectively (Golder, 2021b). The creek slopes near Anderson Road and before crossing Innes Road are potentially unstable or only marginally stable with factors of safety at or near 1.0 for both static and seismic loading conditions (Golder, 2021b).

Limit of Hazard Lands were calculated with consideration for the following three components: “Stable Slope Allowance”, “Erosion Allowance” and “Access Allowance”. The erosion allowance was determined to vary between 0 and 8 m, depending on the floodplain width within the study area (Golder, 2021b). An additional allowance access was not considered necessary for this project, though additional stability analyses were undertaken to assess the stable slope allowance requirements. The results indicate that the magnitude of the stable slope allowance, as well as the required setback distance to the Limit of Hazard Lands are consistent with the 2015 report and analysis (Golder, 2021b).

Golder notes that the above Limit of Hazard Land offsets along the breadth of Mud Creek within the study area are considered sufficient at this planning stage (Golder, 2021b). Additionally, Golder determined through a series of calculations that values indicate a low potential for flow behaviour of the remolded clay within the study area (2021b).

7.1.3 Accessibility in the Design

The Brian Coburn Boulevard Extension/Cumberland Transitway project should be designed to meet the City of Ottawa Accessibility Design Standards (2015a), as well as the Accessibility for Ontarians with Disabilities Act (AODA). Pending current standards and policies at the time of detailed design, the following Standards are examples for inclusion:

- Requirements for clear width for exterior paths of travel-sidewalk minimum width of 1.8 m.
- Longitudinal grade kept to 5% or less.

- Crossfall of pedestrian facilities set at 2% maximum.
- Intersections to incorporate appropriate waiting areas at crosswalks, accessible pedestrian signals, and Tactile Walking Surface Indicators (TWSI).
- Bus transit stops, where provided, to include space for accessible ramp deployment.
- Where adjacent to each other, pedestrian surfaces and cycling surfaces to have tactile delineation or separation between them.
- Multi-use pathways, where provided, to provide a smooth surface for users of wheeled mobility devices.
- Consider providing rest areas/benches (~30m) to maximize the usability of the pathways for people with reduced stamina.

7.1.4 Drainage & Stormwater Management Criteria

Proposed drainage and stormwater management designs should meet the requirements stipulated in the following standards, specifications, and guidelines listed below

- Ministry of the Environment (MOE), Stormwater Management Planning and Design Manual, March 2003
- City of Ottawa, Sewer Design Guidelines, October 2012
- Ministry of Transportation Ontario (MTO), Highway Drainage Design Standards (HDDS), January 2008
- MTO, Drainage Management Manual (DMM), 1997
- City of Ottawa, Low Impact Development (LID) Technical Guidance Report, February 2021
- Toronto and Regional Conservation Authority (TRCA) and Credit Valley Conservation Authority (CVC) Low Impact Development (LID) Stormwater Management Planning and Design Guide, 2010
- RVCA, Regulation of Development, Interference with Wetlands and Alterations to Shorelines and Watercourses (Ontario Regulation 174/06 under Section 28 of the Conservation Authorities Act, R.S.O 1990, c. C.27), September 2018

The Functional Design Report – Drainage and Stormwater Management (MH, 2021c) is provided in APPENDIX C.4.

7.2 Design Alternatives

As presented in the key plan (**Figure 7-1**) the Preferred Corridor (Option 7) was subdivided into smaller segments for development of alternatives and evaluation purposes. The Corridor was subdivided into four segments, as follows:

1. Segment 1: West of Anderson Road to Innes Road
2. Segment 2: Anderson Road to Maurice Street
3. Segment 3: Mud Creek Crossing
4. Segment 4: East of Mud Creek to Navan Road

7.2.1 Segment 1: West of Anderson Road to Innes Road

The BRT in Segment 1 (**Figure 7-2** and **Figure 7-3**) follows Anderson Road, north of the proposed BCBE, crossing Innes Road via a tunnel. Under Option 1 BCBE follows Anderson Road and connects to the IWHC Connection approximately 400 m south of Innes. Option 2 for the BCBE follows the Prescott-Russell Trail to the IWHC Connection.

It is noted that in the area between Renaud Road and Innes Road, Mud Creek is more prone to incision (narrow erosion away from the watercourse base level). Very recent landslides/landslide risk exists and increases further downstream. As the existing Anderson Road is within existing hazard limits for the creek, the Study Team initially proposed that design options remain out of the RVCA identified hazard lines. Otherwise, mitigation measures should be applied to the Mud Creek slopes which would allow locating the BRT within the existing Anderson Road footprint and minimization of the encroachment on the agricultural land to the south.

7.2.2 Segment 2: Anderson Road to Maurice Street

Segment 2 (**Figure 7-4**)only had one design alternative identified by the Study Team. The purpose of this segment is to connect between the various design alternatives identified for Segments 1 and 3. Throughout this Segment, the BRT runs adjacent to the BCBE. It is proposed that the BCBE follow existing Renaud Road and connect with the existing intersection on Anderson Road with a new MUP provided parallel to the new roadway to the south.

7.2.3 Segment 3: Mud Creek Crossing

Segment 3 is characterized by the various crossing alternatives available for Mud Creek, west of Renaud Road and east of Segment 2. Five alternatives were developed for the creek crossing. Trade-offs relating to advantages and disadvantages of each design alternative are presented in the evaluation section below (**Section 7.4**).

7.2.3.1 Option 1

Option 1 is generally characterized by a co-located road and transit corridor north of Mud Creek, with a greater separation between the BRT and road corridor around the Renaud Road intersection. Option 1 BRT includes a proposed underpass to allow a pathway and farm equipment crossing. Option 1 is presented in (**Figure 7-5**).

This alternative would require crossing Mud Creek twice (main channel and tributary), with a total of four bridge structures spanning the hazard limits of the creek. Bridge lengths would range from approximately 135-140 m across the tributary to 160-200 m for the main channel crossings for both BRT and roadway.

7.2.3.2 Options 2 & 3

Options 2 and 3 also include a proposed pathway/farm access underpass and are generally co-located where they cross Mud Creek. Option 2 crosses Mud Creek closest to the north-south tributary inlet with 2 bridges between 170 and 200 m, as illustrated in (**Figure 7-6**). Option 3 crosses Mud Creek east of the tributary with proposed bridge lengths of 210m-240m (**Figure 7-7**).

7.2.3.3 Option 4

Option 4 has one proposed crossing of Mud Creek for the BRT, with a bridge length of approximately 170 m on the north-south section of Renaud Road. The portion of Renaud Road south of the proposed traffic circle would be realigned to remove a sharp bend and two road/trail crossings (which could also be included with the other four options). The road corridor and MUP would cross Mud Creek with the use of culverts east of Renaud Road. Option 4 is illustrated in (**Figure 7-8**).

7.2.3.4 Option 5

Option 5 differs from the other design options in this Segment in that it would require realignment of a section of Mud Creek. Realigning the creek allows the BRT and road to be co-located for the extent of the Segment along the existing Renaud Road footprint and use a box culvert crossing of Mud Creek, rather than bridges. An underpass would be included to allow a pathway and farm equipment to cross the BRT. The MUP in this option is located south of the roadway for the extent of the segment. Cut and fill operations are required within the hazard limits of Mud Creek, as depicted on (**Figure 7-9**).

7.2.4 Segment 4: East of Mud Creek to Navan Road

Segment 4 of the Preferred Corridor is constrained by the Hydro One corridor and Bradley Estates subdivision and connects Segment 3 with Navan Road. It is noted that the area by the 90° bend in Mud Creek is a high flood risk area by the RVCA, and as such the design option developed for this Segment remains south of the high-risk area. The BRT and MUP infrastructure are co-located with the new proposed BCBE roadway, to the north of the existing Hydro One corridor. The new roadway and MUP would connect with the existing roundabout on Navan Road. Segment 4 is illustrated in (**Figure 7-10**).

Navan Road is located on top of an existing escarpment that is approximately 14 m above the proposed BCBE alignment to the west. The alignment has a proposed embankment that varies in height from 2.0 m to 10 m. Geotechnical considerations anticipate the use of light weight fill material to limit the anticipated settlements. The proximity of the proposed BRT to the proposed roadway, and variance in elevation between the two, required the BCBE embankment to be supported by retaining walls as the BRT alignment will be in a cut to cross under Navan Road, connecting to the future BRT Station east of Navan.

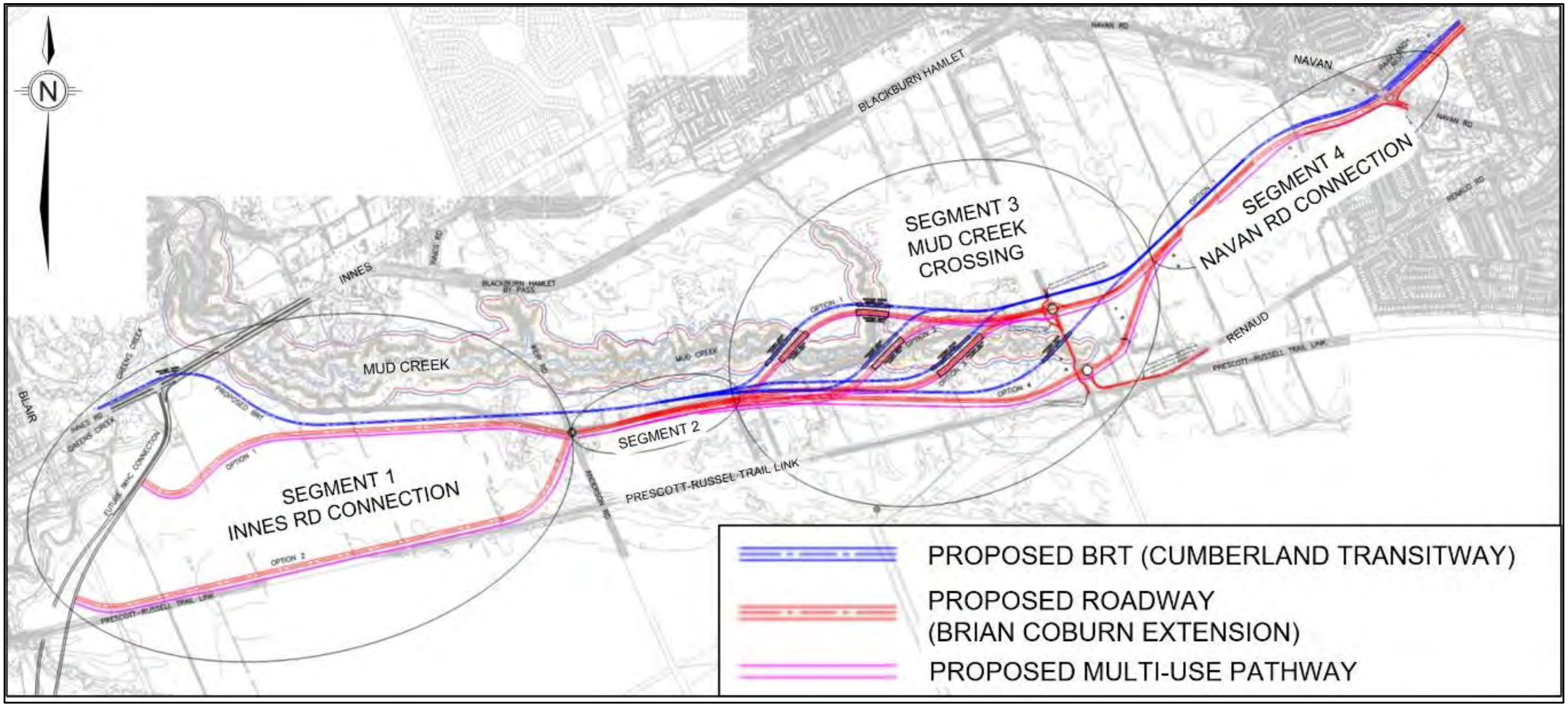

Figure 7-1: Corridor 7: Segment & Design Alternatives Overview

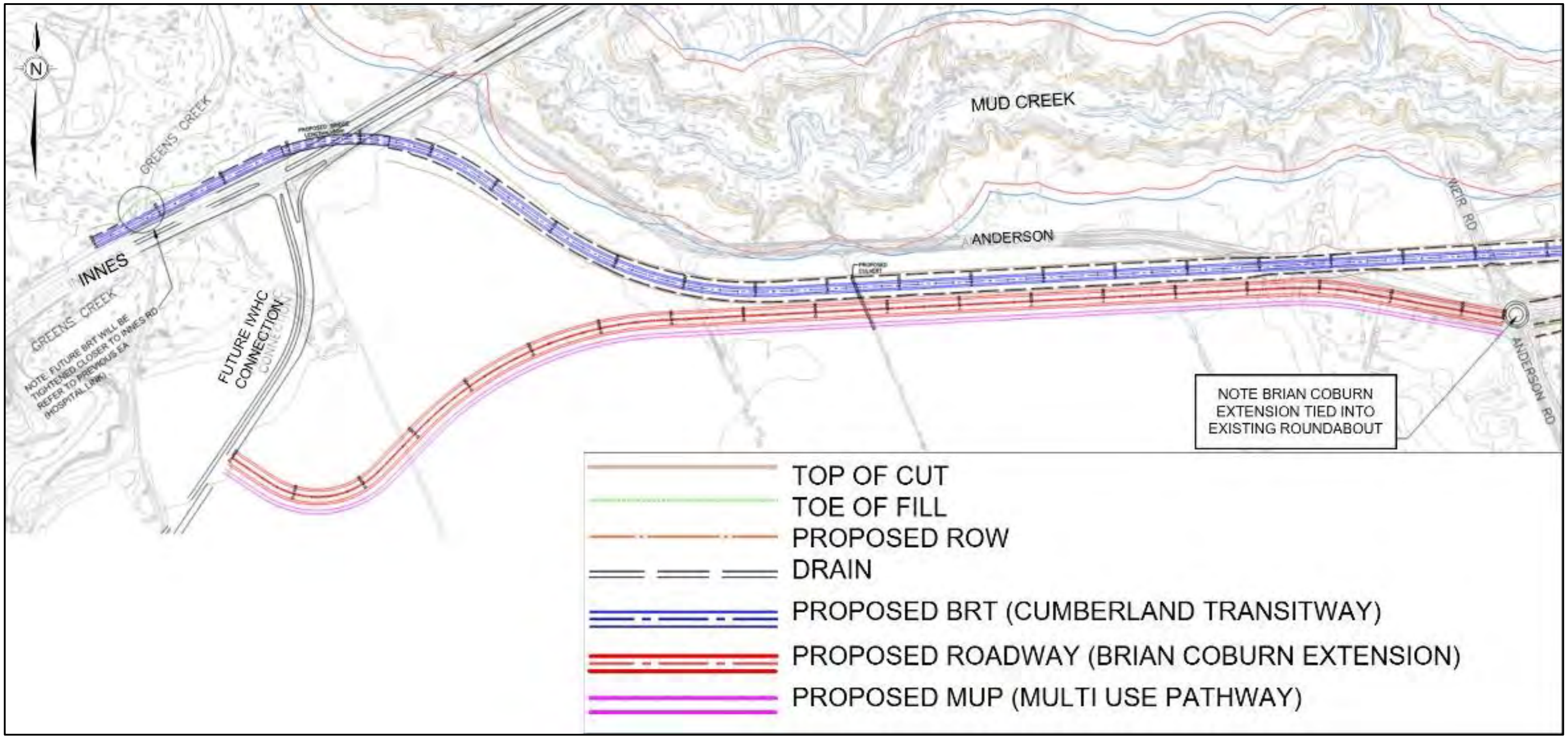

Figure 7-2: Corridor 7: Segment 2, Option 1

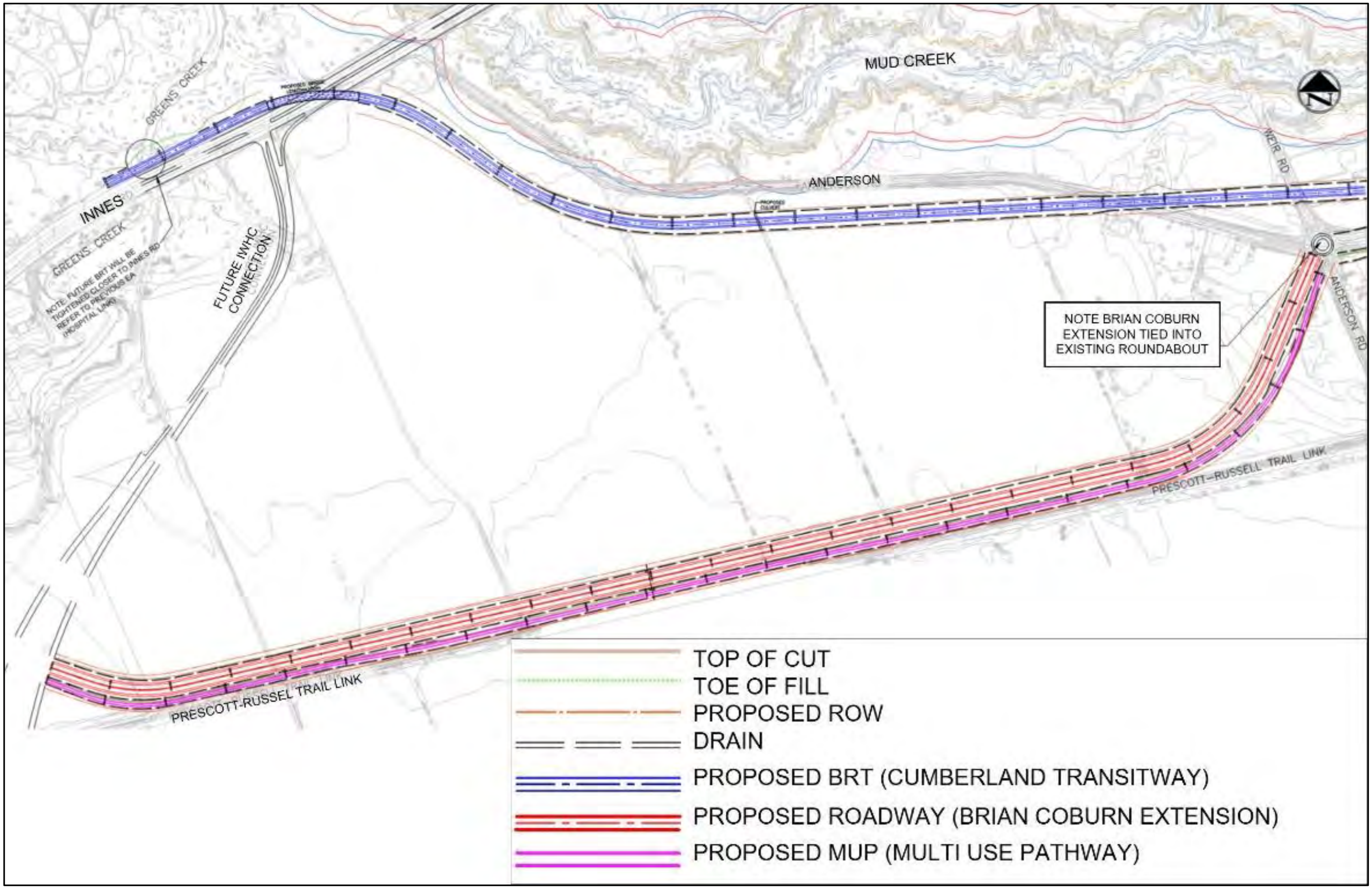

Figure 7-3: Corridor 7: Segment 1, Option 2

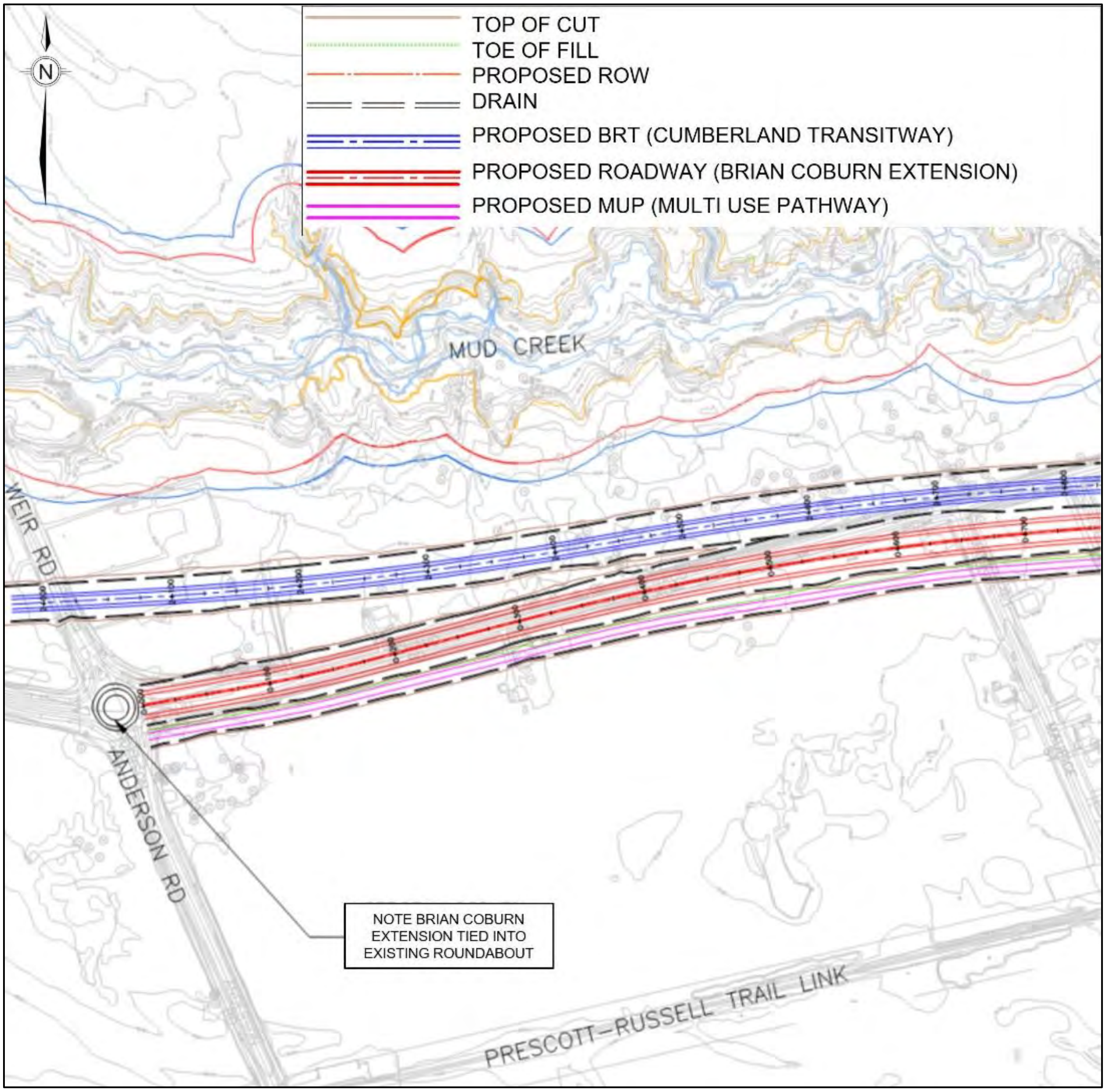

Figure 7-4: Corridor 7: Segment 2

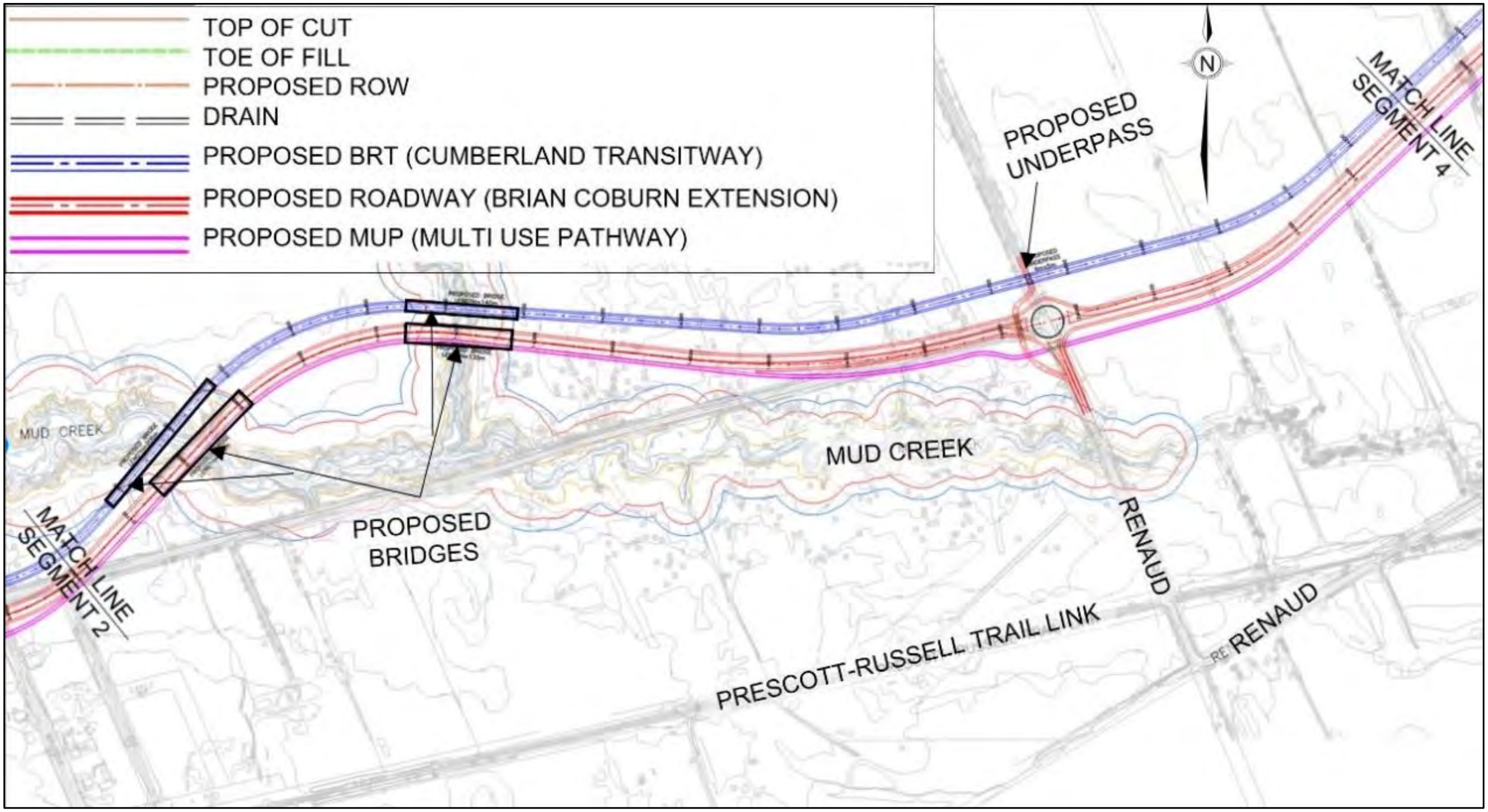

Figure 7-5: Corridor 7: Segment 3, Design – Option 1

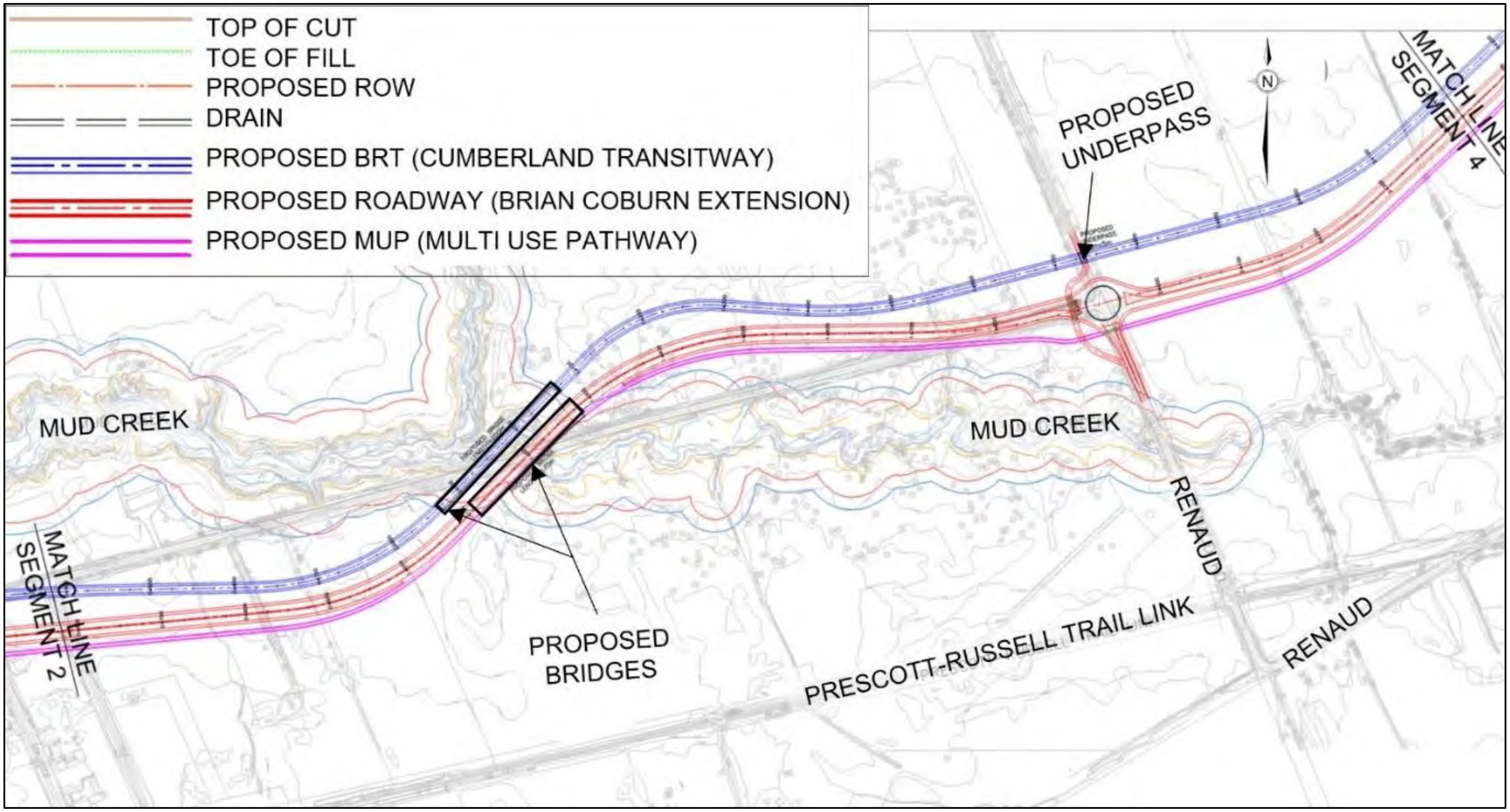

Figure 7-6: Corridor 7: Segment 3 Design – Option 2

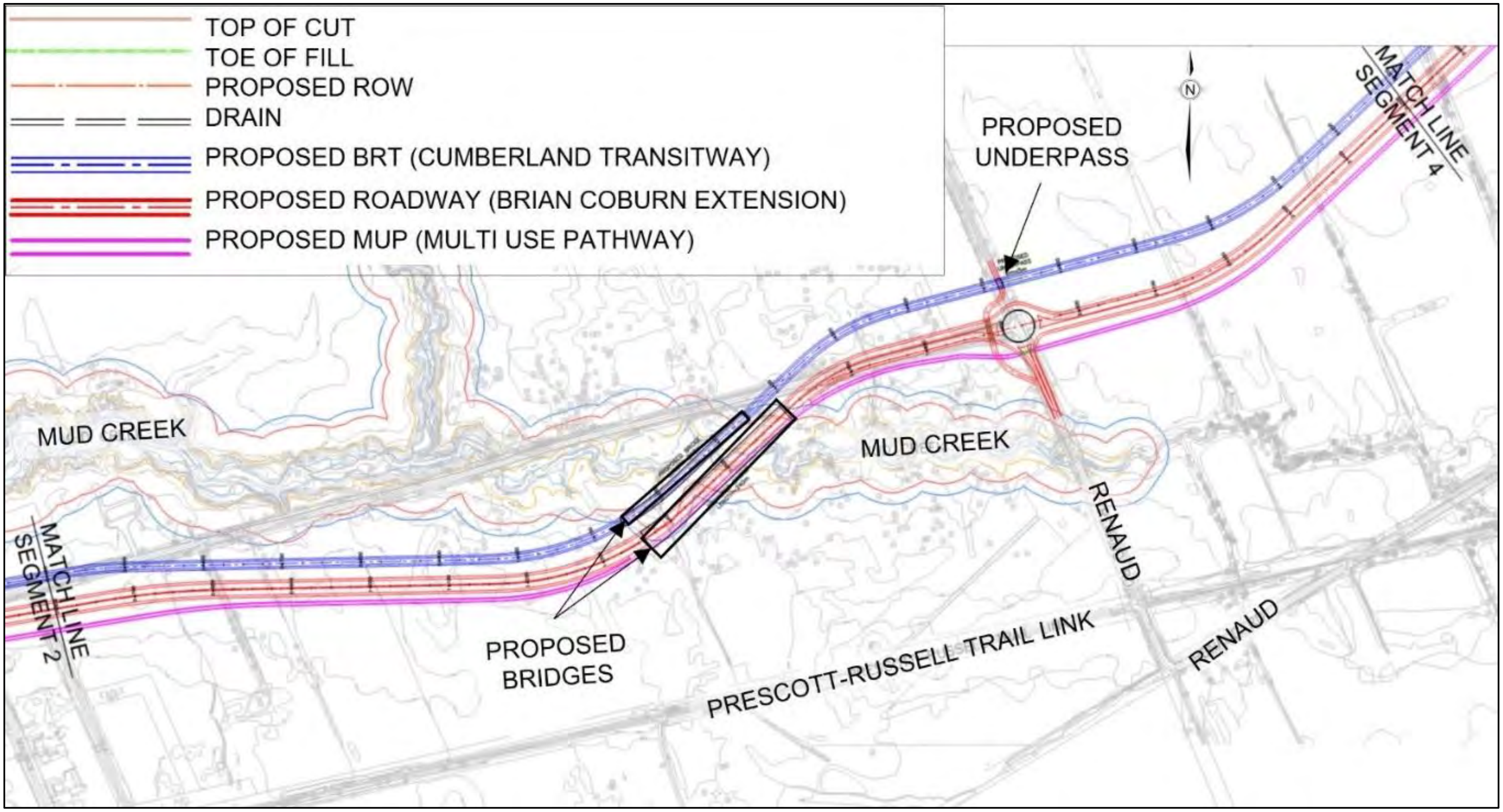

Figure 7-7: Corridor 7: Segment 3, Design – Option 3

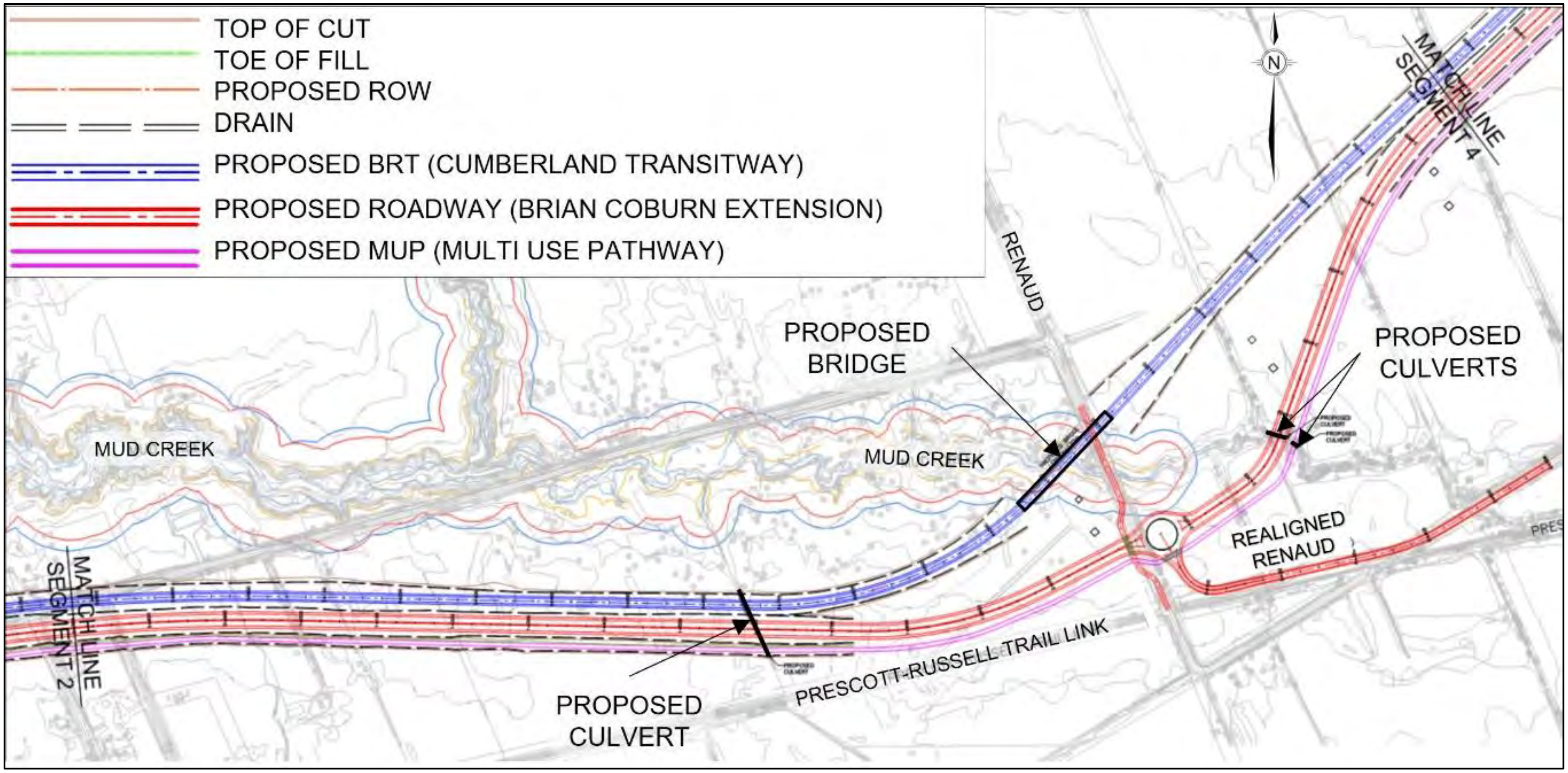

Figure 7-8: Corridor 7: Segment 3, Design – Option 4

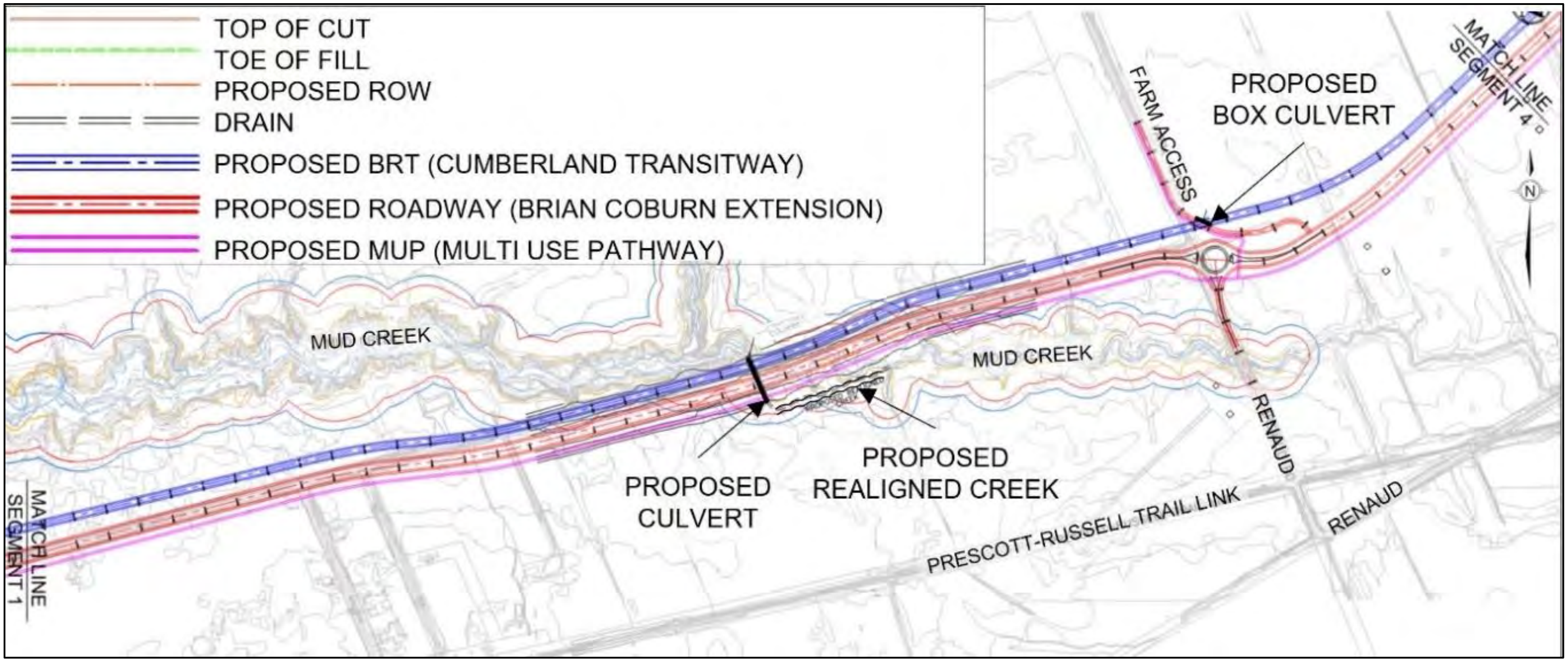

Figure 7-9: Corridor 7: Segment 3, Design – Option 5

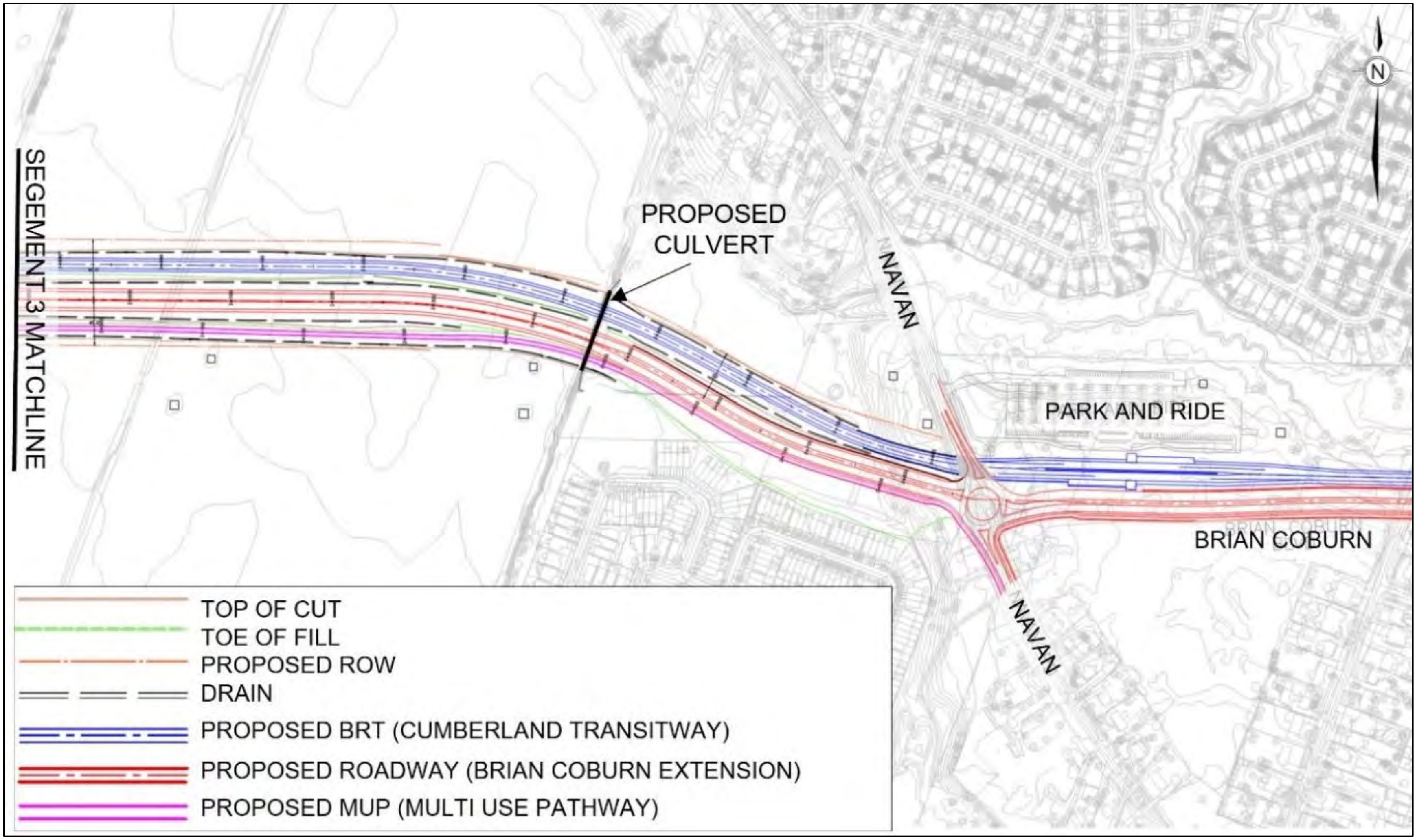

Figure 7-10: Corridor 7: Segment 4

7.3 Design Evaluation Methodology

The evaluation of alternative designs was completed using professional judgement with input provided by members of the Design Team, Planners, Biologists, and other subject matter experts.

The evaluation criteria used for the assessment of Alternative Corridors was carried forward and re-examined for the purposes of the evaluation of alternative designs. A screening process was completed to determine which criteria should apply. Segments 1 and 3 were evaluated for their various design options, while Segments 2 and 4 did not have alternative designs developed as they were considered “connections” between the other segments.

7.4 Design Evaluation Results

7.4.1 Segment 1: West of Anderson to Innes

Segment 1 had two design options developed, with both options equally preferred from an active transportation perspective, though Option 2 could utilize the Prescott-Russell Trail in place of a new MUP. From a Natural Environment perspective, Option 1 was preferred as, with mitigations applied, could generally be co-located with Anderson Road. It would also not sever the unevaluated wetland in the area and is located further from the Mer Bleue Wetland. Options 1 and 2 within Segment 1 have socio-cultural trade-offs and were thus considered equally preferred. Option 1 is preferred when considering Higher Class Agricultural Soils, Recreation and Noise Impacts, while Option 2 is preferred when considering Severed Farm Impacts and Archaeological Potential. Option 2 is anticipated to have lower anticipated property costs and is thus preferred for this factor group. Option 1 was most preferred overall.

Table 7-1: Segment 1: Design Option Evaluation Summary

	Option 1	Option 2
Transportation	-	-
Natural Environment	✓	×
Social – Cultural Environment	-	-
Cost	×	✓
Overall Preferred	✓	×

7.4.2 Segment 3: Mud Creek Crossing

All five options are equally preferred from a transportation perspective, with all options including a proposed NCC trail/pathway underpass of the BRT and the potential for removal of 2 Renaud Road crossings of the Prescott-Russell Trail. From a Natural Environment perspective, Options 2 – 5, rank similarly with pros and cons associated with each. For example, though Option 5 would require a major creek realignment (300 m), it would present opportunities for enhancement. Option 5 additionally had greater avoidance of wetlands, and Core Natural Areas. Option 5 was preferred from a socio-perspective given the lower potential impact to property and farm area lost, though potential number of well impacts for Option 5 is greater than the other options. It is expected that Option 1 would have the highest cost due to extra Mud Creek crossings and Option 4 would have the lowest cost due to smaller upstream Mud Creek crossings with Options 2, 3 and 5 in between. Though Option 5 makes use of box culverts and avoids bridge construction, Option 5 has an anticipated 35% higher construction cost vs. Options 2 & 3 due to creek relocation and in-stream treatments (north side).

Overall Option 5 is most preferred when compared to the other design options. Option 3 is considered second best as it is slightly preferred to Option 2 and avoids several of the negative aspects of Option 4. Option 1 is least preferred overall.

Table 7-2: Segment 3: Design Option Evaluation Summary

	Option 1	Option 2	Option 3	Option 4	Option 5
Transportation	-	-	-	-	-
Natural Environment	✗ ✗	✓	✓	✓	✓
Social – Cultural Environment	✗	✗	✗	✗	✓
Cost	✗	-	-	-	-
Overall Preferred	✗✗	-	-	-	✓

8. RECOMMENDED PLAN

The Recommended Design addresses the needs of the study area beyond 2031. The functional design plans and profiles for the recommended design are shown in an Annex entitled 'Functional Design Plans'. The road and transitway design criteria are provided in the table below.

LOCATION:Brian Coburn Boulevard Extension (BCBE)/ Cumberland Transitway (BRT)

LIMITS: BCBE: From Innes Walkley Hunt Club to Navan Road BRT: From Blair Road Transit Station at Innes to Navan Road Transit Station at Navan

LENGTH: 6.0 km

		DESIGN STANDARDS	PROPOSED STANDARDS
FUNCTIONAL HIGHWAY CLASSIFICATION		RAD 100	RAD 100
DESIGN SPEED		100 Km/h	100 Km/h
POSTED SPEED		80 Km/h	80 Km/h
RADIUS MINIMUM		440 m	220 m (a)
STOPPING SIGHT DISTANCE		185 m	185 m
EQUIVALENT MINIMUM "K" FACTOR	Crest	52	60
	Sag	45	50
GRADES MAXIMUM		3 %	3.5 % (b)
AADT (Horizon Year 2046)			

% TRUCKS (Horizon Year 2046)		
NUMBER OF LANES	4	4
LANE WIDTHS	2 @ 3.50 m	2 @ 3.50 m
SHOULDER WIDTH	3.0 m	3.0 m
SHOULDER ROUNDING	1.0 m	1.0 m
MEDIAN WIDTH	1.5m Raised (b)	1.5m Raised
R.O.W. WIDTH	50m (c)	50m
MISCELLANEOUS	N/A	N/A

NOTES:

a) Curve approaching the IWHC intersection is 220m that meets 70 km/hr design speed criteria is considered acceptable as we are approaching a tee intersection, and the speed is expected to be lower.

b) Proposed grade of 3.5% just west of Navan Road roundabout is larger than 3% is acceptable as we anticipate the speed to be slower in the uphill direction approaching the roundabout. The 3.5% downhill grade is acceptable leaving the roundabout.

c) A 1.5m raised median on multi lane arterials with posted speed limit at or above 80km/hr was recommended by the City of Ottawa Planning Committee on Oct 24, 2017, and approved by City Council on November 8, 2017.

d) A typical Right of Way width is assumed to be 50m to accommodate the Road and the MUP and associated drainage. This will increase in high fill areas, and at the embankment approaching Navan Road. This width will increase to 77m to accommodate the BRT.

	DESIGN STANDARDS	**Proposed STANDARDS**
FUNCTIONAL HIGHWAY CLASSIFICATION	RAU 90	RAU 90
DESIGN SPEED	90 Km/h	90 Km/h

POSTED SPEED		80 Km/h	80 Km/h
RADIUS MINIMUM		340 m	340 m
STOPPING SIGHT DISTANCE		160 m	160 m
EQUIVALENT MINIMUM "K" FACTOR	Crest	55	55 (a)
	Sag	40	40
GRADES MAXIMUM		3.5 %	3.5 %
AADT (Horizon Year 2046)			
NUMBER OF LANES		2	2
LANE WIDTHS		3.5 m (Rural) 4.0 m (Urban)	3.5 m (Rural) 4.0 m (Urban)
SHOULDER WIDTH		2.5 m	2.5 m
SHOULDER ROUNDING		1.0 m	1.0 m
MEDIAN WIDTH		N/A	N/A
R.O.W. WIDTH		30m (b)	30m

MISCELLANEOUS	N/A	N/A

NOTES:

a) The crest and sag of the BRT profile approaching the Blair Station are slightly substandard to tie with the Innes Road profile. That can be further assessed during the detail design stage.

b) A typical Right of Way width is assumed to be 30m to accommodate the Transitway and associated drainage. This will reduce to 27m when sharing the drainage with with BCBE. So, the total typical R.o.W width will be 77 m.

8.1 Brian Coburn Boulevard Extension & Cumberland Transitway

Figure 8-1 provides an overview of the Recommended Ultimate Design for the BCBE, approximately 6.1 km in length, and the Cumberland Transitway, approximately 6.5 km in length. At the eastern extent, the project connects to the Chapel Hill Park and Ride in the northeast corner of the Brian Coburn Boulevard and Navan Road intersection. Over most of the project limits, the BRT corridor is located along the north side of the recommended BCBE alignment to reduce overall project footprint and environmental impact.

Four 'gateway' locations have been incorporated within the Recommended Plan, providing opportunities for landscaping enhancements. These are identified at the intersections of the BCBE with Navan Road, Renaud Road, Anderson Road, and the future Innes-Walkley-Hunt Club Connection, as illustrated on **Figure 8-2**. Gateways will help create an identifiable character along pathways to enhance the user experience. More detail related to the gateways and overall landscape strategy is provided in **Section 8.1.5.1**.

8.1.1 Typical Cross Section

The Typical Ultimate Cross-Section (**Figure 8-2**) is shown facing towards the east and includes both the 12.5 m two-lane segregated Cumberland Transitway and the 21.5 m four-lane Brian Coburn Blvd. Extension. A narrow 1.5 m raised median is proposed to separate the eastbound and westbound lanes on Brian Coburn Blvd. to improve safety. The raised median will result in modified right-in/right-out property access along the corridor.

To minimize the project's footprint, the recommended ultimate transit and arterial roadway corridor will make use of the existing east-west section of Renaud Road and the existing section of Anderson Road northwest of Renaud Road. A paved 3.0 m MUP is proposed along the south side of the corridor to accommodate active transportation users and serve as a bi-directional cycling facility. A rural cross-section will match with the existing rural conditions. Context sensitive planting is recommended along the outer edges of the Transitway and roadway and will maintain existing views and vistas.

Figure 8-1: Recommended Plan - Overview

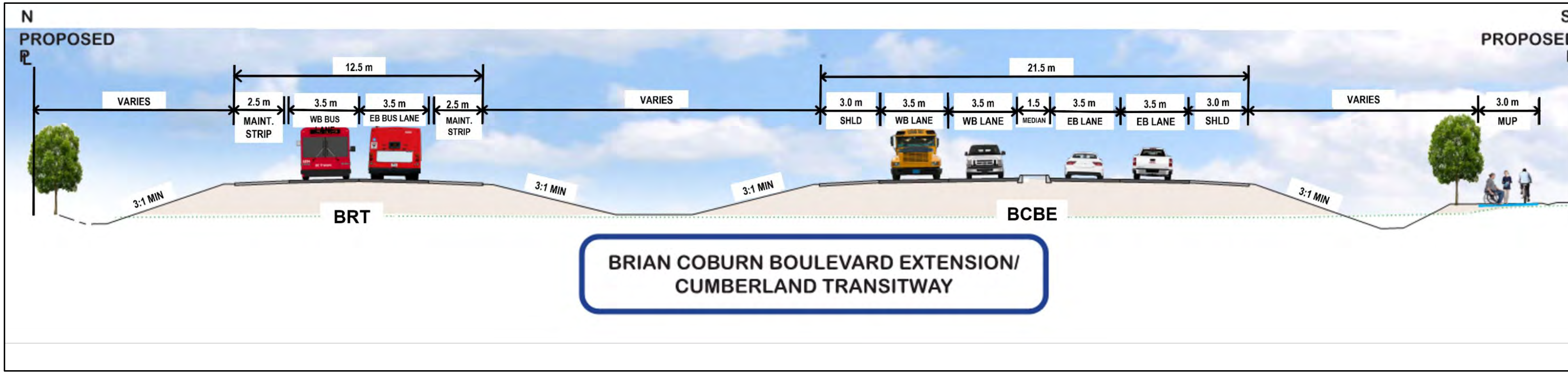

Figure 8-2: Recommended Plan - Typical Cross-Section

The typical cross-section for the ultimate design requires a minimum right-of-way for all three transportation elements of 77.0 m. The next phase of the project (detailed design) will examine how this width can be reduced.

In the Ultimate Recommended Plan, stormwater will be managed with a typical trapezoidal section for enhanced grass swales with rock check dams, with maximum of 2.5:1 and a preferred 4:1 side slopes (H:V) if possible. There may be multiple rock dams along the swale if it is sufficiently long.

8.1.2 Navan Road Intersection & Chapel Hill Park & Ride

The Cumberland Transitway BRT and Brian Coburn Boulevard will match to existing conditions between Navan Road and Pagé Road. A bus-only connection will be provided from the Transitway to and from the Chapel Hill Park and Ride and a new on-line transit station will be added at this location and will include a grade-separated accessible pedestrian/cycling overpass structure. The Transitway will pass under Navan Road via a new bridge structure while Brian Coburn Boulevard will be extended to the west of Navan Road down an embankment to the elevation of the lands below the escarpment.

The existing roundabout at Brian Coburn Boulevard and Navan Road will be expanded to a two-lane roundabout and multi-use pathways will be added to ensure convenient community access to the transit station. These will include a direct pathway connection from Percifor Way to Navan Road. Noise attenuation barriers, 2.8 metres in height, are proposed along the north side of Bradley Estates and along the south edge of the residential property at 2870 Navan Road. **Figure 8-3** illustrates the recommended ultimate design in the Navan Road roundabout and Chapel Hill Park and Ride.

8.1.2.1 Navan Road Overpass

It is proposed to run the two-lane BRT underneath existing Navan Road. Due to the existing alignments and site constraints in the area, this crossing will be near the existing round-about at this location. This proposed bridge would carry two lanes of traffic on Navan Road in each direction, a 4 m MUP in each direction, a 2 m boulevard on each side, and a median. The structure is proposed to be a single-span precast concrete I-girder bridge with integral abutments. The skew relative to Navan Road would be approximately 60 degrees. The foundations are proposed as steel H-piles driven to bedrock, due to the soft clay soils in the area.

Figure 8-3: Navan Road & Chapel Hill Park & Ride

8.1.3 Renaud Road Intersection & NCC Access

The new BCBE and Transitway will extend from Navan Road to Renaud Road through existing farmland near the existing hydro corridor to bundle both infrastructure corridors and minimize the project footprint. A protected signalized intersection will be provided at the new BCBE and Renaud Road intersection and will include multi-use pathway crossings on the south and west legs of the intersection, as illustrated in **Figure 8-4**.

In this area the separation of the Transitway and roadway corridor increases to accommodate a north-south multi-use pathway under the Transitway as well as farm vehicle access to connect to a proposed NCC pathway/trail and to serve existing farmland to the north. The north-south multi-use pathway will also extend to the south to connect to the existing Prescott-

Russell Trail. In this area, a realignment of Renaud Road is proposed to eliminate a very sharp roadway 'bend' as well as two roadway/trail crossings. This realignment also results in the removal of this section of Renaud Road to outside of the RAMSAR designated limits of the Mer Bleue wetland.

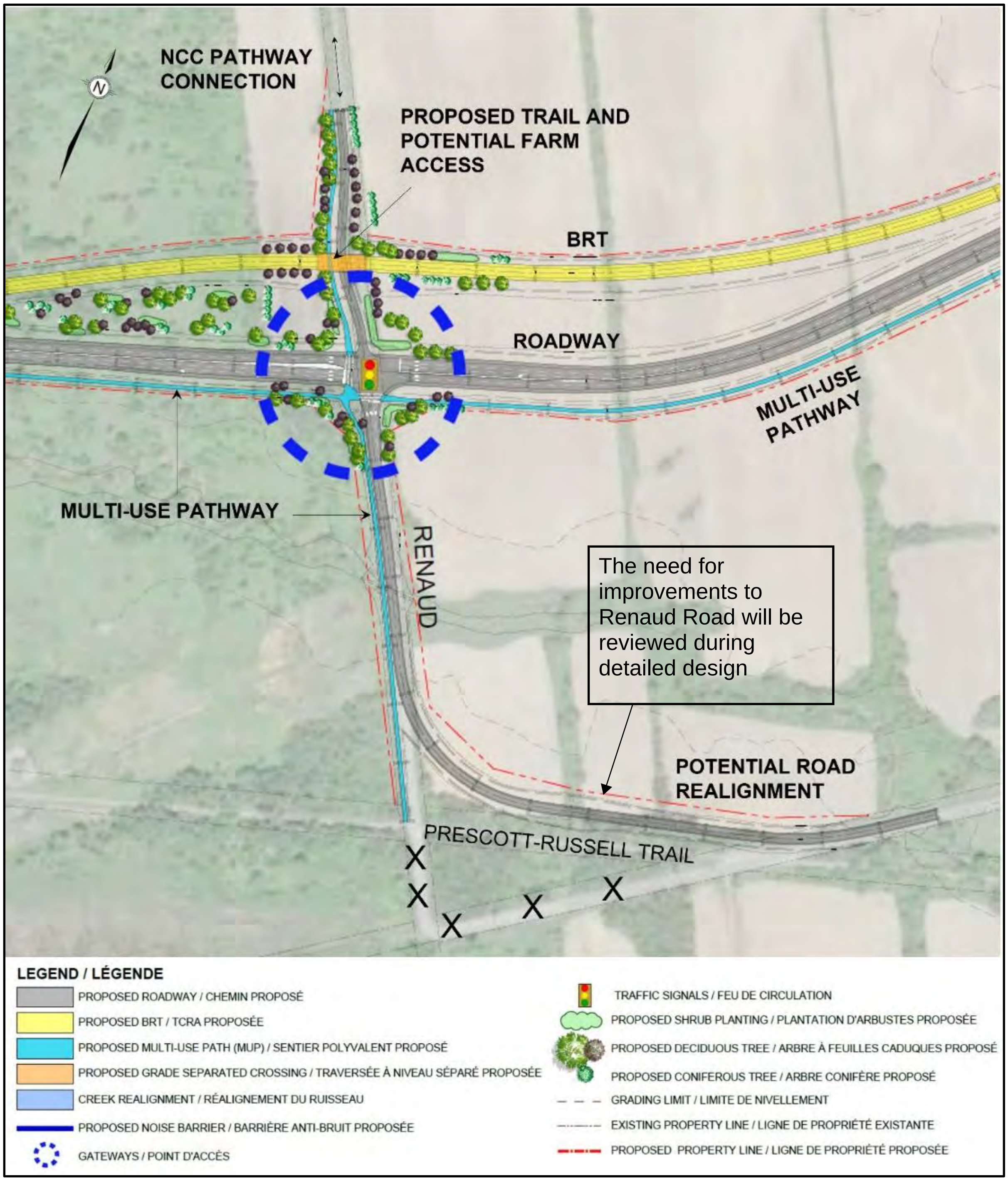

Figure 8-4: Renaud Road Intersection & NCC Access

8.1.3.1 Proposed Trail & Farm Access

There is an existing north-south farm access route near the existing “dogleg” to the south of Renaud Road which should be maintained. It will be necessary to construct a new bridge to accommodate the proposed two-lane Transitway over the existing farm access road. This structure is proposed as a single-span precast concrete box girder bridge with integral abutments and an approximate 28 m span, to also accommodate the proposed 3 m NCC pathway. This bridge will be super-elevated (high side on the north) due to the horizontal curve at this location, will not have surface expansion joints, and will have concrete barrier walls, concrete wing walls, and steel beam guiderail in each quadrant. The foundations are proposed as steel H-piles driven to bedrock.

8.1.3.2 Mud Creek Crossing & Creek Alignment

In the area of the existing Mud Creek crossing, the Transitway and roadway corridors return to their minimum separation. The widening of Renaud Road for the BCBE will encroach on the erosion and slope stability zones of Mud Creek. An approximately 300 m long realignment of Mud Creek is proposed in this area and provides an opportunity to improve existing creek conditions through natural channel design, terrestrial and aquatic habitat enhancements, erosion protection and slope stabilization measures. The multi-use pathway is proposed to pass over the realigned creek on its own pedestrian bridge.

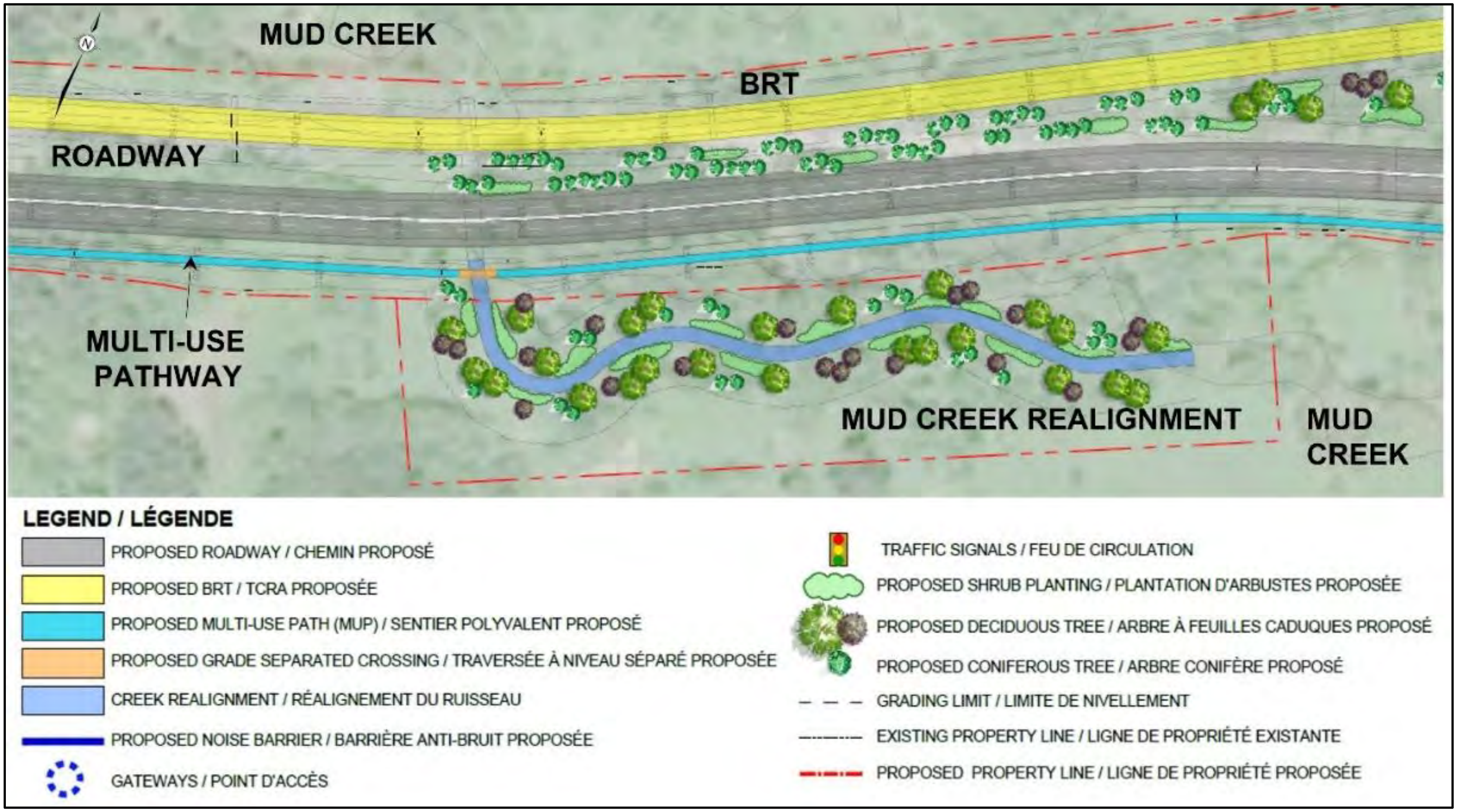

Figure 8-5: Mud Creek Alignment

8.1.3.3 Mud creek Culvert & Pedestrian Foot Bridge

There is an existing corrugated steel plate (CSP) open-footing arch culvert for Mud Creek under the existing two-lane Renaud Road, built circa 1965. With the proposed widening of the corridor for the BCBE, the required length of this culvert will increase to approximately 66 m. It is proposed to replace the existing culvert with a new precast concrete culvert and construct a new pedestrian bridge for the MUP. Due to the soft clay soil conditions at the site, an open-footing precast concrete frame culvert on cast-in-place concrete footings with steel H-piles driven to bedrock is proposed. The proposed culvert geometry is 6.4 m span by 3.2 m rise, based on the hydraulic requirements. The site typically experiences high flow levels only during the spring flood, with much less flow over the rest of the year. It is proposed to run the normal flow in a contained channel inside the culvert, with raised sides used for wildlife passage over most of the year (except during flooding).

For the pedestrian bridge, a 15 m span prefabricated steel truss bridge with timber deck is proposed, with steel H-pile foundations to bedrock. Precast concrete block retaining walls are proposed to retain the embankments at both ends of the bridge.

8.1.4 Anderson Road Intersection

The existing roundabout at Anderson Road is proposed to be replaced with a protected signalized intersection with the new BCBE roadway. The traffic analysis for the 2031 planning horizon to expand the existing Anderson Road roundabout to two lanes identified long delays and poor levels of service in both peak hours due to heavy peak direction volumes. A traffic signal was found to operate much better than a roundabout at this intersection. Consequently, a protected signalized intersection is proposed with the multi-use pathway crossing on the south side of the intersection (**Figure 8-6**). Construction of the transitway will block Weir Road and result in loss of access to the community gardens. Opportunities will be explored for the potential relocation of the community gardens.

A 2.5 m high noise attenuation barrier is proposed along the south side of the road right-of-way between Maurice Street and Ida Street. Two NCC buildings will likely need to be removed along the north side of existing Renaud Road in this area to accommodate the transitway. Design modifications will be explored to avoid encroachment on, and possible removal of three NCC buildings along the south side of existing Renaud Road and Anderson Road in this area.

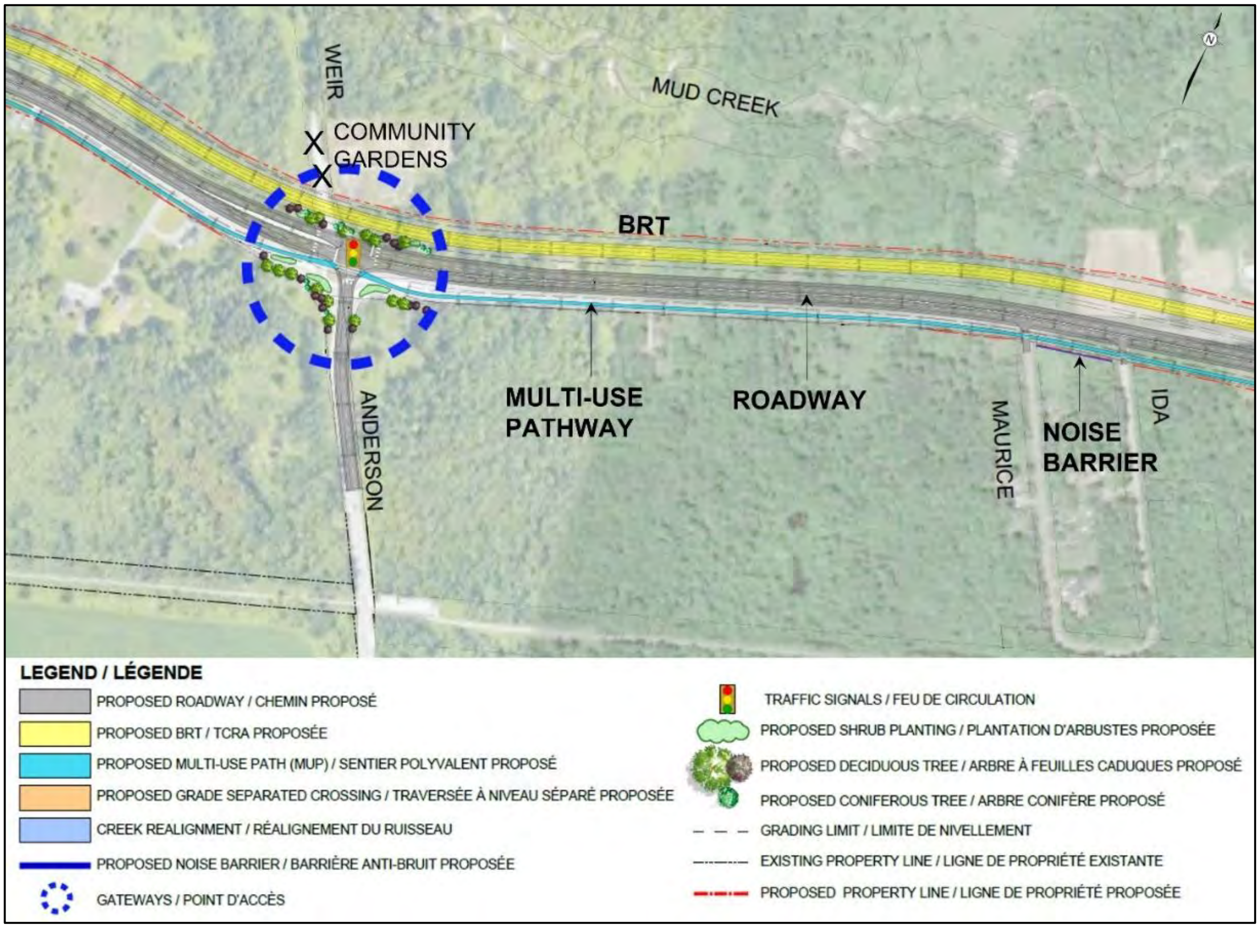

Figure 8-6: Anderson Road Intersection

8.1.5 Connections to Innes-Walkley-Hunt Club & Blair Road

West of the proposed new Anderson Road intersection with the BCBE, the existing Anderson Road will be closed to accommodate the transitway. The transitway will follow the existing Anderson Road alignment and pass under Innes Road via a tunnel and then continue west following the north edge of Innes Road to Blair Road (**Figure 8-7**). In this area the new BCBE roadway and multi-use pathway will extend west through existing Greenbelt farmland to connect to a protected signalized intersection with the future Innes-Walkley-Hunt Club arterial roadway link. Although not part of this project, the EA study for the future Innes-Walkley-Hunt Club link was previously completed in 2008.

A future multi-use pathway, shown in blue, is proposed to connect north to Innes Road and will extend along the south side of Innes Road to Blair Road. Some widening of Innes Road is required to accommodate the proposed transitway and multi-use pathway with minor impact to the existing bridge structure at Greens Creek.

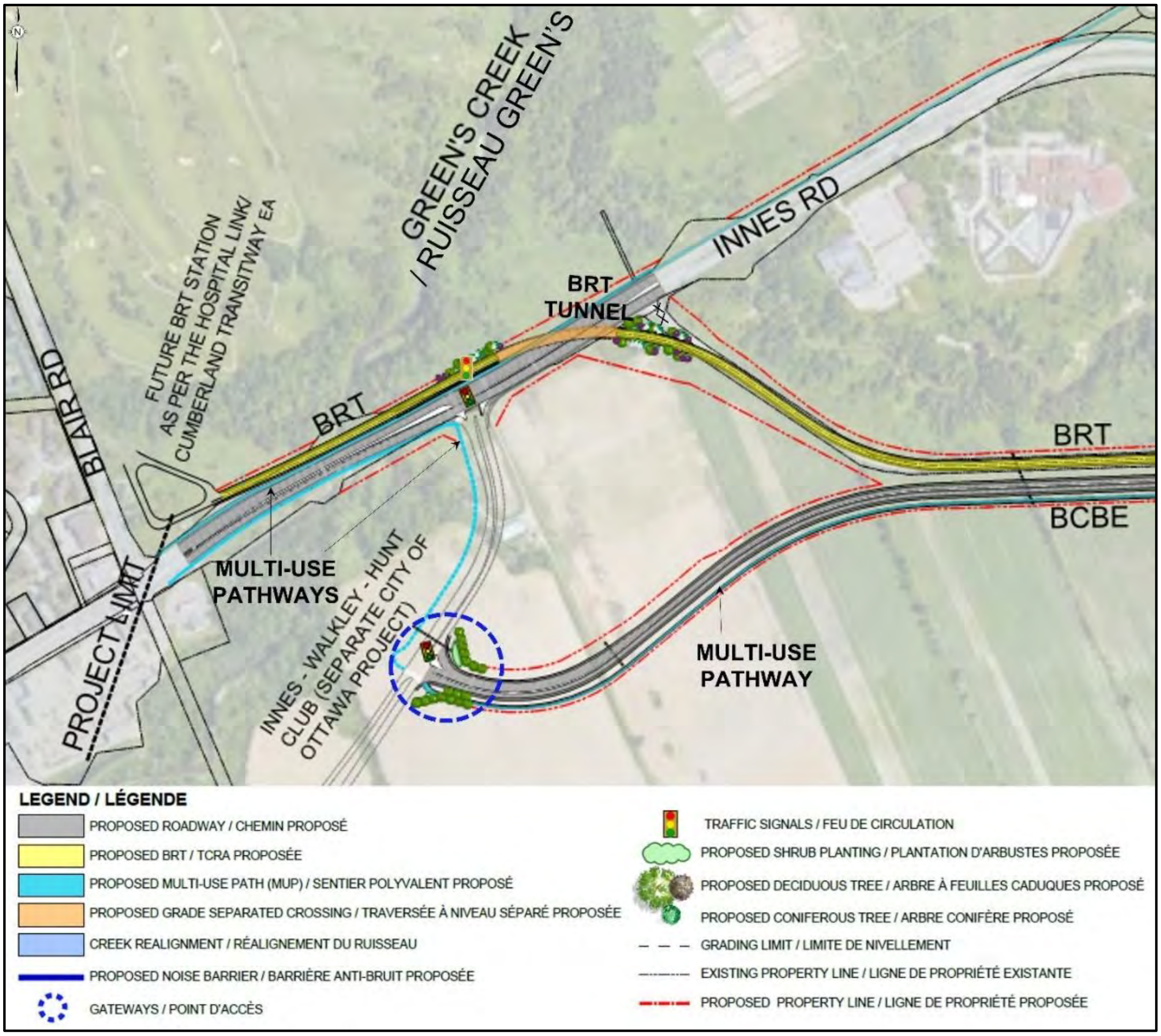

Figure 8-7: Connections to Innes-Walkley-Hunt Club & Blair Road

8.1.5.1 Innes road BRT Tunnel

A concrete rigid frame tunnel structure is considered feasible to connect BRT traffic on the north side of Innes Road to a new BRT route along the current Anderson Road alignment, on the south side of Innes. The new tunnel will have an approximate 14 m span, 5.5 m minimum vertical clearance, and will house a BRT lane and a 2.5 m MUP in each direction. The fill cover depth over the structure will be approximately 0.3 to 1.4 m. The length of the tunnel would be approximately 175 m. Steel H-pile foundations driven to bedrock are proposed. The size of the structure precludes the use of precast concrete, as it would need to be cast-in-place.

8.1.6 Landscape Strategy

A Landscape Strategy is included as part of the recommended design. The strategy includes recommended design principles, concepts for pathway character and pathway corridor guidelines. Three key zones have been identified based on existing landscape features, including an Ecological Zone, Agricultural Zone, and Residential Zone (**Figure 8-8**).

8.1.6.1 Design Principles

Design principles identified for the Landscape Strategy include achieving a net ecological gain and developing a landscape character rooted in the existing land uses. It is recommended that the design incorporate landscaping elements to enhance existing views and vistas, screen undesirable views, and locate the pathway structure to mitigate impacts on sensitive environments. Additional elements include protecting and enhancing existing woodlands, wetlands, and wildlife corridors. Creating an identifiable character, providing rest areas along pathways, and adopting principles of Crime Prevention through Environmental Design (CPTED) are aimed to enhance the user experience.

8.1.6.2 Pathway Characters

Gateway features are recommended at four locations within the study area where Brian Coburn Boulevard intersects Navan Road, Renaud Road, Anderson Road and the future IWHC Connection. The recommended gateway features include adding landscape elements including the use of unique plant groupings to further define the character of the area (ecological/agricultural/ residential). Gateways should be designed to ensure clear views to avoid user conflicts and ensure user safety. Consideration should be given to the addition of wayfinding to notify users of upcoming and surrounding areas.

Wayfinding/pathway intersections should ensure clear view both from and toward intersections for user safety. Adding recognizable features/prominent landscape elements (e.g., group of trees) should be used as place markers.

Rest areas should be provided along the pathway, with no more than 500 m between rest areas and design elements should ensure accessibility requirements are met.

8.1.6.3 Ecological Zone

Design guidelines have been developed with consideration for existing wetland and woodland features. Guidelines for wetlands include reinforcing wetland landscapes with high coverage of wetland shrub groups and accent tree plantings, while woodland landscapes should be reinforced with high coverage of tree canopy with native woodland species. Salt tolerant seed mix is recommended on road edges and ditches to minimize pollutants from roadway run-off. The wetland and woodland buffers will reinforce the ecological character of the area, provide visual interest, and prevent glaring between the BRT and the roadway.

8.1.6.4 Agricultural Zone

The agricultural zone incorporates windrow and hedgerow design guidelines. Hedgerows should be perpendicular to the road/pathway to reinforce agricultural character and parallel to the road/pathway to screen views. It is important to ensure views are maintained for CPTED. Windbreaks should be used to reinforce the agricultural character when perpendicular to the roadway. Windbreaks should have tight spacing to hide views and wide spacing to enhance views when running parallel to the roadway. Windbreaks may be used as a possible snow barrier and should use drought tolerant seed mix on the edge of roads and ditches to minimize pollutant runoff.

8.1.6.5 Residential Zone

The residential landscape elements should reinstate and reinforce nature views from residential areas. A layered landscape may be used to act as a noise barrier. Landscape features should provide shade and visual interest and screen views from the roadway. Rest areas along the MUP near shaded and scenic views should be considered, and tree plantings should be used along the MUP for shade.

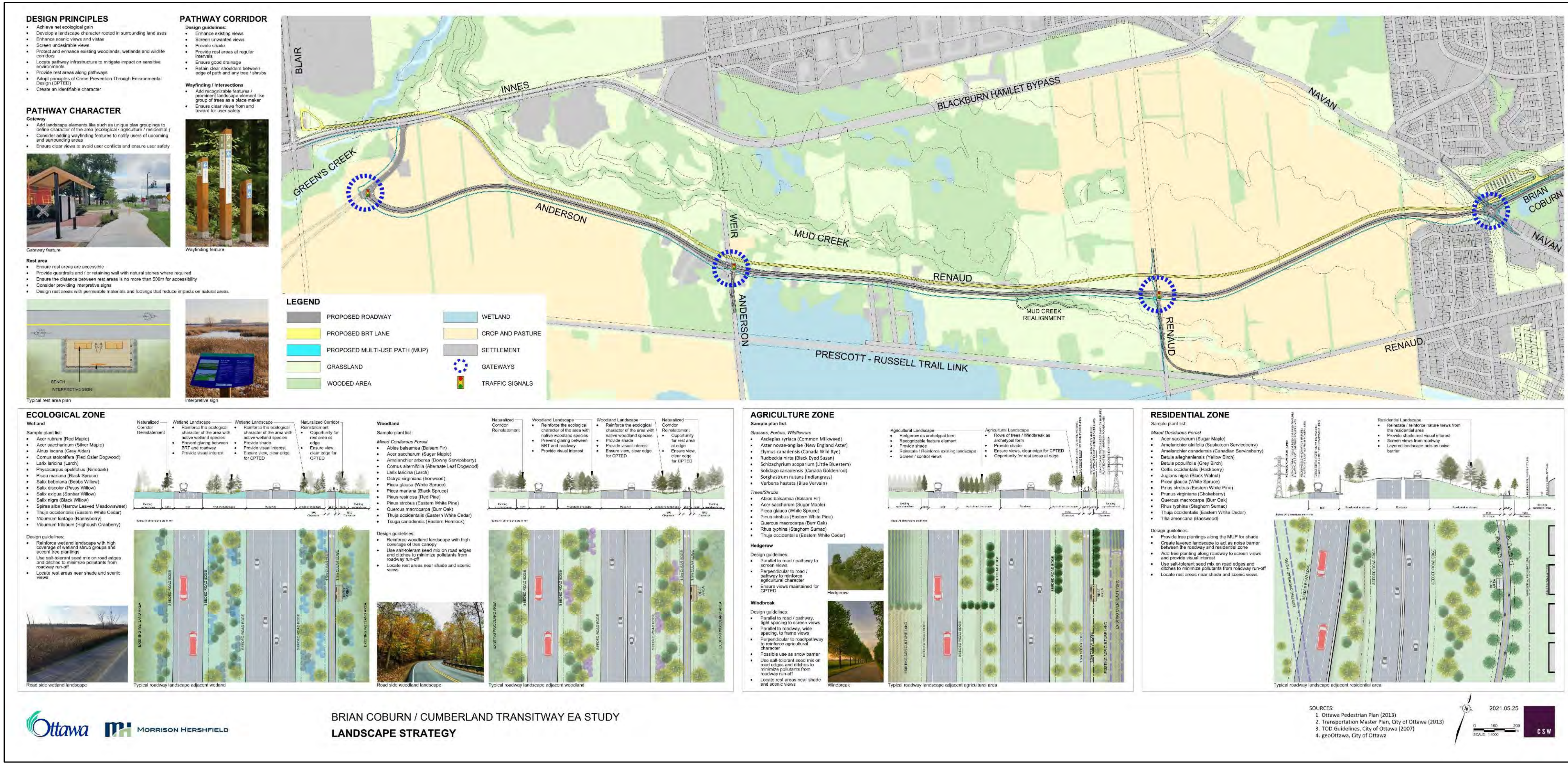

Figure 8-8: Recommended Landscape Strategy

8.2 Peak Hour Traffic Analysis

A review of intersection operations along the corridor for the Existing Conditions and Ultimate Recommended Plan Conditions was completed for the morning and afternoon peak hours. Synchro Version 10 software was used to model intersection performance, using signal timing plans from the City of Ottawa.

This analysis reviewed the arrangements at intersections for the functional design of the Ultimate Conditions. **APPENDIX C.2** provides a summary of the intersection operations in existing and future conditions, along with recommendations for auxiliary lane lengths (i.e., right or left turn lanes).

9. ASSESSMENT & EVALUATION OF IMPACTS

9.1 Scope of the Assessment

The impact assessment includes a determination of the effects of the project on the environmental components identified in the existing conditions. To scope the environmental effects, both the temporal and spatial impact has been assessed.

- Temporal bounds of this assessment include pre-construction, construction, and operation of the project. Construction of the Recommended Plan is not anticipated until beyond the 2031 timeframe, with implementation dependent on affordability.

- Spatially, this assessment includes those lands within and adjacent to the project limits needed for the construction and operation of the project, including all related works, temporary easements, permanent easements, and any new infrastructure. Spatial boundaries for the project reflect the geographic range and temporal extent over which the project's environmental effects may occur. Boundaries for the Valued Ecosystem Components (VECs) and Valued Social Components (VSCs) were determined on an individual basis and are specific to the anticipated spatial and temporal extent of potential impacts, with some VECs having a narrower spatial footprint than others.

9.2 Assessment & Evaluation Approach

The values and conditions identified in the documentation of existing conditions were used as the basis for assessing the effects of the recommended plan on the natural, physical, social, cultural, built, and economic environments. The impact analysis involved applying the following steps (**Table 9-1**).

Table 9-1: Impact Assessment Approach

Step 1 Interactions	Identify and analyze instances where the project, as described in **Section 8: Recommended Plan**, may interact with existing environmental conditions, as described in **Section 5: Existing Environmental Conditions**, and identification of Potential Environmental Effects.
Step 2 Mitigation	Document built-in mitigation measures (**Section 9.3: Built-In Mitigation Measures** that consist of primarily standard construction practices. Identify opportunities for further mitigation of residual effects, if possible/practical.
Step 3 Residual Effects	Identify the residual environmental effects, if any (**Section 9.4: Assessment & Evaluation of Effects**).
Step 4	Determine the significance of the residual environmental effects (**Section 9.4: Assessment & Evaluation of Effects**).

Professional judgment and experience formed the basis for identifying environmental effects and mitigation measures. The analysis was based on comparing changes to the existing environment during all phases of the project including pre-construction,

construction, and operation. The scope of the factors to be considered in the assessment includes the environmental criteria and indicators described in **Section 6**.

9.2.1 Determination of Significance

The assessment and evaluation of effects was based primarily on comparing the existing environment with the anticipated future environment, during and after construction. The prediction of effects considered:

- The interaction between the project and the environmental values.
- The effects of the project activities on the environmental values.
- The combined effects of multiple activities and/or multiple effects.

Within this context, consideration was given to:

- The magnitude, spatial extent, and duration of effects.
- The proportion of a species population or the number of people affected.
- Direct or indirect effects.
- The degree to which the effect responds to mitigation.
- The level of uncertainty about the possible effect.

In this assessment, “residual” environmental effects are defined as changes to the environment caused by the project, and vice versa, when compared to existing conditions and considering all built-in-mitigation measures, best management practices and site-specific mitigation measures. Potential residual environmental effects are assessed as to their significance, including spatial and temporal considerations.

Significant: An effect that may exhibit one or more of the following characteristics: widespread; permanent transcendence or contravention of legislation, standards or environmental guidelines or objectives; permanent reduction of species diversity of population of species; permanent loss of critical/productive habitat; permanent alteration to community characteristics or services, land use or established patterns; which is severe and undesirable to the community as a whole; permanent alteration to groundwater flow direction or available groundwater quality and quantity; and/ or permanent loss of archaeological/heritage resources.

Not Significant: An effect that may exhibit one or more of the following characteristics: not widespread; temporary or short-term duration (i.e., only during construction); recurring effect lasting for short periods of time during or after project implementation; not permanent, so that once the stimulus is removed, the integrity of the social/environmental components is resumed.

Negligible/Moderate Residual Effect: Effects that are reversible; small/ localized/limited to the construction phase of the project; a nearly zero or hardly discernable effect; impacting a population at a localized area.

Positive Residual Effects: Refer to those that exhibit a beneficial outcome.
The above definitions of significance were adopted for use in this assessment because many of the impacts cannot be quantified in absolute terms, although changes and trends can be predicted. The definitions provide guidance and are intended to minimize personal bias.

9.3 Built-In Mitigation Measures

Mitigation measures refers to those means employed to eliminate, reduce, control, or offset the adverse effects of a project, including restitution for any damage caused by those effects through replacement, restoration, compensation, or any other means. In this assessment, “built-in mitigation” is defined as the actions and design features that have been incorporated in the pre-construction, construction, and operational phases, with the specific objective of lessening the significance or severity of environmental effects that may be caused by the project. In addition to design features, built-in-mitigation measures for this project include standard construction practices and Best Management Practices (BMPs) as presented below.

9.3.1 Natural Environment

9.3.1.1 Environmental Protection Plan

It will be the responsibility of the Contractor to ensure that no contamination, waste, or other substances, which may be detrimental to aquatic life or water quality, will enter a watercourse as either a direct or indirect result of construction. In this regard, any floating debris resulting from construction which accumulates on watercourse beds and watercourse banks is to be immediately cleaned up and disposed of. Any spills or contamination, waste or other substances which may be detrimental to aquatic life or water quality will also be immediately cleaned up.

Any construction works which will cause or be the cause of discharge to the watercourse are to be prohibited unless appropriate approvals are granted by governing authorities. At all times, construction activities are to be controlled in a manner that will prevent entry of deleterious materials to watercourses. Measures included in the plan may include, but will not be limited to:

- The construction access, work areas and associated requirements for removal of riparian vegetation, will be minimized to the extent required for the construction activities. These areas will then be delineated in the field using properly installed protective silt fencing.

- Any temporarily stockpiled soil, debris or other excess materials, and any construction-related materials, will be properly contained (e.g., within silt fencing) in areas separated at least 30 m from the watercourses.

- All construction materials, excess materials and debris will be removed and appropriately disposed of following construction.

- All clearing of riparian vegetation required for construction purposes will be conducted in accordance with relevant municipal specifications and best management practices.

- Re-vegetation and re-planting along disturbed areas adjacent to watercourses will occur as soon as possible following disturbance. Restoration planting plans for the realigned channel sections will incorporate a diverse mix of native woody and herbaceous vegetation, consistent with the site locations, conditions, and functions along a watercourse (e.g., bank stabilization, cover).

- No equipment should ford/cross into or otherwise enter any watercourse except as specified in the contract or unless authorized by the appropriate environmental agency/ permit.

- Machinery arriving on site must be in a clean condition and maintained free of fluid leaks, invasive plants, and noxious weeds.

9.3.1.2 Spills Prevention & Response Plan

A Spills Prevention and Response Plan should be developed and implemented during construction. The plan will highlight spills response and reporting procedures for the construction period with procedures to be initiated immediately in the event of a sediment release or spill of a deleterious substance.

Considerations for this plan may include, but will not be limited to:

- All construction-related activities will be controlled to prevent entry of any petroleum products, debris, or other potential contaminants/deleterious substances, in addition to sediment as outlined above, to the watercourses.

- No storage, maintenance or re-fueling of equipment will occur near (within 30 m) the watercourses (or associated wetlands and ditchlines); these activities will be undertaken in properly situated and fully contained areas removed from the given watercourses.

- A Spills Prevention and Response Plan should be developed by the Contractor and kept on site at all times. All materials necessary for containment, including a supply of silt control fabric, will be readily available on the site.

- The Ontario Spills Action Centre (1-800-268-6060) will be notified immediately of any "spills", including (but not limited to) sediment and/or fuel/lubricant. Additional agencies may require notification should the Response Plan or specific permits/approvals state spill notification is a requirement. Spills or discharges of pollutants or contaminants will be reported immediately to the landowner and any affected regulatory authorities (i.e., RVCA, NDMNRF, MECP, NCC, DFO etc.).

- Clean up of any spills should be initiated quickly to ensure the protection of the environment to the extent possible. An adequate supply of clean-up materials is to be kept on-site with a work crew that is fully trained to prevent and respond to accidental spills.

- Proper spill control equipment/items (spill kits, Safety Data Sheets, absorbents, containers, caution signs/tape, etc.) will be readily available in areas where large quantities of hazardous materials may be stored. An emergency spill kit will be kept on site in case of fluid leaks or spills from machinery.

9.3.1.3 Erosion & Sediment Control Plan

The purpose of the Erosion and Sediment Control Plan is to determine the degree of erosion and sedimentation that may occur under normally anticipated weather conditions during the life of the project, and to develop and implement mitigation strategies to control any unforeseen areas determined to have a pre-disposition to the problem. Measures may include, but not be limited to the following:

- Perimeter silt fence will be installed between the work areas, and all reaches of those watercourses where works are required, including ditch and drainage works that drain to them. The fencing will be properly installed and regularly inspected and maintained. It will be left in place and maintained until all surfaces contributing drainage to these watercourses/drainage features are fully stabilized.

- All exposed and newly constructed surfaces will be stabilized using appropriate means in accordance with the characteristics of the soil material and slope conditions.

- Exposed surfaces will be fully stabilized and re-vegetated as quickly as possible following completion of the works.

- An Environmental Inspector experienced in working around watercourses will be responsible for ensuring the erosion and sediment control measures are functioning effectively and being maintained, and all other general mitigation measures are being implemented as intended. The Environmental Inspector will ensure all environmental mitigation and design measures are properly installed/constructed and maintained, and appropriate contingency and response plans are in place and implemented if required.

The following erosion and sediment control measures should be implemented to protect sensitive natural features within the project area:

- NSSP OC_EN_02: Erosion and Sedimentation Control

- OPSS 804: Construction Specification for Seed Cover

- OPSS 805: Construction Specification for Temporary Erosion and Sediment Control Measures

During construction, the Contractor should inspect and record the status and effectiveness of the erosion and sediment control measures regularly. The Contractor will make all necessary repairs if any damage occurs. The Contractor will ensure that effective erosion and sediment control measures are maintained until revegetation of disturbed areas is achieved.

Erosion and sediment control measures are to remain in place until the site of the project is re-stabilized following construction. This plan includes the identification of planting and slope rounding specifications within the contract tender; identifying and specifying seeding and sodding locations; identifying areas requiring slope benching or retaining structures in the detailed design process;

and construction and post-construction monitoring and mitigation practices.

9.3.1.4 Dewatering Management Plan

A Dewatering Management Plan will identify methods of management and environmental protection measures and procedures relevant for the management and/or discharge of water/waste waters which are directly derived from construction activities, such as concrete curing water, drill waste cutting material and clean-up water. A Dewatering Management Plan must be in place for excavations. Contaminated water must be contained and treated prior to disposal. No contaminated groundwater should be discharged to the environment.

During construction, there may be a requirement for dewatering activities, such as around the Innes Road BRT underpass. A Dewatering Management Plan should include, but not be limited to, the following:

- How groundwater control for the Project will be performed in compliance with Environmental Laws, Regulations, and best practices.
- Procedures for conducting all monitoring as required in the Project permits, licenses, authorizations, and approvals.
- Additional impact assessments and acquisition of appropriate approvals prior to discharging groundwater into adjacent natural environments from an area of known or suspected groundwater contamination.
- Procedures for addressing any complaints received related to groundwater control activities.
- No groundwater from an area of known or suspected groundwater contamination should be discharged to the environment without the completion of an impact assessment and the appropriate approvals.
- Reporting procedures to document how all groundwater management activities and best practices have been implemented.

If improperly abandoned wells are encountered, these would be decommissioned in accordance with the regulations. The presence/conditions of wells within the anticipated radius of influence of dewatering will need to be assessed in more detail as part of detailed design or for preparation of supporting documents for a Permit to Take Water (PTTW) application/Environmental Activity and Sector Registry (EASR) registration as applicable.

Parts of the study area are supplied with municipal water and private water supply wells are used elsewhere for drinking and agricultural purposes. If encountered, groundwater supply well integrity may be at risk due to construction activities. Monitoring and Contingency Plans should be developed to provide temporary alternate water supply should the need arise.

9.3.1.5 Stormwater Management Plan

Stormwater management will consist of quality and quantity control of runoff from the BRT and road network consistent with the MECP guidelines, and City of Ottawa Sewer Design Guidelines (2012) and should provide an enhanced level of sediment removal.

Given the sensitive nature of both Mud Creek and Greens Creek, water quantity control (post to pre) and erosion threshold protocol should be followed as general stormwater criteria through detail design. As per enhanced water quality target of MOECC, 80 % Total Suspended Solids (TSS) removal will be required for water quality treatment. During preliminary and detailed design, erosion threshold exceedance analysis will be required.

Stormwater management plans should consider, among other matters, the maintenance, restoration, and protection of downstream aquatic ecosystems as necessary based on site specific requirements identified through aquatic habitat impact assessments, including conformance to any existing rehabilitation plans, maintenance of temperature regimes, and as per federal or provincial agency permit/approval requirements. These considerations may include, but will not be limited to:

- Measures for managing water flowing onto the site during rain events and periods of high flow, as well as water being pumped/diverted from the site such that sediment is filtered out prior to the water entering a waterbody. For example, pumping/diversion of water to a vegetated area (natural area of attenuation) or construction of a settling basin or other filtration system which should be completed at a minimum setback of 30 m from the receiving watercourse (where possible).

- Following the management of stormwater, ensure water is clean and free of fine particulate matter before being discharged to a watercourse. Ensure discharge is done in a manner that does not cause erosion or other damage to adjacent lands/channel banks.

Any works or fill within the RVCA Regulation Limit will need to address a cut fill balance in accordance with the requirements and approvals from the Conservation Authority.

9.3.1.6 Excavated & Imported Materials Management Plan

This plan describes the management of all excavated and imported materials generated as part of construction activities, i.e., soil, rock, solid waste, liquid waste, hazardous waste, and contamination. Management of excavated and imported materials includes, but is not limited to, excavation, handling, transportation, testing, on-site re-use, off-site re-use, disposal, and/or ultimate disposition. The Excavated and Imported Materials Management Plan should be written by a Qualified Person within the meaning of section 5 of Ontario Regulation 153/04. The Excavated and Imported Materials Management Plan should be written with due consideration for Ontario Regulation 406/19 – On-site and Excess Soil Management.

9.3.1.7 Management of Contaminated Materials

The MECP, the NCC (if on NCC lands) and the City's Construction Manager are to be notified immediately upon discovery of any contaminated material encountered within the construction area. If contaminated materials or contaminated groundwater are encountered within the construction limits, these are to be removed and disposed of in accordance with all applicable acts and regulations. Contaminated materials if encountered should not be placed within areas where they may enter surface water features. Treatment and discharge of contaminated groundwater is to be in accordance with applicable legislation and regulations (e.g., Provincial Water Quality Objectives (MOECC, 1994) or the Canadian Council of Ministers of the Environment's Canadian Environmental Quality Guidelines) to ensure that it can be discharged without causing an environmental impact/impairment/adverse effect.

Contaminated soil may be encountered and possibly contaminated groundwater. Groundwater supply wells that may be at risk due to construction activities should be monitored and Contingency Plans developed to provide temporary alternate water supply should the need arise.

9.3.1.8 Geotechnical Considerations

Geotechnical investigations will be required to confirm groundwater and subsurface conditions and potential impacts that will need to be considered in the detailed design phase of the project. Foundation investigation will be required for structural design of below- and above-grade structures, culvert extensions etc.

Geomorphological investigations will be required to determine details on the nature of erosion protection for Mud Creek at the time of design and construction. Erosion control measures are considered feasible along Mud Creek, and the details of specific measures can be further developed during detailed design that are reflective of the dynamic conditions closer to the time of design/construction.

9.3.1.9 Landscape Plan

A Landscape Plan to compensate for vegetation and tree removal will be prepared during the detailed design and implemented during the construction phase. The *Landscape Plan* will clearly identify existing plant material to be retained, removed or relocated on site and will propose vegetation to be planted on site. The plan will identify species including its common and botanical names, size, total quantity, and its condition or special requirements. The Landscape Plan should consider the recommended Landscape Strategy (**Section 8.1.5.1**) and findings of the Cultural Heritage Assessment Report in any work pertaining to cultural heritage resources.

9.3.1.10 Ecological Restoration & Enhancement Plan

An Ecological Restoration and Enhancement Plan should aim to offset losses, address the management of invasive species, enhance quality of existing habitat, and potential installation of habitat features that may currently be lacking due to historic impacts. The plan may include the installation of key habitat features, identification and installation of wildlife crossings and road exclusion fencing. It is recommended that wildlife friendly lighting be implemented. Details will include the type and position of lighting to reduce light pollution while still providing road and pathway safety.

It is recommended that all mitigations be reviewed with regulatory stakeholders during detailed design. The detailed design should be scrutinized with an eye to minimize project disturbance to ecologically sensitive areas, particularly in naturalized areas to avoid removal of vegetation unless absolutely necessary.

The following mitigations should be considered and reviewed with regulatory stakeholders during detailed design:

- Consider installation of interpretive information for the public, which provides awareness about habitat protection measures and things the public can do to reduce their impacts.

- Inclusion of research programs which answer key questions related to species recovery or the effectiveness of various mitigation features.

- Develop a monitoring program with the NCC to use groundwater monitoring wells within the Mer Bleu Wetland to improve the understanding of its hydrology, and potential impacts from the project.

9.3.1.11 Protection of Wetland Features

During the next phase of design, confirmatory field investigations must be completed to delineate the boundaries of wetlands within the project limits. The following mitigation measures are recommended to minimize the impacts to the wetland communities within the study area include:

- Ensure that machinery arrives on site in a clean condition and is maintained free of fluid leaks, invasive species, and noxious weeds for the duration of construction according to **OPSS 182: General Specification for Environmental Protection for Construction in Waterbodies and on Waterbody Banks.**

- Wash, refuel and service machinery and store fuel and other materials for the machinery a minimum of 30 m from any surface water features to prevent any deleterious substances from entering the water according to **NSSP 001A850: Equipment Refueling, Maintenance and Washing.**

- Restore disturbed areas (i.e., channel, bank, and riparian) immediately following completion of work to pre-existing or better condition and seed to establish vegetative cover as per **OPSS 182: General Specification for Environmental Protection for Construction in Waterbodies and on Waterbody Banks** and any proposed **Landscape Design**

- Implementation of a naturalization strategy that includes the planting of mixed native shrubs, shrub seedlings, wetland plugs and seeding.

9.3.1.12 Protection of Terrestrial Natural Features

Due diligence to protect the terrestrial natural features within the study area should include implementation of industry standard best management practices and mitigation measures to reduce or eliminate potential negative effects because of project construction.

Clearing of vegetation should be kept to a minimum, and existing trails, roads, or cut lines should be used to avoid disturbance to vegetation and prevent soil compaction. Recommended mitigation measures to protect terrestrial habitat and vegetation include:

- Surplus material resulting from vegetation removal operations shall be managed in accordance with OPSS 180: General Specification for the Management of Excess Materials and Ottawa Specification 201 - Clearing and Grubbing.

- Tree not planned for removal must be protected according to Ottawa Specification Section 32 01 90.33 - Tree Preservation.

- In the event of accidental damage to trees, or unexpected vegetation removal, vegetation shall be replaced/restored with native species according to **Non-Standard Special Provision (NSSP) 1396: Construction Specification for Planting, Ottawa Specification Section 32 93 10 – Trees, Shrubs and Ground Cover Planting and/or Section 32 90 11 – Bare Root & Naturalization Planting** and **F-8047 Hedgerows, Nursery Stock and Reforestation.**

- Disturbed vegetation/soils within the impacted areas shall be re-established as soon as weather/conditions permit to provide stabilization to exposed soils and minimize sedimentation into the watercourses within the study area according to **OPSS 206: Construction Specification for Grading**; and **OPSS 802: Construction Specification for Topsoil** and **Ottawa Specification F-8041 Section 32 91 19 13 – Topsoil Placement and Grading.**

- Following completion of grading and topsoil application, disturbed areas will be re-seeded with a standard roadside seed mixture as specified in **OPSS 804: Construction Specification for Seed and Cover** and **Ottawa Specification F-8041 Seeding and Mulching.**

- During ditching or culvert replacement works, any tree roots greater than 25 mm in diameter shall be cut off cleanly according to the following **F-05 – Tree Removal and Pruning**, **Standard Special Provision (SSP) 032S09: Special Provision for Tree Trimming** and **Ottawa Specification F-8047 Section 32 93 43.01 – Tree Pruning.**

- Develop a Tree Protection Plan which identifies locations to be preserved as specified in F-8011- Tree Protection, City of Ottawa's Tree Protection Fencing detail, OPSS 565: Construction Specification for the Protection of Trees and OPSD 220.01: Barrier for Tree Protection.

    - Ensure that trees larger than 10 cm DBH that are to be protected are included in this Plan.

- To allow for rapid regeneration within disturbed areas, the following steps will be taken:

    - Close cut mature trees in very poor or dead condition within 10 m of the road to avoid possible windfalls toward the road or construction area.

    - Retain all suitable fully branched deciduous trees within 3 m of the newly constructed ditchline, where possible.

- Close cut young, spindly deciduous trees to allow regeneration.

- Retain original ground on remaining areas to allow for the existing tree and shrub seedling stock to establish in response to post-construction conditions. Develop a *Tree Protection Plan* identifying trees for protection, removal and retention and references the City's Tree Protection Fencing detail *(F-8011), OPSS.MUNI 801: Construction Specification for the Protection of Trees and OPSD 220.01: Barrier for Tree Protection.*

- During ditching or culvert replacement works, any tree roots greater than 25 mm in diameter should be cut off cleanly according to the following *F-05 – Tree Removal and Pruning, Standard Special Provision (SSP) 032S09: Special Provision for Tree Trimming and Ottawa Specification F-8047 Section 32 93 43.01 – Tree Pruning*.

- Surplus material resulting from vegetation removal operations should be managed in accordance with *OPSS.MUNI 180: General Specification for the Management of Excess Materials and Ottawa Specification 201 - Clearing and Grubbing*.

- In the event of accidental damage to trees, or unexpected vegetation removal, vegetation should be replaced/ restored with native species according to *Non-Standard Special Provision (NSSP) 1396: Construction Specification for Planting, Ottawa Specification Section 32 93 10 –*

Trees, Shrubs and *Ground Cover Planting and/or Section 32 90 11 – Bare Root & Naturalization Planting* and *F-8047 Hedgerows, Nursery Stock and Reforestation.*

- Disturbed vegetation/soils within the impacted areas should be re-established as soon as weather/conditions permit to provide stabilization to exposed soils and minimize sedimentation into the watercourses within the study area according to *OPSS.MUNI 206: Construction Specification for Grading*; and *OPSS.MUNI 802: Construction Specification for Topsoil* and Ottawa Specification *F-8041 Section 32 91 19 13 – Topsoil Placement and Grading*.

- Following completion of grading and topsoil application, disturbed areas will be re-seeded with a standard roadside seed mixture as specified in *OPSS.MUNI 804: Construction Specification for Seed and Cover and Ottawa Specification F-8041 Seeding and Mulching*.

9.3.1.13 Protection of Wildlife

Harassment and/or harm to wildlife during construction is prohibited, as prescribed by **NSSP 001A860: Prevention of Wildlife Harassment** and as described in the **City of Ottawa *Protocol for Wildlife Protection during Construction* (2015c)** and **D-032A/B Appendix A – Wildlife Protocol for Road Construction/Rehabilitation Projects.** The City of Ottawa protocol is a compilation of best practices that serves as a guide and a common frame of reference for addressing wildlife protection during construction (City of Ottawa, 2015c). This protocol is intended to help reduce the direct impacts of development on wildlife that occur during construction and promotes best management practices relating to sensitive timing windows for clearing, pre-stressing, site clearing, construction site management, wildlife encounters, wildlife-proofing, and owner awareness.

9.3.1.14 Protection of Migratory/SAR Birds

To avoid contraventions under the *Migratory Bird Convention Act* (1994), Environment Canada recommend vegetation removals occur outside of the breeding bird season (April 15th – August 31st). If tree removal activities are necessary within the breeding bird season, a qualified avian biologist should conduct a nest survey prior to tree clearing to confirm the presence or absence of bird nests.

The MBCA provides legal protection of migratory birds and their nests in Canada. There is also a high probability for several SAR birds (including Bobolink, Eastern Meadowlark and Evening Grosbeak) to be present within the project area. The following mitigation measures are recommended to minimize the impacts to migratory/SAR birds within the study area:

- All vegetation and tree removal operations and/or clearing should be completed between September 01 and April 14 of any year, outside of the breeding bird active season (ECCC 2018) and nests or eggs of protected migratory birds should not be disturbed or destroyed as per *NSSP 001A870: Migratory Bird Protection – General*

- If vegetation removal is required during the breeding bird season for this region (April 15 – August 31 within a 'simple habitat' (habitat that contain few likely nesting spots or a small community of migratory birds), a nest search may be completed during the nesting period by a qualified biologist prior to construction. The biologist needs to confirm that the proposed works would not affect the nest or young of a protected species or wait for the young to fledge.

- If breeding birds and/or nests are encountered within the construction area, the Contractor will consult an Avian Specialist, and works will not continue in the location of the nest until after September 01 (or until the nest is no longer active). Species specific buffers (or setback distances) may be established by the Avian Specialist using guidance provided by Environment and Climate Change Canada (2019; refer to the following website for more information: https://www.canada.ca/en/environment-climate-change/services/avoiding-harm-migratory-birds/reduce-risk-migratory-birds.html#toc5).

9.3.1.15 Protection of Significant Wildlife Habitat

Mitigation measures can be applied to mitigate effects to species' habitat from site operations and alterations include the following:

- Harassment and/or harm to wildlife during construction is prohibited, as prescribed by **NSSP 001A860: Prevention of Wildlife Harassment and** The City of Ottawa's *Protocol for Wildlife Protection during Construction* (2015c) and D-032A/B Appendix A – Wildlife Protocol for Road Construction/Rehabilitation Projects**.**

- Exposed soils should be revegetated as soon as possible using a seed mix composed of native species which are appropriate for the site conditions, in accordance with **OPSS 804: Construction Specification for Seed and**

Cover and Ottawa Specification F-8041 Section 32 92 19 13 – Mechanical Seeding.

- All vegetation and tree removal operations and/or clearing should be completed as per the details provided in the above section "Vegetation and Terrestrial Habitat Protection".

9.3.1.16 Protection of Species at Risk

To ensure compliance under Section 9 and/or Section 10 of the ESA, and to protect SAR and SAR habitat during development and operations of the proposed project activities, the general mitigation measures provided in the **City of Ottawa's Special Provision, D-032B – Appendix B** are recommended. Refer to **Attachment 6** for the full details of the City of Ottawa's Recommended Mitigations Measures (#1 - #22) from D-032B – Appendix B. The City of Ottawa's SAR Mitigations #1, #2, and #4 provide recommendations that can be applied to construction activities to reduce risks to SAR. These include:

- A worker awareness program should be provided to all on-site personnel that includes species at risk identification and habitat characteristics and provides general species-specific guidance with respect to appropriate actions to be taken whenever these species are encountered.

- A daily pre-construction search of the machinery and the work area should be implemented to identify presence of species at risk, as animals may be found hiding or basking around equipment, rocks, debris piles etc.

- If endangered or threatened species are observed in or near the study area, work should stop immediately, a photograph should be taken of the species (if possible) and the SAR should be allowed to move out of the work area on its own. The MECP and ECCC should be notified (as required).

In addition, the **D-032A/B Appendix A – Wildlife Protocol for Road Construction/Rehabilitation Projects** is recommended.

Following verification of presence, should any SAR habitat be determined to be impacted by the project works, appropriate mitigations must be implemented on a species-specific basis to avoid impacts. The SAR legislation (provincial and federal) are updated on a regular basis and should be consulted during the detailed design stage to identify any new species under the protection of the Act or any new Management Plans. Permits/ approvals from MECP/ECCC will be obtained as needed.

9.3.1.17 In & Near Water Works

Below is a list of standard mitigation measures recommended for inclusion within the appropriate “Site Specific” mitigation plans for in and near-water works. These measures must be refined and updated according to results of the detail design impact assessment.

Dewatering & Flow Management

- Adherence to in-water/channel bank timing window (works permitted) from July 1st to March 14th for Mud Creek and Greens Creek.

- Appropriate ‘temporary flow passage’ measures will be developed and implemented to isolate the work areas. These measures will be developed with specific consideration of flow conditions and timing and duration of works and designed to avoid erosion and sediment entrainment and mobilization.

- Only clean materials free of fine particulate matter will be placed in the water for temporary construction measures (e.g., coffer dams will be constructed of ‘pea gravel’ bags, geotextile fabric, sheet pile or other clean material).

- Any hoses employed in temporary flow passage (or any water withdrawal from fish-bearing watercourses) will be properly screened to prevent ingress of fish. The following measures should be followed to ensure fish protection during dewatering activities (as per DFO *Measures to Protect Fish and Fish Habitat*).

- During any temporary dewatering required for works, appropriate energy dissipation and settling/filtration measures will be used for discharge of dewatering water to ensure no erosion, scour, or sediment release occurs in the watercourses/drainage features. The Dewatering and Flow Management Plan will include properly sized, designed and sited temporary filtration facilities. Discharge points for release of dewatering discharge will be sited and designed to prevent erosion and ensure only clean flow is released to the receiving watercourses.

- If alterations to any of the flow management or related mitigation measures provided in the Contract are required, notify the respective agencies (NCC, RVCA, DFO and NDMNRF) of the proposed changes for approval.

Fish Salvage & Relocation

- Any fish stranded within the temporary work zone which has been isolated for the in-water works, or for sections of channel that will be abandoned, will be rescued using appropriate techniques by qualified Fisheries Biologist(s) and released ‘downstream of’/away from the temporary work zone.

- Relevant permits (e.g., NDMNRF Fish Collection License, Permits To Take Water, permits under Ontario Regulations 174/06 and 170/06,) will be obtained as required for dewatering activities.

- Additional “Site specific” mitigation measures recommended for areas where in-water work is anticipated include, but are not limited to, the following:

    - Where replacement of rock reinforcement/armouring (i.e., installation of rip-rap) is required to stabilize eroding or exposed areas, ensure that appropriately sized, clean rock is used, and that rock is installed at a similar slope to maintain a uniform bank/shoreline and natural stream/shoreline alignment; and

    - Restore bed and banks of the watercourse to their original contour and gradient; if the original gradient cannot be restored due to instability, a stable gradient that does not obstruct fish passage should be restored.

When impacts from project activities cannot be completely mitigated, residual effects such as permanent loss of instream habitat or riparian cover are likely to persist which warrants the need for approvals, permits or authorizations by regulatory authorities for the work to proceed. As the current design of the BCBE project is in the preliminary stages, the Future Commitments, Permitting and Approvals section below summarizes the requirements that may need to be addressed during the detailed design stage based on the following impact assessments.

Additional future commitments for the recommended design that must be considered by the proponent include, but are not limited to:

- Undertake detailed fish and fish habitat field investigations as required to update the existing conditions in areas where permission to enter NCC property was not granted, as well as where new interactions between the project and aquatic environments arise due to modifications of the project design.

- This may include a *Headwater Drainage Feature Assessment using the Evaluation, Classification and Management of Headwater Drainage Features Guidelines Protocol* (TRCA, 2014).

- Review of aquatic SAR background information (i.e. DFO/CA aquatic SAR mapping) and SAR listings (ESA and SARA) to ensure that any updated SAR occurrences or changes to relevant legislation are identified and addressed.

- Refine both “Built-in” and “Site Specific” mitigation measures and provide input to the protection plans listed within the impact assessment.

When impacts from project activities cannot be completely mitigated, residual effects such as permanent loss of instream habitat or riparian cover are likely to persist which warrants the need for approvals, permits or authorizations by regulatory authorities for the work to proceed. As the current design of the BCBE project is in the preliminary stages, the Future Commitments, Permitting and Approvals are summarized in **Section 10**.

9.3.2 Social Environment

9.3.2.1 Noise, Air Quality & Vibration

The City’s Construction Manager will be responsible for preparing and implementing a mitigation strategy with the intent of satisfying the requirements of Ontario Regulations 419 for dust emissions, MECP NPC-115 and City of Ottawa By-laws for noise, and MECP NPC-119 for ground vibrations (MOE, 1978a and 1978b).

Air Emissions BMPs

Suggested methods to control air emissions include, but are not limited to:

- Monitor wind conditions and plan operations to take advantage of calm wind periods.

- Minimize site storage of granular material in height and extent.

- Locate storage piles in sheltered areas that can be covered.

- Provide movable windbreaks.
- Use water spray and suppression techniques to control fugitive dust.
- Cover haul trucks and keep access routes to the construction site clean of debris.

Noise & Vibration BMPs:

For noise and vibrations, common control methods include but are not limited to:

- Limit speeds of heavy vehicles within and approaching the site.
- Provide compacted smooth surfaces, avoiding abrupt steps and ditches.
- Keep equipment properly maintained and functioning as intended by the manufacturer.
- If required, implement a blast design program prepared by a blast design engineer.

9.3.2.2 Health & Safety Plan

The preparation of an Occupational Health and Safety Plan by the contractor before any work begins will be required, to ensure that proper protocols and recommendations are in place to protect workers against personal injury or loss of life. The plan should be completed in accordance with federal and provincial regulations.

9.3.2.3 Lighting Plan

A *Lighting Plan* should be completed in accordance with municipal standards, and in consultation with the NCC. The Plan will be prepared during the detailed design process. This plan will include lighting fixtures and illumination along the various sections of the corridor. A lighting audit of the preferred lighting design plan may be conducted to ensure clear sight lines and appropriate illumination.

9.3.2.4 Communications Plan

The purpose of the *Communications Plan* is to keep the public informed about the work in progress and the construction activities. Residents and other stakeholders must be kept aware of scheduled road disruptions, interruptions to other services and other construction related details in advance so that their activities can be planned with reduced disruption. The plan should detail how to communicate the information to the public, what information should be disseminated, and in which project stages the communications should take place.

9.3.2.5 Construction Waste Management Plan

During construction there will be some excess materials that will require removal away from the project site. These may include but are not limited to concrete rubble, asphalt, waste steel/metal structural components, earth, and road right-of-way appurtenances such as signs, lighting, and utility poles. During the detailed design a *Construction Waste Management Plan* will be developed to ensure that surplus material is recycled wherever practical and to describe the methods to be used by the contractor for disposal of all other surplus material in accordance with provincial or local municipal practices and guidelines.

9.3.3 Cultural Environment

9.3.3.1 Archaeological Resources

If undocumented archaeological resources are impacted by project work, all activities impacting these resources must cease immediately, MHSTI and the NCC must be notified, and a licensed archaeologist is required to carry out an archaeological assessment in accordance with the *Ontario Heritage Act* and the Standards and Guidelines for Consultant Archaeologists.

If human remains are encountered, all activities must cease immediately and the local police as well as the Cemeteries Regulation Unit of the Ministry of Government and Consumer Services must be contacted. In situations where human remains are associated with archaeological resources, MHSTI and the NCC should also be notified to ensure that the site is not subject to unlicensed alterations which would be a contravention of the *Ontario Heritage Act*. If a discovery occurs on federal lands, the appropriate federal agency should also be notified.

9.3.4 Transportation

9.3.4.1 Traffic Management, Access & Pedestrian Control Plan

A Traffic Management, Access and Pedestrian Control Plan will be developed to manage transportation functions for all travel modes, including equipment and material deliverables at various times during the construction period.

The intent of this plan is to ensure continued travel within the study area, throughout construction. This plan is to be developed during the detailed design/pre-construction phase and implemented in the construction phase. Any pedestrian/cycling detours, traffic detours, turning movement restrictions, and/or lane reductions associated with the project will be identified. The Contractor will be required to develop the Traffic Management, Access and Pedestrian Control Plan for all detours, which will be monitored by the City.

9.3.4.2 Emergency Response Plan

The preparation of an Emergency Response Plan will be completed by the Contractor to allow full access of emergency services during the construction period so that at any given time there is a method to access the site and all adjacent land uses. The plan should include provisions for providing temporary services to end users in the event of a construction related service outage or other service disruption.

9.4 Assessment & Evaluation of Effects

This section describes the potential effects, prescribed mitigation measures, residual effects, and their significance for the recommended plan.

9.4.1 Natural Environment

9.4.1.1 Geotechnical (Design)

Potential Project Interaction

Construction of new infrastructure where the subsurface conditions generally consist of fill overlying a thick deposit of firm to very stiff silty clay. The groundwater level varies from about 1.3 to 2.9 m below ground surface, with seasonal fluctuations.

Potential Environmental Effect

The silty clay beneath this site has a limited capacity to support additional stresses caused by foundation loads and/or grade raises.

Proposed Mitigation Measures

Lightweight fill (LWF) materials should be considered for any infilling or embankment exceeding 2.5 m in height, thereby reducing the stress increase on the compressible clay, and mitigating the anticipated settlement.

Conventional cast-in-place concrete retaining walls and bridges need to be supported on deep foundations driven to bedrock, as shallow foundations would not provide sufficient bearing resistances or acceptable settlement performance for the structure.

Significance of Residual Effects

Negligible/Moderate: Potential for localized stresses on geotechnical conditions mitigated by using LWF.

9.4.1.2 Embankment/Excavation Stability (Design)

Potential Project Interaction

Embankments will be required at various locations throughout the study area, including at the agricultural/MUP underpass crossing at the BRT.

Potential Environmental Effect

The clay deposit is relatively weak within the study areas and therefore the potential for deep-seated rotational shear failure (i.e., bearing capacity failure) of the embankment subgrades exists.

Proposed Mitigation Measures

Detailed design to confirm lightweight fill material requirements, to avoid excessive settlements and provide an adequate factor of safety against instability.

Embankments as high as 2.5 m (such as the agricultural/MUP underpass crossing at the BRT) constructed with select subgrade material should have adequate factors of safety against static and seismic global instability with side slopes no steeper than 2 horizontal to 1 vertical (2H:1V).

The embankment stability for any embankments higher than 2.5 m, such as the 10 m high embankment west of Navan Road where the use of lightweight fills has been recommended, should be assessed during detailed design once the embankment materials and construction details have been selected.

Significance of Residual Effect

Negligible: Potential for deep-seated rotational shear failure of embankments would be localized and can be mitigated via design by the inclusion of LWF.

9.4.1.3 Groundwater (Construction)

Potential Project Interaction

Various construction activities, including those requiring foundations for structures, and associated with the Innes Road BRT tunnel may require dewatering during construction.

Potential Environmental Effect

In general, lowering of the groundwater level may increase the effective stress in the overlying soil, resulting in consolidation and settlement of overlying structures, utilities and surface features. That increase in stress can lead to consolidation of sensitive silty clay soil.

Proposed Mitigation Measures

The impact of groundwater lowering should be assessed during detail design for any potential impacts to utilities, roadway and surface features in the area. Further hydrogeological assessment may be required to determine the dewatering radius of influence during detailed design and confirm the extent of settlement and need for LWF.

Significance of Residual Effect

Not Significant: Potential for temporary, short-term (construction), localized ground water impacts to be mitigated via future study and verifying limits for LWF requirements and dewatering management.

9.4.1.4 Unstable Slopes & Ravines (Design)

Potential Project Interaction

The proposed road widening and transitway will likely require some encroachment into ravines associated with Greens Creek and Mud Creek. The stability of the Mud Creek slopes has been documented and certain segments are known to be at risk of slope failures, largely connected to active erosion undercutting the toe of slopes within the creek.

Potential Environmental Effect

Encroachment in ravines associated with the watercourses poses potential fluvial geomorphological risks/impacts to Greens Creek and Mud Creek.

Proposed Mitigation Measures

An Erosion Allowance of 8 m will need to be included in the determination of the Limit of Hazard Lands given the active erosion observed along many portions of the Mud Creek bank. This value can be reduced in areas that have an existing flood plain width or where erosion control measures are being considered.

Significant filling of the table land areas could have a negative impact on the stability of the Mud Creek slopes and should therefore be avoided. Erosion allowances will be confirmed during detailed design. Erosion protection is required west of the Renaud Road intersection, where the Mud Creek realignment is proposed and where the recommended set-back may not be achievable.

Detailed and site-specific erosion control measures are considered feasible along Mud Creek and will be developed during detailed design. Erosion protection measures may include but will not be limited to erosion protection rip-rap, placed on a maximum 2 horizontal to 1 vertical front slope up to the 100 year flood level and underlain by a non-woven geotextile, channeling of tributary flows with open (“half-pipe”) culverts along steep grades and partial infilling and live crib walls. Additional design details are available in Golder’s (2021b) Functional Design Level Geotechnical Input Memo in **APPENDIX D.4**.

The clay soil at this site is susceptible to erosion particularly at the outside bends of the valley slopes. Surface water should not be directed to flow over the creek slopes without erosion protection measures. To the extent possible, limit the magnitude of the foundation stresses since higher stresses will result in increased magnitudes of settlement.

Concrete closed box culverts are considered most feasible since the foundation loads are distributed over a larger area, resulting in lower foundation stress levels, and therefore reduced settlement magnitudes (as opposed to a rigid frame open box culvert). However, open box culvert(s) with piled foundations to bedrock could also be considered. Modifications within the Mud Creek channel should be designed and constructed with oversight and input from fluvial geomorphologist or other channel design experts.

The RVCA has raised concerns about slope stability and the risk of landslides at locations where the recommended alignment is close to Mud Creek. RVCA has recommended that additional geomorphological study, slope stability analysis and landslide hazard assessment be conducted prior to finalizing an alignment. The analysis completed for this study, indicated the potential for retrogressive slide to occur was very limited.

The City will undertake more detailed investigations and assessments to manage and confirm the Limits of Hazard Land (LOHL) setbacks. This will allow for an assessment of the dynamic creek conditions at the time of construction.

Significance of Residual Effect

Negligible/Moderate: Potential for geomorphological impacts to be verified and LOHL adjusted as necessary for final design inputs.

9.4.1.5 Geomorphology: Mud Creek

Potential Project Interaction

The stability of the Mud Creek slopes has been documented and certain segments are known to be active for slope failures, largely connected to active erosion undercutting the toe of slopes within the creek.

Potential Environmental Effect

Realignment of Mud Creek poses potential fluvial geomorphological risks/impacts to the watercourse.

Proposed Mitigation Measures

More detailed hydraulic modeling should be prepared for Mud Creek during the detailed design to ensure that the implementation of the proposed measures, including at creek crossings, does not negatively impact adjacent property. Erosion thresholds, cumulative impacts and changes to peak flow resulting from the project will need further consideration during detailed design.

Where stormwater management alone may not be sufficient, recommendations for in-stream works will be made. Where possible, it is proposed to increase the watercourse length by meandering with micro pools, expand the vegetated buffer and increase the resilience of the creek bed and banks by providing a layer of less erodible materials to protect the underlying finer creek substrate.

Significance of Residual Effect

Negligible/Moderate: Potential for fluvial geomorphological risks to be mitigated with known design practices and offers opportunities for potential enhancements.

9.4.1.6 Surface Water (Construction)

Potential Project Interaction

Potential pollutant release and run-off related to various construction activities, including but not limited to sediment release and accidental spills or leaks from construction machinery.

Potential Environmental Effect

Potential for short-term localized pollutant release into watercourses related to crossings and work adjacent to the road/ BRT corridor during construction.

Proposed Mitigation Measures

Best Management Practices and Built-In Mitigation Measures such as those described in **Section 9.3** including but not limited to: Environmental Protection Plan, Contaminant and Emergency Spill Response Plan, Dewatering Management Plan, Stormwater Management Plan, and Near/In-Water Works Site Specific Mitigation Measures.

Significance of Residual Effect

Not Significant: Potential for temporary, short-term (construction), localized surface water impacts to be mitigated via best management practices and built-in mitigation measures.

9.4.1.7 Surface Water: Stormwater Management (Design)

Potential Project Interaction

New roadway, widened roadway, connections, transitway and project components will increase the impervious surfaces within the study area.

Potential Environmental Effect

Increase in impervious surfaces (due to widening/new infrastructure) will lead to increases in stormwater runoff peak and volume following rain events with enough rainfall to generate runoff into adjacent watercourses.

Proposed Mitigation Measures

Runoff quality treatment and quantity control (peak flow attenuation) will be achieved through enhanced grass swales with rock check dams and vegetated filter strips. This approach is preferred due to several factors including the rural landscape. The proposed stormwater management controls and any mitigation measures will be included within the proposed right-of-way.

For the proposed works, post development peak flow rates are required to meet pre-development peak flow rates with application of LID measures, where feasible.

Detailed design should evaluate enlarging culverts to allow for better distribution of water flow, where culvert replacements are necessary to mitigate the effects of flash flooding events within Mud Creek. The sizing of all infrastructure is to be confirmed with detailed dynamic hydrologic/hydraulic modelling during preliminary and detailed design.

The design of the major crossing at Mud Creek should consider requirements for hydraulics, fluvial geomorphology, and fish and wildlife passage.

Consider Mud Creek and Greens Creek protection and enhancement during detailed design. Natural channel design such as roots wads/live stakes to be considered for bank stabilization and water quality improvements. Further considerations and recommendations are detailed in The Functional Design Report – Drainage and Stormwater Management (MH, 2021c) provided in **APPENDIX C.4**.

Significance of Residual Effect

Negligible/Moderate: Potential for recurring, short-term surface water impacts (rain events) to be mitigated via quantity and quality design elements and future permits/authorizations.

9.4.1.8 Fish & Aquatic Species (Construction)

Potential Project Interaction

Both land-based and in-water activities are anticipated to result from the proposed construction works, including excavation, grading, vegetation clearing, use of industrial equipment, change in timing, duration and frequency of flow, and wastewater management.

Potential Environmental Effect

Short-term, localized sediment release may result from run-off associated with various construction activities. Sedimentation of fish habitat may decrease water quality in the short-term, as well as cause respiratory distress and reduced feeding efficiency in fish.

Proposed Mitigation Measures

Undertake detailed fish and fish habitat field investigations as required to update/confirm the existing conditions. This may include a Headwater Drainage Feature Assessment using the Evaluation, Classification and Management of Headwater Drainage Features Guidelines Protocol (TRCA, 2014).

Review of aquatic SAR background information (i.e., DFO/CA aquatic SAR mapping) and SAR listings (ESA and SARA) to ensure that any updated SAR occurrences or changes to relevant legislation are identified and addressed.

Fish passage and natural channel flow regimes are proposed to be maintained at culvert water crossings. Details to be confirmed in detailed design.

Best Management Practices and Built-In Mitigation Measures such as those described in **Section 9.3**. Including but not limited to: Erosion and Sediment Control Plan, Environmental Protection Plan, Stormwater Management Plan.

Adherence to in-water/channel bank timing window (works permitted) from July 1st to March 14th.

Complete *DFO Aquatic Effects Assessment* using Pathways of Effects (PoE) diagrams if proposed works to occur below the high-water mark.

Operation of machinery and shoreline/bank re-vegetation and stabilization should be conducted as per *DFO Measures to Protect Fish and Fish Habitat* and relevant environmental specifications.

Potential opportunities to reduce the severity of impacts to be confirmed at detail design. These may include but will not be limited to the following considerations:

- Natural channel bank stabilization (i.e., plantings, woody structures)
- Incorporation of natural fluvial geomorphology design features
- Incorporation of fish passage enhancement features within new culvert at the western most Renaud Road Crossing)

Significance of Residual Effect

Negligible/Moderate: Appropriate mitigation measures will be implemented and adhered to for the duration of construction.

Permits, licenses, and authorizations will be obtained prior to commencing any in-water/near-water work.

9.4.1.9 Fish & Aquatic Species: Mud Creek Realignment (Construction)

Potential Project Interaction

Both land-based and in-water activities are anticipated to result from the proposed construction works, including excavation, grading, vegetation clearing, use of industrial equipment, change in timing, duration and frequency of flow, and wastewater management. The Mud Creek realignment will alter the naturally occurring watercourse.

Potential Environmental Effect

Short-term, localized sediment release may result from run-off associated with various construction activities. Sedimentation of fish habitat may decrease water quality in the short-term, as well as cause respiratory distress and reduced feeding efficiency in fish.

The overall goal of the creek realignment will be to improve or limit potential impacts on both aquatic life and aquatic systems, and wildlife and terrestrial systems (e.g., riparian areas).

Proposed Mitigation Measures

Undertake detailed fish and fish habitat field investigations as required to update/confirm the existing conditions. This may include a Headwater Drainage Feature Assessment using the Evaluation, Classification and Management of Headwater Drainage Features Guidelines Protocol (TRCA, 2014).

Review of aquatic SAR background information (i.e., DFO/CA aquatic SAR mapping) and SAR listings (ESA and SARA) to ensure that any updated SAR occurrences or changes to relevant legislation are identified and addressed.

The Channel should be designed and constructed with oversight from a fluvial geomorphologist or other channel design experts.

It is recommended that the channel design incorporate natural channel features and meanders as well as fish and aquatic habitat. This may include riffles, pools, and breeding areas. The goal is to increase and enhance the riparian vegetation buffer along Mud Creek; and re-establish areas where riparian features are absent or inadequate.

Culverts and/or water crossings will be designed to maintain fish passage. Natural channel flow regimes will be maintained to avoid accelerated erosion and scouring in downstream areas.

Development of a site-specific management and monitoring plan for construction. This plan should include undertaking fish removals and wildlife sweeps before implementing flow diversions and/or dewatering. The plan will have consideration for all works undertaken below the high-water mark and based on final detail design. Refer to built-in mitigation measures outlined in **Section 9.3.1.17**.

Refine impact assessment at detail design stage including completion of DFO Aquatic Effects Assessment with use of PoE diagrams to determine the likelihood of proposed activities resulting in death of fish or HADD of fish habitat.

A DFO Request for Review (RFR) would be required under the Fisheries Act for the proposed channel re-alignment works along Mud Creek. Potential for a *Fisheries Act Authorization* being required, which would be dependent upon site specific field investigations and final design. An application to RVCA for permit under Ontario *Regulation 174/06 – Development, Interference with Wetlands and Alterations to Shorelines and Watercourses* will likely be required.

Significance of Residual Effect

Negligible/Moderate: Appropriate mitigation measures will be implemented and adhered to including development of site-specific management and monitoring plans. Permits, licenses, and authorizations will be obtained prior to commencing any in-water/near-water work. Habitat should be recreated/enhanced to the greatest extent possible with the new channel design. Potential exists for enhancement.

9.4.1.10 Wetlands (Unevaluated)

Potential Project Interaction

Construction of the project has the potential to temporarily infringe on unevaluated wetlands. A 2 m buffer has been applied to the recommended design for the purposes of evaluating the potential direct project environmental effects on unevaluated wetlands. A 120 m buffer has been applied to the recommended design for the purposes of evaluating the potential indirect project environmental effects on unevaluated wetlands.

Potential Environmental Effect

Approximately 0.8 ha. of unevaluated wetlands will be directly impacted by the project. Approximately 8 ha. of unevaluated wetlands may be indirectly affected by project activities when a 120 m buffer is applied to the Ultimate Recommended Plan.

Proposed Mitigation Measures

Built-In Mitigation Measures including those identified for the protection of wetland features (**Section 9.3.1.11**).

Field verification surveys are required to confirm wetland boundaries within the project limits prior to construction to ensure riparian habitats adjacent to watercourses were captured within the FSA, and to confirm wetland communities are not currently identified as other landcover types. Proper wetland delineation for communities situated on federal lands is key to avoiding contravention to the Federal Policy on Wetland Conservation, which requires a No Net Loss of Wetland Functions.

A project specific *Wetland Mitigation Plan* will be developed during detailed design in consultation with the NCC. The Plan will identify a series of measures to limit and where required offset potential effects.

In accordance with the federal policies a 4:1 compensation will be required for loss of any wetlands on federal land, though compensation does not need to be strictly area based. The compensation may include natural and/or social enhancements and would be subject to review and approval from Environment and Climate Change Canada. Compensation may include eco-passage road culverts as amphibian crossings and/or invasive species (i.e., buckthorn) mitigation, educational signage or other measures as determined in consultation with appropriate authorities.

Significance of Residual Effect

Negligible/Moderate: Implementation of proposed mitigation measures will ensure no net loss of wetland function for wetlands on federal property. Potential for enhancement.

9.4.1.11 Significant Wetlands (Mer Bleue Bog)

Potential Project Interaction

The Recommended Plan does not intersect directly with either the Mer Bleue Bog Wetland of International Importance (Ramsar

Convention) boundary or with the Provincially Significant Wetland (PSW).

A 120 m buffer has been applied to the recommended design for the purposes of evaluating the potential indirect project environmental effects on the Mer Bleue Bog. The 120 m buffer extends close to the Ramsar Site boundary south of the existing Renaud Road/Anderson Road intersection and extends into the Ramsar Site boundary (an area of 4.9 ha.) along a section of Renaud Road west of Bradley Estates. This latter encroachment results from proposed work in this area to relocate this section of Renaud Road outside of the Ramsar Site boundary and also some minor work associated with a new MUP connection to the Prescott-Russell Trail.

Potential Environmental Effect

Construction of the project has the potential for temporary indirect impacts on the Mer Bleue Bog during construction including noise, light pollution, and fugitive dust.

Change in land use may affect the quality and quantity of the Mer Bleue Wetland, including an opportunity for introduction of exotic and invasive species.

Proposed Mitigation Measures

A project specific *Wetland Mitigation Plan* will be developed during detailed design in consultation with the NCC. This plan will ensure there is no net loss as required by the Ramsar Convention agreement. It will account for mitigation such as the existing portion of Renaud Road currently within the Ramsar boundary that is proposed to be relocated to outside of the boundary. The *Ecological Restoration and Enhancement Plan* will be developed with the NCC and have consideration for restoration and enhancement of the area of relocated roadway. The Plan will include clear criteria and defined outcomes.

Design consideration has been given to reducing proximity and potential impacts to the footprint of the wetland. Field investigations to confirm significant wetland features and boundaries are recommended closer to the time of design and implementation to properly identify wetland conditions at the time of construction. It is proposed that the *Ecological Restoration and Enhancement Plan* address management of invasive species, installation of key habitat features, contingency measures and adaptive management. Consultation with the NCC will be required regarding implementation of various recommendations and key actions to achieve objectives as outlined in existing wetland management plans including, but not limited to the *Mer Bleue Wetland Management Plan (NCC, 2007)* and the *Ramsar*

Handbook for Addressing Change in Wetland Ecological Character.

On-going collaboration with the NCC in advance of design should be undertaken to implement some of the key actions as identified in the 2007 Mer Bleue Management Plan. Actions to consider may include, but not be limited to:

- Develop effective strategies to ensure the long-term viability of species at risk occurring in the Mer Bleue Management Area.
- Map priority habitats to ensure maintenance of composition and structure of native vegetation communities.
- Identify appropriate prevention and control methods for invasive species that threaten native plant species and communities. Promote public awareness of, support for, and involvement in the control of non-native plants.

The new transportation corridor has an opportunity to provide multi-modal access to the Mer Bleue Wetland, increasing the accessibility for recreation and educational purposes. The protection of the ecology of the area however is still the first priority. To mitigate for the proximity of the project to the Wetland, the City can partner with the NCC to assist in undertaking some of the recommendations in the Mer Bleue Wetland Management Plan (2007) such as:

- Assess and monitor the occurrence and condition of wetland classes and vegetation communities within the Ramsar boundaries.
- Identify Species at Risk and rare species populations and asses associated habitat conditions.
- Conduct a comprehensive study to improve understanding of the hydrology of the Management Area focused on influencing factors such as beaver, drainage ditches, and climate change.
- Conduct a water quality monitoring program.
- Identify benchmark ecosystems in the Management Area for research, monitoring, and educational purposes.
- Updating/continuing research regarding the benefits of Mer Blue Bog (e.g., Continuing building of previous studies such as Peatland Carbon Study (PCARS); Measurement and Modelling of the Contemporary Carbon Sequestration in Peatlands – integration of Mer Bleue; Trent University

Carbon and energy fluxes at the Mer Bleue bog – Carleton University; Mer Bleue Peatland Observatory (MBPO), which is a 10-hectare site within the conservation area known for its long term research in northern peatlands.

Significance of Residual Effect

Negligible/Moderate: Implementation of proposed mitigation measures including an *Ecological Restoration and Enhancement Plan*, and a *Wetland Mitigation Plan* will identify a series of measures to limit, and where required to offset the impacts. There is also a potential for benefits to result from the improved multi-modal access in proximity to the Wetland.

9.4.1.12 General Wildlife

Potential Project Interaction

Site development (construction and operation) will result in the reductions and disturbance of natural areas within the study area.

Potential Environmental Effect

The project will result in the reduction and disturbance of natural areas within the Greenbelt, an increase in habitat fragmentation and reduction of habitat connectivity, potential increases in wildlife vehicle collisions and wildlife mortality, edge effects (noise, road salt and other vehicle pollutants, lights, reduction of core habitat, etc.).

Proposed Mitigation Measures

Further field study is required to identify and assess impacts during detail design. In addition to best management practices and built-in mitigation measures, the following mitigations are recommended:

Ecological Restoration and Enhancement Plan including installation of key habitat features and wildlife friendly lighting as determined in detailed design phase.

It is proposed to vegetate swales with a diverse assortment of robust native or non-invasive vegetation that may provide general wildlife habitat and foraging opportunities. Flowering plants are proposed to be added for interest and for pollinator habitat.

It is proposed that short and salt/drought tolerant vegetation be planted in swales and filter strips.

Significance of Residual Effect

Negligible/Moderate: Implementation of proposed mitigation measures including an *Ecological Restoration and Enhancement Plan* will identify a series of measures to limit, and where required, offset the impacts of the final project.

9.4.1.13 Significant Wildlife Habitat (SWH)

Potential Project Interaction

There is potential for candidate SWH to be present within the project limits. Forest and swamp communities within the project limits may have the potential to support bat life processes, such as reproduction, rearing, hibernation, migration or feeding. Wetland communities located directly within the project footprint area may support breeding or hibernation habitat for SAR amphibian or turtle species. Agricultural and meadow communities located directly within the project footprint area may support Bobolink (*Dolichonyx oryzivorus*) and Eastern Meadowlark (*Sturnella magna*) breeding and foraging habitat, both Threatened species protected under Schedule 1 of SARA.

Potential Environmental Effect

The project will result in localized reduction and disturbance of natural areas within the Greenbelt, an increase in habitat fragmentation and reduction of habitat connectivity, increases in wildlife vehicle collisions and wildlife mortality, edge effects (noise, road salt and other vehicle pollutants, lights, reduction of core habitat, etc.).

Proposed Mitigation Measures

Further surveys are required during detail design and construction planning to confirm the presence/absence of seasonal concentration areas; the presence/absence of rare vegetation communities or specialized habitat for wildlife; the presence/absence of habitat for Species of Conservation Concern; and the presence/absence of animal movement corridors.

Best Management practices such as wildlife exclusion fencing, wildlife crossings should be considered based on the results of further surveys.

Significance of Residual Effect

Negligible/Moderate: Implementation of proposed mitigation measures including an *Ecological Restoration and Enhancement*

Plan will identify a series of measures to limit, and where required, offset the impacts of the final project.

9.4.1.14 Species at Risk Vegetation (Butternut)

Potential Project Interaction

There is potential for Butternut trees to be found within the project area, based on the confirmed candidate habitat present within wooded areas, and other treed vegetation communities. The Butternut is listed as an Endangered species both federally and provincially and it is prohibited to harm or remove this species under the ESA.

Potential Environmental Effect

Any vegetation clearing (including tree removals) anticipated to occur within the project area resulting from ultimate construction and staging activities has a high potential to impact existing Butternut.

Proposed Mitigation Measures

During Detail Design, on-site field investigations including tree inventories will be conducted to confirm the presence or absence of Butternut within the project area. A 50 m buffer from the limits of construction will also be incorporated into the field investigations, to account for suitable areas for Butternut, or other SAR trees that may be indirectly affected by construction.

If Butternut is identified on site during the field investigations, a Butternut Health Assessment will be completed for each specimen to determine whether it is retainable (resistant to the Butternut Canker). The results of this assessment may allow for a conditional exception for the removal of a Butternut under Ontario Regulation 242/08. It is recommended that work, including equipment operation and material storage is not carried out within 50 m of any Butternut tree.

The proper installation of tree protection fencing, or sediment fencing will clearly delineate the project boundaries and allow for laydown areas, minimizing any indirect impacts to vegetation located outside of the construction zone. Consideration to trees located outside of but within close proximity to the project area should be given when installing tree protection fencing, to minimize damage to their critical root zones.

To avoid impacts to bat species and breeding birds, tree removal activities must be completed outside the species active seasons (i.e., between October 1 and April 8). Vegetation clearing should not extend past the limits of the new road expansion area.

Impacts to Butternut are possible, however are expected to be minimal as the proposed project impact area is primarily located along grassland, crops, and pastureland. It is anticipated that any Butternut which need to be removed due to the project can be compensated for through new plantings in the general area.

Significance of Residual Effect

Negligible/Moderate: Impacts to Butternut are possible. It is anticipated that any removals can be compensated for through new plantings in the general area or through known and accepted mitigation measures including financial compensation as outline in the Ontario regulations.

9.4.1.15 Species at Risk Insects (Monarch Butterfly)

Potential Project Interaction

There is a probability of occurrence for Monarch to be found within the general project area, based on the confirmed candidate habitat present within cultural meadows and grassland communities. The Monarch is currently designated as a Special Concern species and is not afforded species or habitat protection under the ESA. However, Monarch habitat is protected under the *Provincial Policy Statement (2020)*.

Potential Environmental Effect

Any vegetation clearing and land stripping anticipated to occur within the project area resulting from ultimate construction and staging activities has a potential to impact Monarch species and habitat.

Proposed Mitigation Measures

During Detail Design onsite field investigations should be carried out to confirm the presence of Monarch/habitat, including a general search of candidate habitat (meadows, grasslands). The findings will help determine appropriate mitigation measures to ensure conservation of habitats where possible.

Site restoration activities should include the use of native seed mixes along disturbed areas where appropriate. These seed mixes should include pollinator plants, milkweed and butterfly weed to provide habitat and foraging plants for the Monarch.

To minimize incidental impacts to Monarch, areas requiring vegetation clearing/stripping should be maintained (i.e., mowed) prior to and during construction to prevent the growth of flowers or milkweed attractive to Monarchs.

Significance of Residual Effect

Negligible/Moderate: Consideration of incidental impacts to Monarch will be identified during detail design and confirmed closer to the time of construction.

9.4.1.16 Species at Risk Amphibians & Reptiles

Potential Project Interaction

There is a moderate to high probability for several SAR amphibians and reptiles (including Blanding's Turtle, Snapping Turtle, Western Chorus Frog and Spotted Turtle) to be found within the project area, based on confirmed, or potential candidate habitat present within wooded areas, crop and pasture, settlement, and wetland areas.

Potential Environmental Effect

The vegetation clearing and grubbing anticipated to occur within the project area, encroachment on wetlands, and the installation of roadway/culvert infrastructure resulting from ultimate construction and staging activities has a high potential to impact or displace SAR amphibians and reptiles.

Proposed Mitigation Measures

During Detail Design onsite field investigations to target reptiles and amphibians must be carried out to confirm the presence of SAR and SAR habitat as well as associated Significant Wildlife Habitat within the project area. The findings will help determine appropriate best management practices and mitigation measures to ensure conservation of habitats where possible.

Field investigations targeting Turtle Nesting Areas or Turtle Overwintering Areas should also be completed during the design phase to confirm the presence of potential suitable habitat within the project area. Confirmed nesting and overwintering areas are afforded protection under the Provincial Policy Statement. If a SAR turtle is observed at any of the potential nesting sites, that area is considered habitat for SAR and is protected under the ESA and permits may be required depending on the nature of impact.

Vegetation clearing and work within or adjacent to watercourse or wetland areas should occur outside the peak activity period for reptiles which extends from May 1 – September 30.

Wildlife Exclusion Fencing (WEF) should be considered based on the results of the targeted reptile and amphibian studies. Temporary and/or permanent WEF should be installed following recommendations outlined in *Best Management Practices for Mitigating the Effects of Roads on Amphibians and Reptiles Species at Risk in Ontario (MRNF, 2016)*, and the *Wildlife Protocol for Road Construction/Rehabilitation Projects* in order to protect SAR species as well as exclude SAR from entering construction work areas.

During construction, frequent (i.e., weekly) inspections of WEF should be conducted to ensure mitigation measures are properly maintained throughout the construction phase, minimizing accidental harming of amphibian and turtle species within the construction work areas.

As a result of new infrastructure, there is potential for habitat fragmentation following construction. To mitigate impacts to movement patterns of reptiles and amphibians, the design of culverts must consider wildlife passage with a focus on size and openness ration to ensure crossings meet species requirements.

Significance of Residual Effect

Negligible: Consideration of temporary localized construction impacts, and reptile/amphibian crossing will be confirmed during detail design. The study findings will help confirm appropriate best management practices and mitigation measures to ensure conservation/enhancement of habitats.

9.4.1.17 Species at Risk Birds

Potential Project Interaction

There is a probability for several SAR birds (including Bobolink, Eastern Meadowlark and Evening Grosbeak) to be present within the project area, based on confirmed, or potential candidate habitat present within wooded areas, crop and pasture, grassland, and wetland areas.

Potential Environmental Effect

Any vegetation clearing (including tree removals) anticipated to occur within the project area from ultimate construction and staging activities has a high potential to impact SAR birds through loss of habitat and nesting areas.

Proposed Mitigation Measures

During Detail Design onsite field investigations must be carried out to confirm the presence of SAR birds and associated Significant Wildlife Habitat within the project area. The Forest Bird Monitoring Program developed by Environment Canada and the Canadian Wildlife Service, and the Ontario Breeding Bird Atlas (OBBA) Guide for Participants outline the methods for conducting breeding bird surveys in Ontario. The results of these studies will determine appropriate mitigation measures required for confirmed species and habitats.

Several provincial and federal legislations protect the destruction of bird species and their habitats, including the *Migratory Birds Convention Act* (MBCA). The MBCA protects breeding migratory birds, their nests and young in Canada. To remain compliant with the MBCA, it is recommended that any vegetation removal take place outside the breeding bird season for this region (April 15 – August 31). If the vegetation communities could be considered 'simple habitats' (habitats that contain few likely nesting spots or a small community of migratory birds), a nest search may be completed during the nesting period (April 15 – August 31) by a qualified biologist prior to construction. The biologist needs to confirm that the proposed works would not affect the nest or young of a protected species or wait for the young to fledge.

Significance of Residual Effect

Negligible/Moderate: Timing windows, best management practices and built-in mitigations will be incorporated during detail design. The study findings will help confirm appropriate best management practices and understood mitigation measures at the time of design/construction.

9.4.1.18 Species at Risk Mammals

Potential Project Interaction

There is a high probability for SAR bats (including Eastern Small-footed Myotis, Little Brown Myotis, Northern Myotis and Tri-colored Bat) to be found within the project area, based on confirmed potential foraging and roosting habitat within wooded areas and man-made structures.

Potential Environmental Effect

The vegetation clearing (including tree removals) anticipated to occur within the project area from ultimate construction and staging activities has a potential to impact SAR bats.

Proposed Mitigation Measures

Field investigations should be completed prior to construction within appropriate forested communities that may support bat species. These should include a bat cavity tree survey during leaf off season, where potential tree cavities for bats may be observed. Specific criteria will assist in identifying a candidate bat tree, including size, tree species and general location. If necessary, an acoustic monitoring program may be initiated to confirm the presence of SAR bats within the project study area. The results of these studies will determine future steps, and mitigation measures taken to protect SAR bats.

To avoid construction impacts to bats (including SAR), limit construction to daytime hours, and shield lights downward should night works be required.

Removal of forest stands which potentially contain bat cavity trees must be completed during the SAR bats inactive season which extends from October 1 through April 30.

Vegetation clearing should not extend past the limits of the new road expansion area.

Significance of Residual Effect

Negligible/Moderate: Timing windows, best management practices and built-in mitigations will be incorporated during detail design and confirmed by further study.

9.4.2 Social Environment

9.4.2.1 Land Use: Greenbelt Core Natural Areas & Natural Link Areas

Potential Project Interaction

New infrastructure, including the roadway and transitway will encroach on Greenbelt designated areas including Core Natural Areas and Natural Link Areas.

Potential Environmental Effect

Approximately 1.0 ha. of Greenbelt Core Natural Area and 10.0 ha. of Greenbelt Natural Link Area may be impacted based on the recommended ultimate project footprint (i.e., limits of grading plus a 2.0 m buffer).

Proposed Mitigation Measures

Overall protection/enhancement of the Greenbelt may include general BMPs during construction such as the prevention of introduction of invasive species within the project area is highly important, especially around significant, and sensitive natural features. Introduction of invasive species (e.g., Wild Parsnip) has the potential to reduce species diversity, encroach on wildlife habitat and out-compete native species.

To mitigate this potential, all equipment must arrive onsite clean (construction site should include a wash station for vehicles entering the project area), and any invasive growth within the project area or adjacent lands should be controlled (ex: invasive plants can be pulled by hand and disposed of at a municipal landfill site).

Create a partnership with the NCC to develop enhancements to the existing Mer Bleue Sector features; plan for trail improvements, add new signage or interpretive resources (ex: QR Code) to improve visitor experience and understanding of ecological impacts.

To reestablish vegetation within Greenbelt Core Natural Areas, it is proposed to install erosion blankets with native seed mix coupled with plantings of trees and shrubs to restore disturbed areas as well as exposed areas along watercourses and wetland areas. Seed mixes for these areas should include species which will thrive in that specific soil type and include pollinator plants such as milkweed and butterfly weed to provide habitat for Monarch.

There is potential for habitat fragmentation following construction. To mitigate impacts to movement patterns of reptiles and amphibians, the design of culverts must consider wildlife passage with a focus on size and openness ration to ensure crossings meet species requirements.

Significance of Residual Effect

Negligible/Moderate: With careful consideration of restoring temporary and permanently disturbed areas within the Greenbelt Natural Link Areas, and compensating where required, the anticipated impact to the Greenbelt should be low.

9.4.2.2 Visual Aesthetics/Landscape

Potential Project Interaction

New roadway and transitway infrastructure will be built in a primarily agricultural and rural landscape.

Potential Environmental Effect

Grade separations associated with the BCBE and transitway infrastructure may impact established views and existing landscape character.

Proposed Mitigation Measures

Three key impact/mitigation zones have been identified based on existing landscape features, including an Ecological Zone, Agricultural Zone, and Residential Zone.

Design principles identified for the Landscape Strategy have been recommended to maintain a landscape character rooted in the existing land uses. It is recommended that the design incorporate landscaping elements to enhance existing views and vistas, screen undesirable views, and locate the infrastructure to mitigate impacts on sensitive environments. Creating an identifiable character, providing rest areas and benches along pathways, and adopting principles of Crime Prevention through Environmental Design Principles will enhance the user experience.

Areas that are proposed to receive particular attention as part of the Landscape Strategy include intersections, grade separations, the Mud Creek realignment and the area of the existing Chapel Hill Park and Ride lot and proposed transit station. Additional planting is proposed along the north edge of the Park and Ride lot to provide visual screening between it and the residences located to the north.

Significance of Residual Effect

Positive: Recreational features in this portion of the Greenbelt are currently limited to the Prescott-Russell Trail. A new MUP and incorporation of design principles creating an identifiable character and rest areas will enhance the existing Greenbelt experience for many users.

9.4.2.3 Land Use: Businesses

Potential Project Interaction

The recommended ultimate plan will require severing various agricultural land parcels to accommodate the project footprint. Access to existing businesses and commercial establishments will be maintained.

Potential Environmental Effect

Businesses, including farms and NCC lease agreements, may be fragmented due to reduced/loss of access due to new road/ transitway facilities. Approximately 30 ha. of agricultural land will be required to accommodate the recommended ultimate project footprint and farm access may be disrupted.

Proposed Mitigation Measures

Potential impacts to farm access during operation of the new infrastructure have been mitigated via design with the provision of new access. This includes: a grade separation for continued farm equipment access; consideration of farm drainage requirements in the final design and upgrading (as possible) municipal and farm drainage systems in final design.

The loss of lands will need to be calculated during the design and the actual uses of the lands confirmed based on the agricultural practices at the time of design. Mitigation measures may include measures to improve the remaining farmlands including soils amendments, improved drainage; improved access to farm stalls and/or irrigation. The type and extent of the measures will need to be confirmed dependent on the uses at the time of design.

Significance of Residual Effect

Negligible/Moderate: Grade separated access provides continued farm equipment access across the new ROW. Local inconvenience may be experienced by farm operators at greater distances from the crossing. Physical soils and access improvements can be considered depending on the uses at the time of construction.

9.4.2.4 Land Use: Community Gardens

Potential Project Interaction

New transportation infrastructure may result in road realignments, closed intersection, and changes to the transportation network configuration.

Potential Environmental Effect

The recommended ultimate plan will result in loss of access to community gardens just north of Weir Road once the BRT is built.

Proposed Mitigation Measures

Opportunities will be explored for the potential relocation of the community gardens or the access during detailed design.

Significance of Residual Effect

Not Significant: Opportunities will exist for continued access/ relocation of the community gardens.

9.4.2.5 Land Ownership

Potential Project Interaction

New road and transit right-of-way will require property from federal and private landowners.

Potential Environmental Effect

Approximately 42 ha. of property will need to be acquired from the NCC. Removal of 2 NCC owned buildings (one residence and one shed) will be required for construction of the Transitway. Up to 3 additional NCC owned residences may be affected along the south side of the new roadway although design modifications will be considered to avoid having to remove these buildings. Discussions will need to occur and be in accordance with the land uses at the time of planned construction.

Approximately 1.1 ha. of property will also need to be acquired from one private property owner.

Proposed Mitigation Measures

Acquisition of NCC property will be negotiated by the City by means of land purchase, land exchange or land lease. Federal Land Use, Design and Transaction Approval (FLUDTA) will be required for NCC lands.

Acquisition of the privately owned property will be negotiated by the City and fair market value established and provided.

Significance of Residual Effect

Negligible/Moderate: Local land owners will be financially compensated.

9.4.2.6 Air Quality (Construction)

Potential Project Interaction

Varied construction activities, including soil/ground disturbance, are expected to create isolated and short-term local air quality impacts.

Potential Environmental Effect

Short-term and isolated construction related impacts may be a nuisance/annoyance for individuals. The impacts will be controlled, minor and intermittent over short cycles of activity.

Proposed Mitigation Measures

BMPs including a Communications Plan, Complaints Protocol and Air Quality BMPs as summarized in **Section 9.3.2.1**.

Significance of Residual Effect

Not Significant: Short-term, localized nuisance for some adjacent land users.

9.4.2.7 Air Quality (Operations)

Potential Project Interaction

The general trend is that the concentrations of all pollutants marginally deteriorate with the project implementation.

Potential Environmental Effect

Over time, pollutant concentrations are expected to improve with vehicle environmental controls and newer engine technologies, therefore the project undertaking will have a negligible impact on air quality. For details related to the highest 24-hour NOx concentrations for future conditions without and with the project, respectively, refer to **APPENDIX E.3**.

Proposed Mitigation Measures

None required.

Significance of Residual Effect

Not Significant: The project undertaking will have a negligible impact on air quality.

9.4.2.8 Noise & Vibration (Construction)

Potential Project Interaction

Construction will involve surface works for replacing or construction of the new roadbed. As such, many areas along the corridor are expected to experience some degree of air quality, noise and vibration impacts during construction.

Potential Environmental Effect

The expected impacts from construction will be limited to isolated and local surface construction generating an increase in intermittent noise. Intermittent noise may be a disturbance to various individuals.

Proposed Mitigation Measures

Noise and Vibration BMPs as summarized in **Section 9.3.2.1**.

Significance of Residual Effect

Not Significant: Short-term, intermittent, localized nuisance for some adjacent land users.

9.4.2.9 Noise & Vibration (Design)

Potential Project Interaction

New roadway and transit infrastructure will result in changes to existing noise levels within the study area. The vibration levels resulting from the ultimate design are not expected to exceed the level commonly considered perceptible by most building occupants.

Potential Environmental Effect

Noise levels at a number of areas are greater than 55 dBA with the future conditions having an increase in noise levels more than 5 dBA. A few areas are also expected to exceed 60 dBA. Therefore, noise sensitive areas may be affected by the operation of the new roadway/transitway.

Vibration levels due to the project are not expected to exceed the level commonly considered perceptible by most building occupants. Future vibration would also be negligible with respect to the risk of structural damages or even cosmetic damages to building finishes.

Proposed Mitigation Measures

Noise control measures in the form of noise attenuating berms, walls, or in combination, will be required as part of the project, and have been incorporated into the design.

Noise levels at 2870 Navan Road, 2253 Maurice Street, 70 Whispering Winds Way, in addition to the lots north of Whispering Winds Way and Percifor Way (identified by Receptors 5-8, 11, 14) will require mitigation. Noise levels can be reduced by 6 dBA using a 2.8m tall sound barrier in most cases.

The maximum noise reduction possible for the property located at 2253 Maurice Street is 3 dBA, resulting in a noise level of 59 dBA at the OLA. Given the setback distance from the BCBE and the OLA, implementation of a noise barrier to achieve a 6 dBA reduction is not technically and administratively feasible. Should a barrier be implemented, it is recommended that a 2.5 m barrier be constructed. It is recommended that the requirement for noise mitigation be confirmed based on final/detailed design.

At the design stage further examination into potential noise and visual mitigation measures will be undertaken in relation to proposed changes in the vicinity of the Chapel Hill Park & Ride facility.

Significance of Residual Effect

Negligible/Moderate: Localized noise sensitive areas (Maurice Street) may be affected by the operation of the new roadway/ transitway and can be mitigated with noise walls/barriers.

9.4.3 Cultural Environment

9.4.3.1 Archaeological Resources

Potential Project Interaction

Potential construction activities include the use of excavators, dump trucks and heavy traffic as well as vegetation removal. The project will result in a new roadway, transitway, transit station, connections, bridge structures, channel realignment, a modified park and ride lot and widening of existing roads. In addition, there needs to be consideration of the locations of construction staging areas and temporary workspaces which have not yet been determined.

Potential Environmental Effect

Ground disturbance has the potential to destroy/disturb archaeological resources.

Proposed Mitigation Measures

A Stage 2 field investigation is required to confirm the nature and extent of disturbance to the existing landscape. In areas where ploughing is possible, a Stage 2 pedestrian survey assessment should be implemented. Where ploughing is not possible, the Stage 2 Assessment should consist of a test pit survey at 5 m intervals. Stage 2 Assessment recommendations are detailed in the Stage 1 Archaeological Assessment, provided in **APPENDIX F.1**.

Significance of Residual Effect

Negligible/Moderate: Potential effects on archaeological resources can be managed through accepted mitigation measures/BMPs.

9.4.3.2 Cultural Heritage Resources: 2090 Innes Road

Potential Project Interaction

Potential construction activities include the use of excavators, dump trucks and heavy traffic as well as vegetation removal. The project will result in a new roadway, transitway, and widening of existing roads in the vicinity of 2090 Innes Road. The exact locations of construction staging areas and temporary workspaces have not yet been determined.

Potential Environmental Effect

No anticipated impact to cultural heritage property located at 2090 Innes Road (**APPENDIX F.3**).

Proposed Mitigation Measures

The project is located a minimum of 115 m away from the built heritage resource (farmhouse). No further cultural heritage study or mitigation required.

Significance of Residual Effect

Negligible/Moderate: Indirect impacts can be fully mitigated with no permanent and negative effect if the proposed mitigations are implemented.

9.4.3.3 Cultural Heritage Resources: 2750 Navan Road

Potential Project Interaction

Potential construction activities include the use of excavators, dump trucks and heavy traffic as well as vegetation removal. The project will result in a new roadway, transitway, connections, park and ride lot and widening of existing roads. The exact locations of construction staging areas and temporary workspaces have not yet been determined.

Potential Environmental Effect

No anticipated impact to cultural heritage property located at 2750 Navan Road (**APPENDIX F.3**).

Proposed Mitigation Measures

The project is located a minimum of 425 m away from the built heritage resource (i.e., the chapel). No further cultural heritage study or mitigation required.

Significance of Residual Effect

Not Significant: Indirect impacts can be fully mitigated with proposed mitigation measure and no permanent or negative effect.

9.4.3.4 Cultural Heritage Landscape: Prescott Russell Trail

Potential Project Interaction

Potential construction activities include the use of excavators, dump trucks and heavy traffic as well as vegetation removal. The project will result in a new roadway, transitway, connections, park and ride lot and widening of existing roads. Construction staging areas and temporary workspaces will be required.

Potential Environmental Effect

Some vegetation removals will occur in the vicinity of the Prescott-Russell Trail in association with construction and operation.

Construction activities are not anticipated to isolate any heritage attributes from their surrounding environment, context, or significant relationship (**APPENDIX F.3**).

Proposed Mitigation Measures

The following measures are recommended:

- Limit vegetation clearing to the extent possible.
- Develop a Landscape Plan to restore the vegetation.

Significance of Residual Effect

Not Significant: Impacts can be fully mitigated with no permanent and negative effect following construction.

9.4.4 Built Environment

9.4.4.1 Traffic Operations (Construction)

Potential Project Interaction

Construction activities have the potential to cause short-term, temporary, and localized disruptions in traffic operations especially during the peak hours. This includes potential disruptions related to construction detours and lane closures where the BRT and BCBE will cross existing corridors.

Potential Environmental Effect

Traffic disruptions may be an annoyance and inconvenience for road and transit users. Increased delays may result in idling vehicles, contributing to temporary and localized increased pollution.

Proposed Mitigation Measures

BMPs:

- Emergency Response Plan
- Traffic Management, Access, and Pedestrian Control Plan
- Communications Plan

Significance of Residual Effect

Not Significant: Short-term, localized disruption/inconvenience for some users through construction.

9.4.4.2 Traffic Operations (Operation)

Potential Project Interactions

Following construction, the operational capacity of the road network should be improved. The project has the potential to:

- Reduce neighbourhood cut-through traffic.
- Address Volume to Capacity ratio and future traffic demands in the AM and PM peaks.
- Enhance emergency access and connections to communities.
- Enhance connectivity to park and ride and transit station facilities for all modes of travel.

It is anticipated that following construction of the BRT the reliability of transit services will improve and the resulting shift of riders from cars to buses should somewhat improve traffic congestion.

Potential Environmental Effects

A positive environmental effect is anticipated. Following construction of the BRT, the reliability of transit services will improve and the resulting shift of riders from cars to buses should somewhat improve traffic congestion.

Proposed Mitigation Measures

None required.

Significance of Residual Effect

Positive: Potential for improved traffic congestion and reduced neighbourhood cut-through traffic.

9.4.4.3 Transit Operations (Construction)

Potential Project Interaction

Construction activities have the potential to cause short-term, temporary, and localized disruptions in transit operations especially during the peak hours. This includes potential disruptions related to construction detours and lane closures where the BRT and BCBE will cross existing corridors.

Potential Environmental Effect

Transit disruptions may be an annoyance and inconvenience for road and transit users. Increased delays may result in idling vehicles, contributing to temporary and localized increased pollution.

Proposed Mitigation Measures

During the detailed design phase, a plan to manage traffic and transit service during construction will need to be developed in consultation with City Operations, the local communities, and other affected stakeholders.

Significance of Residual Effect

Not Significant: Short-term, localized disruption/inconvenience for some users through construction.

9.4.4.4 Transit Operations (Operation)

Potential Project Interaction

Following construction, the operational capacity of the transit network will be improved. The project has the potential to:

- Enhance transit network connectivity within 600 m of transit stations.
- Reduce the travel time from chapel hill park and ride to Blair station.
- Enhance connectivity to park and ride and transit station facilities for all modes of transport.

Potential Environmental Effect

A positive environmental effect is anticipated. Following construction, the reliability of transit services will improve and the resulting shift of riders from cars to buses should somewhat improve traffic congestion.

Proposed Mitigation Measures

Best management practices, and review of required accessibility and mobility requirements during detail design related to benefit enhancement measures that may be employed.

Significance of Residual Effect

Positive: Potential for improved travel times and reliability in transit services.

9.4.4.5 Active Transportation (Construction)

Potential Project Interaction

Construction activities have the potential to cause short-term, temporary, and localized disruptions to the active transportation network (pedestrian and cycling). This includes potential disruptions related to construction detours where the BRT and BCBE will cross existing pedestrian and cycling network including but not limited to trails, pathways, bike lanes, sidewalks and accessways.

Potential Environmental Effect

Disruptions to the active transportation network (pedestrian and cycling) may be an annoyance and short-term deterrent for network users. Any long-term inconvenience to active transportation users may result in shifting trips to the vehicular mode through the construction period, temporarily increasing pollution.

Proposed Mitigation Measures

BMPs:

- Emergency Response Plan
- Traffic Management, Access, and Pedestrian Control Plan
- Communications Plan

Significance of Residual Effect

Not Significant: Short-term, localized disruption/inconvenience for some users through construction.

9.4.4.6 Active Transportation Network (Operation)

Potential Project Interaction

Improvements to the active transportation network, following construction, includes potential for:

- Enhanced community connections
- New active transportation facilities (including the addition of a new mup)

Potential Environmental Effect

A positive environmental effect is anticipated. Following construction, the active transportation network is expected to have new community connections and network facilities.

Proposed Mitigation Measures

None required.

Significance of Residual Effect

Positive: Potential for enhancements to the active transportation network including new community connections and network facilities.

9.4.4.7 Sewer Infrastructure

Potential Project Interaction

The Innes Road corridor has a large storm sewer (750 mm to 900 mm diameter) and a large sanitary sewer (525 mm diameter) which fall within the grading limits of the proposed ultimate BRT alignment and tunnel, and the ultimate widening of Innes Road. Adjustments or relocations may be required to accommodate the proposed alignment.

The Greens Creek Collector Sanitary Sewer (3000 mm diameter) crosses the corridor just east of Blair Road. An access shaft is located approximately 10 m north of Innes Road. The Greens Creek Collector and access chamber do not fall within the grading limits of the proposed alignment although may require protection during construction.

A large storm sewer (750 mm diameter) on the south side of Navan Road will be in direct conflict with the proposed Navan Road/BCBE intersection modification. The storm sewer may be required to be relocated or adjusted.

Potential Environmental Effect

Short-term localized service interruptions may occur for various utility services due to component relocations prior to various construction activities. Permanent sewer relocation will be required in some locations.

Proposed Mitigation Measures

Coordination with various stakeholders will be required to confirm locates, protection requirements and relocations. Anticipated component relocations include but are not limited to the following:

- Sewer and manhole adjustments or relocations for the sanitary sewer on the north side of Innes Road.

- Sewer, manholes and catch basin adjustments or relocations for the storm sewer on the south side of Innes Road.

- Sewer, manholes and catch basin adjustments or relocations for the storm sewer on the south side of Navan Road.

Significance of Residual Effect

Not Significant: No adverse residual effects anticipated.

9.4.4.8 Water Infrastructure

Potential Project Interaction

There is a 400 mm diameter watermain under traffic lanes on the south side of Innes Road which falls within the grading limits of the proposed BRT and tunnel. Adjustments or relocations may be required to accommodate the proposed alignment.

Potential Environmental Effect

Short-term localized service interruptions may occur due to component relocations prior to various construction activities. Permanent watermain infrastructure relocation will be required in some locations.

Proposed Mitigation Measures

Coordination with the Drinking Water Services and Asset Management Branch to confirm protection requirements and relocations.

Significance of Residual Effect

Not Significant: No adverse residual effects anticipated.

9.4.4.9 Private Water Wells & Septic Systems

Potential Project Interaction

New road and BRT infrastructure will be constructed and operated in the vicinity of identified water wells – some of which are used for domestic and agricultural purposes. Given the lack of municipal services it is anticipated that septic systems exist within the study area. Potential impact to domestic water wells and septic systems within 50 m of the project area.

Potential Environmental Effect

Potential impacts to quality and quantity of water wells during some construction activities that require dewatering. Potential impacts to water quality from infrastructure run-off during operation. Potential impacts to private septic systems due to construction.

Proposed Mitigation Measures

Prior to construction, confirm the presence and use of wells. Identify the water source and usage and proposed monitoring if applicable at the time of construction.

Prior to construction, confirm the presence and use of septic systems in close proximity to the ROW. Identify the need to decommission and/or relocate any septic systems.

Significance of Residual Effect

Negligible: Potential localized effects can be managed with the implementation of BMPs.

9.4.4.10 Utilities: Hydro One

Potential Project Interaction

There are existing high voltage Hydro One Transmission Facilities within the study. The proposed alignment crosses the overhead transmission lines just west of Navan Road and reduces the existing line clearances.

Potential Environmental Effect

Construction works within the Hydro One Corridor have the potential to affect the environment of the transmission facility. This may include changes to drainage, vegetation removal and other natural environment components as previously discussed.

Proposed Mitigation Measures

Any changes to lot grading or drainage within, or in proximity to Hydro One transmission corridor lands must be controlled and directed away from the transmission corridor.

Any construction activities must maintain the electrical clearance from the transmission line conductors as specified in the Ontario Health and Safety Act for the respective line voltage.

As detail design progresses, formally confirm that Hydro One infrastructure and associated rights-of-way will be completely avoided.

Significance of Residual Effect

Not Significant: No adverse residual effects as Hydro One infrastructure and associated rights-of-way will be avoided.

9.4.4.11 Utilities: Enbridge

Potential Project Interaction

There are 300 mm and 150 mm diameter gas mains which run along the south side of Innes Road. In addition, there is an NPS 16 (400mm) diameter vital gas main which runs through the corridor on the south side of Anderson Road/Renaud Road from Innes Road to the north-south section of Renaud Road. There are large valve boxes for the vital gas main in the existing Anderson Road/Renaud Road roundabout. The vital gas main has three access points for inspection, two are in front of 2126 and 2170 Anderson Road and the third is located south of the Innes Road and Anderson Road Intersection. The vital gas main will require relocation to accommodate the proposed BRT tunnel crossing at Innes Road.

Potential Environmental Effect

Short-term localized service interruptions may occur due to component relocations prior to various construction activities. No adverse environmental effects are anticipated if the gas lines are properly located and excavation around the gas line is carried out safely.

The vital 400 mm diameter gas main is required to be internally inspected every few years in accordance with the CSA Z662 code. The inspection requires access to the main via the three access points using open cut excavations for a few weeks at a time. It is required that these points are protected, and access is maintained. Relocating the vital gas main and the associated valves would require an 18–24-month design lead time from Enbridge. The vital gas main will require relocation to accommodate the proposed BRT tunnel crossing at Innes Road.

Proposed Mitigation Measures

The most effective way to reduce risks of working around gas infrastructure is to plan works in locations where gas infrastructure is not located or where the impact can be minimized.

As detail design progresses, formally confirm the protection and relocation requirements with Enbridge. Allocate appropriate lead-time in the project schedule to collaboratively work through potential conflicts with Enbridge.

Significance of Residual Effect

Not Significant: No adverse residual effects anticipated.

9.4.4.12 Utilities: Hydro Ottawa

Potential Project Interaction

There are existing Hydro Ottawa overhead power lines and utility poles on the south side of Innes Road which may be in conflict with the project between Blair Road and the proposed BRT tunnel under Innes Road.

Potential Environmental Effect

Some relocation of Hydro Ottawa infrastructure will be required.

Proposed Mitigation Measures

Developments should not reduce line clearances or limit access to Hydro Ottawa infrastructure at any time. Any construction activities must maintain the electrical clearance from the transmission line conductors as specified in the *Ontario Health and Safety Act* for the respective line voltage. Allocate appropriate lead-time in the project schedule to collaboratively work through anticipated conflicts with Hydro Ottawa infrastructure along Innes Road and develop relocation plans.

Significance of Residual Effect

Not Significant: No adverse residual effects anticipated.

9.4.4.13 Utilities: Telecoms

Potential Project Interaction

There is existing shallow buried telecom infrastructure on the north and south side of Innes Road which may need to be relocated or adjusted to accommodate the tunnel and BRT construction.

Potential Environmental Effect

Short-term localized service interruptions may occur due to component relocations prior to various construction activities. No adverse environmental effects are anticipated if telecoms are properly located and excavation around telecoms is carried out safely.

Proposed Mitigation Measures

Coordination with the utility provider to confirm protection requirements and relocations.

Significance of Residual Effect

Not Significant: No adverse residual effects anticipated.

9.4.4.14 Areas of Potential Environmental Concern

Potential Project Interaction

Due to the relatively long development history, there is a potential to encounter impacted soil and/or groundwater in/on sites as identified in the Phase 1 Environmental Site Assessment (**APPENDIX C.3**). The Phase I Environmental Site Assessment identified areas of potential concern including: fuels spills; dumping/waste storage, former retail fuel outlets and a bombing range.

Potential Environmental Effect

Ground disturbance and/or changes to groundwater in areas of potential environmental concern may cause pollutants to migrate and/or become fugitive dust, thus creating a larger area of impact if left unmanaged. Unexploded ordinance may be a hazard if encountered.

Proposed Mitigation Measures

A Phase II ESA is recommended to confirm/assess if the above noted potential concerns will require additional management during the construction. An unexploded ordinance survey in the vicinity of the bombing range should be undertaken to remove potential dangers.

BMPs:

- Management of Contaminated Materials in accordance with legislation
- Dewatering Management Plan
- Excavated and Imported Materials Management Plan

Significance of Residual Effect

Not Significant: Effects are predicted to not be significant with implementation of known mitigation measures and implementation of the Phase I ESA recommendations, including completion of Phase II Environmental Site Assessments and BMPs as identified, as the project progresses.

9.4.5 Climate Change Adaptation

In December 2017, the Ministry of the Environment and Climate Change (MOECC) released guidelines titled “Considering Climate Change in the Environmental Assessment Process” which lay out the Ministry’s expectations for project proponents to consider including the potential effects of a project on climate change, and the potential effects of climate change on a project. The City of Ottawa’s Climate Change Master Plan lays out a framework to reduce greenhouse gas (GHG) emissions in accordance with Council’s reduction targets and respond to the current and future effects of climate change.

This EA considered the project’s potential impact on GHG emissions; assessed the resiliency or vulnerability of the project to changing climate conditions; and, identified potential climate change adaptations and future monitoring requirements based on regional climate and severe weather projections to 2050 and beyond.

Climate change presents both challenges and opportunities, particularly in relation to infrastructure design, implementation, and operations/maintenance. There are two categories of response to climate change risk, namely:

- Mitigation refers to human interventions to reduce GHG emissions.
- Adaptation refers to any activity designed to reduce the negative impacts of climate change and/or takes advantage of new opportunities.

The Recommended Plan provides new infrastructure for sustainable modes of active transportation and transit, thus reducing greenhouse gas emissions. The landscaping plan will include offsetting of any loss of existing trees and vegetation, which will ensure that study area planting continues to provide a carbon sink. Some of the potential hazards identified for this project include extreme rain impacts to the roadway/transitway, bridges, and culverts; freezing rain impacts to overhead wires, roadways, and walkways; extreme heat impacts to public health;

and extreme wind impacts to landscaping and emergency access routes. To mitigate these impacts, adaptation options for the project may include engineering and technological solutions, as well as policy, planning, management, and maintenance approaches (**Table 9-2**). For example, more frequent storm events with increased runoff of roadway drainage may require larger roadside ditches and/or storm sewers. Increased frequency of extreme heat days may require additional shading and rest areas/benches along pathways and/or landscaping protection at the Chapel Hill Park and Ride transit station or at bus stops along Innes Road.

It is recommended that additional climate lens assessment be undertaken and that climate change adaptation measures be considered during detailed design including those related to flood design, stormwater management, selection of plant species for landscaping and erosion protection. This will be particularly important in relation to the natural channel design for the realignment of Mud Creek. To account for increases in rainfall intensities due to climate change the design of culverts should be based on projected future rainfall events and the design of storm sewers should be checked against the 100-year storm plus 20%. It is also proposed that sustainable design principles be followed including consideration of low carbon material selection and sourcing which should be based on a GHG emissions assessment of the project based on the City's carbon calculator or similar tool.

Table 9-2: Preliminary Recommendations for Climate Change Adaptation

Infrastructure Component ID No.	Potential Functional Design/ Environmental Assessment Considerations	Potential Preliminary Design/ Detail Design Considerations	Potential Maintenance/ Operations Considerations
No. 1: Roadway Pavement	• Increased risk of freeze-thaw damage to pavements. • Document issues for consideration at Preliminary/Detail Design.	• Assess risk and consider modifications during pavement design.	• Assess/monitor climate change implications for maintenance/operations planning and standards (e.g., increased ditch erosion and debris accumulation due to increased severe weather events; increased freeze-thaw; increased freezing rain). • Develop Standard Operating Procedures (SOPs) for: a. Monitoring b. Response Plans c. Contingency/Back-up Plans d. Restoration/Lessons Learned
No. 2: Roadway Drainage	• Increased peak runoff could result in larger roadside storm sewers and/or ditches. • Potential for increased erosion risk along Mud Creek	• Consider climate change implications during design (e.g., peak design storms, stress testing of designs, IDF curves for future conditions). • Consider additional erosion protection of ditches and outlets, as well as natural channel design for the realigned Mud Creek.	
No. 3: Bus Stops	• Projected increases in extreme heat days may require adjustment of bus-stop shelter design and provision of shading. • Document issues for consideration at Preliminary/Detail Design.	• Extreme heat should be considered when choosing materials and designing bus shelters and landscaping.	
No. 4: Landscaping	• Projected changes to average temperatures, extreme heat days and water balance cycle (drought) may influence landscaping design and life cycle. • Document issues for consideration at Preliminary/Detail Design.	• Design should consider future climate change conditions (landscaping composition, tolerance to changing climate, growth rates, invasive species). • Tree planting plan should consider implications of broken off limbs or downed trees.	

9.5 Cumulative Effects

The Joint Study to Assess Cumulative Effects of Transportation Infrastructure on the National Capital Greenbelt (AECOM, 2012) was undertaken in partnership by the NCC and the City of Ottawa to identify projects within the TMP and other transportation projects that could have an impact on the environmental integrity of the federal Greenbelt lands. The fundamental notion behind Cumulative Effects Assessment (CEA) is that if proposed projects are evaluated individually, the broader perspective may be overlooked.

The Cumberland Transitway (OR 174 to Navan Road) and the Blackburn Hamlet Bypass Extension EA projects (Delcan, 1999a and 1999b), approved by the NCC "with conditions", were included in the above 2012 Joint Study of Cumulative Effects.

It is anticipated that the currently recommended Brian Coburn Boulevard Extension and Cumberland Transitway designs will be included in an updated study of cumulative effects of transportation infrastructure on the National Capital Greenbelt to be undertaken after the City's next TMP update.

9.6 Sustainability Statement

Sustainability refers to meeting the needs of the present without compromising the ability of future generations to meet their needs. The concept of sustainability is composed of economic, environmental, and social components. Specifically, this study has considered the following sustainability components:

- Provision of multi-use pathways and accessible transit stations.
- Collaboration with agency, businesses, and the public throughout the study process.
- Evaluation of alternative solutions and designs with natural, social, and cultural environmental considerations.
- Climate mitigation and adaptation/resilience.

The design and implementation of the infrastructure (road and transit) within a single corridor serves to reduce the physical infrastructure footprint and discourage Single Occupancy Vehicles (SOV) travel. Principles outlined in the City's "Basis for Sustainable Road Corridors" will also be utilized for sustainable road corridors in the rural area including:

- Community Connector
- Green Space
- Multi-Modal Routes

- Drainage
- Access Provider

By incorporating sustainability principles throughout the planning and design stages, the project will provide a greater sustainability return at lower cost, compared to inclusion of sustainability opportunities late in the project development process. Given the preliminary stage of the project, it will be important to consider sustainability moving forward, including incorporation/action on the recommendation for climate adaptation strategies, as identified in **Section 9.4.5**.

9.7 Limitations

This evaluation is limited to the physical and temporal boundaries of the project, as defined in **Sections 5.1** and **9.1** of this report. Any other changes or activities that may occur in the future are not considered to be within the scope of this study. The current assessment does not consider potential impacts due to gross human error in the normal operation and/or unpredictable accidental effects that may result. Such incidences are considered outside the scope of reasonable predictability of the purpose of the assessment for this project.

All known available project information has been reviewed to verify and disclose the existence of environmental concerns associated with its activities. The accuracy of discussions, conclusions and recommendations presented herein are limited to the extent of the resources available.

10. FUTURE COMMITMENTS

10.1 Property Acquisition

The preferred option for the BCBE/CTW project is partially within lands that are not currently purposed for a transportation right-of-way. Additional lands are required from landowners, particularly the National Capital Commission.

The acquisition of temporary property needs, including temporary construction easements, will proceed as definitive property plans are developed.

10.2 Implementation/Staging Opportunities

Project staging and phased implementation is likely due to the high cost of the project, consideration of other projects (such as the Innes-Walkley-Hunt Club), and land and budget availability. The City may consider the following possible staging and construction sequences:

- BCBE will connect to a future Innes-Walkley-Hunt Club (IWHC) extension approximately 400 m south of Innes Road. The ultimate recommended plan assumes that the BCBE will connect to at least a completed Innes-Walkley connection, or that the two projects would be completed within the same timeframe.

- When land and budget are available, the ultimate plan may proceed in stages, anticipated to start with the realignment and the stabilization of Mud Creek east of the existing culvert crossing Renaud Road. The ultimate plan would then proceed via construction of road segments in areas that construction will not interfere with existing roads, to maintain traffic. The remainder of construction on existing roadways would follow. The BRT construction will be completed as a second phase of construction, following completion of the roadways.

- The proposed BRT Tunnel under Innes Road may be constructed by driving secant piles through existing pavement, installing the deck and pavement before proceeding with the tunnel excavation. This method of construction would maintain traffic on Innes Road through construction. This construction strategy was utilised in the LRT expansion project to construct the OR174 bridge over Greens Creek.

- The proposed bridge over the BRT on Navan Road can be constructed after the completion of the BCBE. Traffic on Navan Road could then be directed to BCBE while the excavation for the bridge is underway. The proposed retaining walls that support the embankment will be constructed simultaneously with the embankment and lightweight fill construction.

Detailed implementation and staging plans will be developed in advance of construction.

10.3 Design Details

The project design as it currently stands is functional in nature. Refinements to the preferred alternative will continue in subsequent stages of design to achieve the following:

- Improve operating characteristics.
- Reduce future maintenance requirements.
- Minimize construction and operation environmental related impacts/effects.
- Reduce capital and operating costs.
- Minimize impacts to adjacent properties.

In general, measures which must be undertaken to minimize potential negative effects will be worked out such that the design can be tailored to recognize them. Contract drawings and documents will include special provisions to ensure the least impact on the environment.

10.4 Approvals

This Environmental Study Report under the *Ontario Environmental Assessment Act, R.S.O. 1990* does not constitute approval under other legislation required to construct the project. Specific approvals will be required for components of the project.

The Recommended Ultimate Plan requires an estimated 42 hectares of NCC Greenbelt lands to implement this project. To date, the NCC position remains firm that "*federal lands required to implement the Brian Coburn Boulevard /Cumberland Transitway extension alignment Options 5 and 7 will not be made available by the NCC.*"

Although this EA study is following the requirements of the EA Act of Ontario and NCC approval is not required for this legislated process, NCC approval will be required during implementation of the Recommended Plan (post 2031) and is subject to the "*Federal Land Use, Design and Transaction Approval Process".* Given the longer-term plan for implementation is post 2031, there is time for further discussion with the NCC on a mitigation strategy for the required NCC Greenbelt lands.

The following is a list of approvals and permits that may be required and associated agencies that should be consulted moving forward. This list is representative of the types of permits and agencies that may be required and will be finalized during detailed design. Additional approval requirements will be considered and discussed with the approval agencies.

10.4.1 Federal Approvals

10.4.1.1 NCC Federal Land Use, Design & Transaction Approvals

A request for Federal Land Use Approval to the NCC will be required at a future date when funds are committed for more detailed design, and a construction timeframe is proposed. The project would also trigger a federal level environmental effects analysis per the Impact Assessment Act (IAA).

The City will be required to conduct a federal environmental effects analysis that documents the environmental effects indicated within the IAA for the NCC to assess potential impacts and proposed mitigation measures, construction monitoring and follow-up studies.

10.4.1.2 Authorization Under the Fisheries Act

Based on assessment of specialized works such as culvert extension and channel re-alignment at the existing western Renaud Road crossing of Mud Creek, it is anticipated that such works will require review by the Department of Fisheries and Oceans to confirm if death of fish or harmful alteration, disruption or destruction (HADD) of fish habitat can be avoided or mitigated or if a Fisheries Act Authorization is required to proceed.

10.4.1.3 Species at Risk Act Permits

The existing habitat conditions along the preferred BCBE corridor was assessed and determined that potential for terrestrial natural heritage features that support SAR and/or provide SAR habitat exists within the study area. The need for Species at Risk Act Permits will be confirmed at a future date based on details of recommended field studies, detailed design, and construction details as well as the Species at Risk identified in the Act at the time of design/construction. The permits are currently administered by Environment and Climate Change Canada.

10.4.2 Provincial

10.4.2.1 Environmental Activity & Sector Registry or Permit to Take Water

Environmental Activity and Sector Registry (EASR) and/or Permits to Take Water (PTTW) may be required if the construction involves taking, dewatering, storage, or diversion of water in excess of 50 m^3/day - administered by the Ontario Ministry of the Environment, Conservation and Parks.

10.4.2.2 License to Collect Fish for Scientific Purposes

License to collect fish for scientific purposes will be required from the Ontario Ministry of Development, Mines, Natural Resources and Forestry (NDMNRF). NDMNRF is responsible for fish collection and transport in Ontario under the provincial *Fish and Wildlife Conservation Act*.

10.4.2.3 Permit Under the Endangered Species Act

The existing habitat conditions along the preferred BCBE corridor were assessed and determined that potential for terrestrial natural heritage features that support SAR and/or provide SAR habitat exists within the study area. The need for Species at Risk Permits will be confirmed at a future date based on details of recommended field studies, detailed design, and construction details. The permit is administered by the Ontario Ministry of the Environment, Conservation and Parks.

10.4.2.4 Environmental Compliance Approval

Environmental Compliance Approvals (ECAs) are administered by the Ontario Ministry of the Environment, Conservation and Parks. Approvals may be required in accordance with the *Ontario Water Resources Act* and/or *Environmental Protections Act* for discharges related to air, noise, waste, and sewage. Where changes to Oil and Grit Separator units may be required along Innes Road, ECAs may be required.

10.4.2.5 Well Abandonment

To determine if a well needs to be abandoned, the City should refer to Regulation 903 (Wells Regulation), as amended under the Ontario Water Resources Act and the Wells Regulation Well Abandonment: When to Plug & Seal a Well technical bulletin.

10.4.3 Municipal

Municipal permits, licenses, and authorizations may be required for the construction period, including for utility relocates, noise bylaw exemptions, road modification approvals, road cut permits and encroachment permits.

10.4.3.1 Development, Interference with Wetlands & Alternations to Shorelines & Watercourses Approval

As the proposed works fall within natural areas regulated by the RVCA, permission for the proposed works will be required from

RVCA under *Ontario Regulation 174/06 – Regulation of Development, Interference with Wetlands and Alterations to Shorelines and Watercourses* (*O.Reg. 174/06*).

10.4.3.2 Permit to Decommission an Existing Septic System

Given the rural context of the study area, the potential for septic system impacts exists. Details on system location and site-specific impacts will be confirmed during detail design. Where decommissioning of an existing septic system is required, coordination with the Ottawa Septic System Office will be required. A formal process is in place for decommissioning and a permit and inspections may be required by the RVCA.

10.5 Notice of Completion

The Notice of Completion will be issued to complete the screening requirements for this Schedule C project. The review period associated with the Notice of Completion is 30 calendar days.

The Notice will advise the public and review agencies of their rights with regard to requesting an Order and will clearly state the review period and date by which submissions and/ or requests are to be received. Requests for an order requiring a higher level of study (i.e., requiring an individual/comprehensive EA approval before being able to proceed), or that conditions be imposed (e.g., require further studies), may only be submitted on the grounds that the requested order may prevent, mitigate, or remedy adverse impacts on constitutionally protected Aboriginal and treaty rights. Requests on other grounds will not be considered. Requests should include the requester contact information and full name. Requests should specify what kind of order is being requested (request for conditions or a request for an individual/comprehensive environmental assessment), how an order may prevent, mitigate, or remedy potential adverse impacts on Aboriginal and treaty rights, and any information in support of the statements in the request. This will ensure that the Ministry is able to efficiently begin reviewing the request.

If no request is received within the review period specified in the Notice, the proponent may proceed to design and construction of the project.

10.6 Monitoring

Verification of the accuracy of the prediction of environmental effects is completed via monitoring. Monitoring measures have been incorporated to determine what effects occur with project implementation. Mitigation measures may be modified in subsequent stages of design to improve their effectiveness and best management practices at the time of implementation. Monitoring measures should include inspection and surveillance, and compliance monitoring.

The identified environmental impacts are to be monitored during and after construction. The City of Ottawa is to ensure that experienced and appropriately trained staff manage and supervise the construction of the project. The contractor will be required to maintain and replace, as required, certain construction items pertaining to environmental impact mitigation (e.g., erosion and sediment control devices) during construction, as well as a specified post-construction period.

The City of Ottawa will monitor traffic volumes and roadway operations and make adjustments (e.g., traffic signal timing) to ensure the corridor effectively handles traffic conditions. The City of Ottawa will be responsible for regular long-term monitoring and maintenance of the roadworks, bridges and culverts, stormwater management facilities, and landscaping within the right-of-way.

10.7 Revisions to Schedule C Project Files

This Report is based on a functional design level of detail for the Brian Coburn Boulevard Extension/Cumberland Transitway Westerly (Navan Road to Blair Road at Innes Road). The functional design level provides the basis of the design and additional detail will be developed during later stages of preliminary and detailed design. The functional design does provide a sufficient level of detail to assess the environmental effects of the Recommended Plan. The effects identified in the EA are considered reliable for the MECP to base a decision on regarding approval of the proposed project. Once approval is received from the MECP in accordance with the MCEA Schedule C, the project may proceed.

Changes to the project as described may arise in terms of study area conditions, the development of new technology or mitigation measures, cost control, or the identification of previously unknown information. These changes may be consistent with this ESR in that they:

- Do not fundamentally affect the identified impact or mitigation measures,
- Do not change the landowner notification requirements, and
- Do not include additional approval agencies.

Significant modifications to Schedule C projects, as presented to the public during the screening process and as set out in the Notice of Completion should be reviewed by the proponent. Similarly, if the time between filing the Notice of Completion to the commencement of construction for the project exceeds ten years, the proponent must review the planning and design process to ensure that the project and the mitigating measures are still valid in the current planning context.

11. CONCLUSIONS

The Brian Coburn Boulevard Extension and Cumberland Transitway Project has the potential to change the surrounding natural and social environments, including rural features associated with the City's Greenbelt. The purpose of this environmental assessment is to anticipate reasonably foreseeable potential changes to the human and biophysical environments and recommend measures to mitigate the negative effects and enhance or broaden the positive environmental effects.

In this study, the existing conditions were documented, alternative solutions and designs were identified and evaluated, and an Ultimate Recommended Plan of the preferred design was developed. Throughout the process, the study benefited from public and agency engagement including meetings with the Agency and Public/Business Consultation Groups, and three public open houses. The study also was subject to a civic dialogue, which culminated in the City of Ottawa Transportation Committee recommendations and Council approval. Through these meetings, the Study Team was able to identify and mitigate localized impacts for both users and residents/landowners immediately adjacent to the proposed project.

During the construction phase, the overall corridor will be an active construction site. Traffic disruptions, noise, dust, and visual interruptions will be inevitable. Ongoing communications by the City of Ottawa with the NCC and the affected public will go a long way in alleviating potential concerns and ensuring that timely information about the project is shared. Once complete, there will be many positive effects such as the enhanced transit, pedestrian and cycling facilities. While the project has the potential to have effects on the human and biophysical environments during construction in the vicinity of the project, these effects can be largely mitigated with prescribed design features and best management practices.

New infrastructure in an existing natural environment can result in potential negative impacts to the existing environment. Site-specific project mitigation measures have been included to reduce the overall effects of the project. Permanent effects can be largely mitigated with prescribed design features, site-specific mitigation measures and on-going agency/regulatory engagement. Determination of off-setting measures, the recommendation for remediation plans and additional studies will be required at detailed design and will be developed in consultation with regulating authorities. Through incorporating the mitigation measures recommended by this study, no significant adverse environmental effects are expected to result.

In accordance with the provisions of the Municipal Class Environmental Assessment Schedule C Process, the study results are documented in this Environmental Study Report, which will be made available for public review once finalized. During this period, there will be an opportunity for an individual or group to provide a written submission to the Minister of the Environment, Conservation and Parks. A request for a Part II Order requiring a higher level of study (i.e., requiring an individual/comprehensive EA approval before being able to proceed), or that conditions be imposed (e.g. require further studies), may be made to the Ministry of the Environment, Conservation and Parks but only on the grounds that the requested Order may prevent, mitigate or remedy adverse impacts on constitutionally protected Aboriginal and treaty rights. Requests on other grounds will not be considered.

Informed by this Environmental Study Report, this project will culminate in the completion of detailed designs, specifications, and tender documents, as well as other associated approvals for the initial stage of construction. The detailed project mitigation features and plans will be created during the detailed design phase. The project will then be tendered and constructed in accordance with the plans and details.

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APPENDIX A – Functional Design Plans

APPENDIX B – Record of Consultation

Consultation Report
Brian Coburn Extension/Cumberland Transitway Westerly Environmental Assessment Study (MH, 2021a)

APPENDIX C – Built Environment

C1: Travel Demands & Needs Assessment – Brian Coburn Boulevard Extension & Cumberland Transitway Alternate Corridor EA Study (MH, 2019)

C2: Peak Hours Traffic Analysis – Brian Coburn Boulevard Extension & Cumberland Transitway Alternate Corridor EA Study (MH 2021e)

C3: Phase 1 Environmental Site Assessment – Brian Coburn Boulevard Extension & Cumberland Transitway Westerly Project, Ottawa, ON (Golder, 2020)

C4: Functional Design Report – Drainage & Stormwater Management – Brian Coburn Boulevard Extension (BCBE) (MH, 2021c)

APPENDIX D – Natural Environment Records

D1: Memorandum – Fisheries Existing Conditions & Impact Assessment, BCBE/CTWY (MH, 2021b)

D2: Memorandum – Terrestrial Existing Conditions & Impact Assessment, BCBE Update (MH, 2021d)

D3: Technical Memorandum – Subsurface Conditions Overview, Brian Coburn Boulevard Extension & Cumberland Transitway Westerly to Blair Road to Brian Coburn Boulevard, Ottawa, ON (Golder, 2018a)

D4: Functional Design Level Geotechnical Input – Preferred Alternative Brian Coburn Boulevard Extension/Cumberland Transitway Westerly EA Study, Ottawa, ON (Golder, 2021b)

APPENDIX E – Social Environment Records

E.1: Land Use Planning Existing Conditions Report – Environmental Assessment Study Brian Coburn Boulevard Extension & Cumberland Transitway Westerly, Alternate Corridor (CH2M, 2018)

E2: Preliminary Existing Conditions (QEC) – Briand Coburn Boulevard Extension/Cumberland Transitway Westerly Alternate Corridor EA Study (GWE, 2018)

E3: Air Quality, Noise & Vibration Impact Assessment – Brian Coburn Boulevard Extension/Cumberland Transitway Westerly Alternate Corridor EA Study (GWE, 2021)

APPENDIX F – Cultural Environment

F1: Stage 1 Archaeological Assessment – Brian Coburn Boulevard Extension & Cumberland Transitway Westerly (Blair Road to Brian Coburn Boulevard), Alternative Corridor Environmental Assessment Study, Township of Gloucester, City of Ottawa, Carleton County (Golder, 2018c)

F2: Cultural Heritage Existing Conditions Brief – Environmental Assessment, Brian Coburn Boulevard Extension & Cumberland Transitway Westerly Alternative (Golder, 2018b)

F3: Cultural Heritage Report – Existing Conditions & Preliminary Impact Assessment, Brian Coburn Boulevard Extension & Cumberland Transitway Westerly Alternative Corridor Environmental Assessment Study, City of Ottawa, Ontario (Golder, 2021)

APPENDIX G – Corridor Evaluation Summary

G1: Brian Coburn/Cumberland Transitway Alternate Corridor EA Study – Short-Listed Options, Roadway/Bus Rapid Transit (Network), Assessment of Alternatives (MH, 2021)