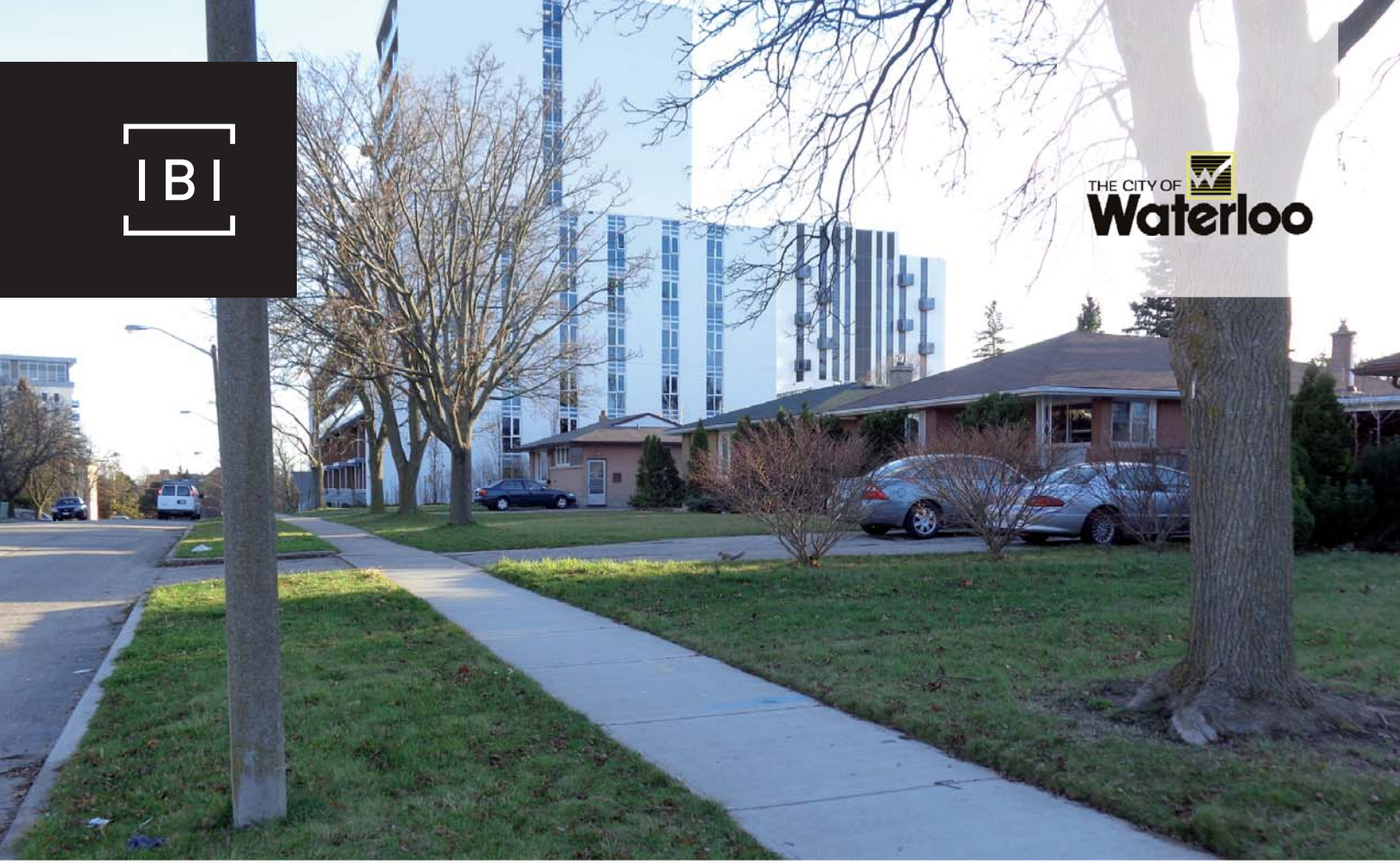

PROJECT FILE REPORT

Part A: Northdale Neighbourhood Streetscape Master Plan & Class Environmental Assessment, Schedule 'B'

Submitted to City of Waterloo
by IBI Group
November, 2016

Final Project File Report

Part A: Northdale Neighbourhood Streetscape Master Plan Class Environmental Assessment Schedule ‘B’

Prepared for City of Waterloo
by IBI Group
November 21, 2016

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REVIEWER:	Don Drackley
AUTHORIZATION:	Don Drackley
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APPENDICES (provided separately)

EXECUTIVE SUMMARY

Purpose of the Master Plan

This Northdale Streetscape Master Plan study area is bounded by University Avenue, Philip Street, Columbia Street and King Street N, although these boundary streets are not included in the study area. Continued development requires an assessment of infrastructure and utilities within the Northdale neighbourhood including design concepts and strategies for public spaces utilities, and reconstruction of city streets. This master plan was developed using a comprehensive and environmentally sound planning process. Public consultation was an important component during the development of this plan with opportunities, such as three Public Information Centres, to facilitate dialogue between those with differing interests. The study was carried out under the direction of the Project Team comprised of staff from the City of Waterloo and IBI Group.

The Northdale multi-modal transportation system will provide transportation choices that encourage more sustainable transportation modes such as transit and active transportation (pedestrian orientated streets, sidewalks and cycling facilities). The City's Official Plan (OP) provides explicit guidance for the redevelopment and urbanization of Northdale. The OP recognizes that Northdale is going through a phase of transition, and supports this transition into a vibrant "mixed-use neighbourhood" that will accommodate residential, commercial and employment uses.

The Northdale Streetscape Master Plan conforms to the "Complete Streets" ideals laid out in the City's Transportation Master Plan to make roads accessible for all users: vehicles, cyclists, pedestrians and transit. It also conforms to; 1) the Northdale Land Use and Community Improvement Plan Study (2012), 2) Community Improvement Plan and 3) Urban Design Manual and Land Use Plan. The Community Improvement Plan (CIP) will aid decision-making by providing development principles for the long-term and implementing the "vision" of Northdale:

> *By 2029, Northdale is revitalized and reurbanized into a diverse, vibrant and sustainable neighbourhood, integrated with educational, residential, commercial, cultural, heritage and recreational functions, and improved open space, pedestrian, cycling and transit networks.*

Consultation

Through an effective consultation program, the City of Waterloo was able to generate meaningful dialogue between the Project Team and the agencies, stakeholders and the public, resulting in an exchange of ideas recorded in the Project Record, and the broadening of the information base leading to better decision making. Formal Public Information Centres were held on December 1, 2015, May 11, 2016 and September 14, 2016. Other stakeholder group meetings were arranged throughout the study, for example with Waterloo Collegiate Institute, the Waterloo Regional District School Boards, Wilfrid Laurier University, Waterloo Fire Rescue and other involved City departments.

Problem / Opportunity Statement

Identified problems that need to be addressed include:

- Water Delivery System - The water delivery system in the neighbourhood is old. In some cases, pipes are not adequately sized to meet the demand of higher density projects.
- Sanitary Sewer System – Many pipes are reaching the end of their useful life, and will require increased maintenance and /or replacement.

- Storm Water Management - The current storm sewer system is undersized by today's standards and shallow. There are also existing overland flow issues.
- Hydro / Telecommunication Utilities – Above ground hydro/telecommunication lines and poles within the street right-of-way are generally unattractive.
- Roadway Lighting – Roadway lighting is predominately provided by fixtures attached to utility poles on any side of the roadway. The light levels are perceived to be deficient when compared to current standards. There is no provision for pedestrian lighting.
- Transportation Management – The roadway network cannot adequately accommodate vehicular and active transportation travel demands.
- On-Street Parking – Challenge to balance the use of space to meet on-street parking needs, as well as the streetscape and urban design objectives.
- Vegetation – Existing street trees in some cases pose problems due to their age, invasive species and impacts from redevelopment.

There are also many opportunities for the Northdale neighbourhood including:

- Implement the recommendations of the Northdale Land Use and Community Improvement Plan for all streets and public spaces.
- Coordinate with prioritized improvements to water, sanitary sewer and storm water management systems.
- Construct new active transportation and on-street parking features, as envisioned by the Land Use and Community Improvement Plan.
- Continuation of the City/neighbourhood partnership in planning how to best manage change in the Northdale neighbourhood.

Existing Transportation Analysis

From the onset of this study, it has been the consensus view of the study team that accommodating traffic, specifically vehicular traffic, should not be the driving force of this study. In keeping with that approach, the objective of the transportation analysis has been:

> not to find ways to accommodate all future demand for vehicular traffic, but rather to present mobility and parking recommendations that will help to shape travel and mode choice within the neighbourhood.

From the analysis, the intersection of King Street at Columbia Street is operating above capacity during both the AM and PM peak periods section.), University Avenue and Albert Street and University Avenue and King Street are operating at or approaching capacity during the PM peak period. This indicates that Albert Street is functioning as a minor arterial, and not simply being used for cut-through traffic (via Hickory Street) or neighbourhood access. All movements entering the neighbourhood are operating below capacity, but many have poor levels of service due to control delays. These results are consistent with typical vehicular operations along major arterials during the peak periods.

There are up to 1320 potential parking spaces available within the neighbourhood depending on restrictions. The primary purpose of existing on-street parking in the study area is to supplement residential off-street parking, in particular by providing extra space for guests and short-term overnight parking. On-street parking is not meant to replace off-street visitor parking, and it remains the responsibility of developers to ensure they are providing adequate visitor parking for their buildings on-site. The majority of the streets within the neighbourhood have some variation of a parking restriction.

The lack of restrictions, such as payment, encourages the use of on-street parking, which was observed to be well-utilized during site visits associated with this study. At present, the primary user of on-street parking appears to be the construction workers, as a significant portion of the neighbourhood is under construction at any given time. The dynamic nature of the neighbourhood and the presence of temporary users (e.g., construction workers) makes it difficult to get an accurate assessment of the long-term demand for on-street parking by residents through traditional means of observation and spot surveys. Therefore, these traditional methods of gathering parking utilization information were not conducted for this study.

Within and around the study area, numerous private and publically-available commercial off-street parking lots are also present. City by-laws mandate that the owners of these parking lots have properly accounted for the parking needs of their patrons; however, due to higher-than-expected demand or a desire to avoid parking fees, concerns have been raised about parking spillover into the neighbourhood.

Multiple intersections along the study area edges are in the Region of Waterloo's top locations for vehicle, pedestrian, and cyclist collisions in 2014. In total, there are 684 individual collisions documented. Rear-end collisions are the most frequent initial impact type, followed by turning movements. This is typical of signalized intersections.

Existing Neighbourhood Conditions

The status of development within Northdale as of mid-2016 will impact the timing of infrastructure upgrades. The status includes:1) properties already developed, 2) under construction, and 3) approved, as well as commercial and institutional areas. Zoning and Building Setbacks are dictated by the Zoning By-Law.

Other relevant conditions included piped infrastructure, electrical/lighting, and environmental considerations.

Piped Infrastructure

The majority of the piped municipal infrastructure (water, sanitary and storm) within the Northdale community was originally installed in the 1960s, or earlier, and is reaching the end of its service life. Recognizing that municipal design standards have been updated since the area was serviced and that the population density and hard surface cover will be increasing in the future, capacity constraints during the fully developed conditions were expected and have been confirmed.

The municipal infrastructure capacity constraints are examined and identified in more detail in previous and ongoing studies completed by the City of Waterloo including Waterloo Core Area Infrastructure Assessment (Stantec, September 2011); City of Waterloo Official Plan (City of Waterloo, October, 2014); City-Wide 2014 Sanitary Servicing Master Plan Update Final Report, (Stantec, August 21, 2015); Master Drainage Study Urbanized Watersheds, Final Report (McCormick Rankin Corporation, March 7, 2005); Update Infrastructure Management Analysis Report and Comprehensive Asset Management Plan (GM Blue Plan Engineering, current).

Sanitary Sewers

Most of the current sanitary sewer infrastructure in the study area predates 1960. A noted level of deterioration has been identified as the pipes are nearing the end of their life cycle and many are in need of replacement. Minor capacity constraints were identified at the full buildout scenario that could be resolved through either minor upsizing of the pipes or an increase in the slope during replacement. The constrained areas are identified in the Waterloo Core Area Infrastructure Assessment (Stantec, 2011).

Storm Sewers and Drainage

Municipal design standards for storm sewers have changed significantly since the Northdale community was serviced. Notwithstanding age and condition considerations, the majority of the storm sewer system will need to be replaced to meet current standards. The Master Drainage Study Urbanized Watersheds, Final Report (McCormick Rankin Corporation, March 7, 2005) provided an assessment of drainage issues within the City of Waterloo, and identified the outlet from Columbia Street West to Spruce Street as an area of concern that requires remediation. The Waterloo Core Area Infrastructure Assessment (Stantec, September 2011) identified storm sewer capacity constraints for drainage areas within the City of Waterloo, including the Northdale area.

Overland drainage patterns and major storm routing do not appear to have been taken into account during the development of the area. The major overland flow routes generally follow the road network, and drainage from lots sheet flow overland toward the road right-of-way. Drainage from a 53.84 ha residential and commercial area to the north of Columbia Street West, drains onto the Waterloo Collegiate Institute (WCI) property, then toward Spruce Street via private lots, and then ultimately to King Street North via Hickory Street West. As a result, there is relatively frequent inundation of the northeastern portion of the WCI property as the storm sewer capacity is exceeded and excess waters drain overland from Columbia Street.

To mitigate the impact of the increased hard surface coverage as a result of intensified development and address the existing flooding issues, the following should be considered:

- Storm sewers for all proposed road reconstruction projects must be sized to convey the 5 year storm event, and meet all required City of Waterloo engineering standards.
- Stormwater quantity controls should be required on-site for all developing areas to control proposed conditions peak flows for the 2 year, 5 year, and 100 year return events to existing conditions levels.
- Stormwater quality controls should be required on-site to provide a Normal Protection Level for runoff discharging off-site as per the 2003 MOE Stormwater Planning and Design Manual (70 percent Total Suspended Solids removal of 85 percent of annual flows).
- Site Plan and municipal infrastructure engineering designs should accommodate active infiltration LID features, if soil and groundwater conditions permit. Long-term monitoring and maintenance should be completed for all LID features and BMPs constructed on private developments to ensure their continued operation.
- The Spruce Street, Hickory Street, and Hawthorn Street storm sewers should be sized to accommodate a 5 year storm peak flow of 1.2 m^3/s discharging from the WCI lands, provided that stormwater quantity control storage can be made available on the WCI lands. The feasibility of providing stormwater control on the WCI lands must be established based on further consultation with the landowner.

Watermains

The Waterloo Core Area Infrastructure Assessment (WCAIA) predicts that some watermains within the Northdale neighbourhood will have capacity constraints (low available fire flows) in the fully developed scenario. To facilitate new developments, the City has allowed developers to complete upgrades to the municipal water system on an ad-hoc basis to provide for fire protection and the domestic demands of high-density developments prior to issuing development approval.

The majority of the system predates 1960 and have reached the end of its service life. Watermain failures are becoming more frequent.

Watermains should be replaced to current standards (as recommended by the WCAIA) as the roadways are reconstructed.

Electrical Infrastructure Burial/Pedestrian Lighting

Electrical

The existing electrical service in the Northdale Study Area consists of mostly overhead 13.8kV electrical power distribution lines with the only exception being Lester Street which is underground. An investigation on the feasibility of burying more electrical service in appropriate parts of Northdale was undertaken. Different options were evaluated based on identified criteria gain an understanding of the cost impacts of each option as summarized in the following table.

METHOD	COST	AESTHETICS	LAND USE IMPACTS	IMPACTS ON STREET LIGHTING
Above Ground	Low	Low	High	Low
Buried Cable Vaulted Equipment	High	High	Med	High
Buried Cable Pad Mounted Equipment	Medium	Medium	Med	High

Various funding options were explored available to local distribution companies. Based on current development status and electrical plant conditions, the capital costs involved and the number of stakeholders impacted, it is recommended that discussions continue to plan for the burial of hydro lines in Northdale. The recommended cross-section for Hazel Street requires relocation of the existing pole-line; potentially off-setting some of the cost of burial in lieu of relocation. Notwithstanding that the plant on Albert Street has recently been reconstructed, aerial, burial should be considered as part of the future roadway reconstruction. Hickory Street should similarly be considered.

Pedestrian Lighting

The redeveloped road network has been developed with an emphasis on active transportation and it is expected that pedestrian scale lighting will be provided during reconstruction efforts to provide appropriate light levels for safety and security.

The study report examines estimated capital, operation and maintenance costs on street-by-street basis within the Northdale community as a guide in selecting and designing the future pedestrian lighting features. Light location/spacing as well as pole and luminaire details will be determined during detailed design in association with the City and Waterloo North Hydro.

Environmental Conditions

There are no significant natural heritage features within the study area. Also, there are no designated or listed cultural heritage properties in the Northdale study area. However, the OP identifies in Section 11.1.45 (22) b) that *Council, in consultation with the Municipal Heritage Committee, may consider appropriate tools for the potential conservation of the Veterans' Green Housing.* There are also provisions in the OP to consider the cultural heritage of this area in any future redevelopment or infill project. The area is bounded by the Public Lane to the north and east, University Avenue to the south, and State Street and Veteran's Green Park to the west.

The Municipal Heritage Committee has expressed an interest in requesting that Council designate Waterloo Collegiate Institute (WCI), for reasons related to its modern architecture and that it was the first high school in the City. It is expected that the status of such a designation will be influenced by the future site planning being conducted on the WCI property.

This study involves a comprehensive neighbourhood-scale streetscape master plan located in an established, built-up urban area. It does not as yet involve any location or project-specific undertakings that would be subject to archaeological assessment under MTCS requirements. Any such, archaeological resources will be identified as part of the detailed design process, and mitigation measures recommended where required.

Evaluation of Streetscape Options

The Northdale Land Use and Community Improvement Plan, and specifically its Preferred Structure Plan introduces the following four (4) street typologies to the current neighbourhood:

- Mixed Use Street – Designed to promote social interaction, while accommodating alternative modes of transportation.
- Green Street – Gives priority to pedestrian movement and adjacent open space connections.
- Residential Street – Designed to retain or enhance the residential character of the streetscape.
- Woonerf Street (Shared Street) – A space designed for all modes of transportation: pedestrians, cyclists and vehicles. Features often include no sidewalks, varied road treatments, and street furniture.

In response, this study evaluated the following 13 streetscape framework options:

TYPOLOGY	#	BASIC FRAMEWORK DESCRIPTION
Mixed Use Street	1a	Hazel Street 2 way, buffered bike lanes with door opening zones, intermittent parking on both sides (Hazel St)
	1b	Albert Street 2 way with segregated bike lanes and pocket parking on alternating sides
	2	2 way with buffered bike lanes, intermittent parking on the west side
	3	2 way with buffered bike lanes, no on-street parking
Green Street	1	2 way with centre landscaped median, buffered bike lanes, no parking
	2	2 way with intermittent unmarked parking and Multi-Use Trail
	3	1 way single traffic lane, Multi-Use Trail one side and parking one side
	4	2 way with offset median, Multi Use Pathway
Residential Street	1	2 way, parking one side, no bike lanes
	2	2 way, parking one side, shared auto/bike lanes
	3	1 way, shared auto/bike lane, parking one side
Woonerf Street	1	Shared space including parking
	2	Shared space without parking (auto)

These framework options were evaluated using a series of criteria representing the Social Environment, Natural Environment, Economic Environment, Technical and Policies and Land Use. As a result, the preferred streetscape framework for each of the four street typologies in Northdale are:

Mixed-Use Street

Hazel Street - Option 1a is preferred with 2-way operations, buffered bike lanes each with a door opening zone and intermittent parking on both sides.

Albert Street - Rationale for the preferred Option 1b for Albert Street is affected by the higher traffic volumes and speeds on this Major Collector. It warrants segregated bike lanes on each side, vertically separated from motorized traffic with a mountable curb separation. Intermittent pocket parking is also included but alternating sides to provide space for the wider segregated bike lanes.

Green Street

Option 2 is the preferred Green Street for the 2 way section of Hickory Street with a 2 way Multi-Use Trail along the north side with intermittent unmarked parking. Option 3 is preferred for the proposed 1 way section of Hickory Street between Hazel Street and Albert Street.

Residential Streets

Option 2 is preferred for the local streets in Northdale with 2-way operations, parking on 1 side and shared auto/bike lanes on these low speed, low volume routes.

Woonerf Street

The two Woonerf Street options are very similar and either option meets the intent of the Community Improvement Plan for Larch Street. Option 1 is slightly preferred mainly because it replaces existing on-street parking on Larch Street, and there is slightly less hard surface.

Streetscape Master Plan

Traffic Flow

The vision of the street public realm for Northdale is that of a vibrant streetscape, embodying the City's "Complete Streets" policy. The recommended detailed designs for the streets will build a balance between built form and natural elements, respond to adjacent property redevelopment and adhere to the recommendations from the "Northdale Urban Design and Built Form Guidelines" (2012) as summarized in the following sections.

The new Light Rail Transit (LRT) will be operated by Grand River Transit (GRT) beginning in 2018. The proximity of the ION stations is expected to enhance transit opportunities and impact the modal split for Northdale. With an increased transit modal split, a lower demand for parking spaces for residents and visitors to the area is expected in alignment with the neighbourhood vision.

New traffic volumes are primarily generated from new developments. The projected developments, their resulting traffic volumes, expected travel characteristics and their potential impact on traffic operations and the Northdale public realm conclude that, while there are projections as to the future traffic growth of the neighbourhood as a whole, there is limited information available as to the exact trip assignment. Therefore the impacts of future conditions have been assessed using the existing baseline volumes. Furthermore, the City has not expressed any plans to expand the roadways within the study area (doing so would be contrary to the neighbourhood vision). Therefore, the only opportunities to add capacity to the internal road network would be in the form of changes to signal timings at the arterial road intersections and/or minor isolated geometric improvements (e.g., turn lanes). Based on the desire to discourage cut-through traffic and reduce operating speeds, it is perhaps more to be expected that future changes to the network would be "more restrictive" to vehicle traffic, rather than "more accommodating".

In keeping with the previously discussed vision for the Northdale neighbourhood (i.e., encourage active transportation and lower operating speeds, while maintaining neighbourhood access and existing capacity), none of the cross-section options evaluated in this study sought to add vehicular capacity to the internal road network. Some limited one-way versions were considered, which might reduce vehicular traffic conflicts and associated delays, without adding additional

through lanes. From a traffic operations and safety perspective, the alternative cross-sections were generally intended to achieve the following:

- Discourage cut-through traffic;
- Reduce operating speeds;
- Encourage and accommodate active transportation users;
- Preserve the existing vehicular capacity; and,
- Serve the adjacent land uses and local users first.

There is the potential for increased congestion as a result of lower operating speeds; however, the roads in the study area are typically well under capacity and this will be partially offset by the reduced cut-through traffic.

The conclusion of this evaluation is that **Concept 5** is preferred for the Northdale area. It includes a one-way Hickory Street westbound between Hazel Street and Albert Street, and manages vehicular traffic within the neighbourhood without drastically modifying overall network operations. The one-way westbound on Hickory Street has the potential to significantly reduce cut-through traffic in the eastbound direction, while the two-way streets elsewhere maintain connectivity for residents and encourage lower vehicle operating speeds. The one-way portion of Hickory Street also presents greater opportunities for streetscaping although there is the potential for vehicular operating speeds to increase along the one-way portion. Clear signage will need to be installed on all approaches to ensure motorists and cyclists understand how to travel along the streets, as is the case whenever changes are made to traffic controls.

At the same time that this report was prepared, the Waterloo Region District School Board (WRDSB) and Waterloo Collegiate Institute (WCI) were considering requesting Hazel Street between Columbia Street and Hickory Street closed to through traffic. The closed section of Hazel Street would be converted to a type of transit hub operation serving both the WCI and adjacent WLU lands. GRT buses and Waterloo Fire Rescue vehicles could still move between Hickory Street and Columbia Street, but it would be closed to other through traffic between Columbia Street and Hickory Street. The numerous negative impacts that Concept 7 has on traffic operations within the neighbourhood, and the surrounding arterial network, lead to the conclusion that the net impacts of this concept are undesirable, and contrary to the vision for the Northdale neighbourhood. Notwithstanding that this concept cannot be supported in this study, the completion of the ongoing WCI study and resulting Site Plan development will offer an opportunity to re-examine this concept in the future.

Parking Plan

On-street parking can be an effective design tool to promote the desired patterns of land use through the neighbourhood. Currently, on-street parking is managed by the City of Waterloo through by-laws and enforcement. Conversely, off-street parking in the neighbourhood is provided exclusively by private land owners, and it is their responsibility to ensure they have provided sufficient parking for the intended land use (also subject to City by-laws). The future parking requirements of the Northdale neighbourhood will be required based on the Zoning By-Laws to ensure adequate parking supply for residents. Generally, the number of visitor parking spaces is significantly less than what is provided for residents, and as the majority of units will have multiple independent students as opposed to families, off-street visitor parking may need to be complemented with on-street parking. This need has been demonstrated through the recent increase in on-street overnight permit requests received by the City.

In line with the philosophy for the Northdale neighbourhood, both universities are actively implementing transportation demand management (TDM) initiatives in an attempt to encourage non-auto modes. This initiative is intended to will allow the universities to convert a portion of their parking supply to new developments.

Active Transportation Plan

The emphasis on cycling lanes and sidewalks, coupled with the decorative features of the redesigned public realm, will promote an increased use of the space by pedestrians and cyclists.

Existing and planned Active Transportation facilities within the Northdale neighbourhood include:

- Existing on-road bike lanes along Columbia Street, University Avenue and Philip Street;
- Walkways that the City has strategically acquired between street blocks;
- Active Transportation features included as part of the preferred street concepts; and
- Pedestrian connection concept between the Northdale neighbourhood and University of Waterloo LRT station.

The preferred Mixed Use Street layout on Hazel Street and Green Street layout on Hickory Street requires that:

Multi-Use Trails along Northdale streets must be accompanied by measures to reduce driveway and street crossing conflicts to an acceptable level (i.e., no more than every 300m), and/or traffic management provisions using signage, pavement markings, warnings and other traffic management measures.

Tree Management Plan

A total of 201 trees were recorded within the study area's public rights-of-way, representing 29 species (including cultivars). Twelve species are native to Ontario and 13 are non-native. The most common species is Norway Maple (28.9%), followed by newly planted Serviceberries (8.0%), and Little-leaf Linden (6.0%). A high percentage of Norway Maple is common for a neighbourhood of this age, although today Norway Maple are known to have invasive characteristics are used sparingly in new landscaping plans.

Two thirds of the trees are in 'good' or 'good-fair' condition, with the majority of those trees being in the < 10 cm size category. The Tree Management Plan prepared for this study (Appendix G) includes recommendations for tree protection, removal and transplanting.

Implementation

The preliminary capital cost estimates for the preferred Northdale Streetscape Master Plan components total approximately $24.3 M in 2016 dollars, and would be implemented over time based in part on potential project staging discussed below in Section 8.3.

The operating and maintenance impact of the preferred public realm improvements in Northdale will increase over time as the capital works progress. Once all works are complete, it is estimated that the ongoing additional operating and maintenance impact compared to today is an additional $60,000 per year. It is recommended that the City address the additional operating and maintenance impacts for the public realm as part of the next budget cycle (either 2019 or 2020 depending on when the first phase of capital improvements starts).

Only the two preferred Mixed Use Street concepts on Hazel Street and Albert Street will require property acquisition beyond the existing road right-of-way. It is expected that property can be acquired over time as part of the property redevelopment process, at no cost to the City. However, this will take time and depends on the staging and timing of construction. Another future option may be to adjust the street reconstruction design to fit within the existing right-of-way, but this would likely impact the preferred design.

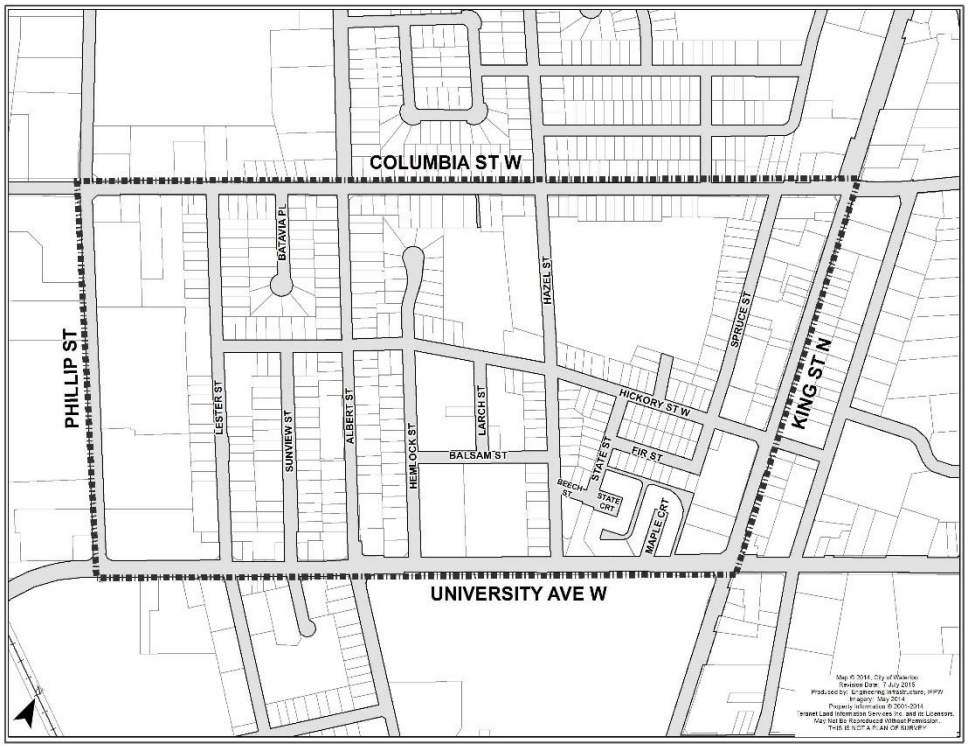
As part of this study, potential staging for the reconstruction of streets within the Northdale neighbourhood has been reviewed based on investment optimization, existing infrastructure condition and replacement needs and the build-out status of each street.

A priority for reconstruction was given to each street within Northdale based primarily on the status of development and need for infrastructure upgrades. **Spruce Street** is considered the **highest priority** as it is currently the most developed with the least impact by future development. The infrastructure on Spruce Street outlets onto Hickory Street and, as a result, downstream upgrades being required to maximize the improvements to infrastructure upgrades on Spruce Street. This section of **Hickory Street** was given the next highest priority. Beyond Spruce Street the **Balsam Street/Larch Street** block was the next most developed area and is given a higher priority as a result. The remainder of the neighbourhood is in a similar state of (incomplete) redevelopment and the timing of improvements should be re-evaluated annually as development continues with streets being ranked higher as they are more completely developed.

1 INTRODUCTION

The City of Waterloo retained IBI Group to undertake the Northdale Streetscape Master Plan and Class Environmental Assessment (Class EA). Within the study area (Exhibit 1-1), the Northdale neighbourhood is located in an area of existing, new and proposed residential and commercial development. This continued development requires an assessment of infrastructure and utilities within the Northdale neighbourhood including design concepts and strategies for public spaces utilities, and reconstruction of city streets. The study was conducted in accordance with the planning and design process for Schedule 'B' projects as outlined in the Municipal Engineers Association *"Municipal Class Environmental Assessment,"* (October 2000, as amended in 2007, 2011 and 2015).

Exhibit 1-1 Study Area



The study area is bounded by Columbia Street West to the north, King Street North to the east, University Avenue West to the south, and Phillip Street to the west. The streets included in this study are: Lester Street, Sunview Street, Batavia Place, Albert Street, Hemlock Street, Balsam Street, Larch Street, Hazel Street, Hickory Street, Spruce Street, State Street, Hawthorn Street, and Fir Street.

1.1 Purpose of the Streetscape Master Plan

This Master Plan was developed using a comprehensive and environmentally sound planning process. Public consultation was an important component during the development of this plan with opportunities, such as three Public Information Centres, to facilitate dialogue between those with differing interests. This study developed a strategic approach to the reconstruction of the neighbourhood roads, taking into consideration the following objectives:

- Inviting the participation of a variety of stakeholders to gather information concerning ideas, concepts, current issues, and views on developing the alternatives;
- Creating a plan for minimal disruption during construction to the environment, existing residents, and commuters that use the neighbourhood roads;
- Developing strategies for the management of resources to protect the environment, through monitoring, mitigation and consultation with affected and interested persons; and
- Complying with all the phases of a Schedule 'B' Class EA.

This process also developed engineering specific information for Northdale including:

- Reviewing and determining the extent to which road design concepts were feasible;
- Reviewing piped municipal infrastructure;
- Creating cross-sections for a number of street typologies within the neighbourhood including:
    - Mixed Use Street (Hazel Street and Albert Street);
    - Green Street (Hickory Street);
    - Residential Street (Lester Street, Sunview Street, Batavia Place, Hemlock Street, Balsam Street, State Street, Fir Street, and Spruce Street);
    - Woonerf (Larch Street).
- Determining the feasibility of burying hydro and providing updated roadway and pedestrian lighting, carried out in conjunction with consultation with key stakeholders and parties.

1.2 Schedule 'B' Municipal Class Environmental Assessment Process

The Municipal Class EA Process is a five-phase planning procedure under the Ontario *Environmental Assessment Act*, which applies to public infrastructure projects. Projects undertaken through this planning process are classified as one of four "Schedule" types ranging from Schedule 'A' and 'A+', through to Schedule 'B" and 'C' in accordance with their degree of anticipated environmental impact and magnitude. Key features of the Class EA process as well as a detailed outline of the process are shown in Exhibit 1-2 and Exhibit 1-3 respectively.

A Schedule 'B' Class EA project generally includes improvements and minor expansions to existing facilities. The Northdale study is being conducted as a Schedule 'B' EA because it involves minor changes to existing facilities that may result in impacts on property, land use and traffic operations.

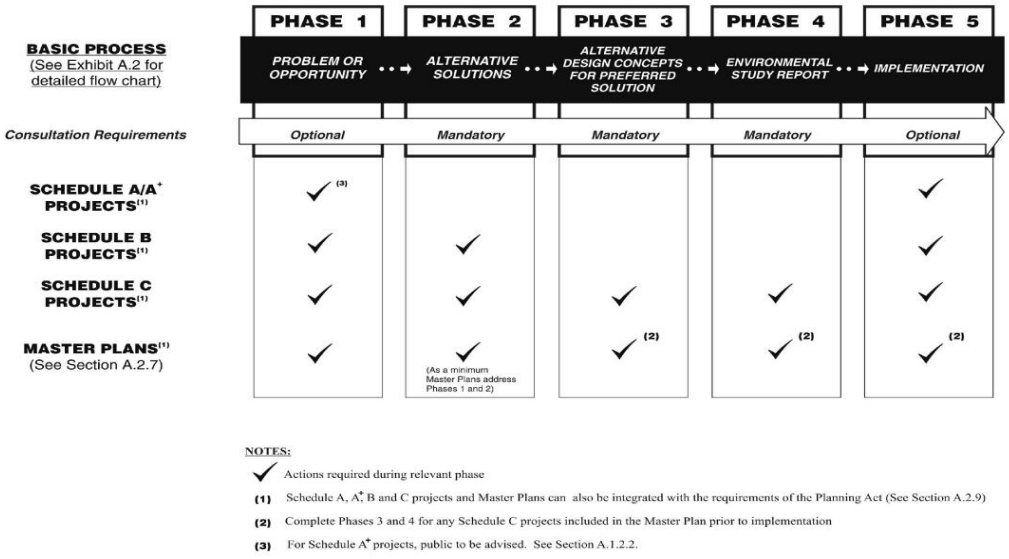
A Schedule "B" Class EA is required to address Phase 1 and Phase 2 of the EA process, namely to:

1. Identify problems or opportunities for Northdale within the study area; and
2. Consult with review agencies and the public, and identify the preferred planning solution.

A Project File is required for Schedule 'B' projects and documents the EA process carried out. In order to complete the Schedule 'B' process, a Notice of Completion will be submitted to review agencies, stakeholders and the public for a period of at least 30 days for comment and input. The Notice will include notification for provision to request a Part II Order.

If concerns are raised that cannot be resolved through discussions with the City as the EA proponent, the Part II Order appeal process may be initiated. If no appeals are brought forth by the expiry of the review period, the project is considered to have met the requirements of the Class EA process and the City may prepare contract drawings, proceed to tender and construct the project.

Exhibit 1-2 Key Features of the Municipal Class EA



NOTES:

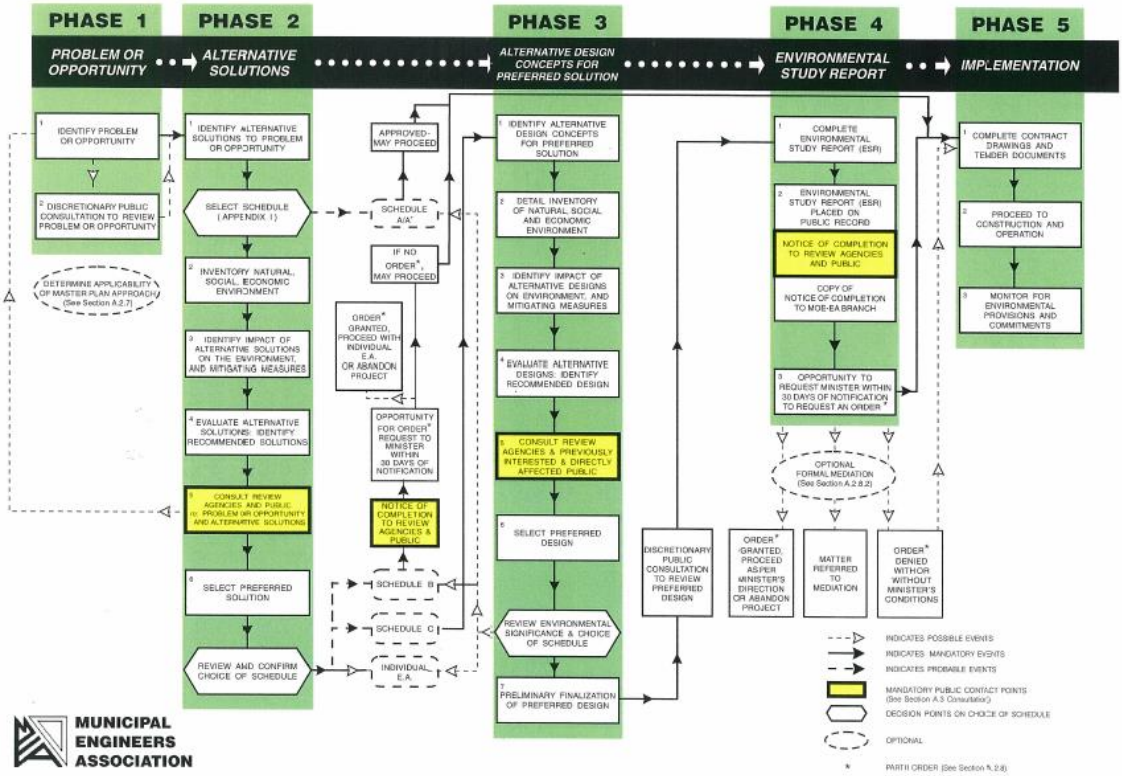
✓ Actions required during relevant phase

(1) Schedule A, A*, B and C projects and Master Plans can also be integrated with the requirements of the Planning Act (See Section A.2.9)

(2) Complete Phases 3 and 4 for any Schedule C projects included in the Master Plan prior to implementation

(3) For Schedule A* projects, public to be advised. See Section A.1.2.2.

Exhibit 1-3 Municipal Class Environmental Assessment Process



As part of the Class EA process, it is suggested that all stakeholders work together to determine the preferred means of dealing with a problem or opportunity. If concerns regarding a project cannot be resolved in discussion with the proponent, members of the public, interest groups or technical review agencies may request the Ontario Minister of the Environment and Climate Change to require a proponent comply with Part II of the *Environmental Assessment Act* before proceeding with the proposed undertaking. The Minister of the Environment and Climate Change then decides whether to deny the request, refer the matter to mediation or require the proponent to comply with Part II of the *Environmental Assessment Act*.

The procedures for dealing with concerns are outlined as follows:

1. For Schedule 'B' projects a person or party with a concern should bring it to the attention of the City of Waterloo (the proponent) in Phase 2 of the planning process.

2. If a concern is not resolved through discussion with a proponent, the person or party raising the objection may request the City of Waterloo to voluntarily elevate the Schedule 'B' project to a Schedule 'C'.

3. If the City of Waterloo declines, and the person or party with the concern wishes to pursue the matter, they may write the Minister of the Environment and Climate Change, or delegate, or request a Part II Order. These requests shall be copied by the requestor to the City of Waterloo and the Director of the Environmental Approvals Branch at MOECC at the same time they are submitted to the Minister, or delegate. For a Schedule 'B' project, a written request must be submitted to the Minister or delegate within the 30 day review period after the Notice of Completion has been issued.

1.3 Project Advisory Team

The study organization reflects the general administrative and technical needs of the study as well as the study's consultation program. The latter has been developed to ensure that all of those with a potential interest in the study will have the opportunity to participate and provide input during the process.

The study was carried out under the direction of the Project Team comprised of staff from the City of Waterloo and IBI Group:

- Mike Lupsa, P. Eng., Project Manager, City of Waterloo
- Sheldon Pereira, Stakeholder Relations Manager, City of Waterloo
- Scott Nevin, Stakeholder Relations Manager, City of Waterloo
- Dan Ditaranto, P. Eng., Manager Design and Construction, City of Waterloo
- Christine Koehler, CET, Traffic Operations Program Manager, City of Waterloo
- Jakub Cyperling, C.E.T, Project Manager Engineering Services, City of Waterloo
- Janice Works, Senior Communications Specialist, City of Waterloo
- Ric Martins, M.PL., MCIP, RPP, Policy Planner, City of Waterloo
- Phil Hewitson, P. Eng., Manager, Active Transportation and LRT Coordinator, City of Waterloo
- Kelly Cobbe, P. Eng., Project Manager, IBI Group
- Don Drackley, MCP, Project Manager for Environmental Assessment, IBI Group

1.4 Related Policies and Guidelines

1.4.1 Provincial Policy Statement

The Provincial Policy Statement (PPS) 2014 promotes densities and mixed land uses that support active transportation, transit and the efficient movement of goods. One objective of the City of Waterloo in planning for the Northdale Streetscape Master Plan is to support these high-level strategic policies where possible.

The PPS also sets out the policy direction to guide land use planning and development in Ontario that support three key areas: building strong communities, wise use and management of resources, and protecting public health and safety.

The PPS also calls for safe, energy efficient transportation systems that facilitate movement of people and goods and support projected needs. It highlights the importance of connectivity of transportation systems, integration of transportation and land use planning to support sustainable transportation choices, and efficient use of existing infrastructure.

The PPS requires that in planning matters, decisions "shall be consistent with" policy statements issued under the Act. Section 1.67 Transportation Systems details:

- *Transportation systems should be provided which are safe, energy efficient, facilitate the movement of people and goods and are appropriate to address projected needs.*
- *Efficient use shall be made of existing and planned infrastructure, including through the use of transportation demand management strategies, where feasible.*
- *As part of a multimodal transportation system, connectivity within and among transportation systems and modes should be maintained and, where possible, improved including connections which cross jurisdictional boundaries.*
- *A land use pattern, density and mix of uses should be promoted that minimize the length and number of vehicle trips and support current and future use of transit and active transportation.*
- *Transportation and land use considerations shall be integrated at all stages of the planning process.*

1.4.2 City of Waterloo Official Plan

One of the visions of the City of Waterloo Official Plan (OP; 2014) is to have roads "*be planned as complete streets, enabling users of all ages and abilities – pedestrians, bicycles, transit riders and motorists - to interact and move safely along and across City streets*" (OP, 2014). The Northdale multi-modal transportation system will provide transportation choices that encourage more sustainable transportation modes such as transit and active transportation (pedestrian orientated streets, sidewalks and cycling facilities).

The OP (2014) classifies Northdale as a Specific Provision Area (SPA) 45 on Schedule 'A6'. A SPA is a location "*where the application of the land use policy framework of this Plan does not provide sufficient clarity regarding the intent of the municipality for the future use of land*". The OP provides explicit guidance for the redevelopment and urbanization of Northdale. The OP recognizes that Northdale is going through a phase of transition, and supports this transition into a vibrant "mixed-use neighbourhood" that will accommodate residential, commercial and employment uses.

1.4.3 City of Waterloo Transportation Master Plan

The City of Waterloo Transportation Master Plan (TMP; 2011) provides strategies and planning policies to direct transportation growth and change in the City. It builds on the promotion of transit, cycling and walking to improve the congestion on the roads.

The Northdale Streetscape Master Plan conforms to the ideals laid out in the TMP making the road accessible for all users: vehicles, cyclists, pedestrians and transit. This undertaking embodies the TMP's "Complete Streets Policy" as demonstrated in the excerpt that follows:

> *The Complete Streets policy is intended to shift Waterloo from the decades-long focus of providing streets to move cars, to providing streets where people can interact and move about whether they are on foot, on a bicycle, in a bus or in a car. Implementing a Complete Streets policy in Waterloo will enable all users of all ages and abilities – pedestrian, people with disabilities, cyclists, transit riders and motorists – to safely move along and across City streets.*

1.4.4 Northdale Land Use & Community Improvement Plan

The City of Waterloo has recently conducted a study of the Northdale community which had three components: 1) the Northdale Land Use and Community Improvement Plan Study (2012); 2) Community Improvement Plan; and, 3) Urban Design Manual and Land Use Plan.

The Community Improvement Plan (CIP) will aid decision-making by providing development principles for the long-term and implementing the "vision" of Northdale:

> *By 2029, Northdale is revitalized and reurbanized into a diverse, vibrant and sustainable neighbourhood, integrated with educational, residential, commercial, cultural, heritage and recreational functions, and improved open space, pedestrian, cycling and transit networks.*

This CIP recognizes that Northdale is moving away from being a predominately student housing and single detached home neighbourhood to one that is comprised of mixed housing types, land uses and demographic groups. This plan provides direction on:

- Neighbourhood Structure – Northdale will be comprised of a mixed-use community that no longer has low density, single detached housing as the predominant housing type. The plan favours a pedestrian and transit orientated neighbourhood.
- Buildings and Development – Guides building design, type and placement. Promotes amenity areas and has stringent parking requirements.
- Public Realm – Promotes a vibrant and active neighbourhood to improve the public realm. Features include: parkettes and plazas, improving pedestrian and cycling connections, incorporation of Crime Prevention through Environmental Design, and streetscaping.
- Universities and Schools – The active frontage policies and regulations, and the public realm in relation to the Urban Design Guidelines, should be met by the Universities. With respect to Waterloo Colligate Institute, the open space components should be maintained for community use and possibly be redeveloped for other uses such as recreation or mixed residential development.
- Incentives and Bonuses – A bonusing structure will be created to advance the key objectives of this Plan including: affordable housing, active transportation, protection of cultural heritage resources (i.e., Veterans' Green) and security.

1.4.5 Northdale Community Urban Design Manual & Built Form Guidelines

The Northdale Community Urban Design and Built Form Guidelines (2012) is a guide to implement and design the Northdale neighbourhood, adhering to the recommendations detailed in the Northdale Land Use and Community Improvement Plan (2012). This document provides comprehensive direction for built form, urban design and landscaping and is supplemental to the City of Waterloo's Urban Design Manual (2010). As detailed in the document, the purpose of the guidelines is to:

- *Foster design excellence in the Northdale neighbourhood;*
- *Implement the Northdale Land Use and Community Improvement Plan Study Official Plan Amendment recommendations;*
- *Implement the City's Urban Design policies established in the Official Plan;*
- *Incrementally implement the vision for the Northdale neighbourhood;*
- *Provide specific built form, landscape and sustainable site and building design guidelines to assist Council in achieving the vision and principles established for Northdale;*
- *Provide eligibility criteria for the CIP's Financial Incentive Programs, with respect to design and sustainable development;*
- *Provide the City with a tool for the review and evaluation of development applications and financial incentive programs and supporting materials; and*
- *Provide supporting strategies for development implementation.*

2 CONSULTATION

Public, stakeholder and agency consultation is a key feature of the Municipal Class EA planning and design process. Through an effective consultation program, the City of Waterloo was able to generate meaningful dialogue between the Project Team and the agencies, stakeholders and the public, resulting in an exchange of ideas recorded in the Project Record, and a broadening of the information base leading to better decision making.

2.1 Notice of Study Commencement

The Notice of Study Commencement for the Northdale Neighbourhood Streetscape Masterplan and Class EA was publish in the Waterloo Chronicle on July 29, 2015 and August 5, 2015 (see **Appendix A**). The notice was also posted on the City's website at http://www.waterloo.ca/northdalestreetscape/. Property owners within Northdale were mailed a notice.

Technical agencies, utilities, special interest groups, stakeholders and First Nations were notified of this EA process by mail on August 4, 2015 by IBI Group. The list of agencies, utilities, stakeholders, First Nations and Special Interest Groups contacted are summarized below. A complete mailing list can be found in **Appendix A**.

- Aboriginal Affairs and Northern Development Canada
- Ministry of Indigenous Relations and Reconciliation
- Ministry of Municipal Affairs and Housing
- Ministry of the Environment and Climate Change
- Ministry of Community and Social Services
- Ministry of Tourism, Culture and Sport
- Ministry of Community and Social Services
- Infrastructure Ontario
- Region of Waterloo
- City of Waterloo
- University of Waterloo
- Wilfrid Laurier University
- Waterloo Region District School Board
- Waterloo Catholic District School Board
- Consell Scolaire de District du Centre Sud-Ouest
- Waterloo Collegiate Institute
- Numerous Advisory Committees and Public Interest Groups
- Mississaugas of the New Credit First Nation
- Six Nations of the Grand River
- Haudenosaunee Resource Centre

2.2 Comments Received

A number of comments were received throughout the study from agencies, First Nations, stakeholders and the public. A full record can be found in **Appendix A**.

2.3 PIC #1 – December 1, 2015

A Notice of Public Information Centre #1 (PIC) in **Appendix A** was published in the Waterloo Chronicle on November 19 and 26, 2015. The PIC was held on December 1, 2015.

2.3.1 Information Presented

The exhibits were organized in a manner which effectively presented information on the project. The exhibits listed in Exhibit 2-1 were on display at the PIC and can be viewed in full in **Appendix A**.

Exhibit 2-1 List of PIC #1 Exhibits

i. Title Board ii. Purpose of PIC #1/ Study Area iii. Study Objectives and Vision iv. Environmental Assessment Process v. Road Classification vi. Existing Traffic/Parking Conditions	vii. Existing/Planned Active Transportation Natural Heritage/ Cultural Heritage viii. Planned Infrastructure Improvement Issues ix. Streetscape/Public Space Issues Today x. Your Input – Other Neighbourhood Issues? xi. Next Steps

2.3.2 Comments from the Public

The public was requested to submit comments by December 22, 2015. Those who provided contact information were added to the project contact list to receive future notifications relating to the study. In total 23 comment sheets and 10 online responses were submitted to the project team. Exhibit 2-2 summarizes written comments/concerns received as of December 22, 2015. All comment forms and correspondence received is available in **Appendix A**.

Exhibit 2-2 Summary of Comments and Concerns

PLEASE PROVIDE COMMENTS ON THE EXHIBITS YOU HAVE SEEN TODAY AND ANY OTHER ISSUES YOU ARE AWARE OF CONCERNING PUBLIC SPACES AND STREETS WITHIN THE NORTHDALE NEIGHBOURHOOD
1. Reduce road widths to decrease capital road construction costs (e.g., less asphalt). 2. No cars on Hickory (2 comments). 3. Concerned about no cars on Hickory and accessing property. 4. Connect Hickory to the University of Waterloo at Phillip Street. 5. Reconsider extending roads, as the objective is to reduce dependence on cars. 6. If there is no on-street parking, there should be an area where parking would still be free. 7. Have paid short-term parking. 8. Parking requirements need to be reduced. 9. Increase on-street parking. 10. Off-street parking preferred. 11. Preserve Veterans' Green (3 comments). 12. Update Veterans' Green attract more usage. 13. WCI heritage. 14. Supports considering native species for new tree plantings. 15. Increase tree canopy (3 comments).

16. Plant a variety of vegetation.
17. Have more green space (4 comments).
18. Consider a community garden.
19. Set a standard for street furniture in balance with the University district.
20. Have more benches on the streets.
21. University Avenue streetscape should blend in with the Northdale and University district (e.g., decorative lighting, banners).
22. Do not have bright lighting.
23. Improve lighting at major intersections (e.g., Albert and University).
24. Improve lighting for students.
25. Have the neighbourhood assessable for people in wheelchairs and with strollers.
26. Garbage is a problem (2 comments).
27. Supports improving/creating active transportation routes (4 comments).
28. Extend Baltavia and Hemlock with pedestrian/cycling routes.
29. Repave the other half of the public lane.
30. Supports a pedestrian corridor through WCI but not a road.
31. Have a pedestrian corridor from Baltavia to Hickory and Lester, and on Phillip Street to the LRT.
32. Should have more bike lanes and pedestrian pathways.
33. Have off-street bike lanes.
34. Have streets changed to one-way and put in wide bike lanes.
35. Enhance cyclist safety (3 comments).
36. Improve bike lane maintenance.
37. Improve bike parking (2 comments).
38. How will this undertaking appeal to students (i.e., affordability) (2 comments).
39. Will there be bus routes.
40. Bus route on Hickory Street West.
41. Connect Balsam through to Albert.
42. Supports burying hydro for Hickory and Albert.
43. For safety have a push/panic button system connected to the university.
44. Concerned about air quality (e.g., building materials, tree pollen).
45. Supports catching stormwater for the trees.
46. Minimize construction impact on businesses

2.3.3 Comments for External Agencies

No comments were received from external agencies regarding the PIC, materials used, or the information presented.

2.4 PIC #2 – May 11, 2016

A Notice of Public Information Centre #2 (**Appendix A**) was published in the Waterloo Chronicle on April 28 and May 5, 2016. The PIC was held on May 11, 2016.

2.4.1 Information Presented

The exhibits listed in Exhibit 2-3 were on display at the PIC and can be viewed in full in **Appendix A**.

Exhibit 2-3 List of PIC #2 Exhibits

i. Title Board	ix. Northdale Sanitary Sewer
ii. What We Heard at PIC #1	x. Northdale Storm Sewer
iii. Problem and Opportunity Statement/ Environmental Assessment Process	xi. Northdale Watermain
iv. Northdale Street Classification	xii. Streetscape Options – Mixed-Use Street
v. Status of Development	xiii. Streetscape Options – Green Street
vi. Northdale Zoning and Building Setback	xiv. Streetscape Options – Residential Street
vii. Traffic Operations/Parking Analysis	xv. Streetscape Options – Woonerf Street
viii. Potential Street Configuration Options	xvi. Option Evaluation Summary
	xvii. Next Steps

2.4.2 Comments from the Public

The public was requested to submit comments by May 25, 2016. In total 23 comment forms, 9 online responses, via Engage Waterloo, and 1 e-mail were submitted to the project team. Exhibit 2-4 summarizes written comments/concerns received as of May 25, 2016. All comment forms and correspondence received is available in **Appendix A**.

Exhibit 2-4 Summary of Comments/Concerns

PLEASE PLACE AN 'X' BESIDE THE STREETSCAPE OPTION OR OPTIONS YOU PREFER (BOLDED OPTIONS WERE SHOWN AS PREFERRED OPTIONS)

Mixed Use Street Options (Albert St., Hazel St.)

TOTAL COUNT:

- 8 **Option 1a: 2-way with buffered bike lanes and door opening zone, intermittent parking on both sides**
- 16 Option 1b: 2-way with segregated bike lanes and pocket parking on alternating sides
- 3 Option 2: 2-way with buffered bike lanes, intermittent parking on the west side
- 4 Option 3: 2-way with buffered bike lanes, no on-street parking

Green Street Options (Hickory St.)

- 8 Option 1: 2-way with centre landscaped median, buffered bike lanes, no parking
- 6 **Option 2: 2-way shared auto/bike lanes with intermittent unmarked parking both sides**
- 6 Option 3: 1-way single lane, multi-use trail on one side and parking on one side
- 12 Option 4: 2-way with offset landscaped median, multi-use pathway

Residential Street Options (Lester, Batavia, Sunview, Hemlock, Balsam, State, Fir, Hawthorn, Spruce)

- 6 Option 1: 2-way, parking on 1 side, no bike lanes, share the road
- 18 **Option 2: 2-way parking on 1 side, shared auto/bike narrow lanes**
- 8 Option 3: 1-way shared auto/bike lane, parking on 1 side

Woonerf Street Options (Larch St.)

- 22 **Option 1: Shared space, including parking**
- 8 Option 2: Shared space, excluding parking

PLEASE PROVIDE COMMENTS ON THE EXHIBITS YOU HAVE SEEN TODAY AND ANY OTHER ISSUES YOU ARE AWARE OF CONCERNING THE PUBLIC SPACES AND STREETS WITHIN THE NORTHDALE NEIGHBOURHOOD

1. Increased cycling facilities.
2. Segregated bike lanes should be considered (7 comments).
3. Albert Street carries substantial through traffic and is a poor place for low separation between bikes and cars.
4. Streets with bus traffic warrant protection of cycling infrastructure, not just paint (specifically Hazel and Hickory).
5. Have bike lanes on Hickory.
6. Have cycle tracks on Albert and Hazel.
7. Circulation analysis needed for pedestrians and cyclists (2 comments).
8. Pedestrians constantly streaming across University.
9. Consider more pedestrian through connections (2 comments).
10. Have well marked pedestrian crossings.
11. Safety should be considered when designing the streets. Curved streets and plantings could limit a driver's ability to see pedestrians walking out onto the road.
12. Hickory is not envisioned as becoming increasingly animated with an east-west active transportation corridor with the imminent completion of the UW Ion stop.
13. Green Street option would only work if there were sharrows.
14. Prefers Green Street Option #3. Believes the multi-use trail is important and would improve walking in the neighbourhood. Don't approve of median options, as it's a green space people will not be able to make use of.
15. Residential Street option would only work if there were sharrows.
16. Prefers one-way Residential Street option as it allows for a wider greenspace.
17. The Mixed-Use option seems the best, but the door zones should have hatch marks to make the zone obvious.
18. Albert has too much traffic for the Mixed-Use Option.
19. Supports Woonerf Street (3 comments).
20. Not sure about the Woonerf idea. Doesn't seem like the right space for it. Too much traffic with all the development occurring.
21. Street design should discourage residents from using on-street parking as a permanent solution.
22. Did not choose options for Hazel and Hickory. The City needs to wait on these streets until a plan for WCL/WLU lands is determined.
23. Lester and University needs any intervention.
24. Large queues on University.
25. Do not support one-way alternatives (3 comments).
26. Do not make Hickory one-way. If WCI becomes a community hub, Hickory will become very important for accessing WCI.

27. The City should try to make the traffic lanes narrower than 3.35 m. It's too wide, too fast and unnecessary.
28. Should be discussion between the trade-off between fire trucks barrelling down through the streets and actual public health and safety. There is a role for smaller vehicles.
29. Consider more risky streetscape components/street reallocation.
30. Need more public greenspace.
31. Bury hydro on Hickory Street.
32. Options do not show what the streets would look like with above ground hydro lines.
33. How would burying hydro affect tree roots and types of trees planted?
34. WCI is soon to be a renewed and possibly expanded secondary school. WCI is not walkable. Student are drawn to the school from all over the region. Students are bussed in. Will the Ion increase the need for an east-west active transportation corridor?
35. Concerned about the impacts on sewers (storm and sanitary), watermains.
36. Have narrower streets and more greenspace to help stormwater infiltrate.
37. Keep air quality in mind when designing the streetscape (e.g., air flow, plants used).
38. Consider the materials used for the roads and sidewalks (e.g., asphalt has a stronger smell than concrete).
39. Consider the chemicals in the materials used in the streetscape.
40. Minimize light pollution.

E-MAIL COMMENTS

1. Sections 14.14 through 14.8 are very well illustrated. It is the complete absence of many of the urban design attributes promised in the final result that may prove to be problematic for the City when noticed in future by the community, design participants and upper level government funders of the Community Improvement Plan.

2.4.3 Comments from External Agencies and Members of Council

Comments were received by Councillor Jeff Henry from the City of Waterloo, Waterloo District School Board and Waterloo Collegiate Institute. They are summarized as follows:

Councillor Jeff Henry:

- Consider bump outs and/or slower design speed turns at intersections.
- Mid-block pedestrian connections not shown. Unsure of what options are being considered for these crossings.
- To what extent are water/waste water/stormwater versus trees conflicting in design choices. Concerned about the loss of tree canopy.

Waterloo Region District School Board:

- Interested in the strategies that influence the design of Hazel Street north of Hickory Street. Consider an option to make this street pedestrian, cyclist and transit only from Hickory Street to Columbia Street.
- Design Hazel Street, between Hickory Street and Columbia Street, to look more like a Woonerf Street, but for non-automobile traffic.
- The above is the Board's favoured approach in the event that a partnership involved in the community hub sees it as a desirable goal in the campus development.

Waterloo Collegiate Institute

- Supports the Larch Street (Woonerf Street) option.
- Change the option on Hickory Street to include a multi-use trail.
- Hazel Street between Hickory Street and Columbia Street should be given a different consideration than Albert Street. Make this stretch friendlier to pedestrians and cyclists, similar to Larch Street.
- The completion of the ION stop will increase the need for an east-west active transportation corridor between Northdale and the University of Waterloo.
- The streetscaping vision for Northdale should align with the broader visions for the Northdale neighbourhood, including that being funded by the feasibility study regarding the Waterloo Region District School Board, Waterloo Colligate Institute and Wilfrid Laurier University.
- Have a large scale community hub facility to service the surrounding educational institutions and provide amenities to the entire community, serviced with an active transportation corridor to the ION.
  - Should take advantage of the opportunity to connect to Northdale to Waterloo Park, and Uptown Waterloo via the Laurel Trail.
  - Date the Streetscape Master Plan will be presented to council.
  - How to receive notification of next steps?

All e-mails can be found in **Appendix A**.

2.5 PIC #3 – September 14, 2016

The Notice of Public Information Centre #3 (**Appendix A**) was published in the following newspapers:

- Waterloo Chronicle: August 31 and September 7, 2016;
- University of Waterloo Imprint Newspaper: August 31, 2016;
- University of Waterloo Imprint website: Banner ad ran on front page of website for one week beginning August 31, 2016;
- Wilfrid Laurier University Newspaper The Cord: September 2, 2016;
- Wilfrid Laurier University Newspaper The Community Edition: September 2, 2016;
- Wilfrid Laurier University Radio website: sidebox ad, September 1 to 15, 2016; and
- Wilfrid Laurier University Newspaper The Community Edition website – sidebox ad September 1 to 15, 2016.

The PIC was held on September 14, 2016.

2.5.1 Information Presented

The exhibits listed in Exhibit 2-5 were on display at the PIC and can be viewed in full in **Appendix A**.

Exhibit 2-5 List of PIC #3 Exhibits

i. Title Board	vi. One-Way on Hickory Street Westbound
ii. Purpose of PIC #3	vii. Preferred Mixed-Use Streets
iii. Summary of What We Heard at PIC #2	viii. Preferred Green Street
iv. Key Agency Input Since PIC #2	ix. Preferred Residential and Woonerf Streets
v. Neighbourhood Public Realm	x. Next Steps

2.5.2 Comments from the Public

The public was requested to submit comments by September 28, 2016. In total 9 comment forms and 10 online responses via engageWaterloo were submitted to the project team. **Exhibit 2-6** summarizes written comments/concerns received as of September 28, 2016. The comment forms and online comments are in **Appendix A.**

Exhibit 2-6 Summary of Comments/Concerns

PLEASE PROVIDE COMMENTS ON THE FOLLOWING PREFERRED STREETSCAPES

a) Mixed-Use Street – Albert Street 2-way segregated bike lanes and pocket parking alternating sides

1. Prefer segregated bike lanes that are elevated and not just painted.
2. Segregated bike lanes should be prioritized.
3. Hope there is good cyclist connectivity to other routes.
4. Good separation between pedestrians and cyclists.
5. Prefers segregated bike lanes (4 comments).
6. Have a buffered bike lane.
7. Have 2-way bike lane on the left side of the road.
8. Prefer the bike lanes not to curve around the hydro poles and go straight.
9. Bike lanes should be straight and not weaving back and forth with the parking spaces.
10. Will keep car and bike traffic moving smoothly.
11. Concerned so people exiting cars; will be creating a dooring hazard (2 comments).
12. Consider bollards or planters for space between vehicles and active transportation.
13. Just have a multi-use trail on one side.
14. How does the trail connect to the Iron Horse trail on Park Street?
15. Nice balance of increasing active transportation with minimal loss of green space.
16. Special attention must be paid to intersections with cross streets using green paint and arrows.
17. Doesn't think pocket parking is possible due to the developments in place, and there are more to come. Hard to get around cars on Albert Street now when cars are parked on the street.
18. Pocket parking should include a pay ticket.
19. Sloped curves are good.
20. Concerned about winter maintenance and snow banks interfering with the flow of traffic.
21. Glad to see full size shade trees. Use a variety of tree species so if some die other will remain.
22. Consider making 1-way going north.

b) Mixed-Use Street – Hazel Street 2-way with buffered bike lanes with door zones, intermittent parking both sides

23. Cyclists can drive straight.

24. Add segregated bike lanes (4 comments) with a different pavement colour or treatment.
25. Painted cycling lanes offer no safety and don't allow casual cyclists feel comfortable.
26. Supports separate cycling lane.
27. Buffer isn't enough as cars will park in it.
28. Bike lane will be in the door zone/concerned about dooring (2 comments).
29. Bike lanes shared with bus stops is a terrible pattern. Re-evaluate curb protected bike lanes.
30. Have a multi-use trail instead of bike lanes.
31. Likes parking doesn't conflict with bike lanes.
32. Reverse car parking and active transportation zones.
33. If Hazel Street is mostly shut down, could widening sidewalks for pedestrian safety be considered. Should be clear indications of drop-off and crossing areas for the high school students.
34. Design is pedestrian and cyclist friendly and allows flow of traffic through the area.
35. Special attention must be paid to intersections with cross streets using green paint and arrows.
36. As a school zone, need a design to keep traffic flowing in the morning and afternoon.
37. Will keep car and bike traffic moving smoothly
38. Concerned about how the buses will function with the dedicated bike lanes (2 comments).
39. Consider making 1-way going south.

c) <u>Green Street – 1) Hickory Street West 1-way single lane westbound between Hazel Street and Albert Street, multi-use trail one side and parking on one side. 2) 2-way with intermittent unmarked parking and multi-use trail for the remainder of the street</u>

- <u>1-way:</u>

40. Walking on both sides preferred.
41. Have bike lanes going both ways on the street.
42. Green space great.
43. Have the green space incorporate plant choices that support diversity.
44. Worried about parking during parties.
45. Endorses 1-way option to reduce car traffic.
46. Supports multi-use trail for active transportation and pedestrian safety.
47. Make entire street 1-way (two comments), less confusing.

- <u>2-way:</u>

48. Cars will go fast.
49. Mark the parking because it reduces apparent lane widths.

- <u>Overall</u>

50. Multi-use trail would have fewer conflicts at intersections if it was on the north side of the street.
51. Multi-use trail will have high conflict due to high foot traffic.
52. Ensure multi-use trail is clearly marked and provisions are made to enter/exit at intersections with bike lanes (2 comments) (e.g., bike boxes, waiting areas for turning).
53. Re-evaluate curb protected traditional bike lanes.
54. All-way stops would reduce risk of conflict at intersections.
55. Prefers 2-way traffic (5 comments), especially with all the construction disruption.
56. Have minimal parking on one side.
57. Supports the one side parking. The unmarked parking may become clogged with vehicles.
58. Bury hydro lines.
59. Special attention should be paid to where Albert Street and Hazel Street active transportation intersects with the trail. Have clear signage, road paint of a different colour and directional arrows.

d) <u>Residential Streets – Lester Street, Batavia Place, Sunview Street, Hemlock Street, Balsam Street, State Street, Fir Street, Hawthorn Street, Spruce Street 2-way, parking one side, shared auto/bike lanes</u>

60. Lester Street should be more like Albert/Hazel/Hickory Streets with high order infrastructure.
61. Lester Street doesn't suit the design as it is a through street. Needs consideration of more explicit cycling infrastructure or be made to be not a through street.
62. Lester Street should has a diverter to limit through traffic.
63. Concerned about speed of traffic, especially on Lester Street.
64. Segregated bike lanes would be advantageous but not necessary if traffic volumes are low.
65. Shared bike lanes will work as long as traffic doesn't increase substantially.
66. Surprised Woonerf isn't expanded to some of these roads.
67. Have pedestrian orientated street lighting (2 comments).
68. Ensure there is parking for visitors. Need to consider parents dropping of kids on moving days.
69. Strategically choose streets for 1-way.
70. Speed limits should be 20 km/h or less when mixing uses. Clearly mark intersections with road paint.
71. Mark the parking, have rollover curbs with narrow through lanes to prevent speeding when there are no cars.

e) <u>Woonerf Street – Larch Street shared space for all users including parking and landscaping</u>

72. Have better integration up to the house fronts/integrate yard with Woonerf.
73. Will there be any driveway entrances off this street for the surrounding developments?
74. Have more amenities and green space.

75. Prioritize and expand green space.
76. Focus on pedestrian uses such as lighting to make it safe at night and have outdoor furniture.
77. Parking should be a half hour maximum, and for deliveries only.
78. Need plenty of room to get around parked cars.
79. Have a design contest to increase awareness for the street.
80. Include public art.
81. Make State, Fir and Spruce Streets Woonerf as well.
82. Reduce and enforce speed limit.
83. Bad design, use the European Woonerf.
84. The design may confuse people. But it is a small street without much traffic.
85. Supports design (4 comments), but need public education.
86. Have signage at both ends of the street to explain concept.
87. Speed limit should be 10 km/h or less.

PLEASE PROVIDE COMMENTS ON THE EXHIBITS YOU HAVE SEEN TODAY AND ANY OTHER ISSUES YOU ARE AWARE OF CONCERNING THE PUBLIC SPACES AND STREETS WITHIN THE NORTHDALE NEIGHBOURHOOD

88. Address problems with garbage on properties adjacent to the study area.
89. Pedestrians and cycling should be the focus. This is a very active transportation focused neighbourhood.
90. The primary occupants of Northdale are students, young professionals and families. The use of trails, road crossings and pedestrian safety should be the highest priority.
91. Need pedestrian orientated lighting towards sidewalks.
92. Improve pedestrian lighting.
93. Reduce speed limits on residential streets to 30 or 40 km/h.
94. Prioritize green space and outdoor seating so people feel they can congregate outdoors.
95. Plans look good. Supports segregated bike lanes on Albert Street.
96. As long as streets are kept open for traffic and not turned into pedestrian only we will adapt.
97. Albert Street is a though fair and is not likely to change will all the developments going in.
98. If Hazel Street continued through to Phillip Street, this would reduce the number of cars turning left onto and off University Avenue and Columbia Street to access the University of Waterloo.
99. Have blue 911 help phone lines in the neighbourhood.
100. Intersection design for cycling crucial but not address through the cross-sections.
101. Use street appropriate emergency vehicles. Don't let huge firetrucks dictate street design.
102. A Northdale BIA could help pay for local improvements (e.g., bury hydro).
103. Modernizing the streets will take away the drab appearance.
104. Bike lanes on Albert should continue north and south of Northdale.
105. Access to the plaza and LRT necessary for Northdale residents.

2.5.3 Comments from External Agencies

2.5.3.1 Ministry of Tourism, Cutlure and Sport

A letter was received from the Ministry of Tourism, Culture and Sport (**Appendix A**) and is summarized as follows:

- Screen project to see if there are impacts to archeological resources ; and
- Screen project to see if there are impacts to built heritage and cultural heritage landscapes.

2.5.3.2 WLU / WCI Feasibility Study

At about the same time in September 2016 that the City held its third PIC for the Northdale Streetscape Master Plan, information was provided by WLU and WCI on their joint Feasibility Study for their property within the Northdale neighbourhood.[1] According to this information, the purpose of this Feasibility Study is to identify opportunities to pursue the redevelopment of the WCI / WLU Northdale Lands, which accounts for 17% of the Northdale neighbourhood, and potentially establish a "Community Hub". This Hub is defined as:

"a collection of facilities, programs, services and uses that support the three parties (City of Waterloo, WLU and WCI) *collective interests and address some broader Northdale and community aspirations in a manner that fosters interaction, gathering and community-belonging."*

One redevelopment configuration in the Feasibility Study has WCI with parking moved to the west side of Hazel Street, with arts, cultural, health and wellness uses on the east side. Three other configuration options are also presented, and the Study will ultimately decide on a preferred arrangement. It is expected to take 12-18 months to confirm and arrange for the optimum land use, and conduct the redevelopment approval process with the City of Waterloo. That process is expected to consider the Northdale streetscape recommendations and guidelines developed for this Streetscape Master Plan.

2.6 City of Waterloo Council Presentation

On October 24, 2016 members of the study team presented the preferred concepts to City of Waterloo council. Council approved the preferred concepts and the Project File Report and directed the study team to post and distribute the Notice of Study Completion. The council presentation is in **Appendix A**.

[1] WLU / WCI Feasibility Study, Live Learn Work Play, September 12, 2016

3 PROBLEM/OPPORTUNITY STATEMENT

The Northdale Neighbourhood is transforming rapidly. In the last 10 years the Northdale neighbourhood has developed approximately 60-70 new infill projects that have accounted for a large portion of the City's intensification growth.

To satisfy Phase 1 of the Municipal Class EA Process, it is first anticipated that Northdale will continue to grow over the next twenty years given the proximity of the neighbourhood to the universities, designated nodes, corridors and planned Major Transit Station Areas (MTSAs). The Streetscape Master Plan provides direction for the design and construction of public spaces in Northdale, focusing on the street right-of-ways with an understanding of engineering requirements. By advancing the vision of the Land Use and Community Improvement Plan at the street level, the Master Plan offers solutions to improve the open space, pedestrian, cycling and roadway component of the Northdale Public Realm.

Identified problems that need to be addressed include:

- Water Delivery System - The water delivery system in the neighbourhood is old. In many locations, pipes are not adequately sized to meet the demand of the higher density redevelopment projects.
- Sanitary Sewer System –Many pipes are reaching the end of their useful life, and will require increased maintenance and /or replacement. Some sewers are inadequately sized to meet future demands.
- Storm Water Management - The current storm sewer system in the neighbourhood is undersized by today's standards and shallow. There are also existing overland flow issues, with rainwater ponding on some streets and private property.
- Hydro / Telecommunication Utilities – Above ground hydro/telecommunication lines and poles within the street right-of-way are generally unattractive and may not work well with the setback requirements approved by Council in the Urban Design Guidelines.
- Lighting – Existing roadway lighting is provided predominately by overhead lighting affixed to hydro poles on one side of the roadway with no pedestrian scale lighting beyond any lighting provided on private developments. Not all of the existing streetlights have been converted to LED as part of the City's conversion program.
- Transportation Management – The capacity of the public roadway network within and around the Northdale neighbourhood cannot adequately accommodate vehicular and active transportation travel demands within and through the neighbourhood. There are no dedicated cycling routes either on or off the streets within the neighbourhood.
- On-Street Parking – Demands for on-street parking for visitors to the neighbourhood are expected to continue, most notably for non-resident university students. There is a challenge to balance the use of space to meet on-street parking needs, as well as the streetscape and urban design objectives of the Land Use and Community Improvement Plan to create more attractive, dynamic streets.
- Vegetation – Existing street trees within and near Northdale's public realm (street right-of-ways and public spaces) in some cases pose problems due to their age, invasive species and impacts from redevelopment.

There are also many opportunities for the Northdale neighbourhood including:

- Providing more detailed strategies, plans and design directions, in the form of a comprehensive Streetscape Master Plan, to implement the recommendations of the Northdale Land Use and Community Improvement Plan for all streets and public spaces. The Master Plan will provide guidance for the ultimate full redevelopment of the neighbourhood over time.

- Planning and designing streetscape improvements in Northdale can be coordinated with prioritizing of improvements to water, sanitary sewer and storm water management systems.
- Implementing transportation elements of the Streetscape Master Plan will provide opportunities to construct new active transportation and on-street parking features, as envisioned by the Land Use and Community Improvement Plan.
- Developing and beginning to implement the Streetscape Master Plan represents an important continuation of the partnership the City of Waterloo established in 2010 with neighbourhood residents, stakeholders, and the general public in planning how to best manage change in the Northdale neighbourhood.

4 EXISTING TRANSPORTATION ANALYSIS

4.1 Approach / Objective

From the onset of this study, it has been the consensus view of the study team that accommodating traffic, specifically vehicular traffic, should not be the driving force of this study. In keeping with that approach, the concepts explored and analysed in this study embody the neighbourhood's vision through designs that attempt to encourage active transportation and lower operating speeds, while maintaining neighbourhood access and existing vehicular capacity.

In particular, the Traffic and Parking Review provided in **Appendix B** of this report investigates the existing traffic operations, parking, and safety aspects of the Northdale neighbourhood, and the effect that proposed streetscape and traffic flow concepts will have on local traffic operations. In terms of accommodating future growth, the study is limited to making basic recommendations for changes to the local and collector road network within the neighbourhood. Therefore, there are few practical instruments for increasing the capacity of the network. In the face of this limitation, and respecting the transformative vision for the neighbourhood, the objective of this analysis is

not to find ways to accommodate all future demand for vehicular traffic, but rather to present mobility and parking recommendations that will help to shape travel and mode choice within the neighbourhood.

The study area (**Exhibit 4-1**) encompasses the Northdale neighbourhood bounded by Columbia Street West to the north, King Street North to the east, University Avenue West to the south, and Phillip Street to the west. The neighbourhood has an area of approximately 706,000m^2 or 70 hectares.

Exhibit 4-1 Study Area

The proximity to both the University of Waterloo and Wilfrid Laurier University has generated significant demand for student housing. Since 2011, the neighbourhood has been under constant construction to convert single detached houses into low and mid-rise apartment buildings. The constant, on-going construction has already had an impact on traffic patterns and parking demand, and will continue to have an impact for years to come. Therefore, the analysis of traffic operations, presented herein, is based on an approximation of "steady state" conditions that have been developed from a combination of new and historical data.

With the exceptions of Albert Street, which is a major collector roadway, all of the roadways within the study area are local roadways and, as such, their primary function is to provide direct access to the adjacent land uses.

In total, 32 intersections were included in the analysis, and they are listed in **Exhibit 4-2**.

Exhibit 4-2 List of Intersections

INTERSECTION	CONTROL TYPE
Signalized Intersections	
University Avenue & Phillip Street	Signalized
University Avenue & Albert Street	Signalized
St. Michael's Pedestrian Crossing	Signalized
University Avenue & Hazel Street	Signalized
University Avenue & King Street	Signalized
Columbia Street & Phillip Street	Signalized
Columbia Street & Albert Street	Signalized
Columbia Street & Hazel Street	Signalized
King Street & Columbia Street	Signalized
King Street & Hickory Street	Signalized
Unsignalized Intersections	
University Avenue & Lester Street	2-Way Stop
University Avenue & Sunview Street	2-Way Stop
University Avenue & Hemlock Street	1-Way Stop
Columbia Street & Lester Street	1-Way Stop
Columbia Street & Batavia Place	1-Way Stop
Columbia Street & Holly Street	1-Way Stop
Columbia Street & Spruce Street	1-Way Stop
Hickory Street & Lester Street	1-Way Yield
Hickory Street & Sunview Street	1-Way Stop
Hickory Street & Albert Street	2-Way Stop
Hickory Street & Hemlock Street	2-Way Stop
Hickory Street & Larch Street	1-Way Stop
Hickory Street & Hazel Street	4-Way Stop
Hickory Street & State Street	1-Way Stop
Hickory Street & Hawthorn Street	1-Way Stop
Hickory Street & Spruce Street	2-Way Stop
Hemlock Street & Balsam Street	1-Way Stop
Balsam Street & Larch Street	1-Way Stop
Hazel Street & Balsam Street	1-Way Stop
Hazel Street & Beech Street	1-Way Stop
State Street & Maple Court	-
State Street & Fir Street	1-Way Yield

Columbia Street, King Street North, University Avenue, and Phillip Street are key traffic arterials and were included in the traffic analysis to properly assess existing traffic operations; however, improvements to these streets are outside of the scope of this study. Therefore, recommendations that involve intersections at Columbia Street, King Street, University Avenue, or Phillip Street will have to impose only minor impacts on the arterial roadway approaches.

4.2 Existing Traffic Operations

Using existing traffic data reported in **Appendix B**, the study area intersections were analyzed using the Synchro 9.0 analysis software, applying the Highway Capacity Manual methodology.

Three different measures of effectiveness were used to provide insights into the existing traffic operations within the study area:

- Level of Service (LOS);
- Volume-to-Capacity ratio (V/C); and,
- Queue lengths.

The level of service is an indicator of intersection performance based on the average delay per vehicle. A lower LOS such an A, B or C indicates a shorter delay and better performance. LOS E and F represent poorer performance to the point of intersection failure or at theoretical capacity (gridlock).

The volume-to-capacity ratio is a measure of the vehicular demand relative to the theoretical carrying capacity of the roadway, based on known relationships with geometry, traffic control, and driver behaviour. The V/C value ranges from 0 to >1.0, with 1.0 indicating the intersection or movement is operating at its theoretical capacity.

Queue length is a measure of the estimated number of queued vehicles on a given intersection approach over the analysis period. The software reports the "typical" (50th percentile) and "maximum" (95th percentile) queues for each lane group on an intersection approach.

The following criteria are used to identify the critical movements for an intersection:

- LOS of D or worse;
- V/C greater than 0.85; and,
- 95th percentile queues that exceed the available storage capacity.

Exhibit 4-3 summarizes the critical movement results from the operational analysis for the signalized intersections throughout both the AM and PM peak periods.

Exhibit 4-3 Critical Movements at Signalized Intersections

INTERSECTION	INTERSECTION LOS	INTERSECTION V/C RATIO	CRITICAL MOVEMENT				
			MOVEMENT	LOS	V/C RATIO	95TH PERCENTILE QUEUE (M)	STORAGE CAPACITY (M)
AM Peak Period							
Hazel Street & Columbia Street	B	0.56	NBL	D	0.64	25.7	15
			NBT	D	0.53	27.9	-
			SBL	D	0.26	13.4	15
			SBT	D	0.71	34.6	-
Albert Street & Columbia Street	C	0.53	NBL	B	0.30	23.3	20
King Street & Columbia Street	E	1.11	EBL	F	1.38	147.2	90
			EBT	D	0.91	167.1	-
			WBT	D	0.88	135.2	-
			SBR	F	1.31	162.9	30
University Avenue & Phillip Street	A	0.51	NBL	D	0.02	2.5	-
			NBT	D	0.02	4.0	-
			SBL	D	0.52	26.1	60
			SBT	D	0.11	13.7	-
University Avenue & Albert Street	D	0.73	NBT	E	0.97	227.4	-
King Street & University Avenue	C	0.74	WBT	D	0.90	145.1	-
King Street & Hickory Street	A	0.26	EBL	D	0.28	14.5	15
			EBT	D	0.15	16.9	-
			WBT	D	0.35	24.1	-
PM Peak Period							

INTERSECTION	INTERSECTION LOS	INTERSECTION V/C RATIO	CRITICAL MOVEMENT				
			MOVEMENT	LOS	V/C RATIO	95TH PERCENTILE QUEUE (M)	STORAGE CAPACITY (M)
Hazel Street & Columbia Street	B	0.64	NBL	D	0.23	13.1	15
			NBT	D	0.76	41.6	-
			SBL	D	0.28	15.0	15
			SBT	D	0.33	20.4	-
Albert Street & Columbia Street	C	0.69	WBL	D	0.60	32.2	33
King Street & Columbia Street	F	1.34	EBL	F	1.68	192.4	90
			EBT	F	1.61	327.5	-
			WBT	D	0.82	110.0	-
			NBT	D	0.88	138.3	-
			SBL	F	1.28	114.9	30
			SBR	E	0.90	104.9	30
Campus Drive/ Hazel Street & University Avenue	B	0.47	NBL	C	0.21	21.5	10
University Avenue & Phillip Street	C	0.71	SBL	F	1.01	96.8	60
University Avenue & Albert Street	E	0.90	EBT	D	0.83	134.1	-
			NBL	D	0.73	40.6	180
			NBT	F	1.13	248.4	-
			SBL	C	0.56	22.7	16
			SBT	F	1.05	219.4	-
King Street & University Avenue	E	1.01	EBT	C	0.86	145.0	-
			WBT	F	1.12	190.1	-
			NBL	F	1.00	61.1	35
			NBT	D	0.87	109.6	-
			SBL	D	0.77	42.9	40
			SBT	E	1.05	147.4	-
King Street & Hickory Street	C	0.62	EBT	D	0.87	146.1	-

From the analysis, the following observations can be made:

- The intersection of King Street at Columbia Street is operating above capacity during both the AM and PM peak periods (This supports the theory that vehicles are using the study area to by-pass this intersection.);
- The signalized intersections of University Avenue and Albert Street, and University Avenue and King Street are operating at or approaching capacity during the PM peak period;
- The northbound and southbound through volumes at the intersection of University Avenue and Albert Street are operating above capacity during the PM peak period, indicating that Albert Street is functioning as a minor arterial, and not simply being used for cut-through traffic (via Hickory Street) or neighbourhood access; and,
- The majority of the movements into the neighbourhood that are critical are a result of signal timings favouring through traffic on the arterials, which increases the delay for side street movements. All movements entering the neighbourhood are operating below capacity, but many have poor levels of service due to control delays.

These results are consistent with typical vehicular operations along major arterials during the peak periods.

Critical movement results for the unsignalized intersections are summarized in Exhibit 4-4.

Exhibit 4-4 Critical Movements at Unsignalized Intersections

INTERSECTION	LANE	LANE LOS	APPROACH LOS	V/C RATIO	QUEUE LENGTH 95TH (M)	STORAGE CAPACITY (M)
AM Peak Period						
Lester Street & Columbia Street	NB	D	D	0.10	2.5	-
Spruce Street & Columbia Street	NB	D	D	0.08	2.0	-
PM Peak Period						
Lester Street & Columbia Street	NB	D	D	0.19	5.0	-
	SB	F	F	0.31	8.9	-
Lester Street & University Avenue	NB	D	D	0.20	5.6	-
	SB	E	E	0.35	11.1	-
Spruce Street & Columbia Street	EB	-	-	1.04	0.0	-
	NB	D	D	0.06	1.4	-
Albert Street & Hickory Street	EB	E	E	0.25	7.1	-
	WB	F	F	0.60	24.1	-
	*All lanes on the stop-controlled approaches are shared left/through/right.					

From Exhibit 4-4, the following observations can be made:

- All of the intersections are operating well below capacity with the exception of Spruce Street at Columbia Street during the PM peak period; however, the delay eastbound is a result of spillback queues from the nearby intersection of King Street and Columbia Street;
- The majority of the delay incurred at these intersections is a function of their mode of control (i.e., minor road stop control). The high traffic volumes along the main roads (e.g., Columbia Street and Albert Street) result in few turning opportunities for vehicles on the minor streets, which results in an increase in delay;
- The queue lengths are typically less than 3 car lengths, indicating that they are operating well within their theoretical capacity; and,
- Overall, all unsignalized intersections within the study area are generally operating well.

Detailed Synchro 9.0 outputs are provided in **Appendix B**.

4.3 Existing On-Street Parking

The primary purpose of existing on-street parking in the study area is to supplement residential off-street parking, in particular by providing extra space for guests and short-term overnight parking. On-street parking is not meant to replace off-street visitor parking, and it remains the responsibility of developers to ensure they are providing adequate visitor parking for their buildings on-site.

The majority of the streets within the neighbourhood have some variation of a parking restriction. The most significant are fully prohibited parking restrictions along both sides of Phillip Street and Albert Street, and along the north side of Hickory Street. A full map with restrictions and approximate number of available parking spaces is shown in **Exhibit 4-5 Existing On-Street Parking**. The approximate number of parking spaces was obtained by dividing the available curbside space by the average length of a parked vehicle (6.0 m), not accounting for gaps at driveways. Therefore, the number of parking spaces shown is an estimate, and the actual number of available parking spaces is likely to be lower than indicated.

The map indicates that there are approximately 1320 potential parking spaces available within the neighbourhood (660 if it is assumed that parking is only possible on one side of the street at a time); 400 of those potential spaces are free of restrictions, outside of the blanket restriction on overnight parking. It should be noted that the City of Waterloo intends to convert the "emergency

no parking due to construction" restriction on the west side of Spruce Street to become a permanent no parking restriction in the near future (or, at least, they have expressed an intent to not allow parking on both sides of Spruce Street).

The current by-laws (see **Exhibit 4-5 Existing On-Street Parking**) suggest that there is a desire on the part of commuters from outside the neighbourhood to use the free on-street parking. For example, the multiple restrictions limited to Monday-Friday indicate that there is demand from patrons of the nearby schools, businesses, and universities that conflicts with the intended utility of the on-street parking. Additionally, the No Stopping designation near schools (e.g., in front of WCI on Hazel St), that is standard City practice for schools, suggests significant demand for student drop-off/pick-up activities that could interfere with bus operations and poses safety issues in the same location. The parking restrictions within the neighbourhood are actually quite varied, with 8 different types of restrictions in effect under existing conditions. The current state of parking regulations within the neighbourhood is a legacy situation that is the result of the City having addressed a number of isolated issues over time. This type of variation in parking regulations can be confusing and lead to difficulties for both the users and enforcement, as there is very little consistency from one street to the next as to when and where parking is permitted.

Where on-street parking is permitted, it is currently free of charge, with no time limit restrictions outside the City's existing by-laws:

- Three hour time limit unless otherwise signed; and,
- No parking during the hours of 2:30AM and 6:00AM without an overnight parking exemption (15 exemptions per license plate per year).

The lack of restrictions, such as payment, encourages the use of on-street parking, which was observed to be well-utilized during site visits associated with this study. At present, the primary user of on-street parking appears to be the construction workers, as a significant portion of the neighbourhood is under construction at any given time. The dynamic nature of the neighbourhood and the presence of temporary users (e.g., construction workers) makes it difficult to get an accurate assessment of the long-term demand for on-street parking by residents through traditional means of observation and spot surveys. Therefore, these traditional methods of gathering parking utilization information were not conducted for this study.

However, inferring from the number of overnight parking exemptions issued over the last few years, there seems to be an increasing trend in the demand for overnight on-street parking. A likely contributor could be the surrounding lands being converted from single detached homes to higher-density developments, and the assumed target market for those new developments (i.e., students and young professionals, who are more likely to have overnight guests). The observed increasing trend in overnight on-street parking is concurrent with a trend towards lower rates of off-street parking provisions with new development (Section 5.2). Citywide figures for overnight exemptions issued were provided by the City of Waterloo and are summarized in Exhibit 4-6. Permit counts specifically for Northdale were not available.

Exhibit 4-5 Existing On-Street Parking

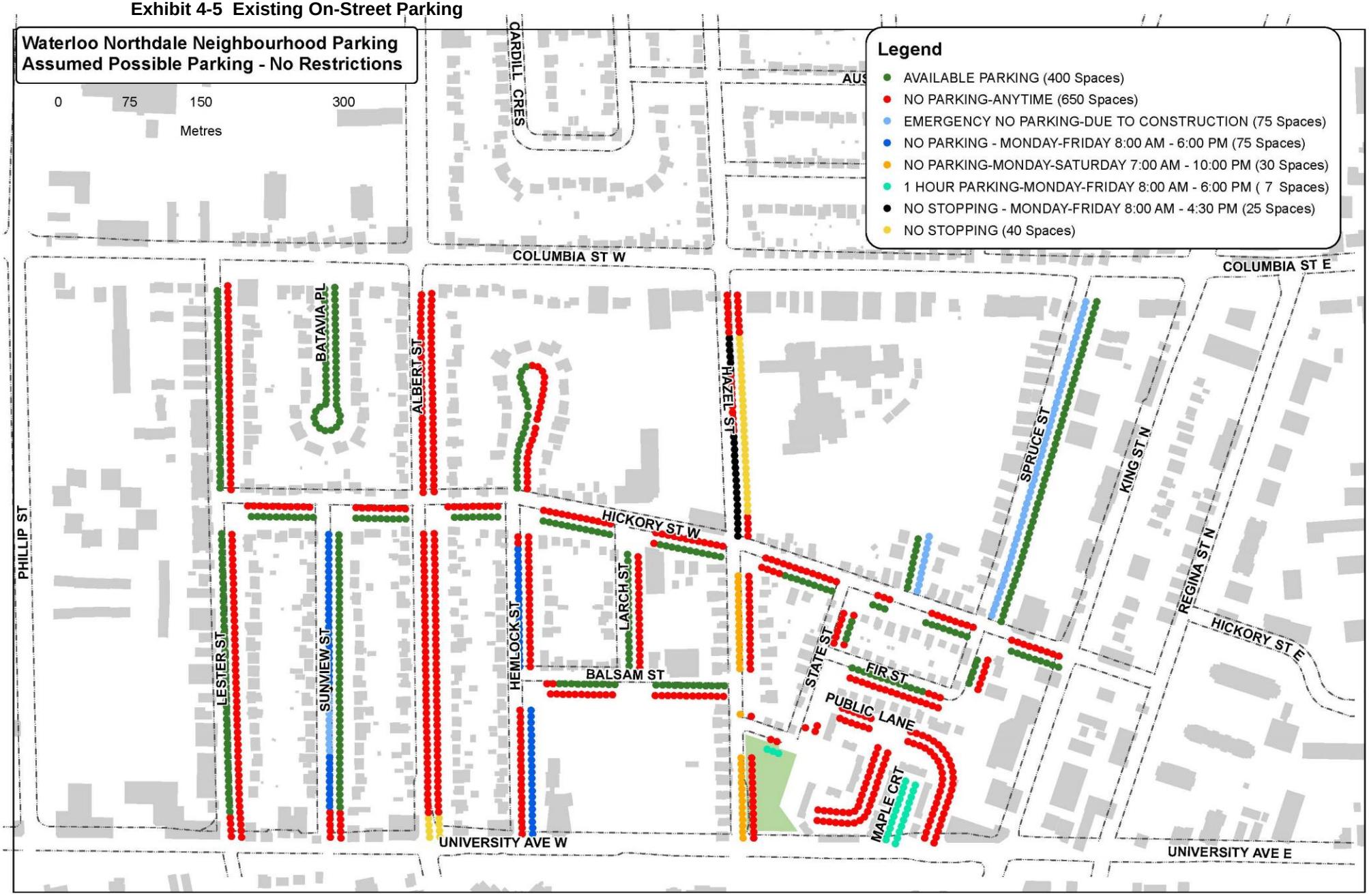


Exhibit 4-6 Overnight On-Street Parking Permits Issued by Year

YEAR	2013	2014	2015
Number of On-Street Overnight Permits	27775	53702	73455

The overnight exemption data show that issuances doubled from 2013 to 2014, and they are up over 260% from 2013 to 2015. Year-to-date figures from 2016 suggest that issuances are on track to equal or exceed the 2015 total.

4.4 Recent Trends in Off-Street Parking

New developments in the neighbourhood are mostly targeted to university students, a demographic that tends to own fewer cars and prefer modes of active transportation and transit for mobility (especially given the proximity of the university campuses, where many of them are destined). Under the current City by-laws, townhouses are required to provide 1 residential parking space per dwelling unit and apartments are required to provide 0.20 residential parking spaces and 0.05 visitor parking spaces per bedroom. Recognizing these trends, some new developments are proposing even lower parking rates. The increasing number of overnight parking exemptions indicates that while this assumption may be accurate for the residents, there may be a greater demand for visitor parking than is currently being accommodated by the new developments.

In recognition of the importance of active transportation for this neighbourhood, bicycle parking requirements have been included in the zoning by-laws at rates higher than those of resident vehicles (0.25 parking spaces per bedroom). Generally, when bicycle parking is noted in the new developments for which TIS reports have been provided, the allotted number of spaces follows the by-law.

Within and around the study area, numerous private and publically-available commercial off-street parking lots are also present. City by-laws mandate that the owners of these parking lots have properly accounted for the parking needs of their patrons; however, due to higher-than-expected demand or a desire to avoid parking fees, concerns have been raised about parking spillover into the neighbourhood. As noted earlier, on-street parking is not meant to replace off-street visitor parking, and it remains the responsibility of the developers to ensure they are providing adequate visitor parking for their buildings on-site.

4.5 Collisions

The Region of Waterloo provided five year historical collision data between 2009 and 2013 for the intersections on University Avenue West and King Street North abutting the Northdale study area. The City of Waterloo provided six year historical collision data between 2009 and 2014 for the rest of the study area intersections. No collision data were provided for the intersections listed below, and the City of Waterloo confirmed that no collisions occurred at those locations during the analysis period:

- Hickory Street / Lester Street;
- Hazel Street / Beech Street;
- State Street / Fir Street;
- State Street / Maple Court;
- Maple Court / State Court; and,
- University Avenue / St. Michaels Church Access.

The surrounding arterial streets (University Avenue, Columbia Street and King Street) are included in the analysis as they influence traffic patterns; however, they are not part of the streetscape master plan; therefore some of the analysis is completed using the internal neighbourhood streets only. The collision data from 2014 is omitted as it was not provided for all intersections and may be incomplete.

Multiple intersections along the study area are in the Region of Waterloo's top locations for vehicle, pedestrian, and cyclist collisions in 2014 (the most recent annual collision report released by the Region of Waterloo). The intersections and their respective rankings are presented in Exhibit 4-7.

Exhibit 4-7 Region of Waterloo Top Collision Rankings for Intersections within the Study Area (2014)

LOCATION	MODE OF TRANSPORTATION	RANKING
King Street & University Ave	Vehicles	17
	Pedestrians	1
King Street & Columbia Street	Vehicles	34
	Cyclists	11
University Avenue & Albert Street	Vehicles	66
University Avenue & Phillip Street	Pedestrians	26
University Avenue & Hazel Street	Cyclists	7

In total, there are 684 individual collisions documented. Collision diagrams for all intersections are included in **Appendix B**. **Exhibit 4-8 5-Year Collision Overview** illustrates the frequency of collisions at each intersection within the study area and the breakdown of the types of collisions at the top 3 intersections, listed below:

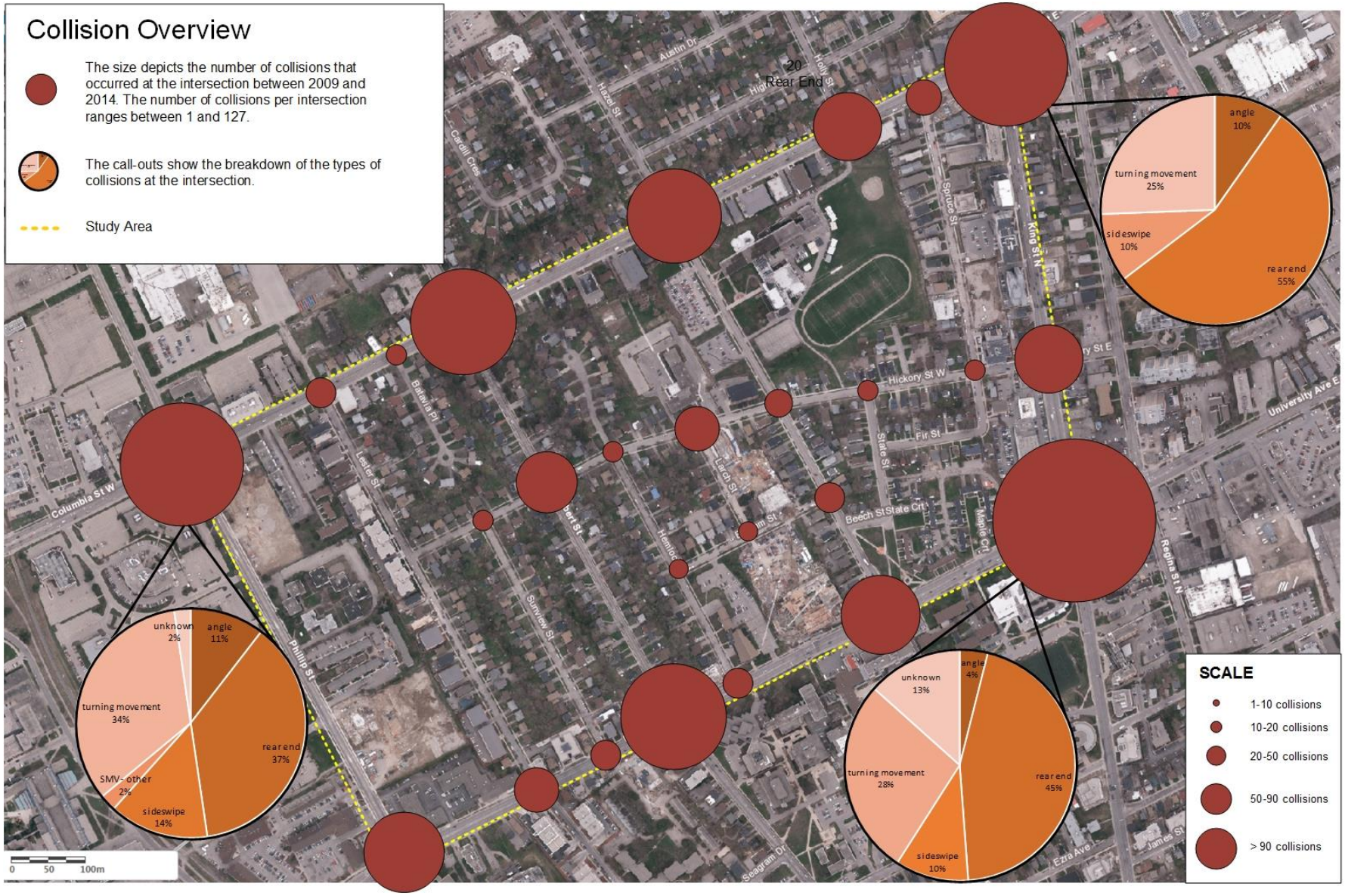
- King Street at University Avenue;
- Columbia Street at Phillip Street; and
- Columbia Street at King Street.

For each of the above listed intersections, rear-end collisions are the most frequent initial impact type, followed by turning movements. This is typical of signalized intersections and these collisions will be analyzed in greater detail later in this section.

Based on **Exhibit 4-8 5-Year Collision Overview**, a majority of the collisions occurred on the surrounding arterial streets with significantly fewer collisions having occurred on the internal neighbourhood streets. Albert Street at Hickory Street is the intersection with the highest number of collisions within the neighbourhood. This is understandable, as Albert Street has the highest traffic volumes of the non-arterial roads.

No fatalities occurred over the 5 years analysed. The majority of "unknown" collisions occurred on University Avenue and has remained consistent over time. Of the 684 reported collisions in the Northdale area, only 40 actually occurred within the Northdale neighbourhood. Further information on the frequency, severity, distribution and type of these collisions is provided in **Appendix B**.

Exhibit 4-8 5-Year Collision Overview



5 EXISTING NEIGHBOURHOOD CONDITIONS

5.1 Road Classification

The Road Classification within the City of Waterloo's TMP (Exhibit 5-1) is not based on traffic movement, but rather on people movement. The arterial roads on Columbia Street, King Street and University Avenue, along with Phillip Street, are outside the scope of the study area. Exhibit 5-2 details the characteristics of Major Collector and Local Roads.

Exhibit 5-1 Road Classification

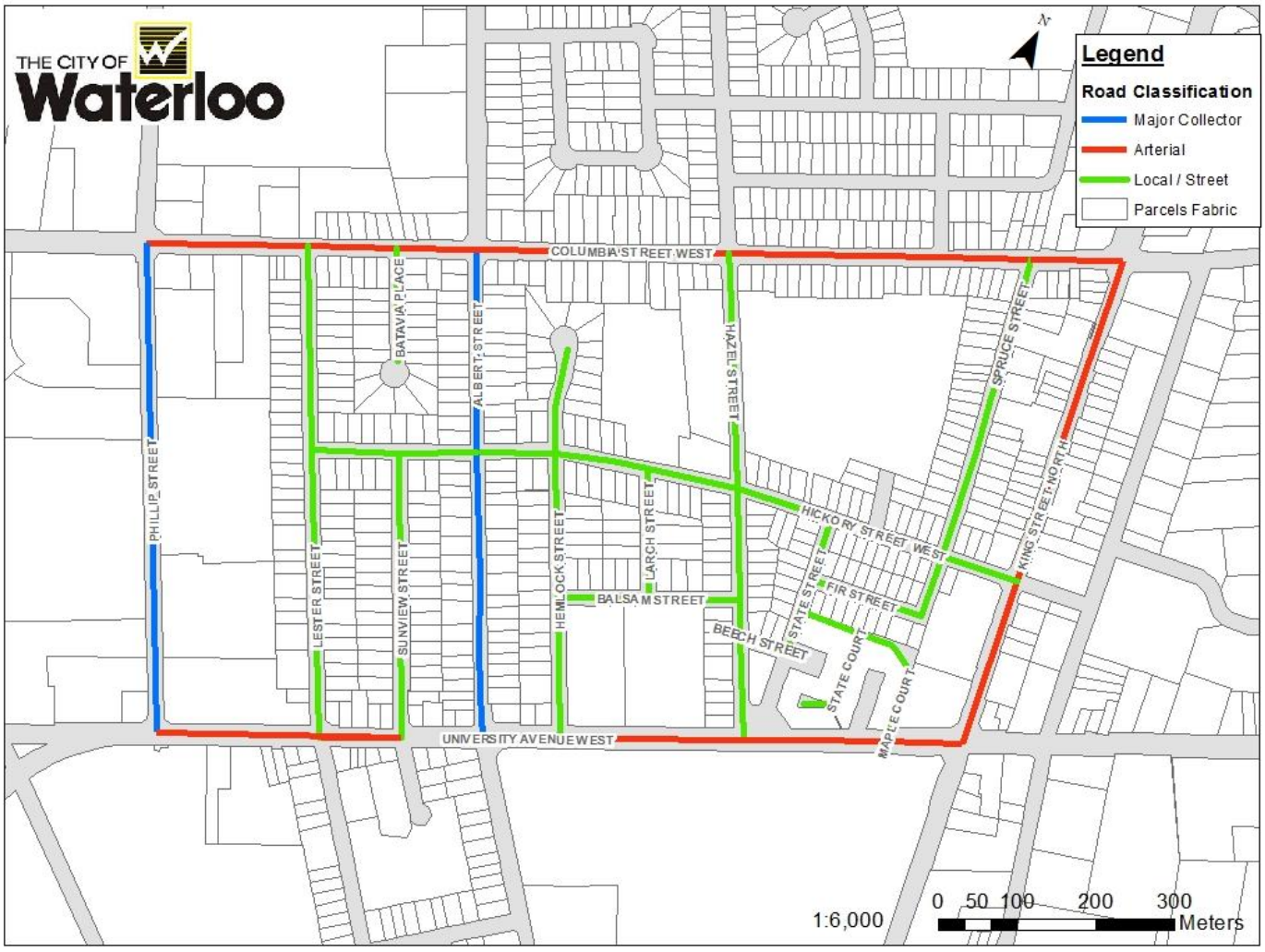


Exhibit 5-2 Characteristics of Major Collector and Local Roads

ROAD CLASSIFICATION CHARACTERISTICS	MAJOR COLLECTOR	LOCAL
ROW Width	20 – 30 m	16 – 18 m
Vehicle Types	Residential: Passenger & Service Vehicles Industrial/Commercial: All types	Residential: Passenger & Service Vehicles Industrial/Commercial: Restricted
Innovation Potential	Opportunities to accommodate non-motorized travel and reduce impacts of vehicular modes.	Opportunities to develop safe and pedestrian friendly streets.
Streetscape Features	Opportunities for basic and enhanced streetscape features such as furniture, lighting, trees and landscaping.	Opportunities for primarily basic streetscape features such as the boulevard, landscaping and sidewalks.
Existing/Planned Adjacent Land Use	Mixed Land Uses in the range of low/medium density	Primarily low density residential, neighbourhood and employment areas.
User Volume (Typical Motorized Traffic AADT*)	<12,000	<2,000
User Volume (Pedestrian)	High	Low
Design Speed	60 km/h	50 km/h
Average Running Speed	60 km/h	40-50 km/h
On-Street Parking Provisions	Generally restricted	Permitted on one or on both sides
Land Service/Access	Property access and people and goods movement of equal importance.	Primary function is to access individual properties.
Transit Service	Conventional transit allowed.	Generally restricted.
Pedestrian Facilities	Sidewalks both sides.	Sidewalks both sides.
Cyclist Facilities	Generally dedicated on-road facilities and off road facilities where appropriate.	Accommodate safety within road right-of-way.
Commercial Vehicle Access	Permitted in Employment Areas or as specified by Truck Route By-Law.	Not permitted except as allowed in Employment Areas or as specified by Truck Route By-Law.
Maximum Intersection Separation	200 m	60 m

Maximum Intersection Pedestrian Crossing	200 m	60 m
Maximum Driveway Spacing	None	1 driveway per lot.

*Average Annual Daily Traffic

5.2 Zoning and Building Setbacks

Zoning and related building setback provisions will also impact Northdale infrastructure in the future. In 2012, a Zoning By-Law amendment (Section 37 added to Zoning By-Law No. 1108) was approved to rezone the lands within the study area. This was done to permit a range of uses and building types. As detailed in the Northdale Land Use and Community Improvement Plan Study (2012) and shown on Exhibit 5-3, this addition resulted in changes to the following:

- Zone Categories – New zoning categories were introduced including Northdale Mixed Use Zone (NMU) and Northdale Commercial Zone (NC).
- Permitted Uses - The NMU zone provides a range of uses that are necessary as the neighbourhood continues to go through transition. This includes a range of housing types (e.g., single detached, triplex) and facilitates the transition to higher density residential uses over time. It also includes non-residential uses such as commercial and retail.

  The NC continues to allow for commercial uses, however it has been revised to permit residential uses provided they are above ground in a mixed use building.
- Street Frontage Areas – Established minimum and maximum setbacks and ground floor building requirements for each street frontage area.

5.3 Sanitary Sewers

The majority of the sanitary sewer infrastructure in the Northdale neighbourhood predates 1960 and is beginning to break down (e.g., nearing the end of its service life). The City of Waterloo conducts regular inspection of its sanitary sewers as part of its ongoing maintenance through CCTV inspections. In order to assess the condition of the existing infrastructure we reviewed the videos and reports provided by the City to determine levels of deterioration. The level of deterioration identified were noted in the reports provided and further confirmed through visual inspection of the videos. A summary of the conditions can be seen in Exhibit 5-4.

Exhibit 5-3 Zoning and Building Setback

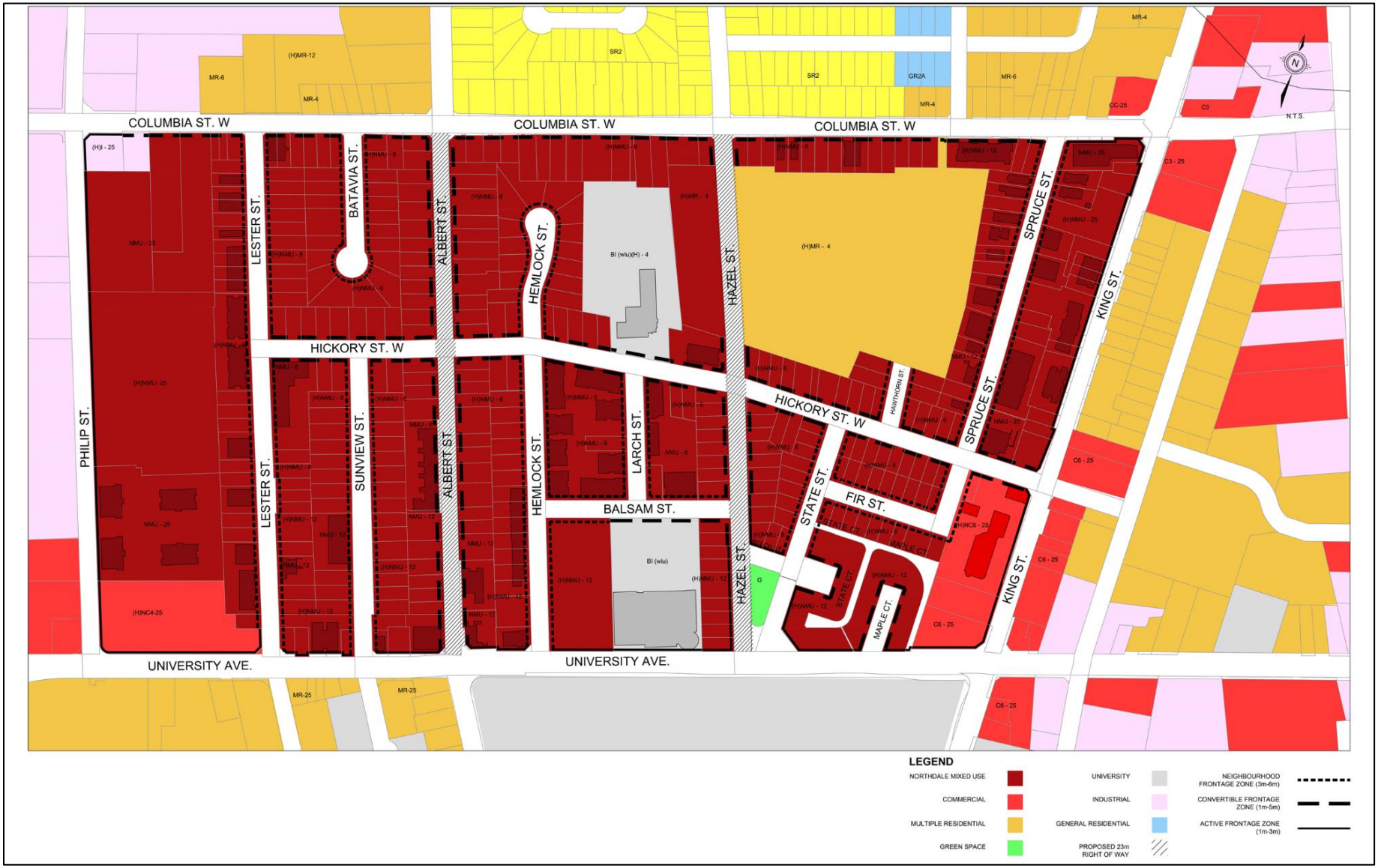
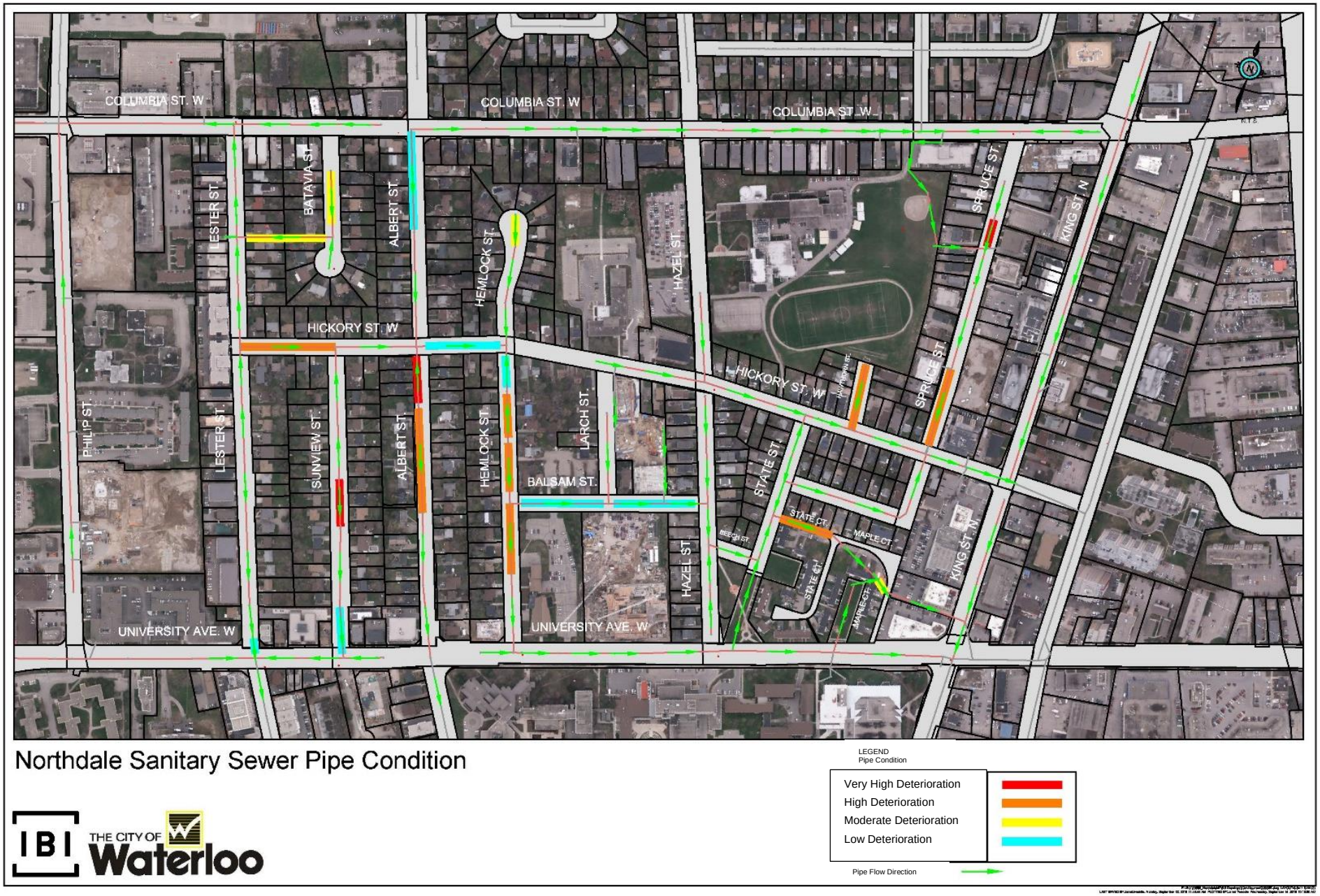


Exhibit 5-4 Sanitary Sewers Structural Condition



As a result of the age of the pipe there is significant amount pipes that are in need of rehabilitation or replacement.

5.3.1 Capacity Constraints

As a result of the growth of the Northdale Neighbourhood more sewage flow is being added to the system. As part of the capacity assessment a rational design was undertaken for each sewer run based on max buildout of the area based on current zoning restrictions.

5.3.2 Zoning

Previous Section 5.3 and Exhibit 5-3 summarize current zoning regulations specific to the Northdale neighbourhood, representing a maximum number of bedrooms per hectare. These regulations were used to determine the future population in the area. To account for additional population per bedroom, a factor of 1.4 persons/bedroom was used for bedroom specific zoning. Associated with Exhibit 5.3, the specified allowable density allowances for each zone as per By-Law 2012-070 can be seen in Exhibit 5-5.

Exhibit 5-5 Zoning Density

ZONE	ALLOWABLE DENISTY (Bedrooms per Hectare)
NMU-6/(H)NMU-6	250
NMU-8/(H)NMU-8	450
NMU-12/(H)NMU-12	600
NMU-25/(H)NMU-25	750
NC4-25	750
NC6-25	750

5.3.3 Design Criteria

To assess the capacity of the infrastructure for a future full buildout scenario, capacity requirements were considered based on rational design. Populations were based on zoning for the Northdale area as discussed in section 5.3.2 above.

Flow rates were based on MOE design criteria and 350 L/cap/day was utilized for residential use. For the existing institutional uses; WCI and the Wilfrid Laurier campus on Hickory Street a rate of 140 L/d/student was used based on the best known student populations. For external areas consisting of single family homes a population of 3.3 persons per unit in accordance with the City of Waterloo Development Manual.

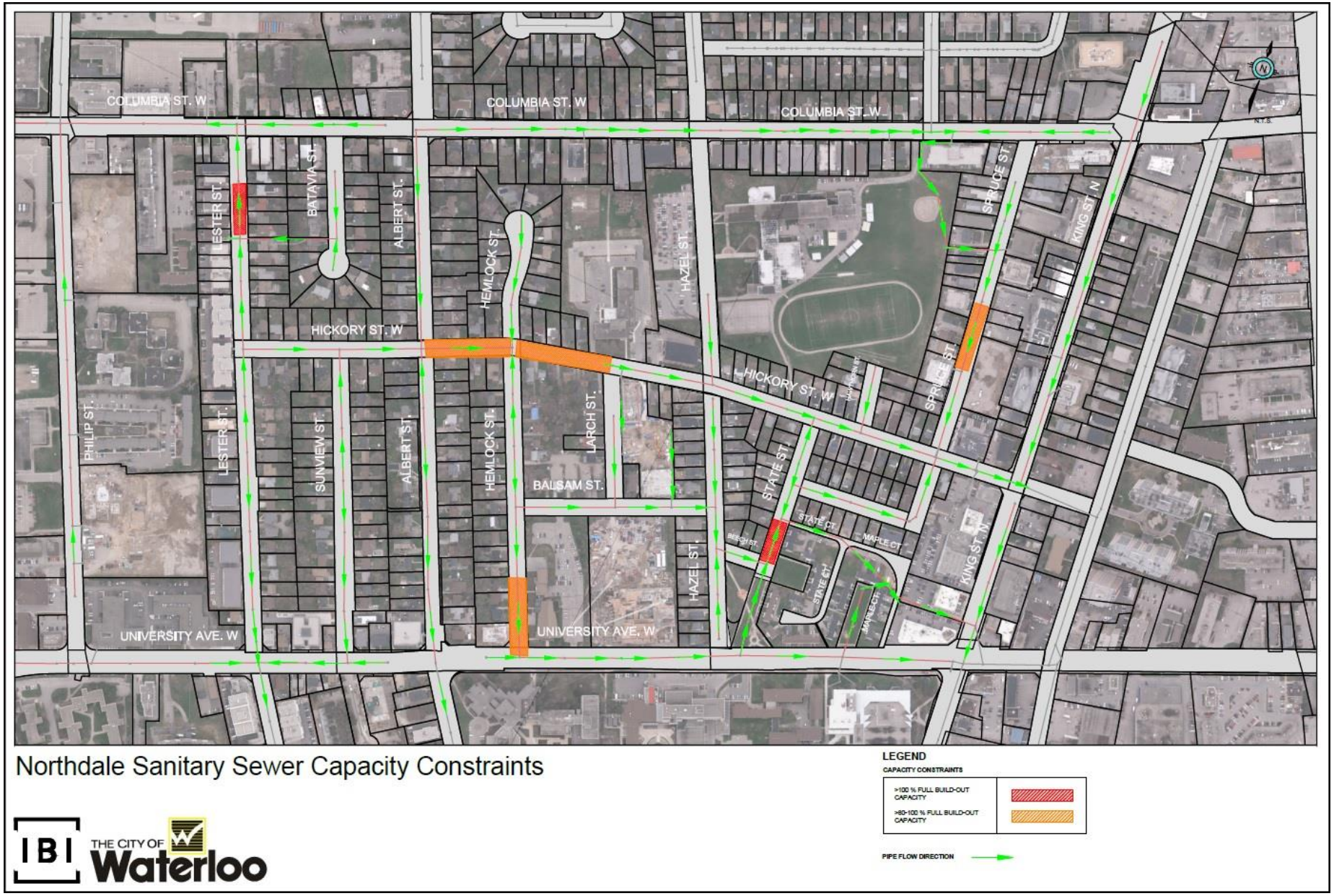
Existing pipe diameters and slopes based on a combination of as-built drawing data, GIS data and field checks were utilized to determine the existing capacities of the pipe.

Based on the rational design completed for the full build out scenario capacity constraints were identified. Capacity constrains were identified as the relationship of peak flow to available capacity. Two conditions were identified as being over capacity; at 80-100% capacity, and >100% capacity.

Capacity constraints were identified at the following locations as seen in Exhibit 5-6:

- Lester Street – single pipe segment between Hickory Street and Columbia Street (>100%);

Exhibit 5-6 Capacity Constraints



- Hickory Street –Albert Street to Larch Street (80-100%);
- Hemlock Street – single pipe segment between Hicklory Street to University Avenue (80-100%);
- State Street –Beech Street to State Court (>100%); and,
- Spruce Street – single pipe segment between Columbia Street and Hickory Street (80-100%).

These results were compared to the findings of the City Master Plan and Core Area Infrastructure Assessment. The Master Plan found only on segment of pipe over 50% capacity based on d/D ratio for their 2029 wet weather flow scenario. This segment was on Spruce Street from Fir Street to Hickory Street.

The Core Area study found capacity constraints over 80% in same areas as identified in Exhibit 5-7 based on their 2031 buildout scenario with the addition of a section on Hazel Street from Balsam Street to Beech Street, on Beech Street and the outlet from Maple Court to King Street. The absence of these constraints can be attributed to plug installed on Hickory and Hazel Streets to redirect flow from Hazel to Hickory.

5.3.4 Sanitary Sewer Conclusions

A review of the condition and capacity constraints of the sanitary sewers within the Northdale neighbourhood show that the condition of the existing infrastructure is the main concern when considering replacement of the existing infrastructure. With a majority of the existing sanitary sewer being installed prior to 1960 the pipes are nearing the end of their life cycle and are in need of replacement.

Although the area is seeing substantial development and more development is expected there are relatively minor capacity constraints identified based on a full buildout scenario. The isolated nature of the capacity constraints can likely be rectified through either minor upsizing of the pipe or increase in slopes.

Given that condition of the existing infrastructure is the driving cause for replacement the design of any replacement sewers as a result should also take into account future growth and capacity. The full report is in **Appendix C**.

5.4 Storm Sewers & Drainage

Municipal design standards for storm sewers have changed significantly since the Northdale community was serviced. Notwithstanding age and condition considerations, the majority of the storm sewer system will need to be replaced to meet current standards. The Master Drainage Study Urbanized Watersheds, Final Report (McCormick Rankin Corporation, March 7, 2005) provided an assessment of drainage issues within the City of Waterloo, and identified the outlet from Columbia Street West to Spruce Street as an area of concern that requires remediation. The Waterloo Core Area Infrastructure Assessment (Stantec, September 2011) identified storm sewer capacity constraints for drainage areas within the City of Waterloo, including the Northdale area.

Overland drainage patterns and major storm routing do not appear to have been taken into account during the development of the area. The major overland flow routes generally follow the road network, and drainage from lots sheet flow overland toward the road right-of-way. Drainage from a 53.84 ha residential and commercial area to the north of Columbia Street West, drains onto the Waterloo Collegiate Institute (WCI) property, then toward Spruce Street via private lots, and then ultimately to King Street North via Hickory Street West. As a result, there is relatively frequent inundation of the northeastern portion of the WCI property as the storm sewer capacity is exceeded and excess waters drain overland from Columbia Street.

The Northdale Area includes seven main storm drainage outlet locations, and the storm drainage areas have been established based on storm sewer outlet locations at the limits of the

Study Area, as summarized in Exhibit 5-7. The location of the pipes and capacity constraints are shown in Exhibit 5-8.

Exhibit 5-7 Storm Catchment Areas

CATCHMENT	AREA (HA)	OUTLET
300	83.46*	Hickory Street West to King Street North
301	8.107	Maple Court to King Street North Outlet
302	1.182	Hemlock Street to University Avenue West
303	1.778	Albert Street to University Avenue West
304	1.963	Sunview Street University Avenue West
305	1.677	Lester Street to University Avenue West
306	8.776	Lester Street to Columbia Street West

* includes 53.84 ha external drainage area outside of Northdale Study Area

The overall drainage areas summarized in Exhibit 5-7 were further discretized into smaller sub-catchment areas, typically representing areas draining to individual manholes. Details, figures, and calculations are included in the Storm Drainage Report included in **Appendix D**. The five-year controlled peak flows from the available Stormwater Management Reports within the Study Area were manually inserted into storm calculation sheets. Flows from all other areas were established using Rational Method calculations as per City of Waterloo standards, utilizing sub-catchment drainage areas, Runoff Coefficient (C) values (based on impervious coverage estimated from available engineering drawings and aerial photography), and time of concentration calculations. Storm sewer calculations were subsequently prepared for various proposed conditions alternative scenarios to determine the required pipe sizing to achieve capacity during the five-year storm event.

To mitigate the impact of the increased hard surface coverage as a result of intensified development and address the existing flooding issues, the following should be considered:

- Storm sewers for all proposed road reconstruction projects must be sized to convey the 5 year storm event, and meet all required City of Waterloo engineering standards.
- Stormwater quantity controls should be required on-site for all developing areas to control proposed conditions peak flows for the 2 year, 5 year, and 100 year return events to existing conditions levels.
- Stormwater quality controls should be required on-site to provide a Normal Protection Level for runoff discharging off-site as per the 2003 MOE Stormwater Planning and Design Manual (70 percent Total Suspended Solids removal of 85 percent of annual flows).
- Site Plan and municipal infrastructure engineering designs should accommodate active infiltration LID features, if soil and groundwater conditions permit. Long-term monitoring and maintenance should be completed for all LID features and BMPs constructed on private developments to ensure their continued operation.
- The Spruce Street and Hickory Street storm sewers should be sized to accommodate a 5 year storm peak flow discharging from the WCI lands. The final design should determine if the existing routing and easement location of the storm sewer through the WCI property to the Spruce Street outlet location is appropriate, and propose an alternative route, if required. A preliminary alignment in shown on Exhibit 5-9.
- The feasibility of providing stormwater control on the WCI lands could be considered based on further consultation with the landowner.

5.5 Watermains

The existing water distribution network within the Northdale area was evaluated through hydraulic modeling to confirm water capacity issues identified by previous studies. The hydraulic modeling was carried out under the scenarios of 2016 Existing Conditions, Future 2031 Conditions with Existing Watermains and Future 2031 Conditions with Ultimate Watermains. Existing conditions are summarized on **Exhibit 5-10**.

The City of Waterloo, through Stantec Consulting Ltd., conducted an assessment of the infrastructure in the Core Area of the City (water, sanitary, stormwater and transportation servicing) to improve the understanding of baseline (2008) capacity conditions; estimate potential future capacity constraints based on current planning projections; and, assist in the evaluation of development applications and capital planning. The Waterloo Core Area Infrastructure Assessment (WCAIA) study also developed a framework for defining priorities for infrastructure upgrades that considers intrinsic physical characteristics, baseline and future capacity assessments, and overlap with concurrent infrastructure rehabilitation needs.

As predicted by the WCAIA, some watermains within the Northdale neighbourhood have capacity constraints (low available fire flows) in the 2016 growth scenario. To facilitate new developments, the City has allowed developers to complete upgrades to the municipal water system on an ad-hoc basis to provide for fire protection and the domestic demands of high-density developments prior to issuing development approval.

Early this year, the City of Waterloo retained GM Blueplan Engineering Ltd. to undertake a City-wide Water Distribution Master Plan (WDMP). The purpose of this study is to complete a functional performance review of all City-owned watermains including watermains within Northdale Area. The study is expected to be completed later in 2016.

5.5.1 Hydraulic Models for Northdale Area

Three (3) hydraulic models have been developed to simulate water distribution within the Northdale area. The models were developed using the WaterCAD V8i Edition software produced by Bentley. The models show the piping network within the Northdale Area bounded by King Street, University Avenue, Phillip Street and Columbia Street. The three (3) models represent existing (2016) conditions and future 2031 conditions.

1. 2016 Existing Conditions Model – represents the existing state of watermains. Demands were populated based on calculated combined domestic water demands of existing single family houses and high-density residential buildings.
2. Future 2031 Conditions with Existing Watermain Model – represents the existing water distribution network. Demands were populated based on calculated domestic water demands based on the Northdale Area having been fully built-out.
3. Future 2031 Conditions with Ultimate Watermain Model – represents the ultimate water distribution network as defined by the WCAIA. Demands were populated based on calculated domestic water demands with full Northdale Area built-out.

GM Blueplan Engineering Ltd. has provided IBI Group with hydraulic conditions information from their WDMP hydraulic model for existing (2016) conditions and future (2031) demands scenarios. This information has been used as hydraulic boundary conditions for this analysis.

Exhibit 5-8 Storm Sewer Pipe Locations and Constraints

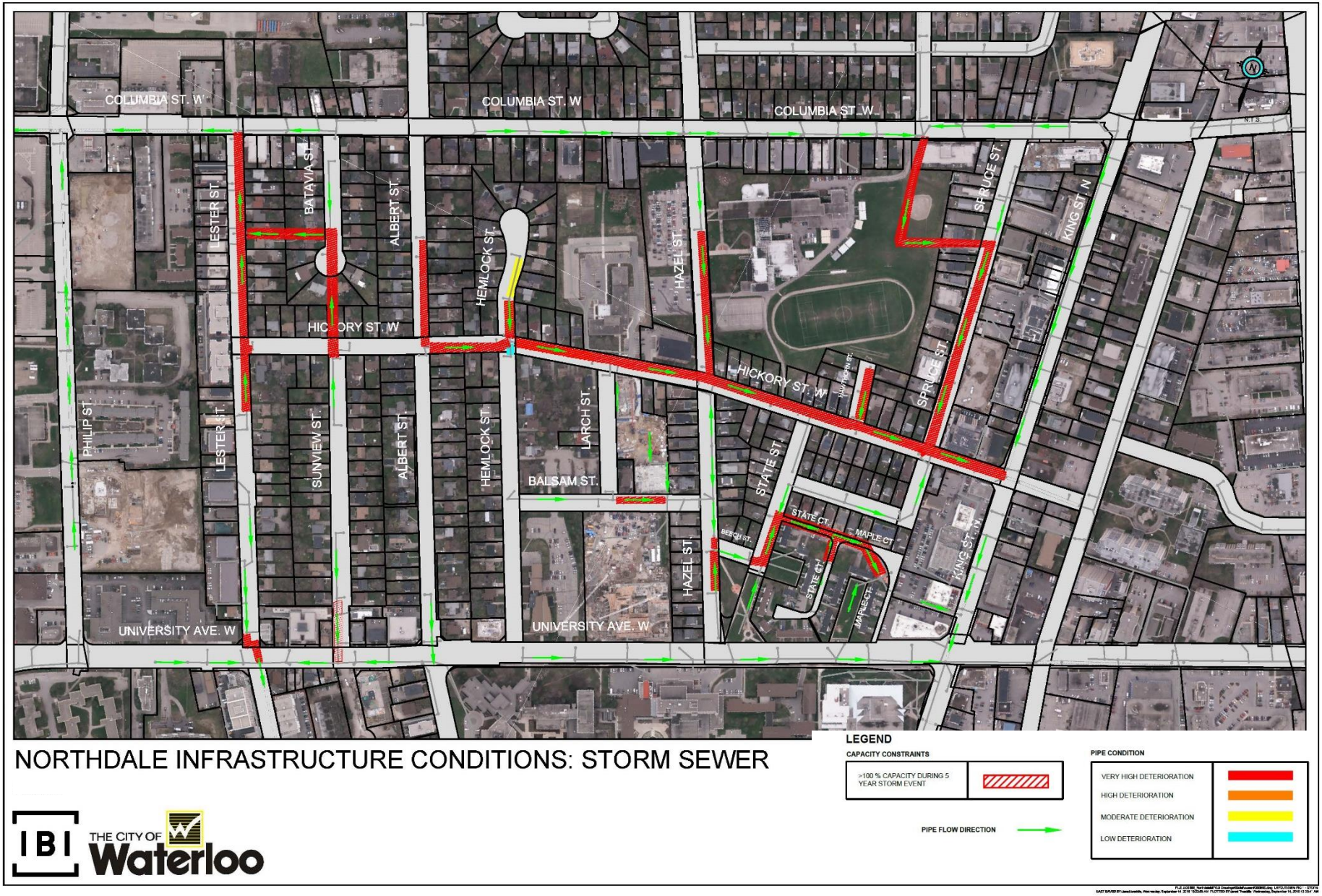


Exhibit 5-9 Spruce Street Preliminary Storm Sewer Alignment

Exhibit 5-10 Existing Watermain Conditions

5.5.2 Fire Flow Demand

The Region of Waterloo's Design Guidelines & Supplemental Specifications for Municipal Services (DGSSMS 2016) requires that fire flow requirements shall be determined in accordance with the current issue of "Water Supply for Public Fire Protection", Fire Underwriters Survey FUS.

At no time shall the available fire flow be less than that required under the Ontario Building Code (OBC).

IBI Group has provided engineering support for the development of several multi-storey residential apartment buildings within Northdale Area. During the development of these properties, it was observed that the calculated FUS fire flow requirements for these multi-storey buildings (that are equipped with fully automatic sprinkler systems) are typically lower than the OBC maximum fire flow requirements of 150 lps (9,000 lpm).

For the existing conditions at Northdale Area, we have used two (2) values of fire flow requirements.

1. 150 lps – at junction nodes where it will be providing fire protection for new multi-storey apartment buildings; and,
2. 100 lps – at junction nodes where it will be providing fire protection for existing single family residences.

For the future conditions scenario, we have assumed that fully automatic sprinkler system will be required and have utilized 150 lps for fire protection.

5.5.3 Hazen-Williams Roughness Coefficient (C) Values

It is important to determine the appropriate values of the pipes roughness coefficient (C) as it directly affect flow rates and head losses within the model. The majority of the watermains within the Northdale Community are 150mm cast iron pipes originally installed in the 1950's and1960's (50+ years old). As the pipe ages, it can be expected that its internal surface develops corrosion and other surficial changes which lead to pipe diameter reduction and roughness increase. A number of reference materials have prepared a summary of reduced roughness coefficient (C) values depending on the age of the pipes. 'C' values may also be estimated by subtracting a factor of 10/decade from the starting 'C' value of 100 for a cast iron pipe. The 'C' value should not fall below 40.

Based on our previous experience modeling the Northdale Area, using reduced 'C' values as described above results in predicted fire flows that are significantly lower than the flows observed through field testing and measurements. A calibration of the 'C' values to 110 has provided fire flow results that were better correlated to data collected through field testing of hydrants.

For the existing conditions at Northdale Area, we have used two (2) values of roughness coefficient (C):

1. 110 – for all existing cast and ductile iron pipes that are 20 years and older; and,
2. 150 – for all new and less than 5 years old PVC pipes.

5.5.4 Modeling Results

Hydraulic models for Northdale Area were prepared and evaluated to confirm the ability of the municipal water distribution system to provide for the domestic supply and fire protection needs of Northdale Area under current and future conditions. This analysis provides inputs to further assessment of staging of the City's road reconstruction efforts.

As expected, modeling results have identified some deficiencies in fire flows based on available fire flows less than 150 lps for apartment buildings and less than 100 lps for single family residences. The deficient fire flows are most notable at the ends of cul-de-sac currently serviced by 100mm and 150mm cast iron watermains. It was also noted that some areas within Northdale will experience system pressures lower than the preferred minimum 280 kPa (40psi) under the peak hour scenario. This result is in agreement with the previous analysis by the WCAIA.

2031 Existing Watermain Scenario - In the 2031 scenario with existing watermains, modeling results have identified more deficiencies in fire flows based on available fire flows less than 150 lps for apartment buildings. The deficient fire flows are most notable at the ends of cul-de-sacs and existing 150mm cast iron watermains. It was also noted that some areas within Northdale would experience low system pressures under the maximum day and peak hour scenarios. The analysis confirms that major upgrades on the Northdale Area water distribution system must be undertaken prior to its full built-out conditions to provide adequate fire protection and domestic supply.

2031 Ultimate Watermain Scenario - In the alternative 2031 scenario with ultimate watermains, all of the existing 100mm and 150mm cast iron watermains in the model have been upgraded to 200mm. The following watermains have been upsized in accordance with the recommendations of the WCAIA:

- Columbia St. (from Lester St. to King St) - upsized 200mm to 300mm;
- Hickory St. (from Lester St. to King St.) – upsized from 150mm to 300mm;
- Albert St. (from Hickory St. to Columbia St.) – upsized from 150mm to 200mm;
- Albert St. (from University Ave. to Hickory St.) – upsized from 150mm to 300mm;
- Hemlock St. (from Balsam St. to University Ave.) upsized from 150mm to 300mm;
- Hazel St. (from University Ave. to Balsam St.) upsized from 150mm to 300mm;
- Balsam St.(from Hazel St. to Larch St.) upsized from 150mm to 200mm; and,
- Balsam St. (from Larch St. to Hemlock St.) – upsized from 150mm to 300mm.

The existing 300mm ductile iron watermains at Lester Street are recommended for replacement with the same size due to its age being more than 50 years old since it was installed.

The model predicts that, with the proposed watermain upgrades described above, the available fire flows anywhere within Northdale Area have exceeded the 150 lps fire flow requirements with the exception of the cul-de-sac at the north end of Hemlock Street where the available fire flow is approximately 122 lps. Low system pressures will continue to be experienced in some areas under the maximum day and peak hour scenarios.

Methodology and modelling of the watermain findings can be found in **Appendix E.**

5.6 Electrical / Lighting

The existing electrical service in the Northdale Study Area consists of mostly overhead 13.8kV electrical power distribution lines with the only exception being Lester Street which is underground as shown on Exhibit 5-11. The focus of this investigation has been on the feasibility or burying more electrical service in appropriate parts of Northdale.

5.6.1 Design Options for Underground Electrical Service Relocation

Partially Vaulted - A partially vaulted approach at key locations would have the switchgear/transformers mounted on pads aboveground. Which could be a streetscape-related concern. However, this is a balanced approach, and easement may be required for pad mounted switchgear/transformers depending on the location

Entirely Vaulted - As visual impact is a concern, this option proposes all switchgear/transformers to be vaulted underground. This is the best option for visual impact mitigation, however more

costly solution and more difficult for maintenance and concern from flooding. Both this option and the pad mount option have a small clearance requirement around the equipment.

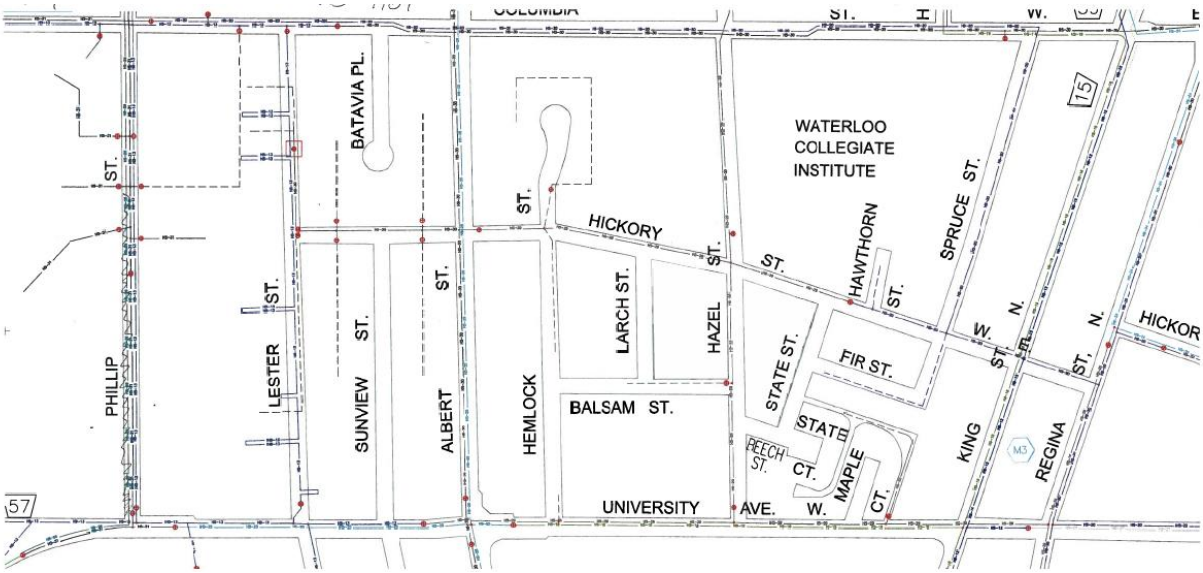
Entirely pad mounted - All switchgear/transformers would be pad mounted on the surface: This is the most common practice and the most cost effective. However visual impact mitigation issues are not addressed. Both this option and the Vaulted option have a small clearance requirement around the equipment.

There are also two options available for Medium and Low voltage Electrical Distribution Cabling:

Partial Burial - Bury only the lines that have the greatest current potential economic development value and leave the remaining as overhead lines. This a Balanced approach.

Full Burial - Bury all existing electrical distribution lines. This the most expensive option. Underground right of ways must be coordinated but it meets visual impact and setback goals.

Exhibit 5-11 Existing Electrical Lines



5.6.2 Land Use Considerations

Exhibit 5-12 below illustrates the required setback for each of the required alternatives.

Exhibit 5-12 Comparison of Required Setbacks and Clearances

	SETBACK/CLEARANCE	EASEMENT
Above Ground Poles	5.0m (horizontal distance from building face to power line) Primary: 4m clearance of trees and vegetation from power lines Secondary: 1.5m clearance of trees and vegetation	May need easement for additional poles deeper into property.
Buried Cable Vaulted Equipment	1.5 – 3m clearance around vault	May be required for switchgear or transformer
Buried Cable Pad Mounted Equipment	1.5 – 3m clearance around pad	May be required for switchgear or transformer

The City of Waterloo Official Plan has identified a proposed right-of-way (ROW) width for each street within the Northdale neighbourhood as well as an allowable building setback from the property line as previously shown on Exhibit 5-3. The required setback as identified in Exhibit 5-12 will determine the allowable location for hydro poles should relocation be required as part of the street reconstruction, as well as the location of buildings if the hydro poles are not being relocated or removed for burial.

The easement column indicates a potential need for an easement for hydro equipment. For pole mounted infrastructure there is a potential requirement for easement depending on the type of service agreed upon between the utility and the owner. An additional poles on customer property would require an easement. There is no easement required for switchgear and/or transformers mounted on poles. For buried or pad mounted infrastructure there may be an easement required in order for the land to be secured for transformers and/or switchgear assemblies.

5.6.3 Cost Comparison

The Exhibit 5-13 illustrates typical per m and unit costs for various levels of service for overhead and underground powerline, switchgear and transformer options.

Exhibit 5-13 Typical Cost Comparisons / m of Installation

FEATURE	OPTION	PRIMARY	SECONDARY
Powerlines *	Buried (Concrete Duct Bank) (Conversion)	$1,500-$4,500 per m ($2,400 typical for suburban location)	$1,500-$6,000 for each residential conversion
Switchgear	Vaulted	$75,000	-
	Pad Mounted	$25,000	-
Transformers **	Buried Vaulted	$55,000	
	Buried Pad Mounted	$18,500	

*Note: All Primary costs are for a 3 phase circuit.
** Note: typical residential installation (225 kVA)

The different options were evaluated based on identified criteria to provide insight on the cost impacts of each option. The results of the evaluation can be seen in Exhibit 5-14 below, with all qualitative descriptions relative to each other.

Exhibit 5-14 Relative Qualitative Comparison of Options

METHOD	COST	AESTHETICS	LAND USE IMPACTS	IMPACTS ON STREET LIGHTING
Above Ground	Low	Low	High	Low
Buried Cable Vaulted Equipment	High	High	Med	High
Buried Cable Pad Mounted Equipment	Medium	Medium	Med	High

5.6.4 Funding Alternatives

The following has been found to be the funding alternatives available to local distribution companies (LDCs) in the province of Ontario. IBI Group has consulted with LDC's it has worked with in the past to form the following alternatives.

- The Local Distribution Company formally submits to the Ontario Energy Board the proposed Capital Project Plan and the associated justification & proposed increase to the electricity ratepayers. The Ontario Energy Board is required to review & approve the Capital Project Plan and the proposed increase to the electricity ratepayers. If And Only If the Capital Project Plan is approved by the Ontario Energy Board, the Capital Project Plan is funded by the increase to the electricity ratepayers.
- The Local Distribution Company proposes a Business Plan to the Shareholders of the Company where the Annual Profits of the Company are used to Fund the Capital Project. The Business Plan should emphasize the proposed increase in revenue with the execution of the Capital Project.
- The Local Distribution Company implements a Connection and Cost Recovery Agreement (CCRA) for the Proposed Project were the Proponent(s) are required to Fund the Capital Contribution. The Proponent(s) are required to fund and complete a fully proposed future distribution system plan and associated capital cost. Subsequent Proponent(s) are required to participate in a Connection and Cost Recovery Agreement (CCRA) with a Capital Contribution Rebate component to the initial Proponent(s). The capital works would need to be funded by either the LDC or the municipality.
- The local municipality institutes a local area development charge for the project, initially funding the capital works from debentures and recovering costs on a per unit basis.

Based on current conditions, probable costs and discussions with stakeholders, we recommend that further discussion is required on the potential to bury hydro in Northdale.

5.6.5 Pedestrian Lighting

The type or types of pedestrian lighting to be installed as part of future street public realm improvements in Northdale will be determined at the detailed design stage. However, for the purposes of this Master Plan, the proposed wattage, general location and spacing of pedestrian lighting features along each of the Northdale streets are presented in Exhibit 5-15, mainly for costing purposes. This information is intended as a guide in selecting and designing the future pedestrian lighting fixtures.

5.6.6 Street / Pedestrian Lighting Plan Summary

Exhibit 5-15 presents a summary of the proposed street and pedestrian lighting features proposed for further consideration in the Northdale neighbourhood. Selections of actual materials will be made during detailed design, but this table provides an indication of lighting types, capital costs and O&M costs.

5.7 Environmental Conditions

5.7.1 Natural Heritage

There are no significant natural heritage features within the study area. Vegetation consists of manicured grasses and street trees. Species of trees include: Norway Maple (*Acer platanoides*), Freemans Maple (*Acer* x*freemanii*), Red Maple (*Acer rubrum*), Bur Oak (*Quercus macrocarpa*), and Ash (*Fraxinus species*). The location of existing street trees is illustrated in Exhibit 5-16 and a full inventory of the trees is provided in **Appendix F**. A tree management plan is included in Section 7.9 of this report.

Exhibit 5-15 Proposed Lighting Summary

NORTHDALE PROPOSED LIGHTING PLAN ANALYSIS																	
		E-W Streets					N-S Streets										
		1. Hickory St.	2. Balsam St.	3. Fir St.	4. Beech St.	5. Maple Crt.	6. Lester St.	7. Batavia Pl.	8. Sunview St.	9. Albert St.	10. Hemlock St.	11. Larch St.	12. Hazel St.	13. State St.	14. State Crt.	15. Spruce St.
Proposed Light Fixture Details	Length (m)	920	235	145	65	250	625	165	365	610	500	168	620	185	135	475
	Streetscape Type	GREEN	RESIDENTIAL	RESIDENTIAL	RESIDENTIAL	RESIDENTIAL	RESIDENTIAL	RESIDENTIAL	RESIDENTIAL	MIXED-USE	RESIDENTIAL	WOONERF	MIXED-USE	RESIDENTIAL	RESIDENTIAL	RESIDENTIAL
	Roadway Luminaire Quantity (unit)	23	8	6	1	5	20	6	11	17	15	5	19	6	4	15
	Total Roadway Pole Wattage (W)	126	126	126	126	126	126	126	126	105	126	105	126	126	126	126
	Roadway Luminaire (W)**	105	105	105	105	105	105	105	105	105	105	105	105	105	105	105
	Pedestrian Luminaire (W)**	21	21	21	21	21	21	21	21	0	21	0	21	21	21	21
	Roadway Luminaire Location	North side Joint-use	North Side Joint-use	South Side Joint-use	South Side Joint-use	Joint-use	East Side Standalone	West Side Standalone	West Side Standalone	West side Joint use	East Side Joint-use	East Side Joint-use	West side relocated Hydro Pole	East Side Joint-use	Joint-use	East Side Joint-use
	Pedestrian Luminaire Quantity (unit)	23	8	6	1	5	20	6	11	34	15	5	19	6	4	15
	Pedestrian Luminaire Wattage (W)**	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21
	Pedestrian Luminaire Location	South side Standalone	South side Standalone	North side Standalone	North side Standalone	Standalone	West Side Standalone	East Side Standalone	East Side Standalone	Both sides Standalone	West Side Standalone	West Side Standalone	East Side Standalone	West Side Standalone	Standalone	West Side Standalone
	Appox. Spacing (m)	40	34	24	33	50	32	33	32	36	36	34	33	31	34	32
Capital Expenditures	Roadway Lighting ($/unit)*	$4,500	$4,500	$4,500	$4,500	$4,500	$7,500	$7,500	$7,500	$4,000	$4,500	$4,000	$4,500	$4,500	$4,500	$4,500
	Pedestrian Lighting ($/unit)*	$6,400	$6,400	$6,400	$6,400	$6,400	$6,400	$6,400	$6,400	$6,400	$6,400	$6,400	$6,400	$6,400	$6,400	$6,400
	Total Cost for Roadway + Pedestrian per Street ($)	**$250,700**	**$87,200**	**$65,400**	**$10,900**	**$54,500**	**$278,000**	**$83,400**	**$152,900**	**$285,600**	**$163,500**	**$52,000**	**$207,100**	**$65,400**	**$43,600**	**$163,500**
Operation & Maintenance Cost	Total Wattage per Street (kW)	3.381	1.176	0.882	0.147	0.735	2.94	0.882	1.617	2.499	2.205	0.63	2.793	0.882	0.588	2.205
	Operating Hours (Hours per year) (12 hrs x 365 days)	4380	4380	4380	4380	4380	4380	4380	4380	4380	4380	4380	4380	4380	4380	4380
	Annual Energy Consumption per Roadway luminaire (kWh)	552	552	552	552	552	552	552	552	460	552	460	552	552	552	552
	Annual Energy Consumption per Pedestrian luminaire (kWh)	92	92	92	92	92	92	92	92	92	92	92	92	92	92	92
	Energy unit price ($/kWh)	$0.1621	$0.1621	$0.1621	$0.1621	$0.1621	$0.1621	$0.1621	$0.1621	$0.1621	$0.1621	$0.1621	$0.1621	$0.1621	$0.1621	$0.1621
	Annual Energy cost per Roadway luminaire ($/year)	$89	$89	$89	$89	$89	$89	$89	$89	$75	$89	$75	$89	$89	$89	$89
	Annual Energy cost per Pedestrian luminaire ($/year)	$15	$15	$15	$15	$15	$15	$15	$15	$15	$15	$15	$15	$15	$15	$15
	Maintenance cost per luminaire ($/year)	$10	$10	$10	$10	$10	$10	$10	$10	$10	$10	$10	$10	$10	$10	$10
	Total Annual Energy & Maintenance Cost per street ($)	**$2,861**	**$995**	**$746**	**$124**	**$622**	**$2,487**	**$746**	**$1,368**	**$2,284**	**$1,866**	**$547**	**$2,363**	**$746**	**$497**	**$1,866**

* **Unit price including mast arm, luminaire, wiring, grounding, conduits, handwells, power supplies and all applicable hardware**

** **Proposed Roadway Luminaire: Phillips Roadstar LED GPLM 105W**
Proposed Pedestrian Luminaire: Sternberg lighting LED 21W

5.7.2 Cultural Heritage

There are no designated or listed cultural heritage properties in the Northdale study area. However, the OP identifies in Section 11.1.45 (22) b) that:

> *Council, in consultation with the Municipal Heritage Committee, may consider appropriate tools for the potential conservation of the Veterans' Green Housing.*

There are also provisions in the OP for considering the cultural heritage of this area in any future redevelopment or infill project. The area is bounded by the Public Lane to the north and east, University Avenue to the south, and State Street and Veteran's Green Park to the west.

The Municipal Heritage Committee has expressed an interest in requesting that Council designate Waterloo Collegiate Institute (WCI), for reasons related to its modern architecture and that it was the first high school in the City. It is expected that the status of such a designation will be influenced by the future site planning being conducted on the WCI property.

5.7.3 Archaeology

This study involves a comprehensive neighbourhood-scale streetscape master plan located in an established, built-up urban area. It does not as yet involve any location or project-specific undertakings that would be subject to archaeological assessment under MTCS requirements. Any such, archaeological resources will be identified as part of the detailed design process, and mitigation measures recommended where required.

Exhibit 5-16 Existing Street Trees

6 EVALUATION OF STREETSCAPE OPTIONS

6.1 Street Typologies

The Northdale Land Use and Community Improvement Plan, and its Preferred Structure Plan introduced the following four (4) street typologies as shown on Exhibit 6-2. As described in the following section, each typology provides a basic framework for how the public realm space on each Northdale street may be laid out for the enhancement of the streetscape:

- Mixed Use Street – Designed to promote social interaction, while accommodating alternative modes of transportation.
- Green Street – Gives priority to pedestrian movement and adjacent open space connections.
- Residential Street – Designed to retain or enhance the residential character of the streetscape.
- Woonerf Street (Shared Street) – A space designed for all modes of transportation: pedestrians, cyclists and vehicles. Features often include no sidewalks, varied road treatments, and street furniture.

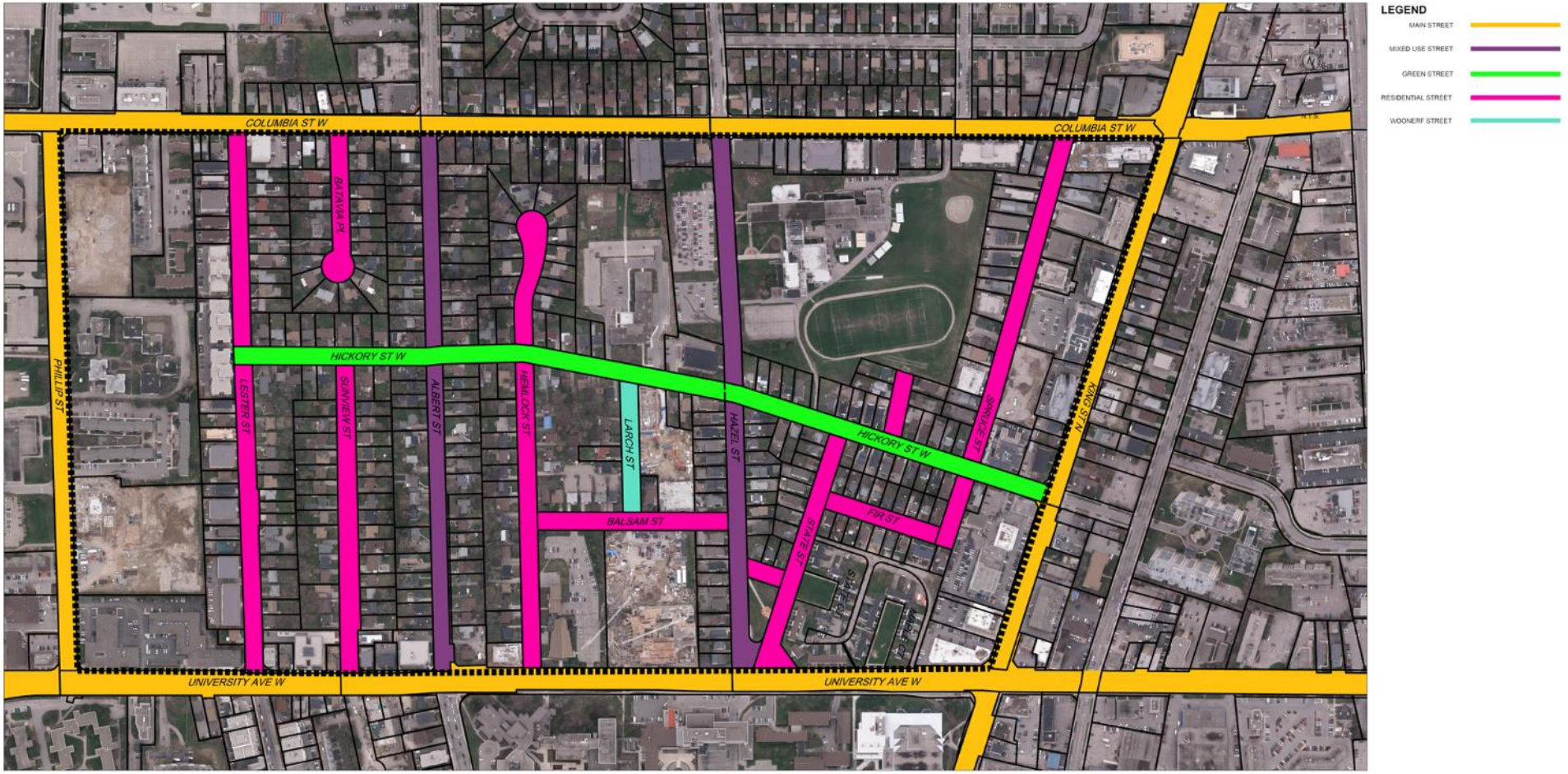
6.2 Streetscape Framework Options

The following series of streetscape options in Exhibit 6-1 were developed as part of this study, each representing a different way that the public realm framework may be designed for each of the established street typologies. These options are also illustrated in the following exhibits along with identification of preferred options based on the results of the comparative evaluation process summarized next in Section 6.3.

Exhibit 6-1 Streetscape Framework Options

TYPOLOGY	OPTION #	BASIC FRAMEWORK DESCRIPTION	EXHIBIT
Mixed Use Street	1a	Hazel Street 2 way, buffered bike lanes with door opening zones, intermittent parking on both sides (Hazel St.)	6.4
	1b	Albert Street 2 way with segregated bike lanes and pocket parking on alternating sides	6.5
	2	2 way with buffered bike lanes, intermittent parking on the west side	6.6
	3	2 way with buffered bike lanes, no on-street parking	6.7
Green Street	1	2 way with centre landscaped median, buffered bike lanes, no parking	6.8
	2	2 way with intermittent unmarked parking and Multi-Use Trail	6.9
	3	1 way single traffic lane, Multi-Use Trail one side and parking one side	6.10
	4	2 way with offset median, Multi Use Pathway	6.11
Residential Street	1	2 way, parking one side, no bike lanes	6.12
	2	2 way, parking one side, shared auto/bike lanes	6.13
	3	1 way, shared auto/bike lane, parking one side	6.14
Woonerf Street	1	Shared space including parking	6.15
	2	Shared space without parking (auto)	6.16

Exhibit 6-2 Northdale Street Typologies



6.3 Evaluation Criteria

The "Reasoned Arguments" methodology was used to evaluate the options developed for this study. This involved identifying the advantages and disadvantages of each option against the following set of multiple evaluation criteria representing social, natural and economic environments, technical issues, and policies and land use:

- Social Environment:
    - Community Cohesiveness – ability to serve neighbourhood transportation;
    - Quality of Life (Health and Safety) – impacts on public realm users;
    - Impacts of Heavy Truck Traffic – on adjacent land use;
    - Aesthetics – visual street impacts;
    - Property Requirements – is property taking needed – how much;
    - Emergency Access – impact on response time;
    - Construction Impact – potential for interference from traffic & parking; and,
    - Pedestrian Circulation/Accessibility - impact on movement within/through neighbourhood.
- Natural Environment:
    - Vegetation – minimize impacts on woodlots, street vegetation and maximize new planting;
    - Road Salt Impact – amount of hard surface; and,
    - Stormwater Quality and Quantity Opportunities.
- Economic Environment:
    - Capital Cost – comparative High, Medium, Low based on non-road surface width/quantity;
    - Property Cost – amount of property taking required; and,
    - Operating Cost – change in O&M requirements.
- Technical:
    - Municipal Services & Servicing
    - Transit Service – serve routes
    - Active Transportation – serve cycling/walking;
    - Complete Street – ability to serve all users;
    - On-Street Parking – impact on existing; and,
    - Impacts on Utilities – impacts on hydro, SWM.
- Policies and Land Use:
    - Land Use – compatibility with existing and future; and,
    - Planning Compliance – with related studies, plans and policies (CIP, TMP).

6.4 Evaluation Results and Preferred Options

The evaluation results are summarized in Exhibits 6.3a-d based on the pros (advantages) and cons (disadvantages) of each option against each of the evaluation criteria. It is intended to provide an objective, traceable response to each criterion for each option. **Appendix G** contains further background on the evaluation.

6.4.1 Mixed-Use Street

The two designated Mixed Use Streets in Northdale, namely Hazel Street and Albert Street have different operational characteristics. Albert Street is classified as a Major Collector extending well north and south of the neighbourhood and serving this area traffic. Hazel Street ends at University Avenue and therefore functions as a designated Minor Collector with a much smaller catchment area. In addition, the basic geometry of each street differs, for example with Hazel being narrower. As a result, the preference framework for each street differs.

Hazel Street - Option 1a on Exhibit 6-4 is preferred with 2-way operations, buffered bike lanes each with a door opening zone and intermittent parking on both sides. This framework for Hazel Street is preferred primarily because because:

- Lower traffic volume supports buffered marked bike lanes sharing road surface with motorized traffic and multiple existing/interim driveways, but will limit use by some cyclists;
- On-street parking and bike lanes help buffer land use from truck traffic;
- Can provide flexible intermittent parking where required based on future land use;
- Albert Street and Hazel Street were not considered for 1-way operation as this would increase traffic volume on these streets, increase speed, reduce property access and create more circuitous routes on intersecting streets; and,
- Comparatively low cost with narrowest non-road surface width (10.2 boulevard zones).

Albert Street - Rationale for the preferred Option 1b shown on Exhibit 6-5 for Albert Street is affected by the higher traffic volumes and speeds on this Major Collector. It warrants segregated bike lanes on each side, vertically separated from motorized traffic with a mountable curb separation. Intermittent pocket parking is also included but alternating sides to provide space for the wider segregated bike lanes.

6.4.2 Green Street

Option 2 is the preferred Green Street for the 2 way section of Hickory Street shown on Exhibit 6-9. It has a 2 way Multi-Use Trail along the north side with intermittent unmarked parking. Option 3 is preferred for the proposed 1 way section of Hickory Street between Hazel Street and Albert Street as shown on Exhibit 6.10. Both are preferred primarily because:

- More useable public realm boulevard space provided with one side Multi-Use Trail;
- 1-way on Hickory Street is short section between Hazel and Albert; and,
- Accommodates emergency vehicle movement better than other Green Street options.

6.4.3 Residential Street

Option 2 shown on Exhibit 6-12 is preferred for the Local streets in Northdale with 2-way operations, parking on 1 side and shared auto/bike lanes on these low speed, low volume routes because:

- Shared auto/bike space and parking 1 side provides wide boulevard zones (6.35m each side);
- Wider boulevard zone for pedestrian movement;
- Wider boulevard zone provides opportunities for aesthetic streetscape enhancement; and,
- All streetscape works within existing road right-of-way with no property acquisition required.

6.4.4 Woonerf Street

Note: the two Woonerf Street options are very similar and many evaluation criteria apply equally to both. Either option meets the intent of the Community Improvement Plan for Larch Street. Option 1 is slightly preferred mainly because:

- Replaces existing on-street parking on Larch Street; and,
- Slightly less hard surface.

Exhibit 6-3a Mixed Use Street Evaluation of Options

MIXED USE STREET (MU) OPTIONS

Hazel Street and Albert Street

EVALUATION CRITERIA	MU1a Hazel 2-way with buffered bike lanes with door zones, intermittent parking both sides	MU1b Albert 2-way with segregated bike lanes, pocket parking alternating sides parking west side	MU2 2-way with buffered bike lanes, intermittent parking west side	MU3 2-way, buffered bike lanes, no on-street parking
SOCIAL ENVIRONMENT				
Community Cohesiveness – ability to serve neighbourhood transportation				
Quality of Life (Health & Safety) – impacts on public realm users				
Impacts of Heavy Truck Traffic – on adjacent land use				
Aesthetics – visual street impacts				
Property Requirements – is property taking needed – how much	All MU Options require ROW widening	All MU Options require ROW widening	All MU Options require ROW widening	All MU Options require ROW widening
Emergency Access – impact on response time				
Construction Impact – potential for interference from traffic & parking				
Pedestrian Circulation / Accessibility - impact on movement within / through neighbourhood				
Summary: Social Environment		(for existing land use)		(for existing land use)
NATURAL ENVIRONMENT				
Vegetation – minimize impacts on woodlots, street vegetation and maximize new planting				
Road Salt Impact – amount of hard surface				
Stormwater Quality & Quantity Opportunities				
Summary: Natural Environment				
ECONOMIC ENVIRONMENT				
Capital Cost – comparative High, Medium, Low based on non-road surface quantity				
Property Cost – amount of property taking required	All MU Options require property	All MU Options require property	All MU Options require property	All MU Options require property
Operating Cost – change in O&M requirements				
Summary: Economic Environment				
TECHNICAL				
Municipal Services & Servicing				
Transit Service – serve routes				
Active Transportation – serve cycling/walking				
Complete Street – ability to serve all users				
On-Street Parking – impact on existing				
Impacts on Utilities – impacts on hydro, SWM				
Summary: Technical				
POLICIES AND LAND USE				
Land Use – compatibility with existing & future				
Planning Compliance – with related studies, plans & policies (CIP, TMP)				
Summary: Policy and Land Use				
EVALUATION SUMMARY	PREFERRED	PREFERRED		

Least Preferred Partially Preferred Preferred

GREEN STREET (GS) OPTIONS

Hickory Street W

EVALUATION CRITERIA	GS1 2-way with centre median, buffered bike lanes, no parking	GS2 2-way with intermittent unmarked parking and Multi-Use Trail	GS3 1-way single lane with Multi-Use Trail one side & parking one side	GS4 2-way with offset median, Multi-Use Pathway
SOCIAL ENVIRONMENT				
Community Cohesiveness – ability to serve neighbourhood transportation				
Quality of Life (Health & Safety) – impacts on public realm users				
Impacts of Heavy Truck Traffic – on adjacent land use				
Aesthetics – visual street impacts				
Property Requirements – is property taking needed – how much				
Emergency Access – impact on response time				
Construction Impact – potential for interference from traffic & parking				
Pedestrian Circulation / Accessibility - impact on movement within / through neighbourhood				
Summary: Social Environment				
NATURAL ENVIRONMENT				
Vegetation – minimize impacts on woodlots, street vegetation and maximize new planting				
Road Salt Impact – amount of hard surface				
Stormwater Quality & Quantity Opportunities				
Summary: Natural Environment				
ECONOMIC ENVIRONMENT				
Capital Cost – comparative High, Medium, Low based on non-road surface quantity				
Property Cost – amount of property taking required				
Operating Cost – change in O&M requirements				
Summary: Economic Environment				
TECHNICAL				
Municipal Services & Servicing				
Transit Service – serve routes				
Active Transportation – serve cycling/walking				
Complete Street – ability to serve all users				
On-Street Parking – impact on existing				
Impacts on Utilities – impacts on hydro, SWM	Same Impacts	Same Impacts	Same Impacts	Same Impacts
Summary: Technical				
POLICIES AND LAND USE				
Land Use – compatibility with existing & future				
Planning Compliance – with related studies, plans & policies (CIP, TMP)				
Summary: Policy and Land Use				
EVALUATION SUMMARY		PREFERRED		

Least Preferred Partially Preferred Preferred

Exhibit 6-3c Residential Street Evaluation of Options

RESIDENTIAL STREET (RS) OPTIONS

Lester Street, Sunview Street, Batavia Place, Hemlock Street, State Street, Fir Street, Balsam Street, Spruce Street, Beech Street

EVALUATION CRITERIA	RS1 2-way, parking 1 side, no bike lanes	RS2 2-way, parking 1 side, shared auto/bike lanes	RS3 1-way shared lane, parking 1 side
SOCIAL ENVIRONMENT			
Community Cohesiveness – ability to serve neighbourhood transportation			
Quality of Life (Health & Safety) – impacts on public realm users			
Impacts of Heavy Truck Traffic – on adjacent land use			
Aesthetics – visual street impacts			
Property Requirements – is property taking needed – how much			
Emergency Access – impact on response time			
Construction Impact – potential for interference from traffic & parking			
Pedestrian Circulation / Accessibility - impact on movement within / through neighbourhood			
Summary: Social Environment			
NATURAL ENVIRONMENT			
Vegetation – minimize impacts on woodlots, street vegetation and maximize new planting			
Road Salt Impact – amount of hard surface			
Stormwater Quality & Quantity Opportunities			
Summary: Natural Environment			
ECONOMIC ENVIRONMENT			
Capital Cost – comparative High, Medium, Low based on non-road surface quantity			
Property Cost – amount of property taking required			
Operating Cost – change in O&M requirements			
Summary: Economic Environment			
TECHNICAL			
Municipal Services & Servicing			
Transit Service – serve routes	No public transit on these streets.	No public transit on these streets.	No public transit on these streets.
Active Transportation – serve cycling/walking			
Complete Street – ability to serve all users			
On-Street Parking – impact on existing			
Impacts on Utilities – impacts on hydro, SWM	Same Impacts	Same Impacts	Same Impacts
Summary: Technical			
POLICIES AND LAND USE			
Land Use – compatibility with existing & future			
Planning Compliance – with related studies, plans & policies (CIP, TMP)			
Summary: Policy and Land Use			
EVALUATION SUMMARY		PREFERRED	

Least Preferred Partially Preferred Preferred

WOONERF (SHARED) STREET (WS) OPTIONS

Larch Street

EVALUATION CRITERIA	WS1- shared space including parking	WS2- shared space excluding parking
SOCIAL ENVIRONMENT		
Community Cohesiveness – ability to serve neighbourhood transportation		
Quality of Life (Health & Safety) – impacts on public realm users		
Impacts of Heavy Truck Traffic – on adjacent land use	Not intended for heavy truck use.	Not intended for heavy truck use.
Aesthetics – visual street impacts		
Property Requirements – is property taking needed – how much		
Emergency Access – impact on response time		
Construction Impact – potential for interference from traffic & parking		
Pedestrian Circulation / Accessibility - impact on movement within / through neighbourhood		
Summary: Social Environment		
NATURAL ENVIRONMENT		
Vegetation – minimize impacts on woodlots, street vegetation and maximize new planting		
Road Salt Impact – amount of hard surface		
Stormwater Quality & Quantity Opportunities		
Summary: Natural Environment		
ECONOMIC ENVIRONMENT		
Capital Cost – comparative High, Medium, Low based on non-road surface quantity		
Property Cost – amount of property taking required		
Operating Cost – change in O&M requirements		
Summary: Economic Environment		
TECHNICAL		
Municipal Services & Servicing	Same Impacts	Same Impacts
Transit Service – serve routes	No public transit on these streets.	No public transit on these streets.
Active Transportation – serve cycling/walking		
Complete Street – ability to serve all users		
On-Street Parking – impact on existing		
Impacts on Utilities – impacts on hydro, SWM	Same Impacts	Same Impacts
Summary: Technical		
POLICIES AND LAND USE		
Land Use – compatibility with existing & future		
Planning Compliance – with related studies, plans & policies (CIP, TMP)		
Summary: Policy and Land Use		
EVALUATION SUMMARY	PREFERRED	

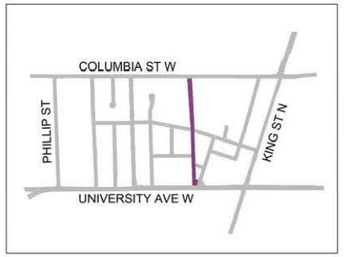
Least Preferred Partially Preferred Preferred

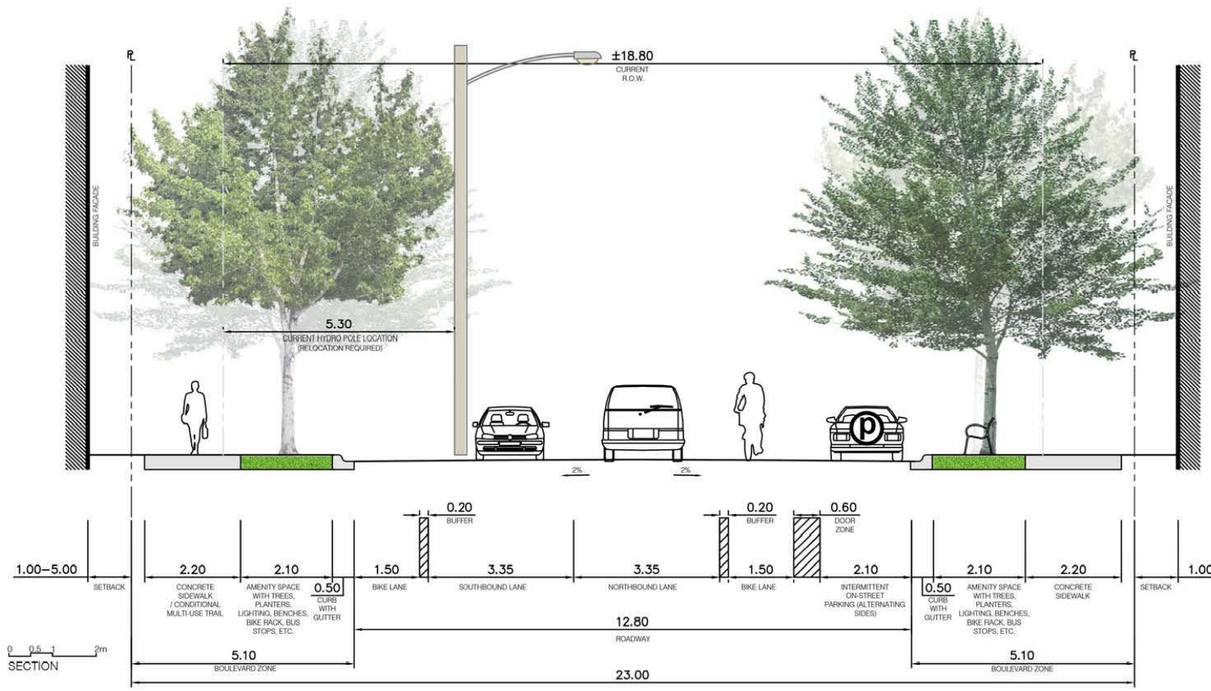
Exhibit 6-4 Mixed Use (Hazel) Street Option 1a: 2-Way with Buffered Bike Lanes and Door Opening Zones, Intermittent Parking on Both Sides

MIXED-USE (HAZEL) STREET - PREFERRED

OPTION 1a

2 WAY WITH BUFFERED BIKE LANES WITH DOOR ZONES,
INTERMITTENT PARKING BOTH SIDES





*Multi-Use Trails along Northdale streets must be accompanied by measures to reduce driveway crossing conflicts to an acceptable level, and/or traffic management provisions using signage, pavement markings, warnings and other traffic management measures.

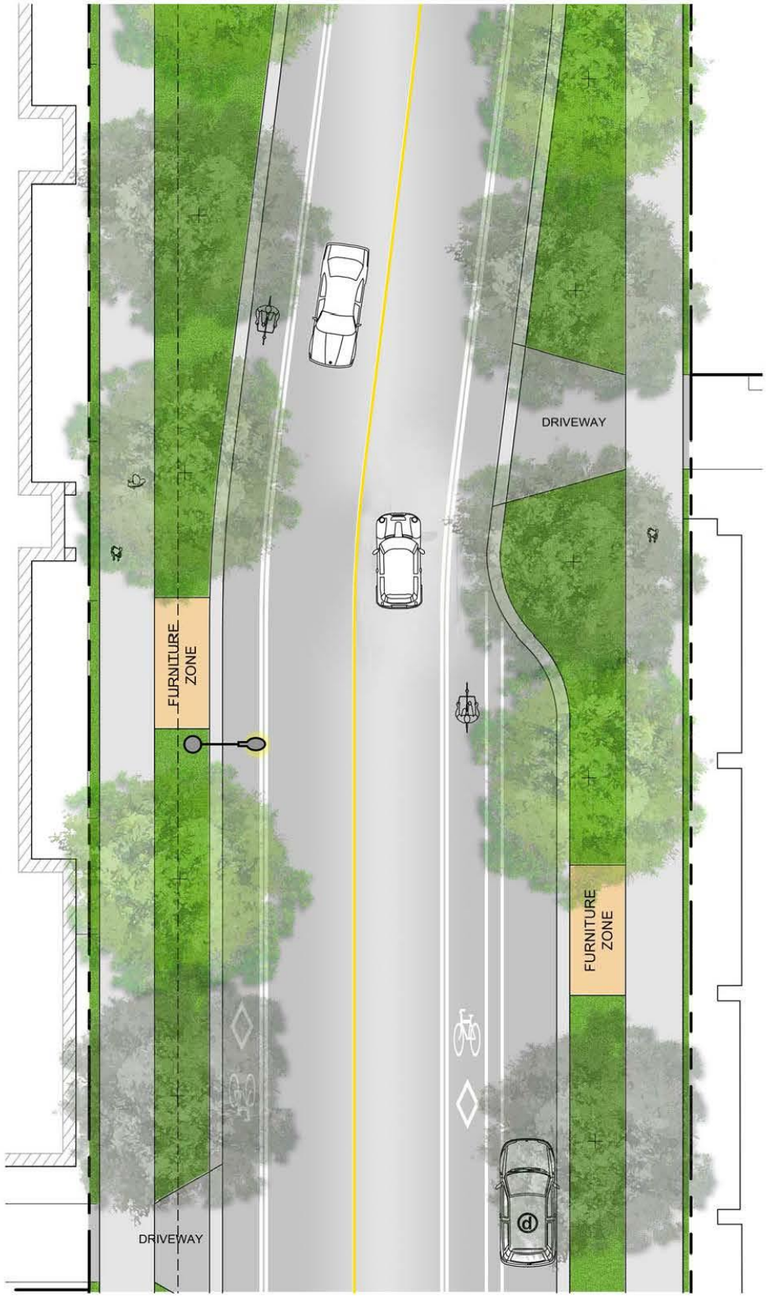
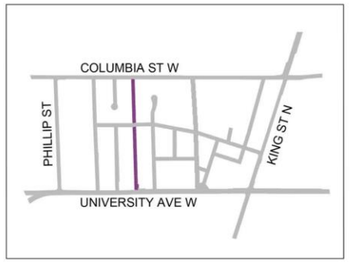


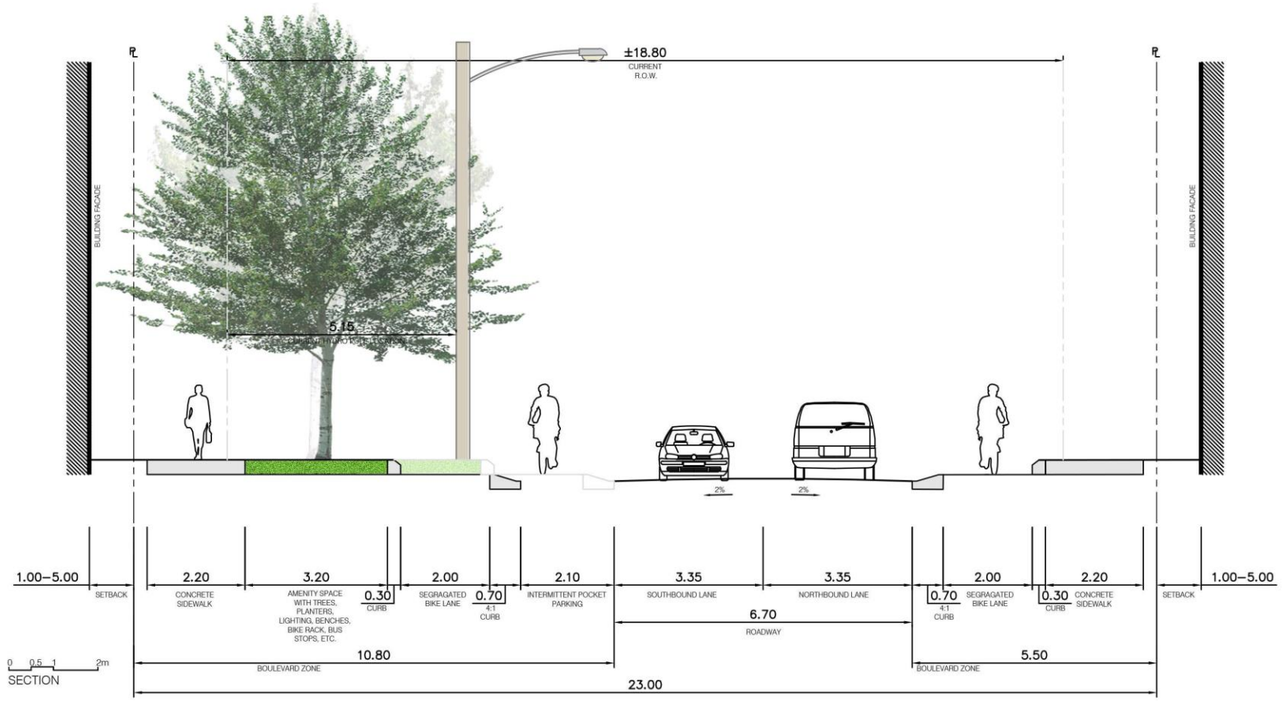
Exhibit 6-5 Mixed Use (Albert) Street Option 1b: 2-Way with Segregated Bike Lanes and Pocket Parking on Alternating Sides

MIXED-USE (ALBERT) STREET- PREFERRED

OPTION 1b

2 WAY, SEGREGATED BIKE LANES AND POCKET PARKING
ALTERNATING SIDES





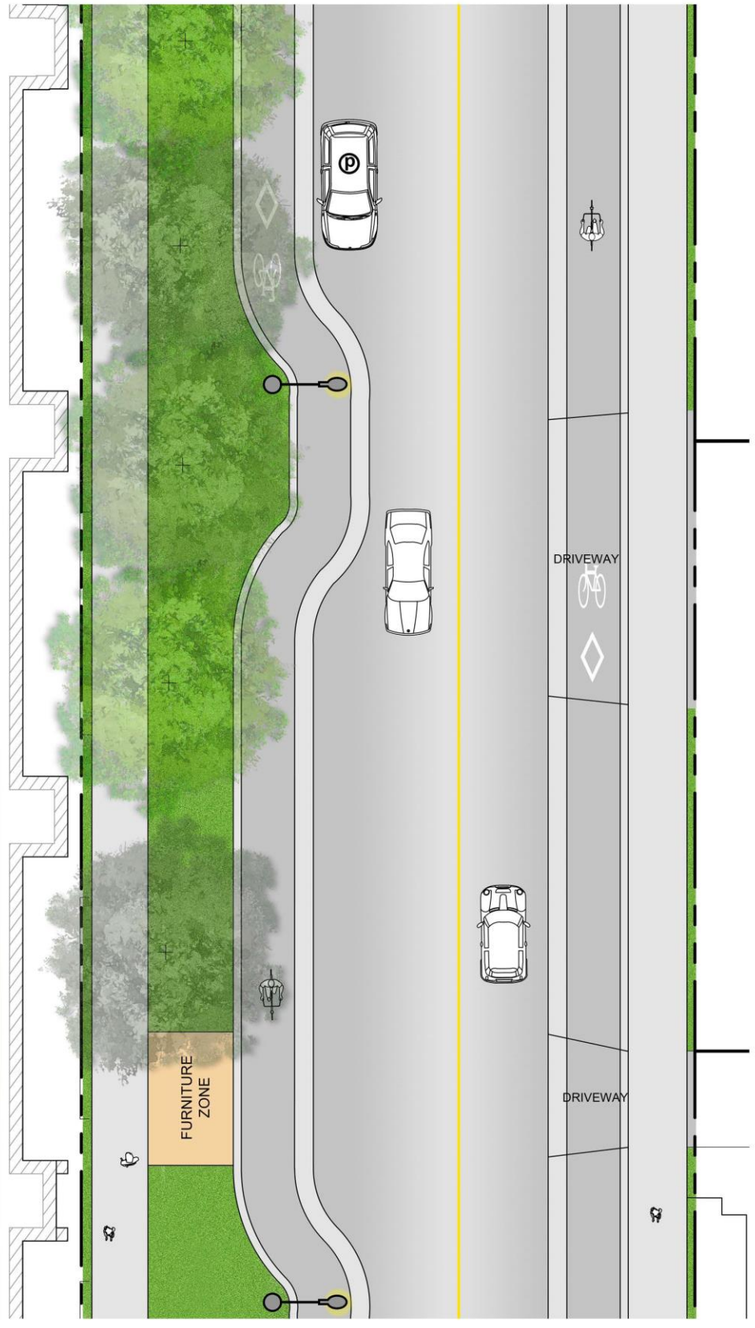


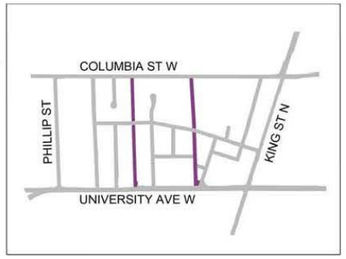
Exhibit 6-6 Mixed Use Street Option 2: 2-Way with Buffered Bike Lanes, Intermittent Parking on the West Side

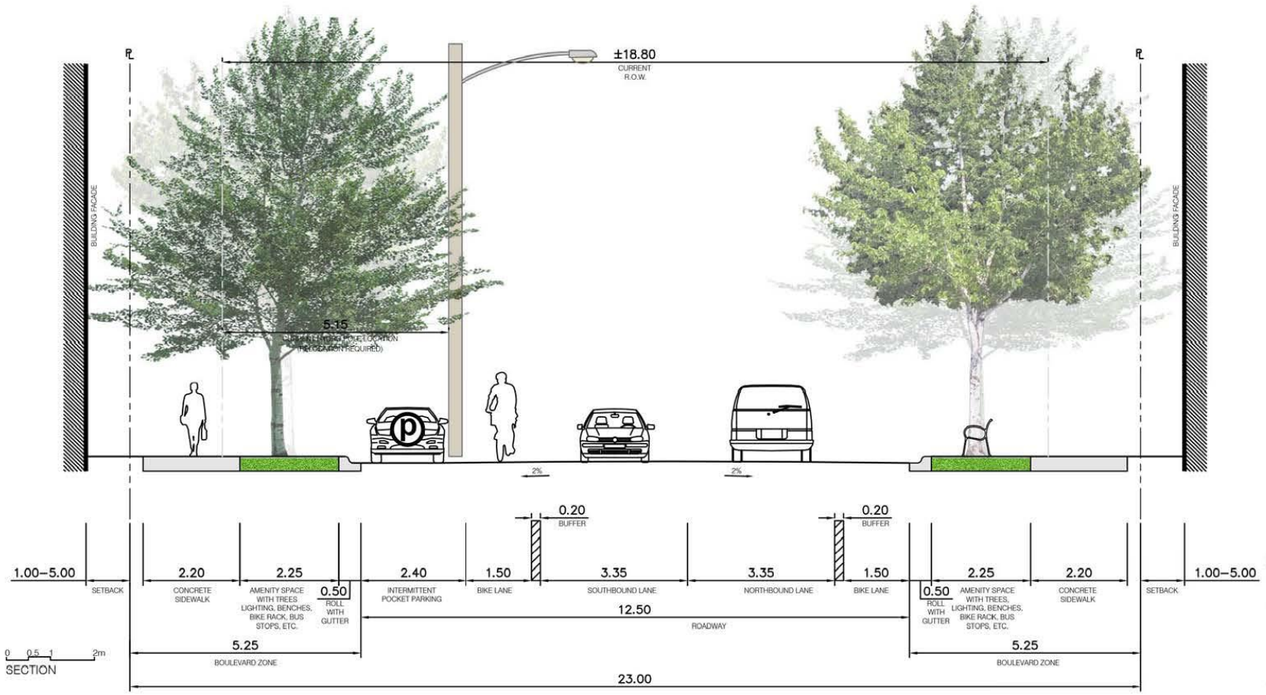
MIXED-USE STREETS

OPTION 2

2 WAY WITH BUFFERED BIKE LANES, INTERMITTENT PARKING
WEST SIDE

- ALBERT ST.
- HAZEL ST.





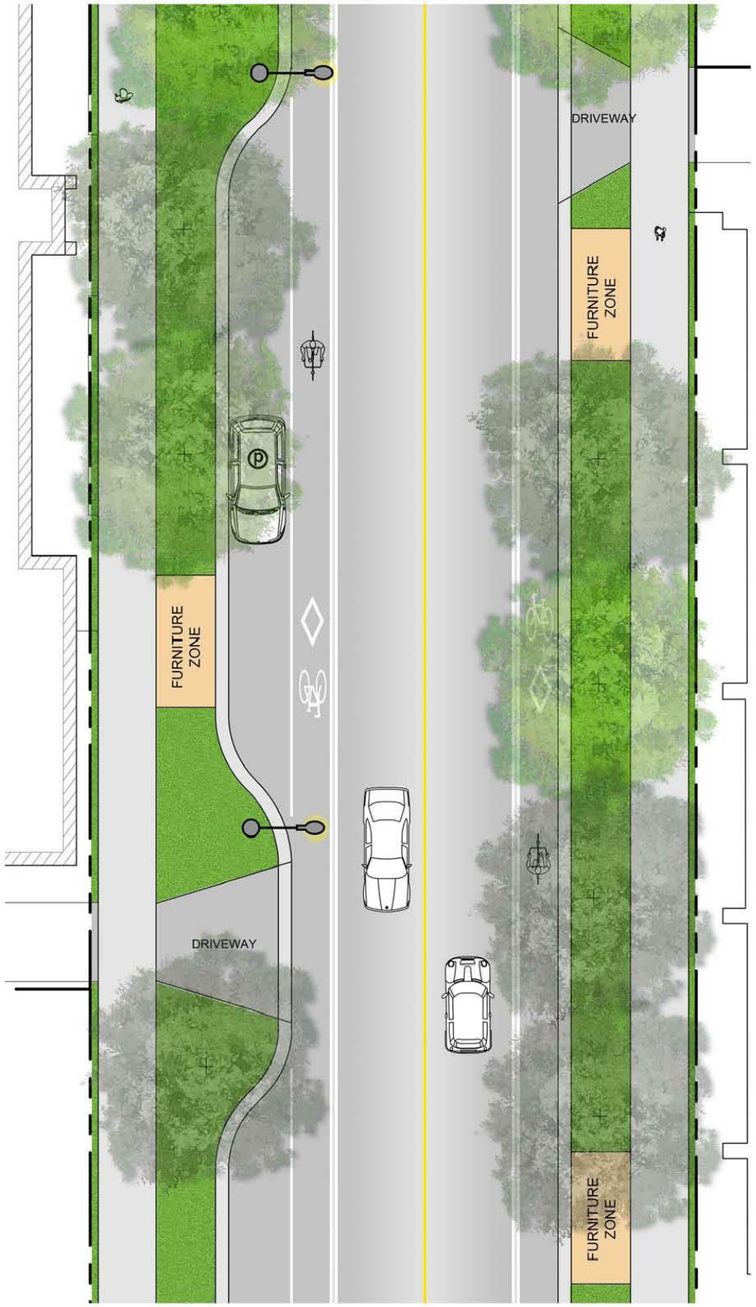


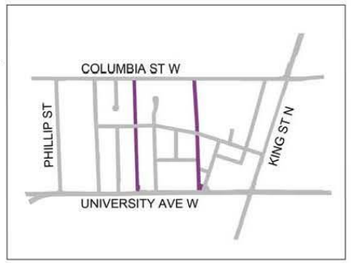
Exhibit 6-7 Mixed Use Street Option 3: 2-Way with Buffered Bike Lanes, No On-Street Parking

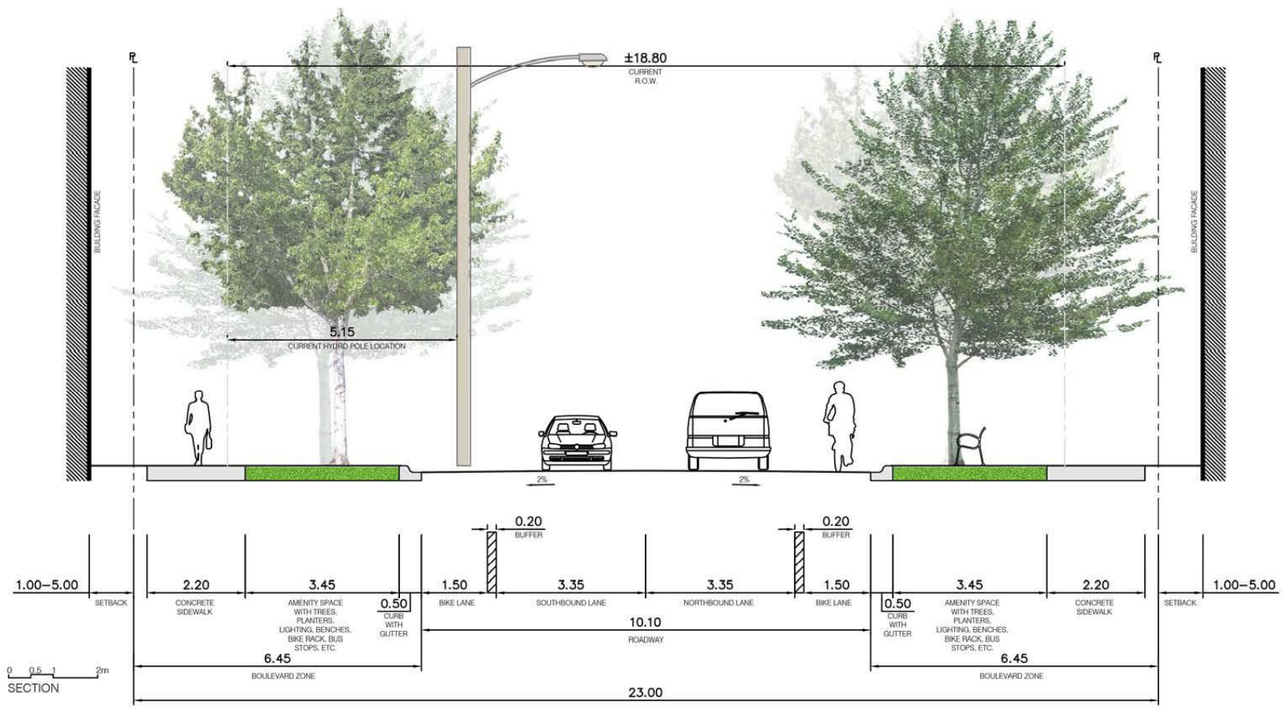
MIXED-USE STREETS

OPTION 3

2 WAY WITH BUFFERED BIKE LANES, NO ON-STREET PARKING

- ALBERT ST.
- HAZEL ST.





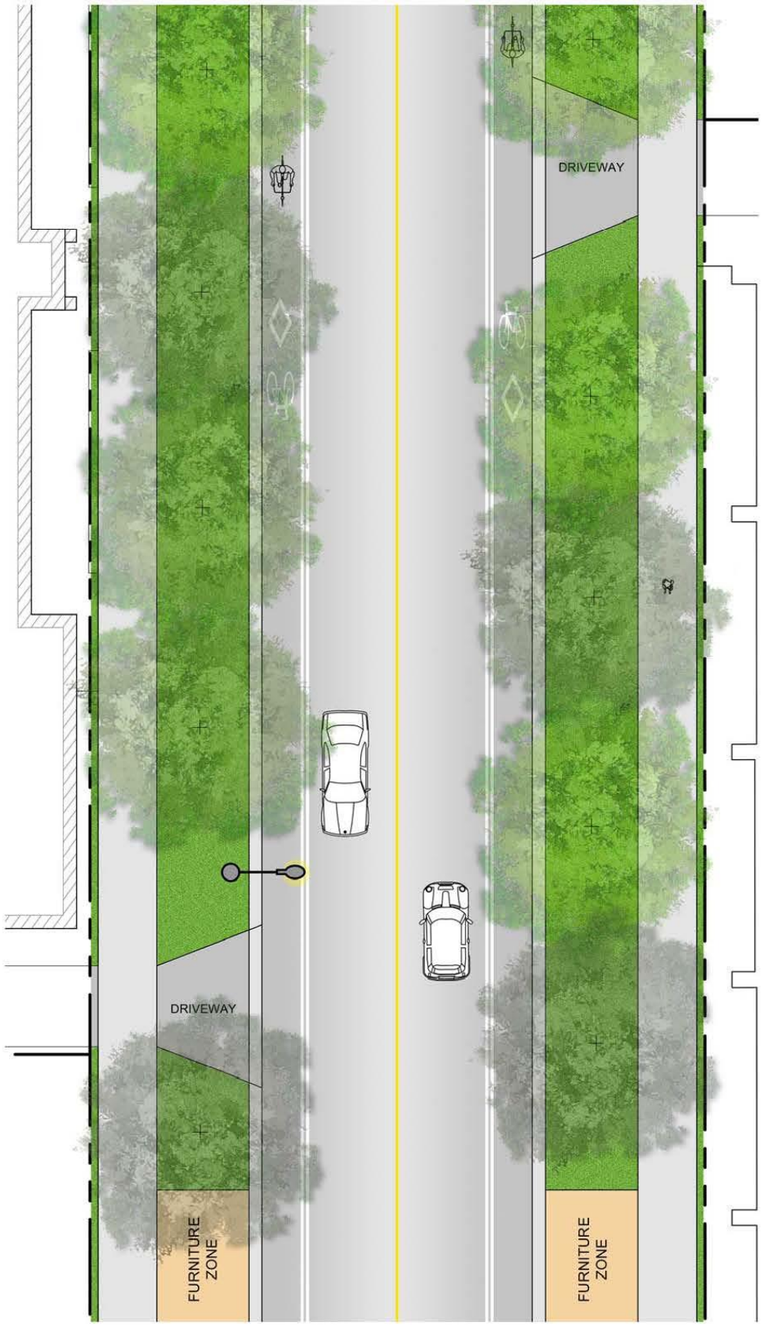


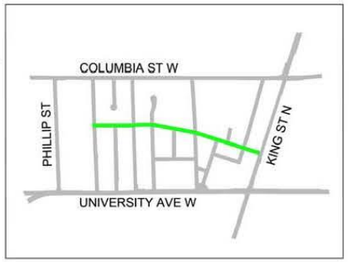
Exhibit 6-8 Green Street Option 1: 2-Way with Centre Landscaped Median, Buffered Bike Lanes, No Parking

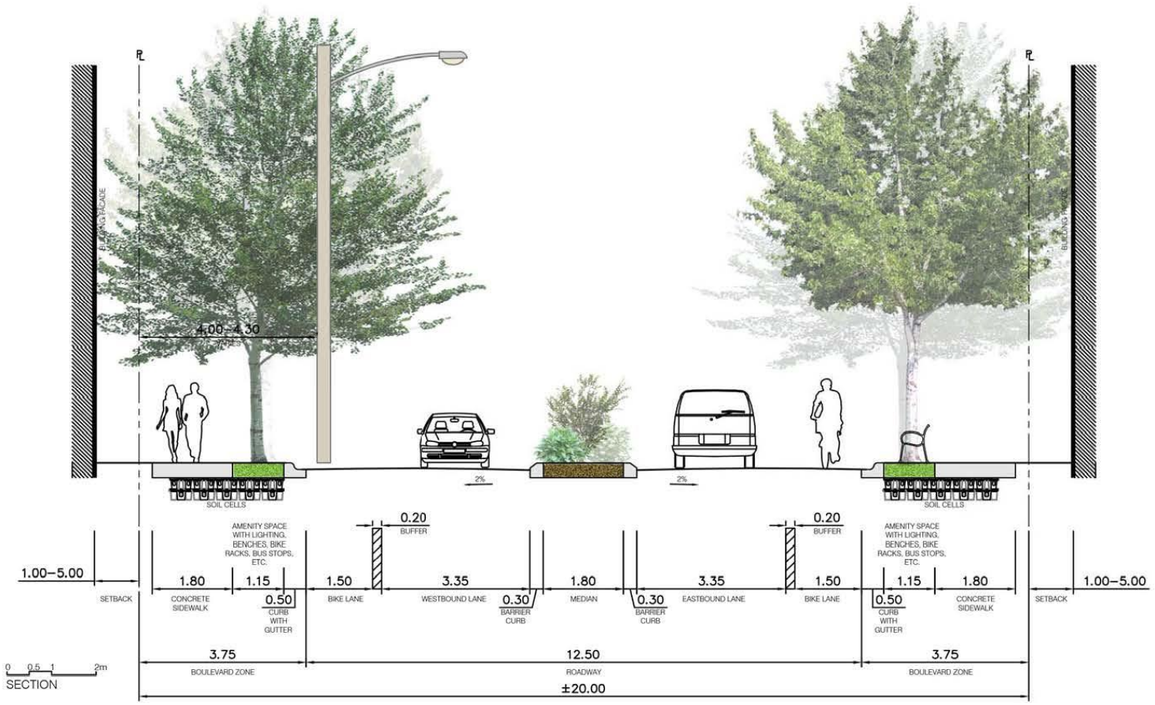
GREEN STREET

OPTION 1

2 WAY WITH CENTRE MEDIAN, BUFFERED BIKE LANES, NO PARKING

- HICKORY ST. W.





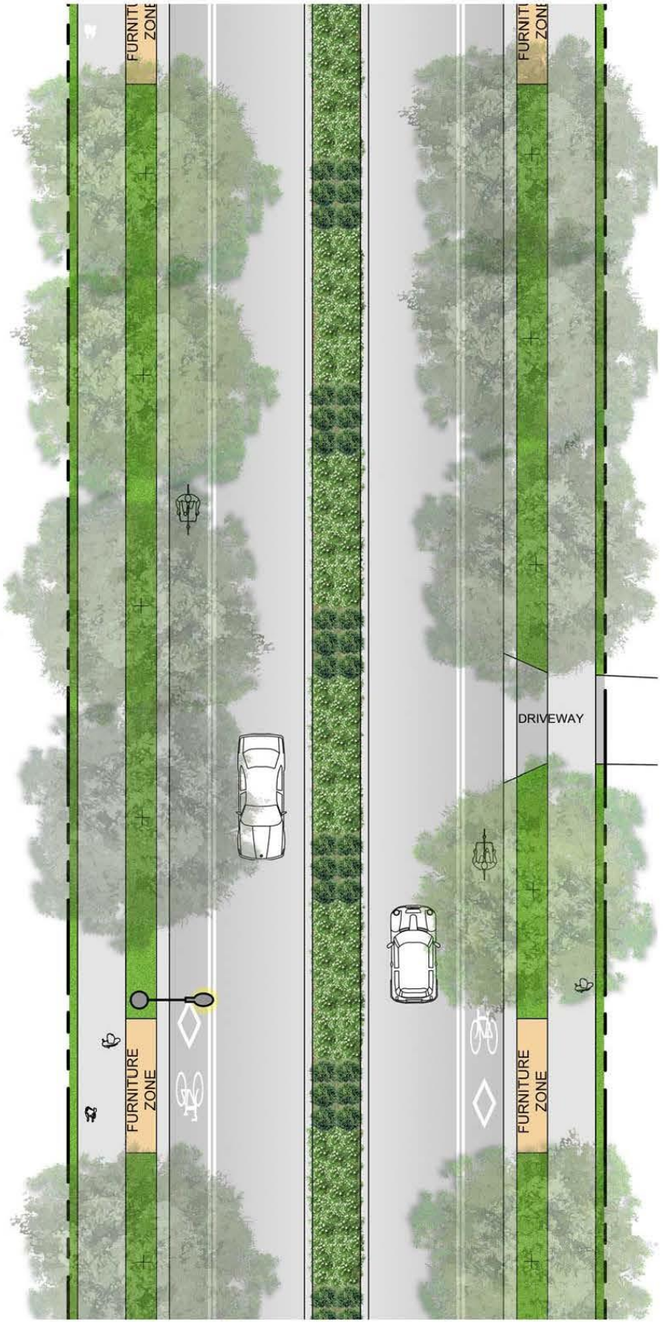


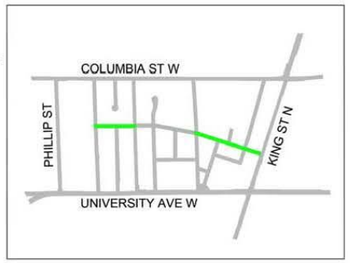
Exhibit 6-9 Green Street Option 2: 2-Way Shared Auto/Bike Lanes with Intermittent Unmarked Parking Both Sides

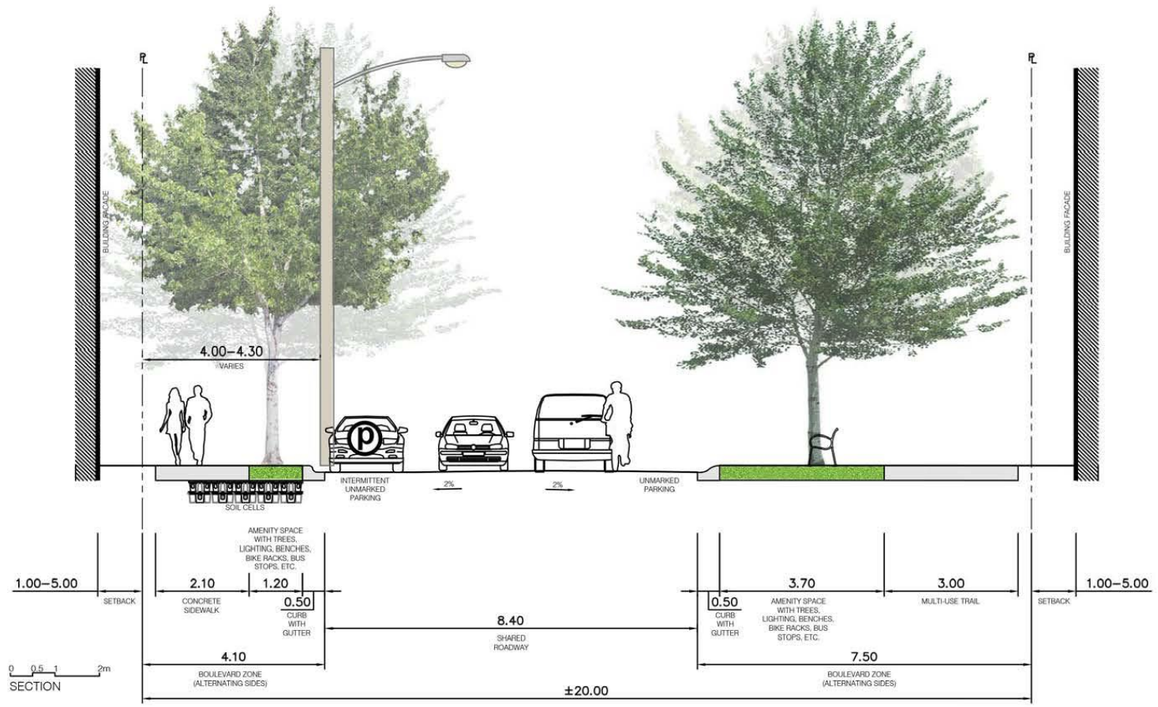
GREEN STREET - PREFERRED

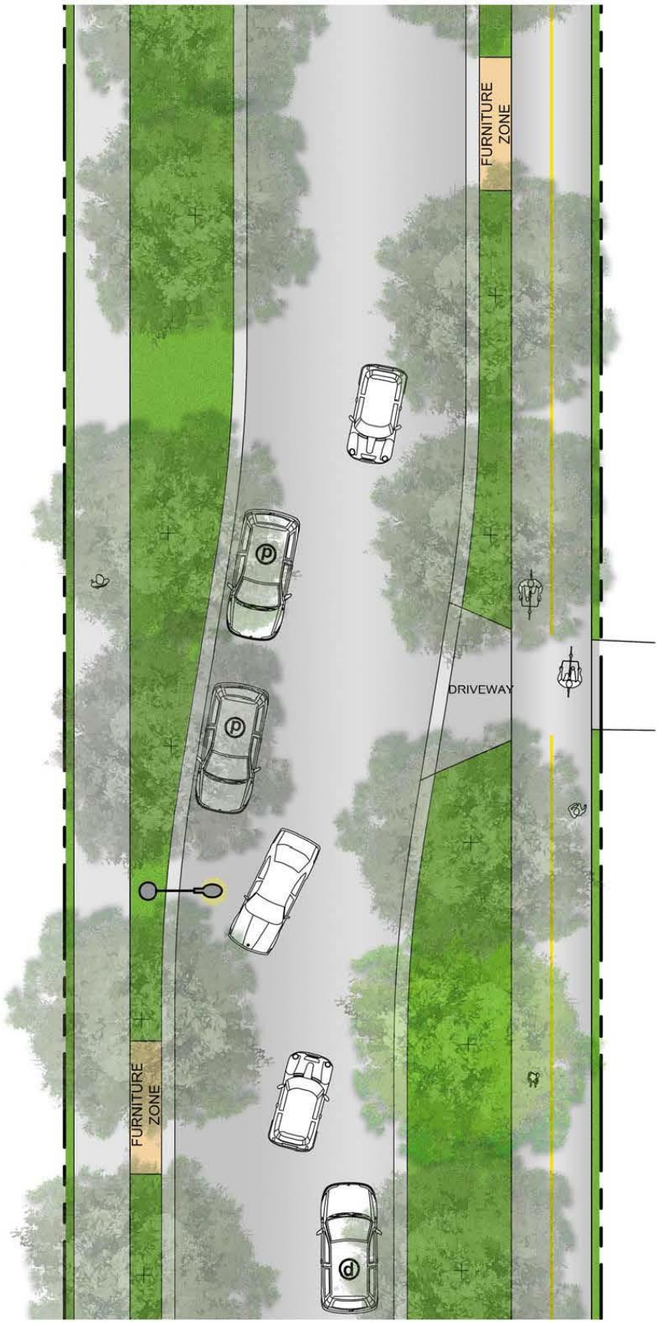
OPTION 2

2 WAY WITH INTERMITTENT UNMARKED PARKING AND MULTI-USE TRAIL

- HICKORY ST. W.







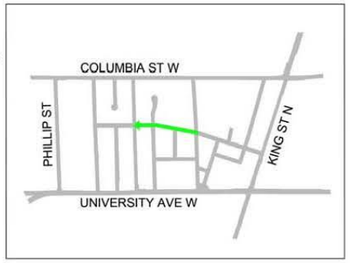
*Multi-Use Trails along Northdale streets must be accompanied by measures to reduce driveway crossing conflicts to an acceptable level, and/or traffic management provisions using signage, pavement markings, warnings and other traffic management measures.

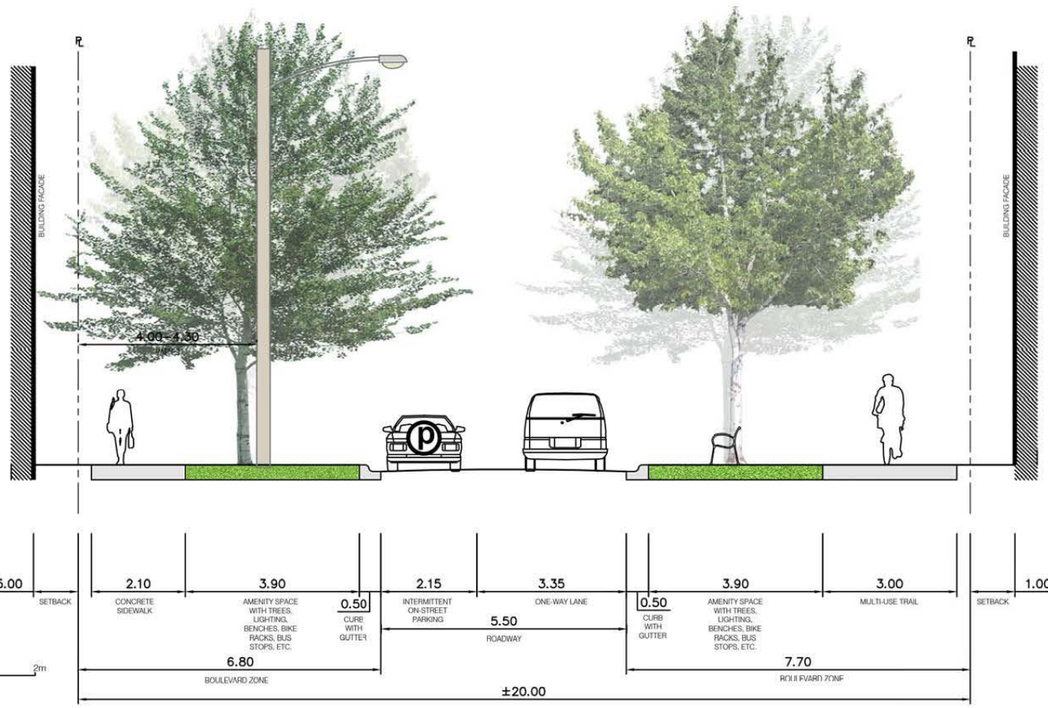
Exhibit 6-10 Green Street Option 3: 1-Way Single Lane, Multi-Use Trail on One Side and Parking on One Side

GREEN STREET - PREFERRED (1-WAY)

OPTION 3

1 WAY SINGLE LANE MULTI-USE TRAIL ONE SIDE & PARKING ONE SIDE





*Multi-Use Trails along Northdale streets must be accompanied by measures to reduce driveway crossing conflicts to an acceptable level, and/or traffic management provisions using signage, pavement markings, warnings and other traffic management measures.

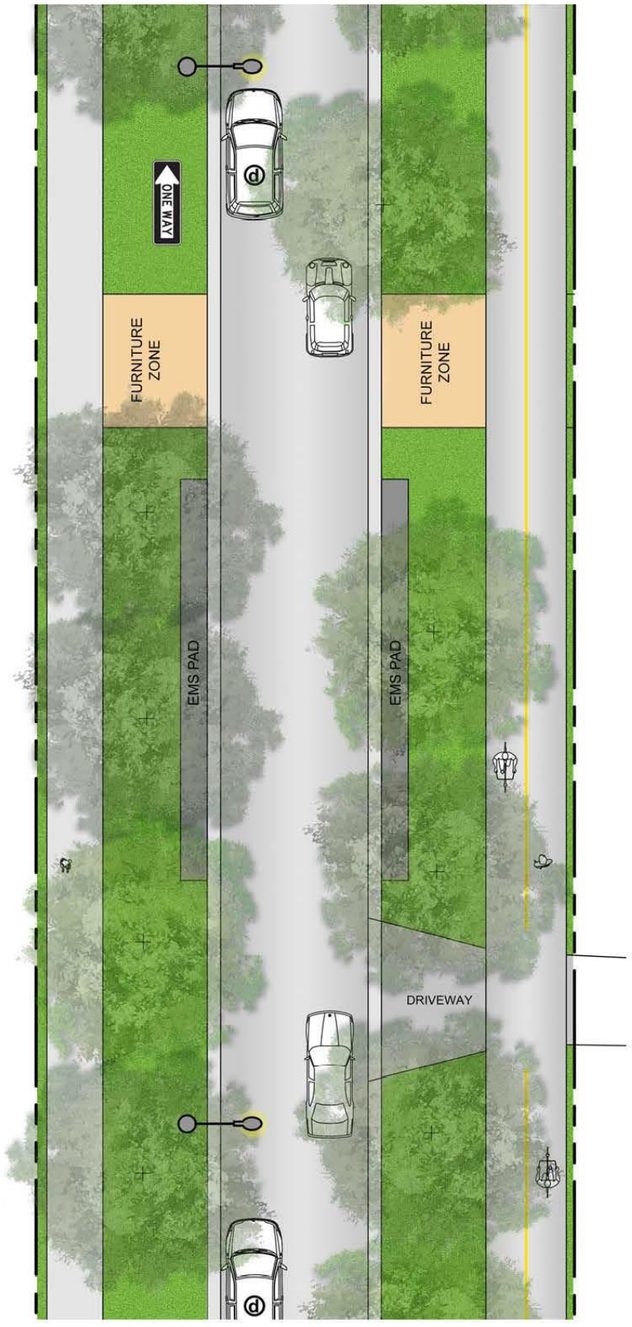


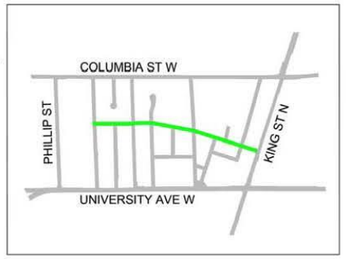
Exhibit 6-11 Green Street Option 4: 2-Way with Offset Landscaped Median, Multi-Use Pathway

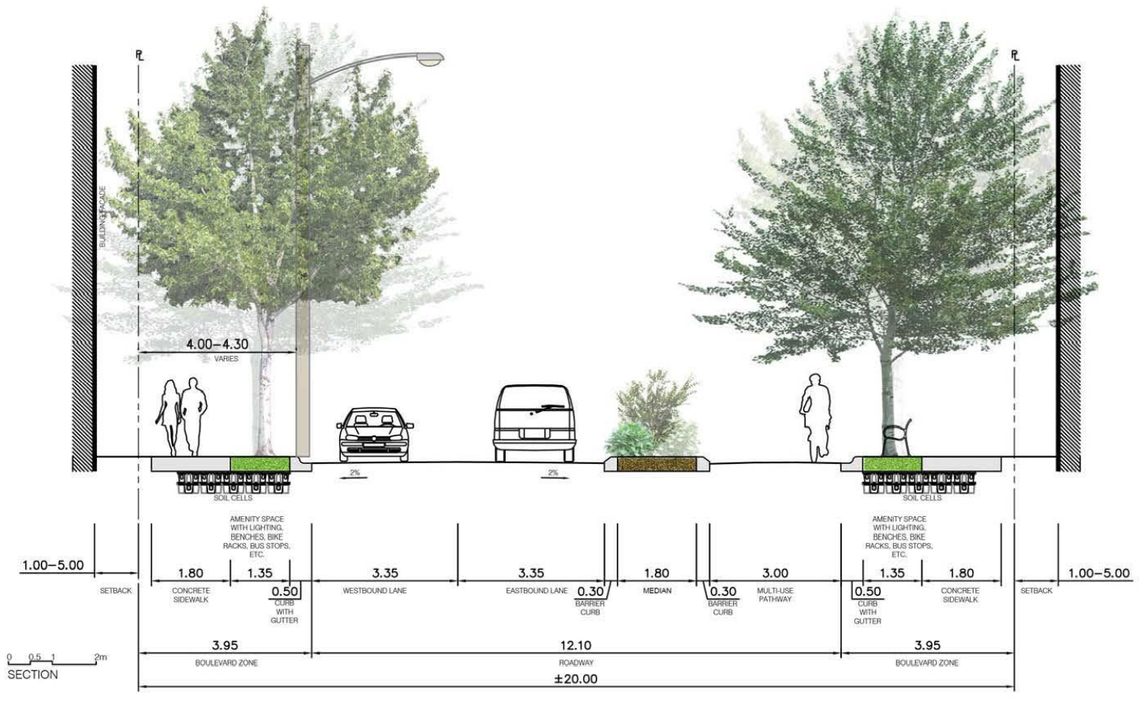
GREEN STREET

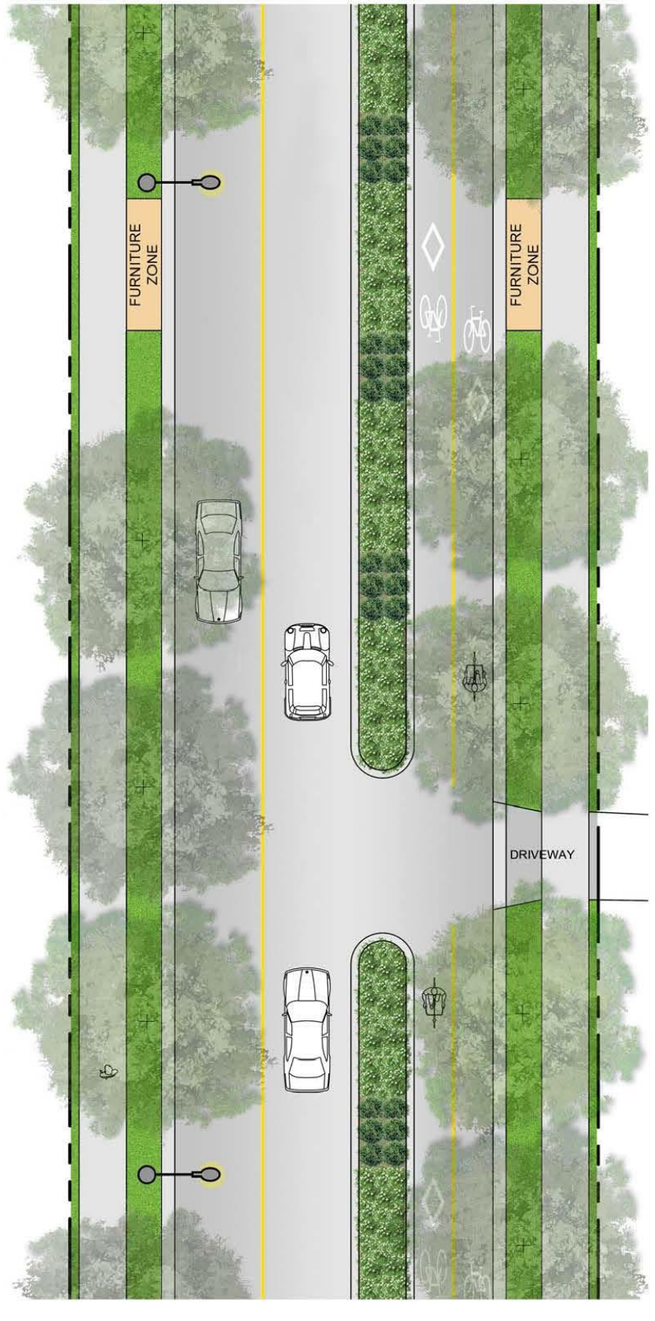
OPTION 4

2 WAY WITH OFFSET MEDIAN, MULTI-USE PATHWAY

- HICKORY ST. W.







*Multi-Use Trails along Northdale streets must be accompanied by measures to reduce driveway crossing conflicts to an acceptable level, and/or traffic management provisions using signage, pavement markings, warnings and other traffic management measures.

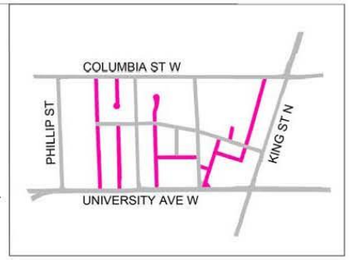
Exhibit 6-12 Residential Street Option 1: 2-Way, Parking on 1 Side, No Bike Lanes

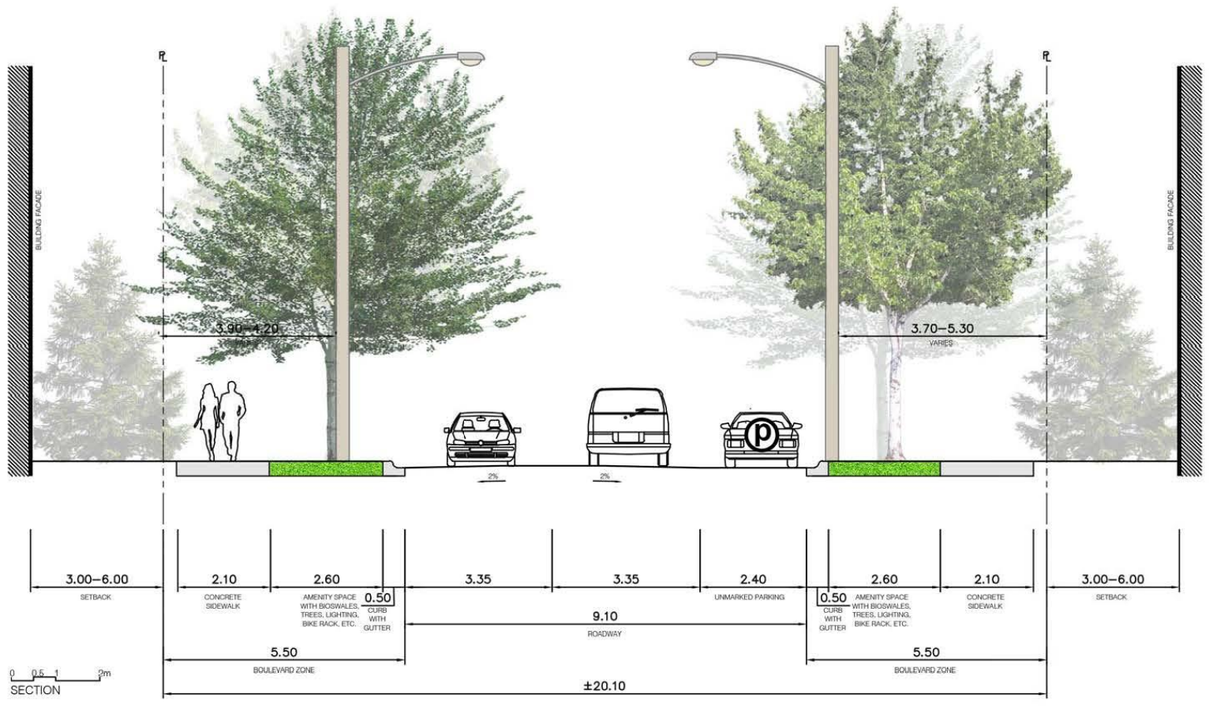
RESIDENTIAL STREETS

OPTION 1

2 WAY, PARKING 1 SIDE, NO BIKE LANES

- LESTER ST.
- BATAVIA PL.
- SUNVIEW ST.
- HEMLOCK ST.
- BALSAM ST.
- STATE ST.
- FIR ST.
- HAWTHORN ST.
- SPRUCE ST.





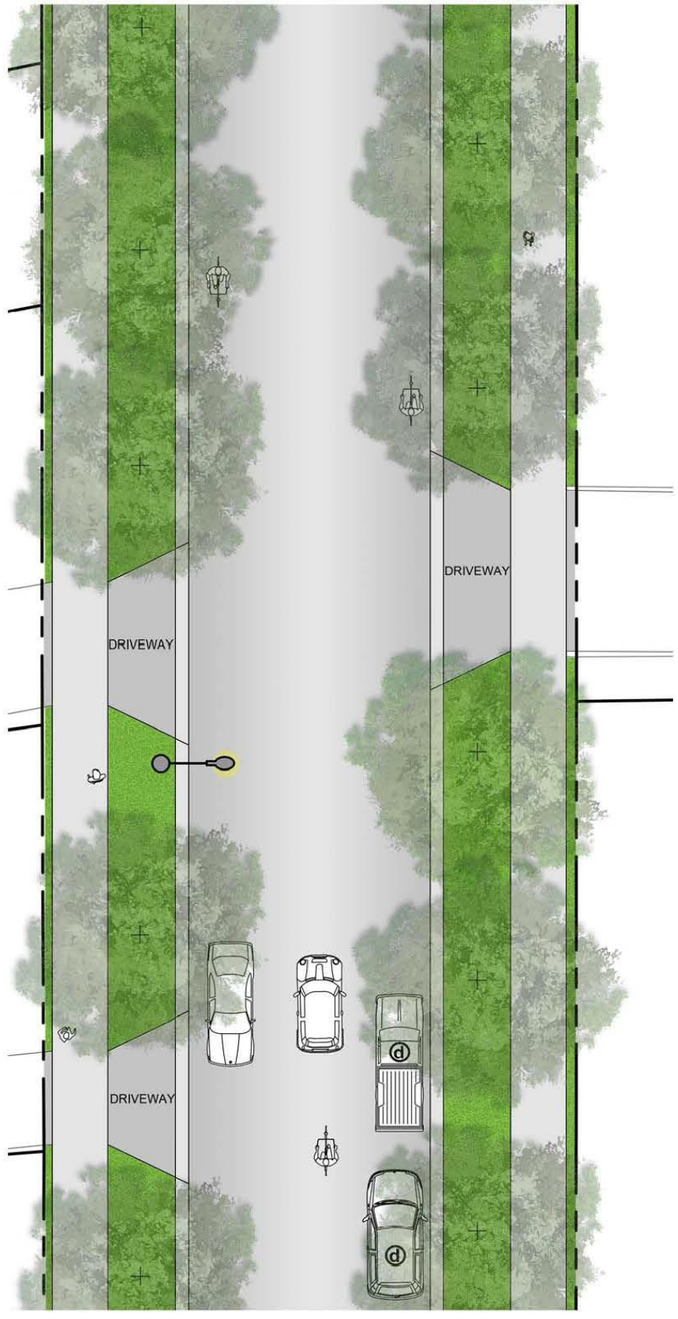


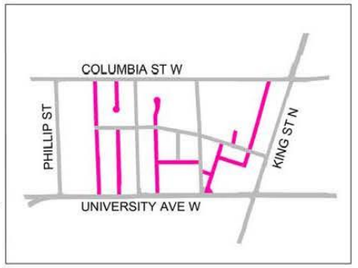
Exhibit 6-13 Residential Street Option 2: 2-Way, Parking on 1 Side, Shared Auto/Bike Lanes

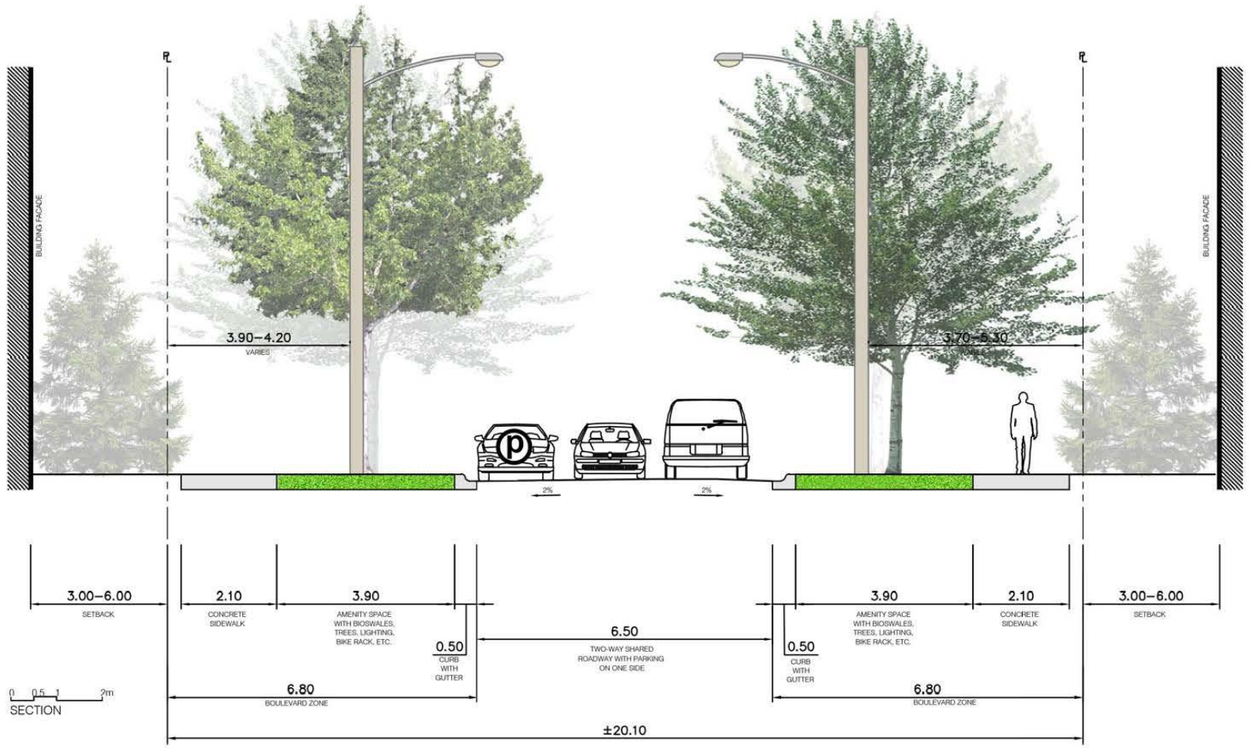
RESIDENTIAL STREETS - PREFERRED

OPTION 2

2 WAY, PARKING 1 SIDE, SHARED AUTO/BIKE LANES

- LESTER ST.
- BATAVIA PL.
- SUNVIEW ST.
- HEMLOCK ST.
- BALSAM ST.
- STATE ST.
- FIR ST.
- HAWTHORN ST.
- SPRUCE ST.





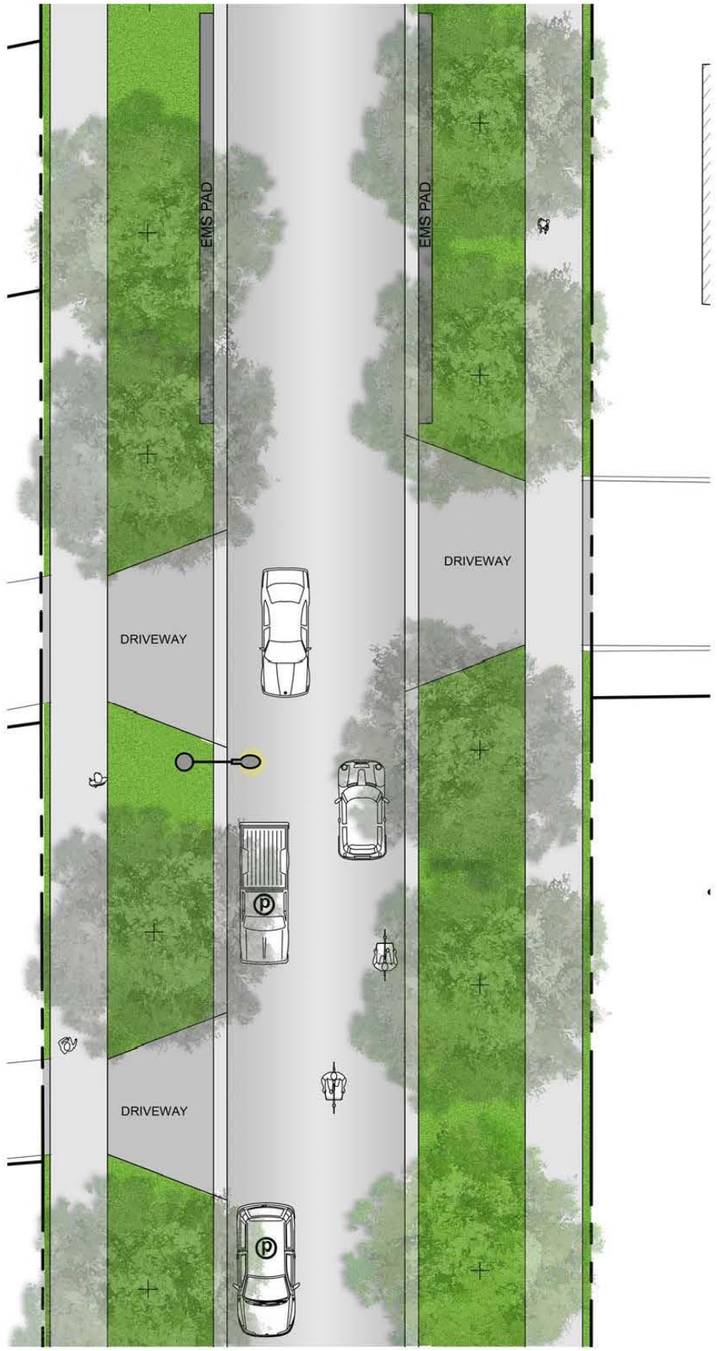


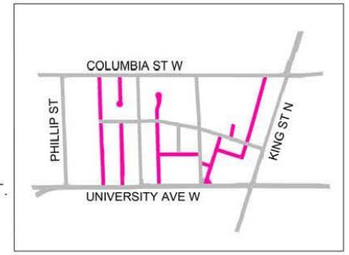
Exhibit 6-14 Residential Street Option 3: 1-Way Shared Auto/Bike Lane, Parking on 1 Side

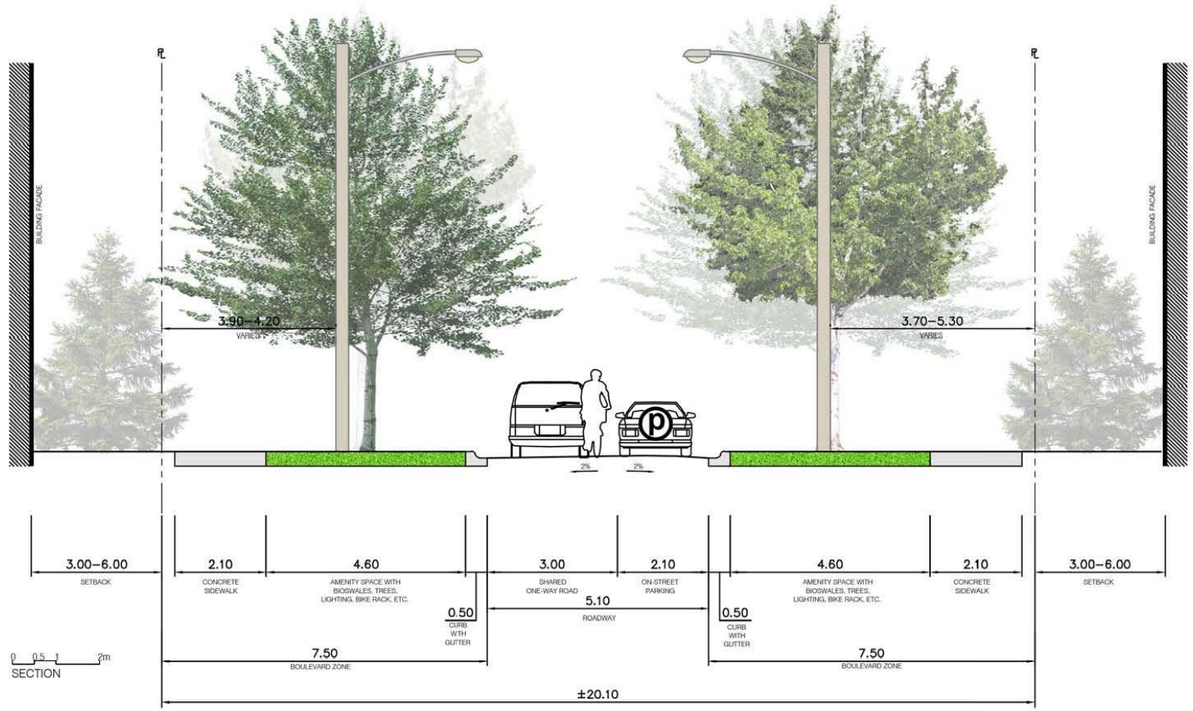
RESIDENTIAL STREETS

OPTION 3

1 WAY SHARED LANE, PARKING 1 SIDE

- LESTER ST.
- BATAVIA PL.
- SUNVIEW ST.
- HEMLOCK ST.
- BALSAM ST.
- STATE ST.
- FIR ST.
- HAWTHORN ST.
- SPRUCE ST.





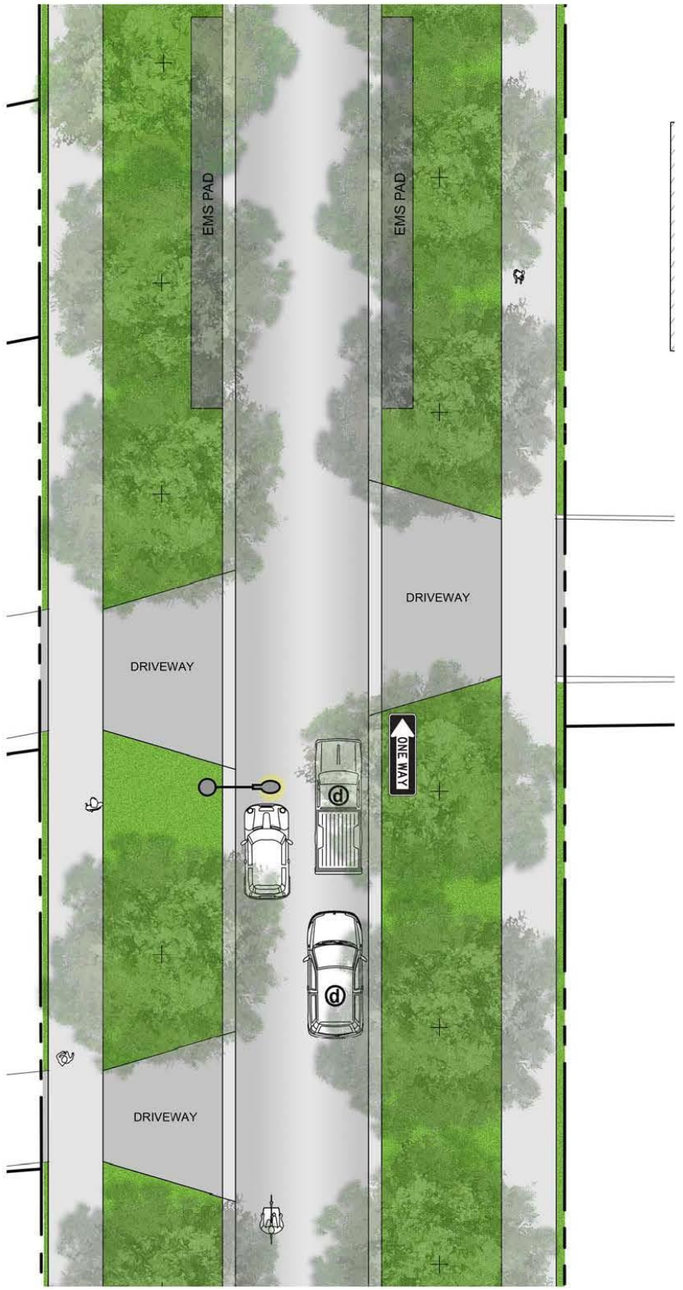
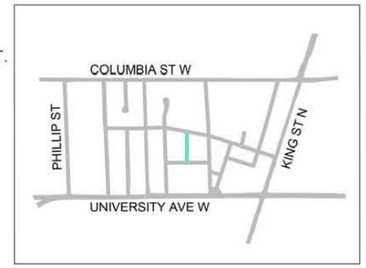


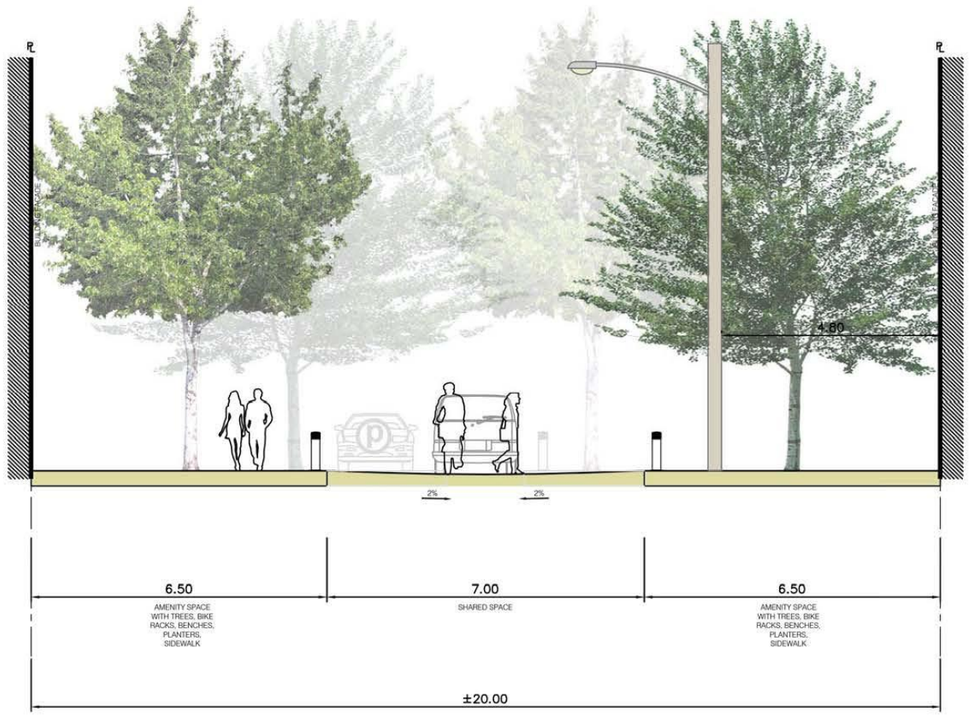
Exhibit 6-15 Woonerf Street Option 1: Shared Space, Including Parking

WOONERF STREET - PREFERRED

OPTION 1

SHARED SPACE INCLUDING PARKING





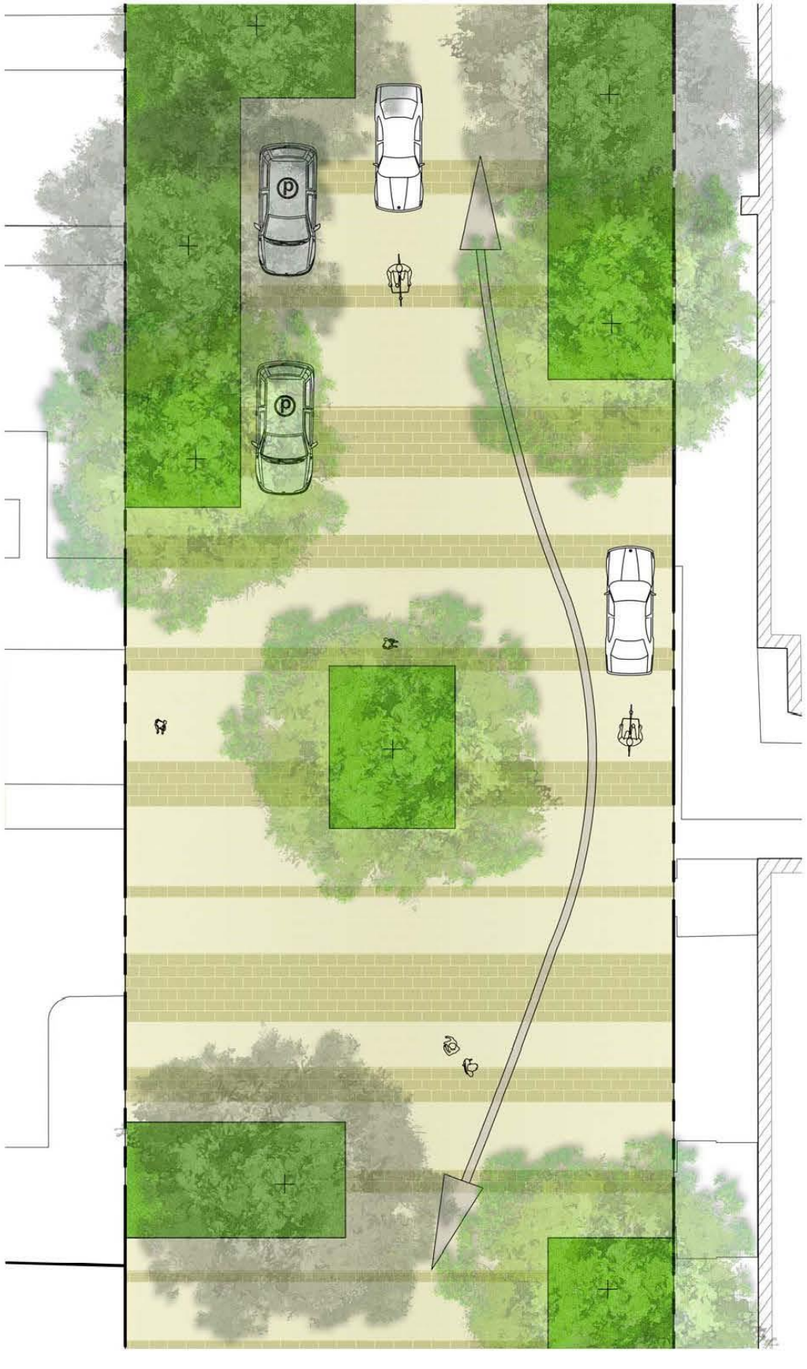


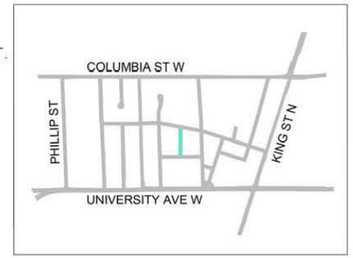
Exhibit 6-16 Woonerf Street Option 2: Shared Space, Excluding Parking

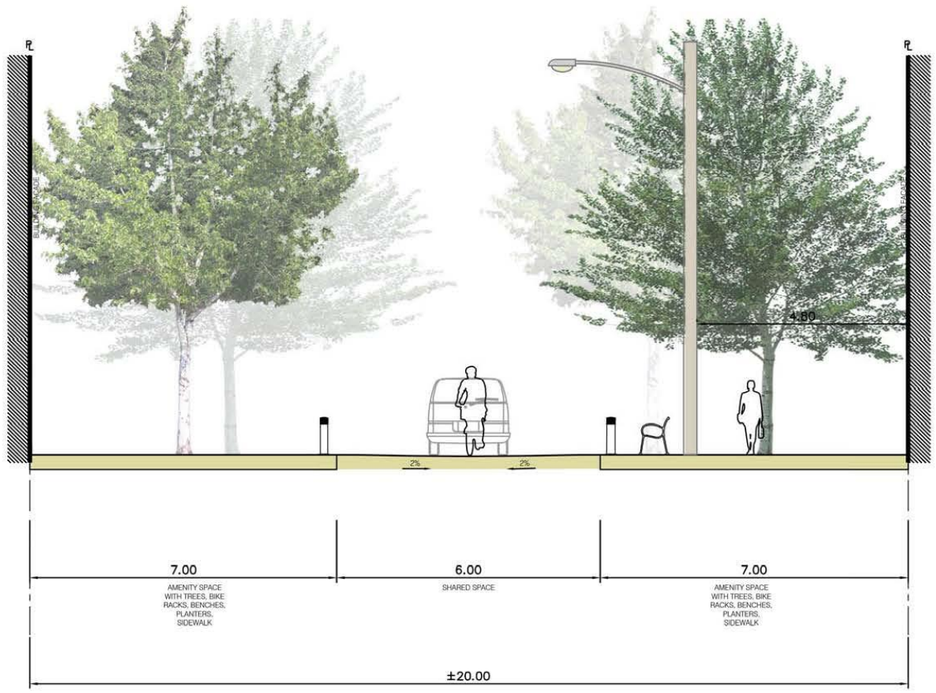
WOONERF STREET

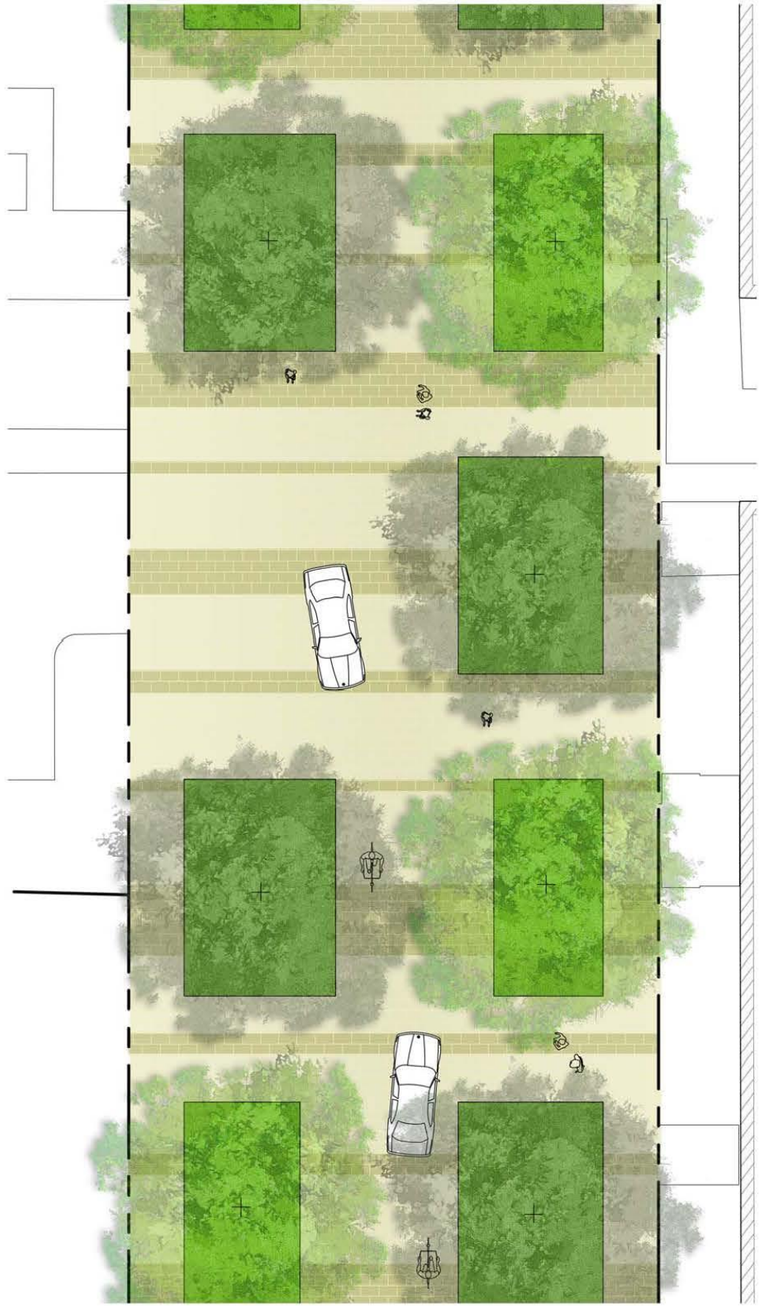
OPTION 2

SHARED SPACE EXCLUDING PARKING

- LARCH ST.







7 STREETSCAPE MASTER PLAN

7.1 Future Public Realm Streetscape Plan

The vision of the street public realm for Northdale is that of a vibrant streetscape, embodying the City's "Complete Streets" policy. The recommended detailed designs for the streets will build a balance between built form and natural elements, respond to adjacent property redevelopment and adhere to the recommendations from the "Northdale Urban Design and Built Form Guidelines" (2012) as summarized in the following sections.

7.1.1 Mixed Use Streets

The preferred Mixed Use Streets, namely Hazel Street and Albert Street as shown on Exhibits 6-4 and 6-5 are intended to promote social interaction, allowing for a variety of uses and activities. Decorative features will include:

- Bike Racks and Posts;
- Benches;
- Bus Shelters (on Hazel Street);
- Lighting, pedestrian and street;;
- Street Trees;
- Waste Receptacles; and,
- Unit Pavers.

Hazel Street and Albert Street will continue to be 2-way streets. Each will integrate active transportation based on traffic speed and volume. Hazel Street with lower traffic levels will incorporate 1.5 m bike lanes and protect cyclists by including a buffered door opening zone. Busier Albert Street has segregated bike lanes on each side separated from the traffic flow by mountable curbs. In each, pocket parking will be on alternating sides.

7.1.2 Green Street

The Green Street planned for Hickory Street will prioritize pedestrian circulation and aim to increase public open space and subsequent connections. Decorative features will include:

- Bike Racks and Posts;
- Benches;
- Waste Receptacles;
- Lighting; and,
- Street Trees.

The section between Hazel Street and Albert Street shown on Exhibit 6-10 will be 1-way westbound (see Section 7.3), with the remainder remaining 2-way as shown on Exhibit 6-9. It will have shared travel lanes (i.e., both automobile and cyclists), through the use of sharrows, and augmented by a Multi-Use Trail along the north side. Because of this, the roadway will be curved to calm traffic. Parking will intermittent and unmarked on both sides.

7.1.3 Residential Streets

The character of preferred Residential Streets shown on Exhibit 6-13 will be more intimate. Decorative features will include:

- Bike Racks and Posts;
- Bioswales;
- Street Trees;
- Lighting; and,
- Waste Receptacles.

These will continue as 2-way streets and have shared travel lanes for autos and bikes owing to the lower traffic volumes and speeds. Lanes will be narrow to increase "friction" and slow down traffic. There will be a large boulevard on both sides of the street, providing ample amenity space. Parking will only be on one side of the street.

7.1.4 Woonerf Street

Known as a "living" or "shared" street, the Woonerf Street planned on Exhibit 6-15 for Larch Street integrates all users (automobile, cyclists, and pedestrian) within the same right-of-way. Decorative features will include:

- Street Trees and Moveable Planters;
- Bike Racks and Posts;
- Benches; and,
- Waste Receptacles.

There are no boundaries separating the roadway, cyclists and pedestrians. Plantings will be placed at strategic locations to calm traffic with some being in moveable containers. Parking will be permitted.

7.2 Future Neighbourhood Traffic Flow

IBI Group compared the 2011 and 2031 PM peak hour traffic volumes from the Region of Waterloo's Active Transportation Master Plan (ATMP) Transcad Model, and it showed that with the exception of Phillip Street, King Street, and the southbound flows on Hazel Street, traffic volumes in and around the neighbourhood are expected to remain stable, or decrease, over the analysis period. As documented in **Appendix B**, the model supports this prediction based on its increasing emphasis on alternatives to private auto use, especially public transit. In particular, the new ION Light Rail Transit (LRT) line in Waterloo and Kitchener is expected to influence the mode choices of Northdale residents with three stations being constructed near the study area. The stations are:

- R & T Park – located east of the David Johnston Research & Technology Park near Columbia Street and Hagey Boulevard;
- University of Waterloo – located on the east side of the UW campus close to Phillip Street; and,
- Seagram – located in Waterloo Park south of Seagram Drive.

The new LRT will be operated by GRT beginning in 2018. The proximity of the ION stations is expected to enhance transit opportunities and impact the modal split for Northdale. With an increased transit modal split, a lower demand for parking spaces for residents and visitors to the area is expected, and aligns with the neighbourhood vision.

New traffic volumes are primarily generated from new developments. The projected developments, their resulting traffic volumes, expected travel characteristics and their potential impact on traffic operations and the Northdale public realm are discussed in Section 3 of the Traffic and Parking Review provided in **Appendix B.** It concludes that while there are

projections as to the future traffic growth of the neighbourhood as a whole, there is limited information available as to the exact trip assignment. Therefore the impacts of future conditions were assessed using the existing baseline volumes.

Furthermore, the City has not expressed any plans to expand the roadways within the study area, and doing so would be contrary to the neighbourhood vision. Therefore, the only opportunities to add capacity to the internal road network would be in the form of changes to signal timings at the arterial road intersections and/or minor isolated geometric improvements (e.g., turn lanes). However, based on the desire to discourage cut-through traffic and reduce operating speeds, it is perhaps more to be expected that future changes to the network would be more restrictive to vehicle traffic, rather than more accommodating.

7.2.1 Streetscapes and Traffic

In keeping with the previously discussed vision for the Northdale neighbourhood (i.e., encourage active transportation and lower operating speeds, while maintaining neighbourhood access and existing capacity), none of the cross-section concepts in Section 6 of this report sought to add vehicular capacity to the internal road network. However, some limited one-way versions were considered, which might reduce vehicular traffic conflicts and associated delays, without adding additional through lanes. The various implications of one-way streets in the neighbourhood are addressed further in Section 7.2.2 as follows. From a traffic operations and safety perspective, the alternative cross-sections were generally intended to achieve the following:

- Discourage cut-through traffic;
- Reduce operating speeds;
- Encourage and accommodate active transportation users;
- Preserve the existing vehicular capacity; and,
- Serve the adjacent land uses and local users first.

7.2.2 Street Types for Managing Traffic Flow

In regards to vehicular traffic, three different types of streets were used:

- One-way street;
- Two-way street; and,
- Woonerf.

Characteristics of these street types in the context of Northdale are summarized as follows.

7.2.2.1 One-Way Streets

One-way streets only allow vehicular traffic to travel in one direction. This often results in higher vehicle operating speeds, as drivers are not confronted with oncoming traffic. As such, one-way streets are useful when the desire is to increase traffic flow, but less so when the desire is to lower operating speeds. Disadvantages of one-way streets are that they restrict movement, which can significantly reduce cut-through traffic. However, those same restrictions also force local traffic to take more circuitous routes to navigate the neighbourhood. This results in a higher number of turning movements, which have a higher chance of resulting in a collision, particularly a collision between a vehicle and a pedestrian.

The main advantage to one-way streets within the study area is the reduced cross-section, which allows for more streetscaping and public realm design flexibility. Where the right-of-way is limited, converting a two-way street to a one-way can free up space to be reallocated to other modes of transportation, such as bike lanes, boulevards for street furniture, and/or wider sidewalks.

7.2.2.2 Two-Way Streets

Two-way streets are often the preferred choice for residential neighbourhoods, as they maintain connectivity throughout the network, and the bi-directional travel encourages lower operating speeds, especially on narrow streets. The major drawback to two-way streets is that they require a wider cross-section, reducing the amount of space available for other modes of transportation and/or amenities. Furthermore, while the increased connectivity is important for residents, it allows for cut-through traffic through the neighbourhood.

7.2.2.3 Woonerfs

Woonerfs are streets that have been physically altered to have no physical or visual delineation between the different modes of transportation (e.g., no continuous curbs). The lack of delineation reduces the required cross-section, allowing for increased streetscaping, while accommodating all users. It also encourages people to view the street as more of a shared social space than simply a vessel for vehicles, which is in line with the Northdale neighbourhood philosophy. The shared street also prioritizes pedestrians over vehicles, which encourages active transportation, and naturally reduces vehicle operating speeds, and increases safety, despite the increased potential for conflicts. As this is a relatively new concept for the City and Region of Waterloo, the potential for conflicts may be higher while users learn how to navigate the shared street. This is especially the case for the Northdale neighbourhood, as its local population is constantly changing.

The limits of the Woonerfs must be clearly distinguished; however, there are no restrictions within the shared street. This maintains neighbourhood connectivity while the lower operating speeds and nature of the shared street discourages cut-through traffic.

There is the potential for increased congestion as a result of lower operating speeds; however, the roads in the study area are typically well under capacity and this will be partially offset by the reduced cut-through traffic. The main drawback to Woonerfs is the capital cost of installation and ongoing maintenance of the shared public space.

7.3 Alternative Traffic Flow Concepts

The Northdale Land Use and Community Improvement Plan Study uses a combination of street types to embody the neighbourhood's vision by encouraging desired behaviour through self-enforcing design. It is desired to change behaviour through design instead of signage and enforcement as it is more in line with the aesthetic vision for the neighbourhood. The desired behaviours include:

- Active transportation;
- Reduced cut-through traffic; and,
- Traffic calming (e.g., lower vehicular operating speeds).

An analysis of traffic patterns revealed likely cut-through trips involving vehicles travelling between Columbia Street at Albert Street, and King Street at Hickory Street – particularly eastbound at King Street. The network concepts attempt to reduce the attractiveness of the identified cut-through route while embracing the vision for the Northdale neighbourhood.

It should be noted that Larch Street was identified as a Woonerf street and is represented as such in all concepts presented.

Seven (7) alternative traffic flow concepts were developed and evaluated for the Northdale area, as reported in Section 3.4 of the Traffic and Parking Review in **Appendix B.** For each concept summarized in Exhibit 7-1 below, an alternative or additional way to reduce cut-through traffic along Hickory Street, and guide traffic patterns while maintaining connectivity throughout the

network was included. This was done by implementing turning restrictions, most effectively via partial diversions at intersections.

Exhibit 7-1 Alternative Roadway Network Flow Concepts Evaluation

NETWORK TRAFFIC FLOW CONCEPT	ADVANTAGES	DISADVANTAGES
1. One-Way Neighbourhood Network	• Cut-through traffic is greatly discouraged; • Greater design flexibility for streetscaping; and, • Existing traffic operations are maintained.	• Reduced residential access and more circuitous routing of vehicles; • Higher number of turning movements increases the potential for a collision to occur; • Potential for increased vehicle operating speeds and wrong-way trips along the one-way streets; • Reduced inbound vehicle capacity; and, • Increased traffic volumes along Albert Street and Hazel Street, potentially requiring infrastructure improvements.
2. One-Way Pairs on Hickory Street & Balsam Street	• Cut-through traffic is discouraged; • Connectivity for residents is maintained; • Two-way streets encourage lower vehicle operating speeds; and, • Existing traffic operations are maintained.	• Increased traffic volumes on Larch Street; • Reduced opportunities for streetscaping; and, • Potential for wrong-way trips on one-way streets.
3. Alternate Configuration of One-Way Pairs on Hickory Street & Balsam Street	• Cut-through traffic is discouraged in both directions; • Connectivity for residents is maintained; • Two-way streets encourage lower vehicle operating speeds; and, • Existing traffic operations are maintained.	• Potential for wrong-way trips on one-way streets; • Increased traffic volumes on Larch Street; and, • Reduced opportunities for streetscaping.
4. Woonerfs on Hickory Street, Balsam Street, and Larch Street	• Cut-through traffic is discouraged in both directions; • Connectivity for residents is maintained; • Greater design flexibility for streetscaping; • Lower vehicle operating speeds are encouraged; and, • Increased safety for all users.	• Reduced capacity along Hickory Street and Balsam Street; and, • The concept might not be compatible with higher volumes associated with redevelopment of the WCI/WLU lands.
5. **PREFERRED** One-Way on Hickory Street Westbound (Hazel Street to Albert Street)	• Cut-through traffic is discouraged; • Connectivity for residents is maintained; • Some infrastructure improvements at Hickory Street and Albert Street are no longer required; and, • Greater design flexibility for streetscaping.	• Potential for increased vehicle operating speeds and wrong-way trips along the one-way street.

NETWORK TRAFFIC FLOW CONCEPT	ADVANTAGES	DISADVANTAGES
6. Hazel Street Closure from Hickory Street to Columbia Street	• Greater design flexibility for the properties on either side of Hazel Street between Hickory Street and Columbia Street; and, • Connectivity for residents is maintained.	• Higher number of turning movements increases the potential for a collision to occur; • Increased volumes on Hickory Street; and, • Three additional critical movements as a result of diverted volumes.

7. Hazel Street Closure Columbia to Hickory, and Hickory Street One-Way	• Greater design flexibility for the properties on either side of Hazel Street between Hickory Street and Columbia Street;
	• Some infrastructure improvements at Hickory Street and Albert Street are no longer required;
	• Cut-through traffic is discouraged;
	• Greater design flexibility for streetscaping; and,
	• Connectivity for residents is largely maintained.
		• Higher number of turning movements increases the potential for a collision to occur;
		• Increased volumes on Hickory Street;
		• Potential for increased vehicle operating speeds and wrong-way trips along the one-way street;
		• Potential capacity problems for the neighbourhood at full build-out; and,
		• Numerous negative effects on traffic operations, including:
		  ○ Southbound left-turn at Hazel Street and Columbia Street has queues exceeding storage; and,
		  ○ Westbound approach at Albert Street and Hickory Street are overcapacity with queues extending beyond the upstream intersection.

7.3.1 Preferred Traffic Flow Concept 5

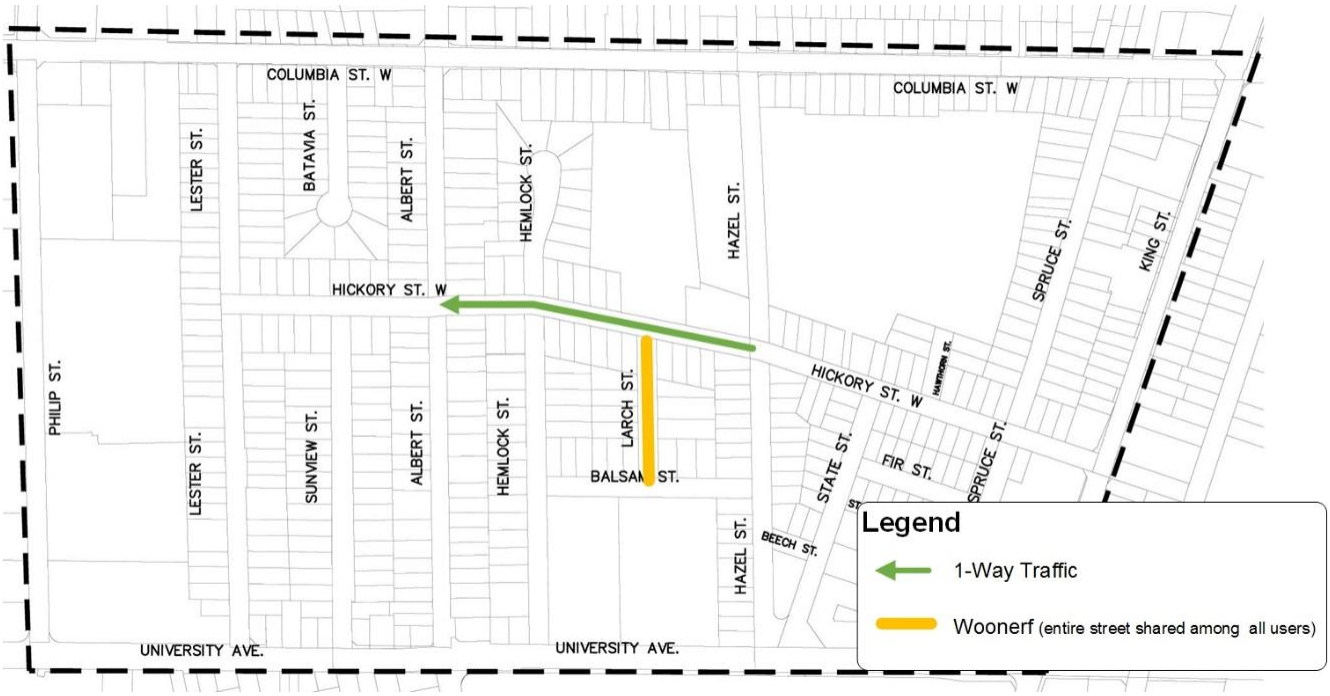
The conclusion of this evaluation is that **Concept 5** is preferred for the Northdale area. As shown on Exhibit 7-2, Concept 5 includes a one-way Hickory Street westbound between Hazel Street and Albert Street. It manages vehicular traffic within the neighbourhood without drastically modifying overall network operations.

The one-way westbound on Hickory Street has the potential to significantly reduce cut-through traffic in the eastbound direction, while the two-way streets elsewhere maintain connectivity for residents and encourage lower vehicle operating speeds. The one-way portion of Hickory Street also presents greater opportunities for streetscaping although there is the potential for vehicular operating speeds to increase along the one-way portion. Clear signage will need to be installed on all approaches to ensure motorists and cyclists understand how to travel along the streets, as is the case whenever changes are made to traffic controls.

Other options for a one-way section of Hickory Street were considered (Concept 2 from Hemlock to Albert) would increase the number of diverted trips, and the more circuitous routing that this creates will increase the number of turning movements, potentially resulting in an increase in the number of conflicts or collisions. Operating speeds on Hickory Street are also likely to increase. The potential exists for wrong-way travel on short one-way segments, particularly by cyclists (exceptions for cyclists might be possible with the appropriate traffic controls and cross-section elements); however, the preferred cross-section includes a two-way multi-use trail along this section of Hickory Street.

To assess the impacts of the Concept 5 modified network, traffic volumes were diverted through the neighbourhood and the operational impacts were assessed. The capacity of most streets remains unchanged, with some vehicular trips being re-routed through the network. One of the more significant changes associated with this concept is the elimination of the southbound left-turn from Albert Street to Hickory Street, which actually provides an operational advantage to through traffic on Albert Street, and it negates the need for an associated left-turn lane. The PM peak period is typically the most constrained period from a traffic operations perspective. Therefore, it was selected as the design hour for analysis to show the greatest impact this concept will have on the traffic network.

Exhibit 7-2 Concept 5 One-Way on Hickory Street



In Concept 5, traffic volumes diverted to the surrounding arterials are low enough in comparison to existing volumes along the arterials that they are easily absorbed by the arterial roads and overall operations remain relatively unchanged with no new critical movements. The majority of the traffic volumes are diverted to either Columbia Street or University Avenue, allowing for reduced capacity along Hickory Street. Some vehicle trips are more circuitous in this concept; however, the network is able to handle the increased volumes and operate similarly to existing conditions. These combined advantages of Concept 5 lead it to be the preferred traffic flow concept for Northdale.

7.3.2 Concept 7 Alternative for WCI / WLU Lands

At the same time that this report was prepared, the WRDSB and WCI were in the process of preparing a future land use feasibility study of their property on the east side of Hazel Street. They proposed to the City that an additional Concept 7 be considered for the Northdale neighbourhood which would have Hazel Street between Columbia Street and Hickory Street closed to through traffic. This concept would have the closed section of Hazel Street converted to a type of transit hub operation serving both the WCI and adjacent WLU lands. GRT buses and Waterloo Fire Rescue vehicles could still move between Hickory Street and Columbia Street, but it would be closed to other through traffic between Columbia Street and Hickory Street. This concept was conditional on final land use plans for the WCI property which are currently being developed.

Concept 7 maintains two-way operations for residents throughout most of the neighbourhood. However, it eliminates one of two signalized access points into the neighbourhood from Columbia Street, which has significant network impacts (see **Appendix B)**. Combined with the preferred one-way implementation on Hickory Street, this concept results in significantly more circuitous routing for many trips while increasing volumes on the surrounding arterial network, as well as on Albert Street and Hickory Street. The more circuitous routing has the potential to increase the number of conflicts or collisions. Furthermore, the City of Waterloo has noted that the signals at Columbia Street and Hazel Street cannot be removed. Operating speeds along the one-way portion of Hickory Street could also increase.

In Concept 7 the peripheral arterial intersections (Phillip Street and Columbia Street, King Street and Columbia Street, King Street and University Avenue, and University Avenue and Phillip Street) are able to accommodate the increased volumes with minimal changes to traffic operations. However, the most significant changes at these intersections occurred at the King Street and Columbia Street intersection where queues in the eastbound and northbound directions increased by 2-3 car lengths when compared with Concepts 5 and 6. Other operational impacts of Concept 7 include:

- The LOS for the southbound left-turn at Hazel Street and Columbia Street deteriorates from D to F with queues doubling such that queues are now exceeding the available storage length;
- The westbound approach at Albert Street and Hickory Street is now overcapacity with a V/C ratio of 1.33 (compared with 0.67 and 0.91 in Concepts 5 and 6 respectively). Queues in the westbound direction also tripled with queues now extending past the upstream intersection;
- Converting Hickory Street to a one-way westbound mitigates the effect the Hazel Street closure had on westbound left movements at Albert Street and Columbia Street as traffic is diverted. However, the north and southbound movements on Albert Street are negatively affected although they continue to operate with LOS C or D;
- Diverted volumes put some additional strain on the north and southbound movements at University Avenue and Albert Street which are already overcapacity; and,
- There are minimal differences in operations at the King Street and Hickory Street intersections between this concept and Concepts 5 and 6, although eastbound queue lengths are reduced in comparison to existing conditions.

The numerous negative impacts that Concept 7 has on traffic operations within the neighbourhood, and the surrounding arterial network, lead to the conclusion that the net impacts of this concept are undesirable, and contrary to the vision for the Northdale neighbourhood. Therefore is cannot be supported in this study.

7.4 Intersection Improvements

The following potential intersection improvements are recommended at key locations within the study area.

- The need for dedicated left-turn lanes at the intersection of Albert Street at Hickory Street was assessed. It was determined that a northbound left-turn storage lane of 15m is required during the PM peak period, and a southbound left-turn storage lane of 25m is required during both the AM and PM peak periods.
- If cut-through traffic is successfully diverted to the arterial network (similar traffic diversions to Concept 2, presented in Section 7.3, the warranted left-turn storage lanes change to the following:
    - 15m northbound left turn storage lane during the PM peak period; and,

- 15m southbound left turn storage lane during the PM peak period.

- Preferred Concept 5 prohibits the southbound left from Albert Street onto Hazel Street, eliminating the need to install a left turn lane at this location.

7.5 Parking Plan

There is both on-street and off-street parking within the Northdale neighbourhood. On-street parking can be an effective design tool to promote the desired patterns of land use through the neighbourhood. Currently, on-street parking is managed by the City of Waterloo through by-laws and enforcement. Conversely, off-street parking in the neighbourhood is provided exclusively by private land owners, and it is their responsibility to ensure they have provided sufficient parking for the intended land use (also subject to City by-laws). The future parking requirements of the Northdale neighbourhood are discussed below based on an overview of existing conditions and the Northdale Land Use and Community Improvement Plan Study policies.

7.5.1 Off-Street Parking

The residents of the Northdale neighbourhood are predominantly university students, as the area is in close proximity to both the University of Waterloo and Wilfrid Laurier University. Generally speaking, university students tend to have low car ownership rates and rely on transit and active transportation for mobility. This is supported by evidence from the Transportation Tomorrow Survey (TTS) and the Northdale Land Use and Community Improvement Plan Study on the comparatively high non-auto travel modal share in the Northdale neighbourhood

In recognition of the emerging trend towards non-auto modes of transportation, the City of Waterloo has developed zoning by-laws specific to the neighbourhood. The minimum parking rates, including bicycle parking, as designated by the zoning by-law, are:

Exhibit 7-3 City of Waterloo Minimum Parking Rates for the Northdale Neighbourhood

		Unit Type	
		Townhouse	Apartment
Residential	Parking Spaces	1 per dwelling unit	0.20 per Bedroom
	Visitor Parking Spaces	-	0.05 per Bedroom
	Bicycle Parking Spaces	-	0.25 per bedroom
Non-Residential	Parking Spaces	4 per 100 sq. m of building floor area	4 per 100 sq. m of building floor area
	Bicycle Parking Spaces	-	1 per 1,500 sq. m of building floor area

Developers are also recognizing this modal shift and while adhering to the minimum parking rates, are typically not providing any additional parking.

7.5.1.1 Projected Developments

Section 5.2 previously reported the projected developments for the Northdale neighbourhood at full build-out. These developments were used to calculate the available off-street parking by 2029. Using the City's minimum parking by-law rates, the potential off-street parking supply is outlined in **Exhibit 7-4**.

Exhibit 7-4 Projected Full Build-Out Off-Street Parking Spaces

Type of Parking Space	Number of Spaces
Resident	3777
Visitor	895
Bicycle	4465
Commercial Vehicle	2312
Commercial Bicycle	39

The number of parking spaces listed in the exhibit above indicates that the Zoning By-Law is ensuring adequate parking supply for residents. However, the number of visitor parking spaces is significantly less than what is provided to residents, and as the majority of units will have multiple independent students as opposed to families, this number may need to be complemented with on-street parking. This is also demonstrated through the recent increase in on-street overnight permit requests (Exhibit 4-6). The pros and cons of on-street parking are discussed within the context of the Northdale neighbourhood further in the report.

7.5.1.2 University Parking

Two significant trip generators are the University of Waterloo (UW) and Wilfrid Laurier University (WLU). Similar to developers, the universities are responsible for providing sufficient parking supply to meet the demand of their patrons. Both universities near the study area have evaluated and planned for their respective parking needs through Campus Master Plans[2,3]. Both Master Plans demonstrate that the universities are providing sufficient supply for their projected growth.

In line with the philosophy for the Northdale neighbourhood, both universities are actively implementing transportation demand management (TDM) initiatives in an attempt to encourage non-auto modes which will allow the universities to convert a portion of their parking supply to new developments.

7.5.2 On-Street Parking

Currently the City of Waterloo's parking by-laws do not have any provisions for supplying on-street parking. However, parking, particularly on-street parking is an effective design tool that can be used to promote the desired patterns of use through the neighbourhood. The physical presence of on-street parking accomplishes this through:

- Traffic calming;
- Road narrowing (both physical and visual); and,
- Providing a buffer between pedestrians and live traffic.

The availability of on-street parking also influences patterns of use by helping to sustain local businesses under mixed use development. The City's 2011 Transportation Master Plan (TMP) includes the following recommendation with respect to on-street parking policy:

> *To maximize the transportation and social use of streets, the TMP recommends that, subject to the 2012-2014 budget, the City modify its current full, year round restriction on overnight on-street parking so that such parking, where deemed appropriate is only restricted during winter months. This would not apply across the entire city but within specific areas that would be selected through a detailed*

[2] Urban Strategies Inc., Paradigm Transportation Solutions Ltd., GSP Group. (2009). *Campus Master Plan Update*. Waterloo, ON. University of Waterloo.
[3] IBI Group. (2010). *Campus Master Plan.* Wilfrid Laurier University.

and systematic review program developed by staff, and any modification would be subject to a trial period.

To effectively promote the desired use of on-street parking, it is important to manage parking availability through regulations, parking rates, and enforcement in a way that maximizes utilization. Some examples include:

- Implementing parking spaces with short durations of parking allowed near businesses to encourage high turnover rates;
- Charge for parking;
- Standardizing parking restrictions;
- Amend the zoning by-laws to provide increased visitor parking on-site; and,
- Allowing overnight parking (as per the TMP recommendations).

While on-street parking can provide numerous benefits, it is not without its challenges. Some potential barriers to implementation include:

- Snow-removal and street-sweeping operations;
- Additional maintenance costs (e.g., snow removal/transport);
- Costs to install additional regulatory signage;
- Cost to provide sufficient lighting (for crime prevention, etc.);
- Disruptions to temporary road works; and,
- By-Law updates and enforcement.

If the initiatives suggested are to be implemented, they will need to be studied further by the City of Waterloo at that time to specifically address issues such as those listed above.

Not considering overnight parking, and beyond the current demand from the construction industry, there appears to be sufficient on-street parking to meet the needs of local Northdale residents. On-street parking is more effective when well-utilized; therefore, the need within the neighbourhood seems to be more a need for proper management of the available parking, as opposed to an increase in supply. Therefore, there does not appear to be an immediate need or mandate for the City to consider adding any sort of off-street parking facilities (e.g., public parking lots or a multi-level parking structure) to the neighbourhood. In fact, introducing additional parking to the neighbourhood, particularly a high-order facility like a garage, would be likely to encourage a mode shift towards driving, which would be contrary to the neighbourhood vision, and encourage recent trends towards higher parking rates. However, to avoid driver frustration and congestion from unavailable on-street parking spaces, publicly accessible off-street parking lots need appropriate signage (e.g., wayfinding signs on the boundary arterial roadways directing visitors to public parking lots).

The ability to provide on-street parking is a function of the roadway geometry and available right-of-way. Therefore, the chosen road cross-sections and character will dictate the supply, and its form (e.g., parking bays versus continuous curbside parking). The relationship between on-street parking and the adjacent land use needs to be taken into consideration when choosing the preferred road cross-section designs.

7.5.2.1 Guidelines for the Preferred Cross-Section Designs

Exhibit 7-5

Exhibit 7-5 Parking Guidelines by Street Type outlines the intended purpose of on-street parking for each of the preferred street cross-sections within the Northdale neighbourhood.

Some potential on-street parking guidelines are also defined to support and guide the intended use.

Exhibit 7-5 Parking Guidelines by Street Type

STREET TYPE	PREFERRED CROSS SECTION	INTENDED PURPOSE OF ON-STRET PARKING	ON-STREET PARKING GUIDELINES
Green Street 2-Way Street	2-Way with Intermittent Unmarked Parking and Multi-Use Trail	• Traffic calming – reduce vehicle operating speeds • Supplement visitor parking for residents	• Allow parking to prevent excessive vehicle speeds
Green Street 1-Way Street	1-Way Single Lane Multi-Use Trail One Side & Parking One Side	• Traffic calming – reduce vehicle operating speeds; • Supplement visitor parking for residents	• Allow parking to prevent excessive vehicle speeds
Mixed Use – Hazel Street	2-Way with Buffered Bike Lanes with Door Zones, Intermittent Parking Both Sides	• Service commercial customers; • Supplement visitor parking for residents	• Short-term parking restriction to encourage higher turnover rates for business vitality during business hours • Extend parking limits outside of business hours
Mixed Use – Albert Street	2-Way Segregated Bike Lanes and Pocket Parking Alternating Sides	• Service commercial customers • Supplement visitor parking for residents • Provides a buffer for more vulnerable road users	• Short-term parking restriction to encourage higher turnover rates for business vitality • Extend parking limits outside of business hours
Residential	2-Way, Parking 1 Side, Shared Auto/Bike Lanes	• Supplement visitor parking for residents; • Provides a buffer for more vulnerable road users	• Allow parking to prevent excessive vehicle speeds

Additionally, if on-street parking is to be considered as a traffic calming feature, then this parking needs to be used, at all times of the day and particularly in the overnight period when traffic volumes are lower and higher operating speeds are possible.

Permitting overnight parking is not without its own challenges, and new regulations would need to be established for the neighbourhood, not the least of which would be how to deal with winter road maintenance (current by-laws within the City of Waterloo prohibit obtaining an overnight parking exemption if there is a snow ban in effect). However, these issues are not unique to the City of Waterloo, and municipalities within and outside the Region of Waterloo have found effective ways to manage year-round on-street parking though the overnight period.

7.6 Collision Mitigation

Future traffic conditions in Northdale will largely be designed to help mitigate collisions throughout the neighbourhood, as opposed to specific measures designed to reduce a specific concerns. To conform to the neighbourhood's vision, vertical traffic calming measures, such as speed humps, are not proposed at this time. Instead, it is proposed that traffic be calmed by altering driver behaviour and reducing vulnerable road user exposure, using measures such as the following:

- Constraining vehicular capacity;
- Lane narrowing;
- Increased separation between active transportation users and drivers where appropriate;
- Dedicated bike lanes where appropriate;
- Curb extensions at intersections;
- Traffic calming through on-street parking management; and,
- Woonerfs.

Nonetheless, two intersections in particular were identified by City staff as locations of concern regarding collisions:

- Columbia Street at Spruce Street; and,
- Columbia Street at Lester Street.

Between 2009 and 2014 there were 14 collisions reported at the intersection of Columbia Street at Spruce Street, 43% of which were a result of an improper turning movement. The majority of these collisions involved a vehicle making a northbound left-turn movement from Spruce Street onto Columbia Street, with one incident involving a vehicle making a westbound left-turn movement from Columbia Street onto Spruce Street. The proximity of this intersection to the intersection of King Street & Columbia Street is such that the long queues create significant sightline limitations and gap selection issues from both streets.

The intersection of Columbia Street at Lester Street experienced fewer collisions within the same 5-year period with only 5 reported collisions. Forty percent of these collisions involved vehicles making a northbound left-turn movement from Lester Street onto Columbia Street; however, the majority of those involved a motorist striking a cyclist riding illegally in the sidewalk. It is possible that with growing volumes and changing traffic patterns there have been a more significant number of collisions in recent years (as was suggested by City staff).

A possible treatment for the collision issues observed at these intersections could be to add channelization to reduce the number of potential conflicts, allowing only right-turns to and from the side streets. The proximity of these intersections to major intersections coupled with their high proportion of collisions involving turning vehicles supports this suggestion, and both streets can be accessed via alternate routing.

7.7 Active Transportation Plan

The OP (2014) encourages the promotion and development of infrastructure to support active transportation. The City of Waterloo included a section on active transportation in the TMP (2011).

The TMP details the goal of active transportation is to:

Establish a cycling and trails network that connects people and places throughout Waterloo for people of varying experience via a network of convenient, safe, well-designed, efficient and comfortable on-road bikeways and multi-use trails.

The Northdale Streetscape Master plan conforms to this goal. The neighbourhood is being revitalized through the creation of mixed land uses that are in close proximity to commercial, institutional and retail to allow people to be close to where they work, go to school, shop and play. The streetscape element builds on these changes by providing a complete street to serve all forms of transportation. The emphasis on cycling lanes and sidewalks, coupled with the decorative features of the redesigned public realm, will promote an increased use of the space by pedestrians and cyclists.

Existing and planned Active Transportation routes within the Northdale neighbourhood are shown in Exhibit 7.6. These include:

- Existing on-road bike lanes along Columbia Street, University Avenue and Philip Street;
- Walkways that the City has strategically acquired between street blocks;
- Active Transportation features included as part of the preferred street concepts; and,
- Pedestrian connection concept between the Northdale neighbourhood and University of Waterloo LRT station.

For the preferred Mixed Use Street layout on Hazel Street and Green Street layout on Hickory Street, please note then following condition for addition of Multi-Use Trails on these streets:

Multi-Use Trails along Northdale streets must be accompanied by measures to reduce driveway and street crossing conflicts to an acceptable level (i.e., no more than every 300m), and/or traffic management provisions using signage, pavement markings, warnings and other traffic management measures.

7.8 Tree Management Plan

A total of 201 trees were recorded within the study area's public rights-of-way, representing 29 species (including cultivars). Twelve species are native to Ontario and 13 are non-native. The most common species is Norway Maple (28.9%), followed by newly planted Serviceberries (8.0%), and Little-leaf Linden (6.0%). A high percentage of Norway Maple is common for a neighbourhood of this age, although today Norway Maple are known to have invasive characteristics are used sparingly in new landscaping plans. The complete Tree Management Plan is included in **Appendix F** to this report.

Two thirds of the trees are in 'good' or 'good-fair' condition, with the majority of those trees being in the < 10 cm size category. A number of the Ash trees inventoried appeared to be in good health and not yet impacted by EAB, although two Ash trees had been recently removed and the cause of decline may have been EAB. Ash only comprised 4% of the trees inventoried. Due to the likelihood that EAB will reach them, retention of these trees is not recommended and further planting of the species is also not recommended.

7.8.1 Tree Protection

The City of Waterloo's By-Law for the Protection of Trees on City Property exempts the removal of the trees within the right-of-way on this project:

3. Exemptions

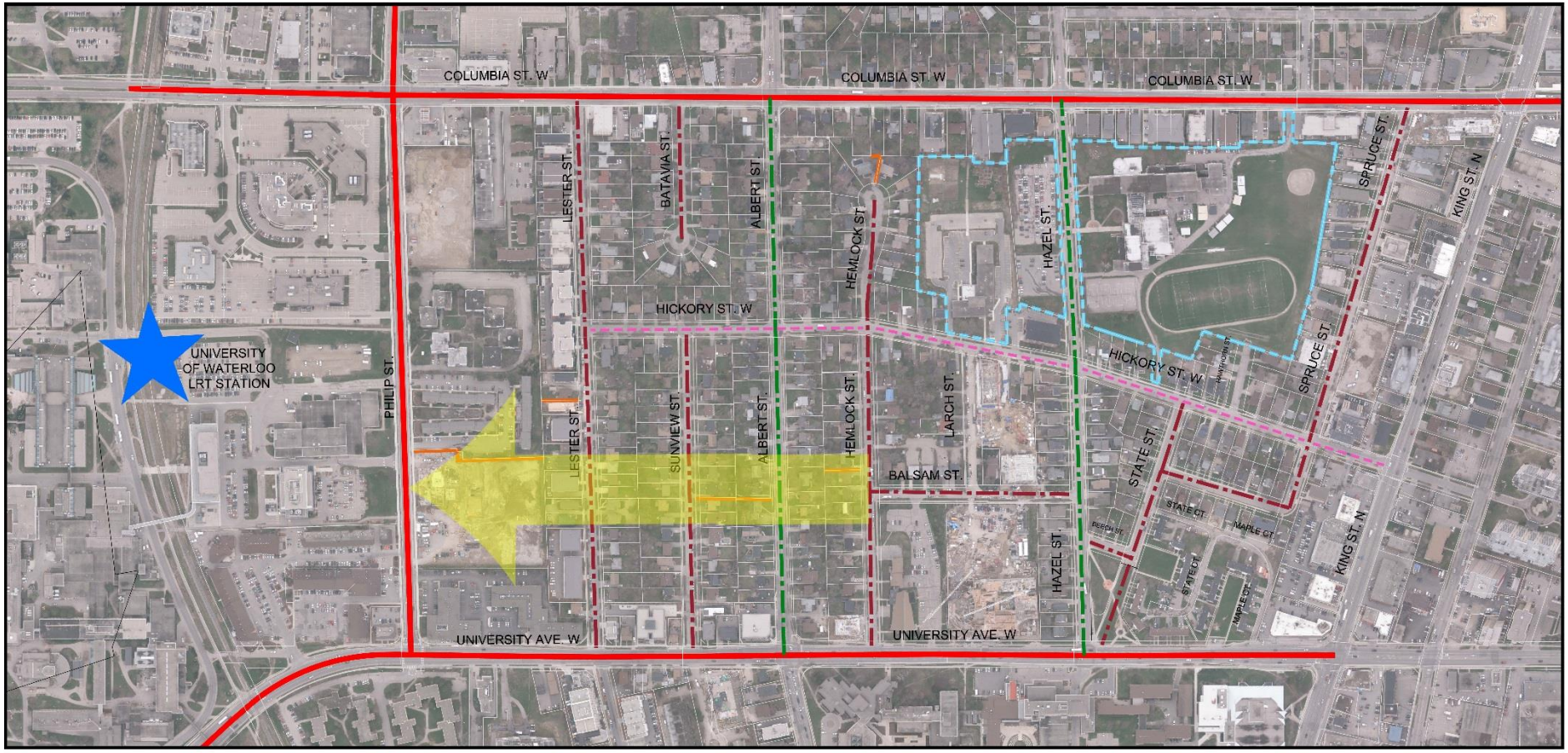
3.1 This By-Law does not apply to:

(a) activities or matters undertaken by a municipality or a local board of a municipality.

The City of Waterloo's Urban Forest Policy (1998) states:

> *"When re-construction takes place near or around trees, the contractor/agency performing the work will protect the trees from damage at all times. The type of equipment used within the area – one and one half times the drip line of a tree will be such that operation of this equipment does not compact and/or damage the roots and limbs of the tree. All work performed will be inspected by City staff.*

Exhibit 7-6 Proposed Active Transportation Plan



A protective barrier such as fencing, plywood, or other method specific to protecting the tree and approved by the City be placed between the construction area and the tree at all times during construction. The method of installation of this barrier will be such that it does not negatively impact the tree.

The preferred method when reconstructing sidewalks in the area of one and one half the drip line of an existing tree will be with an appropriate material that will reduce the effects of compaction and have the least impact on the root zone of the tree, all while providing a safe durable sidewalk. An example of this is to use permeable interlocking paving stones as opposed to continuous concrete slabs."

Maintaining a setback of 1.5 times the dripline of a tree canopy will not be possible in the reconstruction of the roadway and installation of new infrastructure, curbs and sidewalks. For the purpose of this assessment, minimum tree protection zones (TPZ's) will be based on those used in the City of Toronto for street trees as follows.

Exhibit 7-7 Minimum Tree Protection Zones

TRUNK DIAMETER (DBH) (CM)	MINIMUM TREE PROTECTION ZONE (TPZ) (M)
<10	1.2
10-29	1.8
30-40	2.4
41-50	3.0
61-70	3.6
71-80	4.2
81-90	4.8
91-100	6
>100	12 cm per 1 cm DBH

Within the tree protection zone there can be no construction, grading, storage, disposal, vehicle movement, or parking of vehicles. If utilities are required to pass through the area, directional boring can be used at a minimum depth of 1.2 m under the root system. Open trenching is not permissible.

7.8.2 Tree Removal

Trees on public property with a DBH greater than 10cm, and in danger of losing more than 30% of their root zone due to construction activity, will be recommended for removal. Removal of more than 30% of the root zone will comprise the structural stability and overall health of the tree too considerably to be considered safe. Where the minimum TPZ cannot be provided, an assessment of the proposed TPZ impact will determine whether the encroachment can be mitigated. If the encroachment on the TPZ is considered unsafe, trees on public property will be recommended for removal.

7.8.3 Tree Transplanting

Trees within the right-of-way and on public property noted as in 'good' condition, with a DBH of less than or equal to 10cm and in danger of TPZ encroachment will be recommended for transplanting.

Transplanting to the desired location should occur within 48 hours. If the trees cannot be transplanted to the final receiving location within 48 hours they should be healed into a storage

planting bed where they will be watered regularly until the transplant location is ready to receive the trees.

The complete Tree Management Plan in **Appendix F** include further tree planting recommendations including:

- Soil Volume;
- Soil quality;
- Species selection and diversity;
- Tree spacing and location;
- Watering Program; and,
- Monitoring and Maintenance.

8 Implementation

8.1 Preliminary Cost Estimates

8.1.1 Capital Costs

The preliminary capital cost estimates for the preferred Northdale Streetscape Master Plan components are shown in Exhibit 8-1. They total approximately $24.3 M in 2016 dollars, and would be implemented over time based in part on potential project staging discussed below in Section 8.3.

8.1.2 Operation and Maintenance

The operating and maintenance impact of the preferred public realm improvements in Northdale will increase over time as the capital works progress. Once all works are complete, it is estimated that the ongoing additional operating and maintenance impact compared to today is an additional $60,000 per year. It is recommended that the City address the additional operating and maintenance impacts for the public realm as part of the next budget cycle (either 2019 or 2020 depending on when the first phase of capital improvements starts).

8.2 Property Acquisition

Only the two preferred Mixed Use Street concepts on Hazel Street and Albert Street will require property acquisition beyond the existing road right-of-way. On these two streets, the preferred the cross-section has been designed to comply with the proposed right-of-way in the OP, which extends beyond the existing public realm limits.

The City has been taking land along some Northdale streets as properties are developed. This is how required property along Albert Street and Hazel Street could be acquired over time as part of the property redevelopment process, at no cost to the City. However, this will take time and depends on the staging and timing of construction as discussed next in Section 8.3. During this period, there may be parcels that have not yet been taken, and the land would need to be acquired by the City to implement a complete street reconstruction. Another future option may be to adjust the street reconstruction design to fit within the existing right-of-way, but this would likely impact then preferred design.

8.3 Proposed Staging

As part of this study, potential staging for the reconstruction of streets within the Northdale neighbourhood has been reviewed based on:

- Optimizing the impact of the City's investment;
- The state of the existing infrastructure;
- Requirements for replacement based on age and condition;
- The need for and impact of capacity upgrades; and
- The status of the "buildout" on each street.

The intent of the proposed Staging Plan shown on Exhibit 8-2 is to maximize development potential while minimizing future road cuts on newly built streets as part of providing service connections, and damages from construction traffic.

A summary of the required replacements or upgrades to infrastructures as well as building footprints for already developed or currently under construction developments can be seen in Exhibit 8-2. A chart of proposed staging considerations and priority ranking as of this report preparation in 2016 is included in Exhibit 8-3.

The areas most recently developed to higher densities include Lester Street, Spruce Street and the Balsam Street/Larch Street block. The remaining streets are in various stages of conversion. Hickory Street, Hawthorn Street, Spruce Street and the State Street/State Court area are in the greatest need for infrastructure repair/upgrade.

Based on its completed development and its infrastructure needs, Spruce Street is the best candidate for early reconstruction. Given that the outlet for the storm and sanitary sewers is Hickory Street it may also be beneficial to upgrade Hickory Street from Spruce to King Street at the same time, providing an improved storm sewer outlet, a new outlet sanitary sewer watermain and increased capacity.

The remainder of the streets continue to await development and any roadway replacement would be subject to future repairs as a result of development. Based on infrastructure needs, Hickory Street and the State Street area would be the next likely candidates for reconstruction with the understanding that further asphalt, curb and or landscape restoration would be likely after development if it occurs. Potentially, "single pipe" upgrades could be constructed with full reconstruction of the roadway to follow development. For areas that require capacity upgrades, the downstream sections should be reconstructed first if possible.

Exhibit 8-1 Preliminary Cost Estimates

Street	Length (m)	Preferred Option	Piped Infrastructure	Credit for Infrastructure Recently Replaced	Surface Works	Cost to Bury Hydro*	Hydro Relocation Required*	Streetscaping	Pedestrian Lighting	Sub Total	25 % Contingency	Total
Albert Street	617	Mixed Use Option 1b	$789,760	-$246,800	$923,082	$2,159,500	No	$104,099	$172,760	$1,742,901	$435,725	$2,178,627
Balsam Street	229	Residential Street Option 2	$293,120	-$91,600	$266,506	$801,500	No	$20,839	$64,120	$552,985	$138,246	$691,231
Batavia Place	206	Residential Street Option 2	$263,680		$239,739	$721,000	No	$18,746	$57,680	$579,845	$144,961	$724,806
Beech Street	59	Residential Street Option 2	$75,520	-$75,520	$68,663	$206,500	No	$5,369	$16,520	$90,552	$22,638	$113,190
Fir Street	149	Residential Street Option 2	$190,720		$173,403	$521,500	No	$13,559	$41,720	$419,402	$104,851	$524,253
Hawthorn Street	78	Residential Street Option 2	$99,840		$90,775	$273,000	No	$7,098	$21,840	$219,553	$54,888	$274,441
Hazel Street	618	Mixed Use Option 1a	$791,040	-$300,000	$1,116,729	$2,163,000	Yes	$104,268	$173,040	$4,048,077	$1,012,019	$5,060,096
Hemlock Street	507	Residential Street Option 2	$648,960		$590,036	$1,774,500	No	$46,137	$141,960	$1,427,093	$356,773	$1,783,867
Hickory Street	921	Green Street Option 2	$1,178,880		$1,166,682	$3,223,500	No	$643,319	$257,880	$3,246,760	$811,690	$4,058,450
Larch Street	166	Woonerf Option 1	$212,480		$203,313	$581,000	Yes	$387,218	$46,480	$1,430,491	$357,623	$1,788,114
Lester Street	622	Residential Street Option 2	$796,160		$723,871	$2,177,000	No	$56,602	$174,160	$1,750,793	$437,698	$2,188,491
Maple Street	177	Residential Street Option 2	$226,560		$205,989	$619,500	No	$16,107	$49,560	$498,216	$124,554	$622,770
Spruce Street	469	Residential Street Option 2	$600,320		$545,813	$1,641,500	No	$42,679	$131,320	$1,320,132	$330,033	$1,650,165
State Court	211	Residential Street Option 2	$270,080		$245,558	$738,500	No	$19,201	$59,080	$593,919	$148,480	$742,398
State Street	180	Residential Street Option 2	$230,400		$209,480	$630,000	No	$16,380	$50,400	$506,660	$126,665	$633,326
Sunview Street	361	Residential Street Option 2	$462,080		$420,125	$1,263,500	No	$32,851	$101,080	$1,016,136	$254,034	$1,270,169
											TOTAL	$24,304,394

* - To be confirmed with Waterloo North Hydro
Cost to bury hydro not included in total unless required
All piped infrastructure priced to be replaced, credit given for recent upgrades
Pedestrian lighting only considered where hydro is to be buried

Summary of Infrastructure Credits
Albert Street - Watermain already upgraded
Balsam Street - Watermain already upgraded
Beech Street - All services already upgraded
Hazel Street - Recent reconstruction from Hickory Street to University Avenue

Exhibit 8-2 Proposed Infrastructure Upgrades

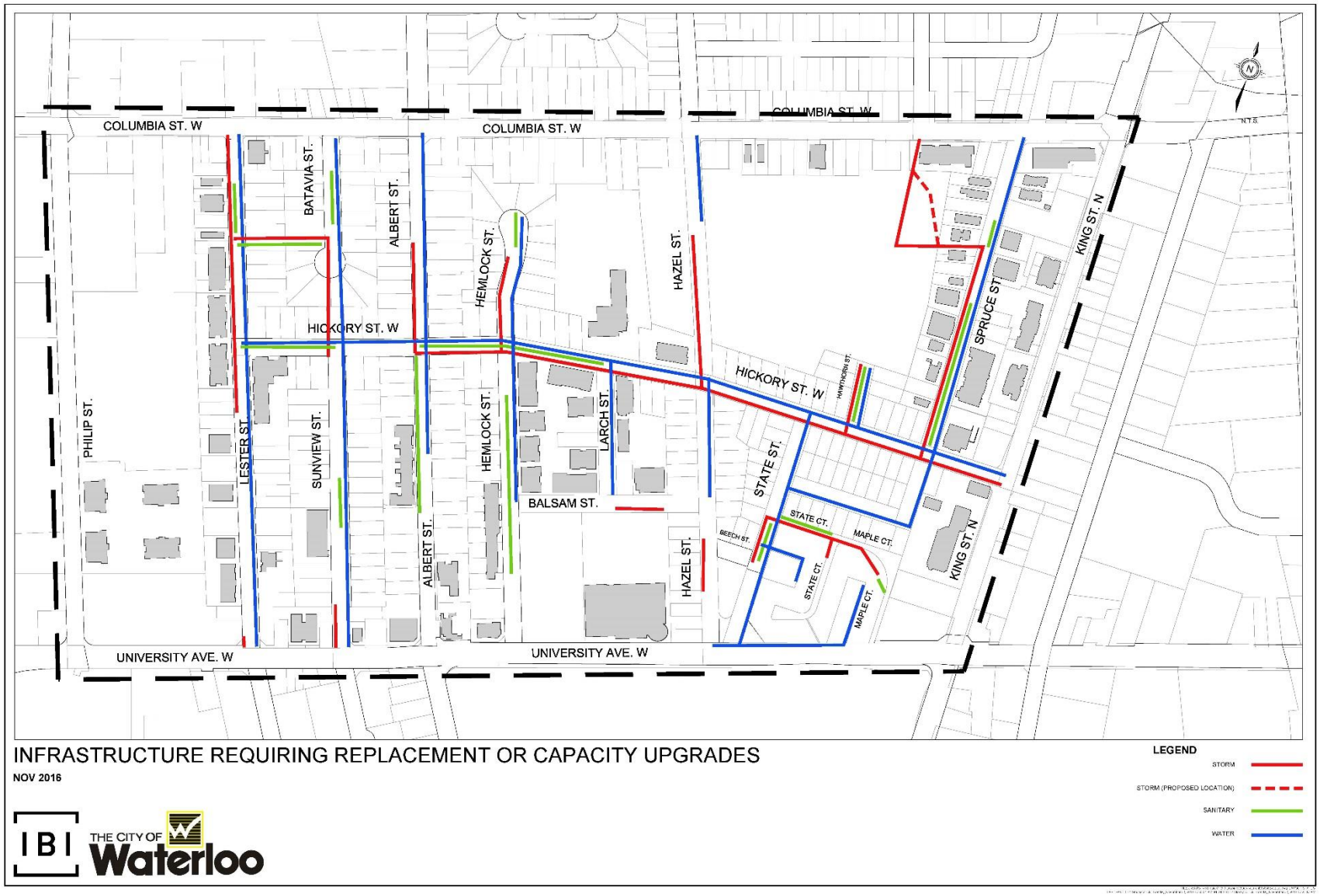


Exhibit 8-3 Proposed Staging Considerations and Priority Ranking

Street	Length (m)	Preferred Option	Cost/m	Utility Relocation*	% of Development	Infrastructure Condition	Infrastructure Capacity Upgrades	Maintenance Requirements	Priority for Reconstruction
Albert Street									
University to Hickory	366	Mixed Use Option 1b	$3,531.00	No	20%	SAN, WAT	STM	Increased	11
Hickory to Columbia	251	Mixed Use Option 1b	$3,531.00	No	0%	WAT	SAN, STM	Increased	11
Balsam Street	229	Residential Street Option 2	$3,018.48	No	90%	None	STM	Same	4
Batavia Place	206	Residential Street Option 2	$3,518.48	No	0%	None	STM	Same	11
Beech Street	59	Residential Street Option 2	$1,918.48	No	0%	None	None	Same	11
Fir Street	149	Residential Street Option 2	$3,518.48	No	10%	WAT	None	Same	11
Hawthorn Street	78	Residential Street Option 2	$3,518.48	No	0%	SAN, STM, WAT	STM	Same	6
Hazel Street									
University to Hickory	313	Mixed Use Option 1a	$8,187.86	Yes	0%	WAT	STM	Increased	11
Hickory to Columbia	305	Mixed Use Option 1a	$8,187.86	Yes	10%	WAT	STM	Increased	11
Hemlock Street									
University to Hickory	346	Residential Street Option 2	$3,518.48	No	70%	SAN, WAT	WAT	Same	11
Hickory to End	161	Residential Street Option 2	$3,518.48	No	0%	SAN, STM	STM, WAT	Same	10
Hickory Street									
Lester to Albert	215	Green Street Option 2	$4,406.57	No	10%	SAN, WAT	WAT	Increased	11
Albert to Hazel	338	Green Street Option 2	$4,406.57	No	40%	STM, WAT	SAN,STM, WAT	Increased	7
Hazel to Spruce	268	Green Street Option 2	$4,406.57	No	10%	WAT	STM, WAT	Increased	5
Spruce to King	100	Green Street Option 2	$4,406.57	No	10%	WAT	STM, WAT	Increased	2
Larch Street	166	Woonerf Option 1	$10,771.77	Yes	90%	WAT	WAT	Increased	3
Lester Street									
University to Hickory	368	Residential Street Option 2	$3,518.48	No	40%	None	STM	Same	11
Hickory to Columbia	254	Residential Street Option 2	$3,518.48	No	50%	None	SAN,STM	Same	8
Maple Street	177	Residential Street Option 2	$3,518.48	No	0%	None	None	Same	11
Spruce Street	469	Residential Street Option 2	$3,518.48	No	90%	SAN, WAT	SAN, STM, WAT	Same	1
State Court	211	Residential Street Option 2	$3,518.48	No	0%	SAN	STM	Same	11
State Street	180	Residential Street Option 2	$3,518.48	No	0%	None	SAN, STM	Same	9
Sunview Street	361	Residential Street Option 2	$3,518.48	No	10%	SAN, WAT	STM	Same	11

* - To be confirmed with Waterloo North Hydro

Transit only option is being considered for Hazel Street from Hickory to Columbia

Hickory Street from Spruce to King increased in priority due to downstream constraints

Priority should be revaluated continually based on status of development

Service replacements in place of full reconstruction to be considered were replacement required