CITY OF

Vaughan Complete Streets Guide

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FINAL GUIDE

VAUGHAN

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CHAPTER 1
INTRODUCTION

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The Vaughan Complete Streets Guide (the Guide) is the City's reference on street design policies, processes, and techniques.

1.1 PURPOSE

The Guide provides direction to staff, developers, and others so they can incorporate Complete Street concepts into the planning, design, rehabilitation, and maintenance of new and existing City streets.

The City of Vaughan's policy documents recognize the need to provide a safe, sustainable, future-ready street network with diverse mobility choices, accessible to all.

Vaughan Official Plan (VOP), Vaughan Transportation Plan (VTP), the City of Vaughan's Pedestrian and Cycling Master Plan, and MoveSmart Mobility Management Strategy emphasize moving away from Vaughan's reliance on vehicles.

The Guide includes the process, techniques, and performance metrics to assist in the delivery of Complete Streets.

It defines the nature, aspirations, and functions of a Complete Street.

It is meant to guide Staff, developers, and other street providers in planning, designing, and implementing street projects.

The Guide focuses on the decision-making process that can apply to any project type.

The Guide will also provide directions to measure performance for effective delivery of Complete Streets.

Street design teams will seek to make each project as complete as possible regardless of the category, project type, scale, or complexity.

'...Recognizing the dominant role the automobile has played in defining patterns of growth and development in Vaughan, the focus over the next 25 years is on strengthening the pedestrian, bicycle and transit networks and systems.'

1.6 Structure of this Plan- Vaughan Official Plan, 2010 (Office Consolidation, 2020).

'...Providing choices that allow people to drive less is a vital component of managing congestion in Vaughan.'

Vaughan Transportation Plan (Ongoing)- Committee of the Whole (Working Session) Report, 2023.

'...Develop a plan that looks beyond the active transportation network infrastructure and provides guidance for shifting the culture and guidance support among all stakeholders.'

Key Goals, Vaughan Pedestrian and Bicycle Master Plan, 2020.

1.2 APPROACH

The Complete Streets approach applies to all stages of the project delivery process- from planning and design to implementation, operations, and maintenance.

The City aims to involve everyone in Vaughan- stakeholders, professionals, and decision-makers in the design and repair of its streets, thus imbibing and promoting the Complete Streets approach.

The process, techniques, and performance metrics in this Guide build upon:

- Policy ambitions and experiences of designing streets in Vaughan.
- Current City of Vaughan processes, workflows, and multi-agency collaboration.
- Recent best practices from around North America and the world.

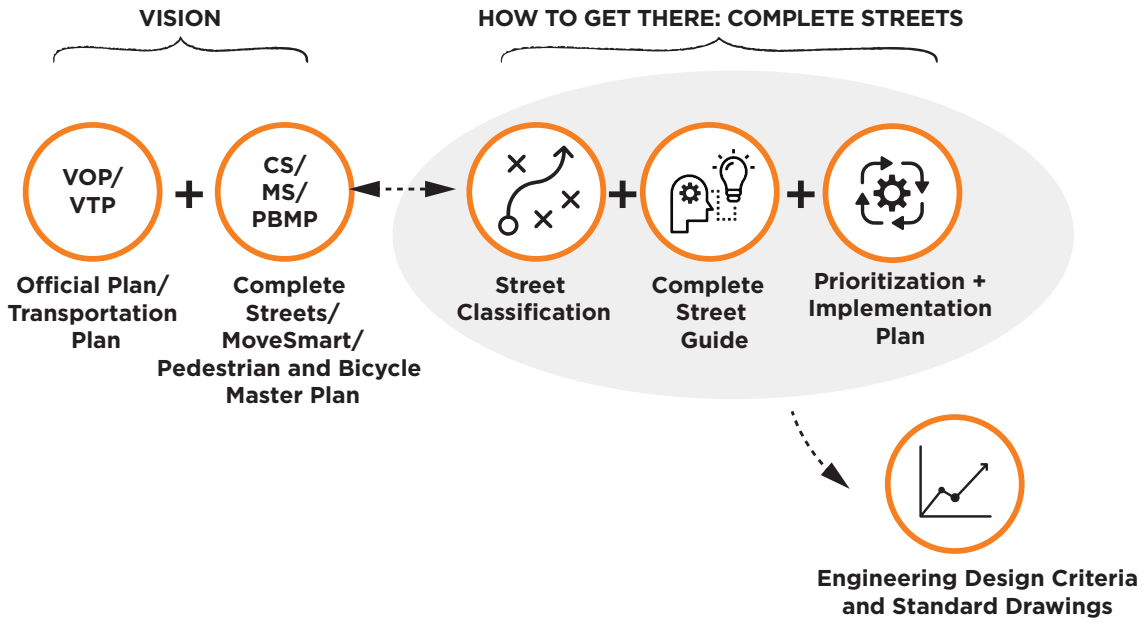


Figure 1.1. Vision and Process for delivery of Complete Streets in the City of Vaughan.

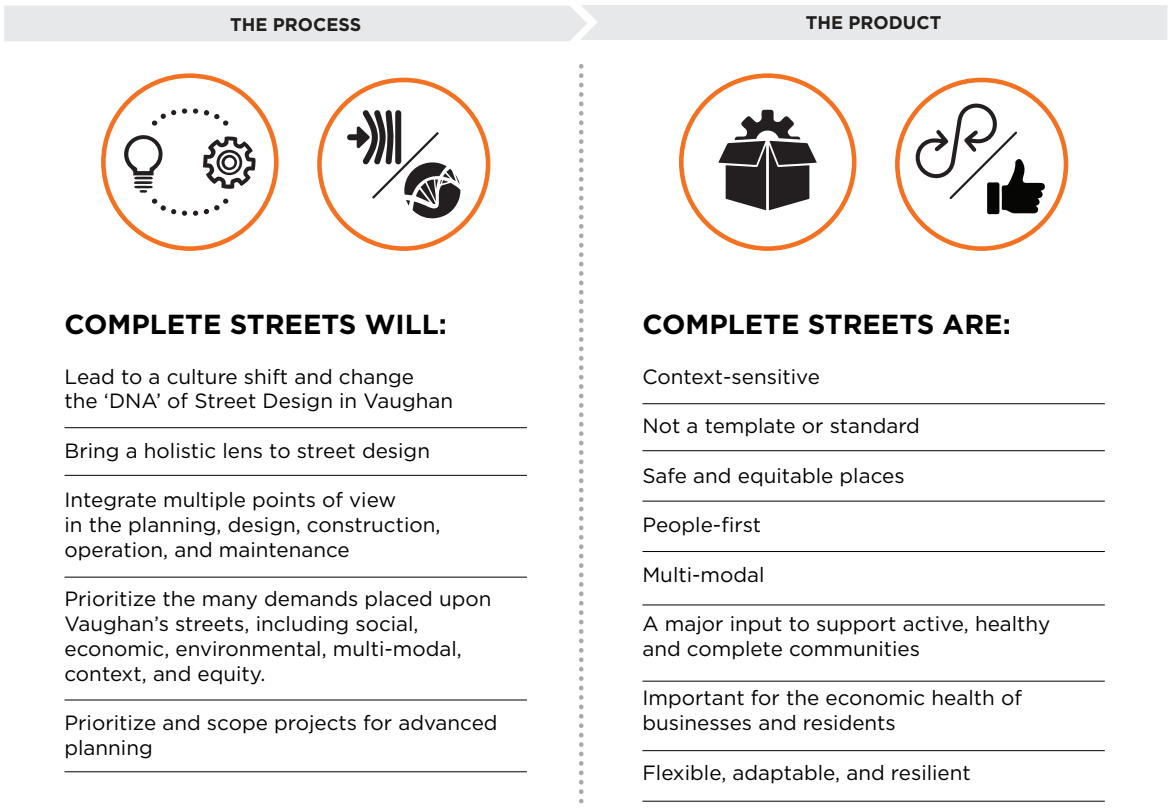


Figure 1.2. The Guide considers how to first improve the street design process to inform a well-considered product.

This Guide promotes a different way of thinking about streets. It favours **process** innovations to inform **product** innovations, improving the process that leads to the product. It includes changes across all activities and steps in the project delivery process.

There are many ways to make a street more complete. It is not good enough to try and replicate a design response from another context that may have different inputs. Many people will refer to an exemplary street that looks good and has an appealing design character, but a Complete Street does not need to have the same elements or have the same appearance. It is more helpful to understand what a Complete Street is and not how to make one that references a design out of a catalogue.

The Guide is intentionally distant from sole reliance on standard drawings, which are helpful as an initial reference but cannot address the myriad conditions possibly encountered in designing a project. Like many of the latest policies and best practices on street design, the Guide subscribes to the 'design domain' concept, where practitioners are encouraged to find solutions within a broader range of possibilities.

1.3 POLICY DIRECTION

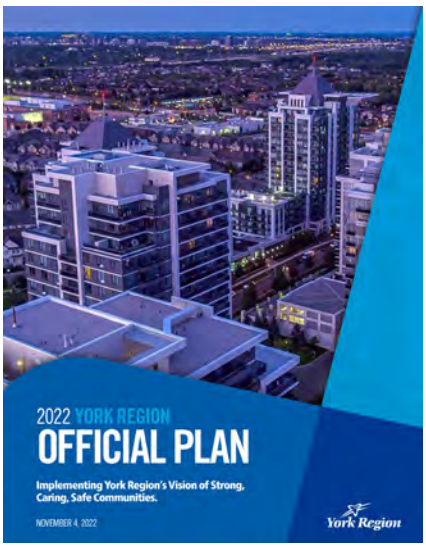
Safe, inclusive, and context-sensitive streets are a priority at all levels of policies- Provincial, Regional, and Municipal. This Guide follows the goals and directions outlined in them.

Figure 1.3. Provincial policy documents and manuals.

PROVINCIAL POLICY

Growth Plan for the Greater Golden Horseshoe (Ontario Ministry of Municipal Affairs, Office Consolidation, 2020): requires that "in the design, refurbishment or reconstruction of the existing and planned street network, a Complete Streets approach will be adopted that ensures the needs and safety of all road users are considered and appropriately accommodated" (3.2.2.3).

2041 Regional Transportation Plan (Metrolinx 2018): sets a high-level vision for transportation network within the Greater Toronto and Hamilton Area. It requires to, "promote modal shift from personal automobiles and reduce personal vehicle travel demand through land use changes, improvements to transit services and street design, new Transport Demand Management programs, and reducing barriers to walking, cycling and transit use." (Strategy 5, Reduce Greenhouse Emissions).



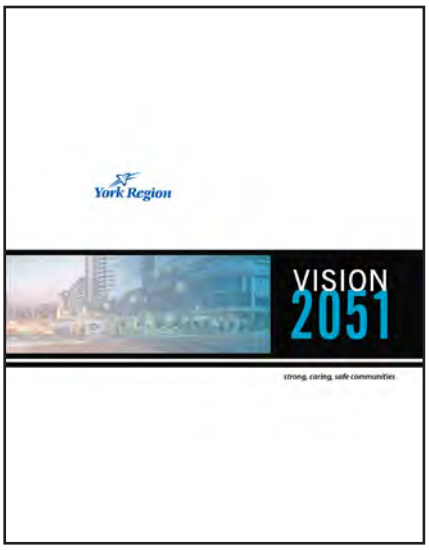


Figure 1.4. Regional policy documents and manuals.

YORK REGION POLICY

York Region Official Plan 2022: sets direction and provides long-term framework to manage growth and development based on planned urban structure, in accordance with its vision to achieve "Strong, Caring, Safe Communities". It promotes a reliable and consistent multi-modal mobility network by maximizing use of existing and future transportation infrastructure and by integrating land use and transportation planning. The Plan prioritizes moving people and goods by enhancing transit and active transportation opportunities and reducing automobile dependency to minimize environmental and health impacts. The Plan also provides directions for development applications to identify 'Transportation Demand Measures' to reduce single occupancy automobile use and complete a 'Mobility Plan' providing transportation options inclusive of all users.

Vision 2051: builds on the Region's policy documents and strategies to address significant changes and issues emerging in the Region and coordinates corporate strategies to address them. A seamless transportation network offering diverse mobility options, is one of the goals of the Vision. The Vision enlists various actions to achieve this goal- ensuring that the planned land use and built environment minimizes the need for travel by implementing transport demand management programs, promoting initiatives that facilitate alternative modes of active transportation by providing a comprehensive pedestrian and cycling network, and increasing and improving existing and future transit connectivity, reliability, and accessibility.

Transportation Master Plan 2022: is a five-year plan that builds on previous plans and provides a long-term vision for planning the Region's transportation infrastructure. It recommends strategies, initiatives, and implementation processes to address the anticipated growth and effects of climate change in the Region, over the next 30 years.

Designing Great Streets (DGS) 2019: promotes a context-sensitive approach to road design to provide diverse mobility options with greater emphasis on pedestrian and cycling infrastructure. The document identifies six street typologies- City Centre Street, Avenue, Main Street, Connector, Rural Road, Rural Hamlet Road, reflecting the Regional road network and provides consistent road designs and features for them. The guidelines provide directions on decision-making by promoting an Environmental Assessment (EA) process and consider the full life-cycle costs for the project. These guidelines are consistent with the vision, goals and directions outlined in the Region's Transportation Master Plan.

Figure 1.5. Regional policy documents and manuals.

Pedestrian and Cycling Planning & Design Guidelines 2018: provides guidance on selection and design of active transportation facility types and intersection design, based on the context and nature of street projects (new, reconstruction or retrofit). The manual, in conjunction with 'Designing Great Streets (DGS)', establishes user characteristics and design criteria while providing design and planning guidelines for other elements like curbside activities, paving signages, signal operations and planting and furnishing options along the streets.

Street Tree and Horticultural Design Guidelines 2022: outlines design standards and guidance on planting within the streetscape in both hard and softscape conditions. The guidelines enlist better planting practices and sustainable site design to help grow healthier, resilient street trees with larger canopies along Regional Roads. The document provides detailed design criteria for planting, for the six context-sensitive road typologies identified in the DGS guide along with their submission requirements.

Street Tree and Forest Preservation Guidelines 2022: directs preservation of existing trees and natural vegetation, owned by the Region and within the Regional rights-of-way, by prescribing standards and specifications. The guidelines establish scope and provide various tools to develop documentation such as- a Region-approved Tree Inventory, Tree Protection Plan, Arborist Report, and tree compensation calculations. It includes standard drawings, templates, and formats for these submissions. It also includes a rating system which defines criteria for establishing existing tree conditions.

CITY OF VAUGHAN POLICY

Official Plan 2010 (Office Consolidation 2020) (VOP): provides policy direction for land use, physical structure, natural systems and transportation connectivity, catering to the future growth in Vaughan. It establishes eight goals to facilitate safe and healthy communities, sustainable transportation network, enhance natural areas and manage growth by maintaining stability of existing employment lands. Goal 5 focuses on creating viable, alternative transportation options- transit, cycling, walking, to reduce reliance on cars. Chapter 4 includes transportation policies to establish a comprehensive street network comprised of hierarchy of street types and provides directions prioritizing transit and active transportation opportunities on each street type.

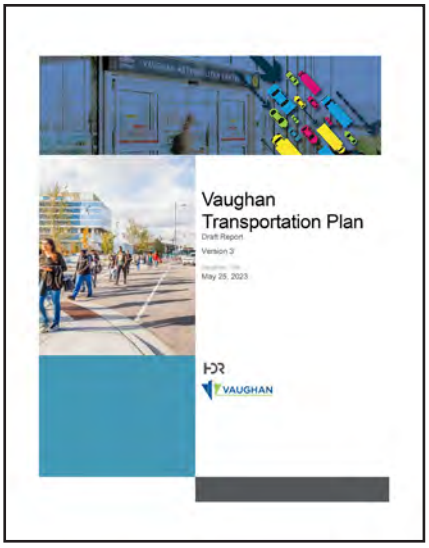


Figure 1.6. Municipal policy documents and manuals.

Transportation Plan 2023 (VTP): highlights the vision, goals and directions guiding efficient use of existing and future transportation infrastructure. It includes studies, programs, initiatives, and actions to provide alternate, sustainable mobility choices for users, urging them to drive less.

Pedestrian and Bicycle Master Plan 2020: directs design and planning of pedestrian and cycling facilities responding to different street typologies (established in DGS) and their surrounding land use context. It includes recommendations for outreach, education, and awareness programs to encourage a shift towards active transportation. The document enlists best design practices, implementation and phasing approaches, funding and costing strategies. The policy focuses on bridging gaps within the existing active transportation network to create first and last mile connections.

City-wide Urban Design Guidelines 2018: directs design and establishes performance standards for new streets such as private roads, driveways, laneways, and mid-block connections in new developments, to promote a connected and continuous street network.

City-wide Streetscape Manual and Financial Strategy Plan (Draft) 2014: establishes strategy and guidelines for managing design, construction, and maintenance, costing and funding for new streetscapes within upcoming Intensification Areas and Corridors, and existing Heritage Conservation Districts. It focuses on four streetscape context types and describes streetscape structure, zones, and components. It identifies different levels of service based on street classification and adjacent land use. Additionally, it enlists different criteria for the levels of service, with a focus on the pedestrian realm.

MoveSmart Mobility Management Strategy: is a five-year plan that sets directions and priorities to enable the City's vision to provide a safe, contiguous, efficient, and sustainable transportation network and system. It provides a framework for engagement and collaboration with community and stakeholders to address the transportation needs of the City, inclusive of all its users. The strategy comprises of four programs which help achieve its vision- Road Safety Program, Mobility Management Program, Traffic Data Management Program and Sustainable Mobility Program. It also includes campaigns like #SlowDownVaughan, and the Speed Limit Policy which help mitigate speeding on public roads.

1.4 GUIDING PRINCIPLES

Making streets safe and inclusive for users of all ages and abilities, along with promoting active transportation and public transit options are key goals of the City of Vaughan and the Complete Streets Guide.

All street projects in Vaughan will adhere to the following principles:

Safe streets for all users. Providing a safe pedestrian and cycling experience along Vaughan streets has been highlighted at all levels of policy. The City's Pedestrian and Bicycle Master Plan Report provides direction to prioritize inclusion of the most vulnerable user.

Streets for a healthy community. Improve streetscape to create a safe and comfortable environment for walking and cycling. In keeping with goals of the City and the Region, this will enhance overall public health.

Streets that support existing and future context. Streets link places and are places themselves. Streets in Vaughan have varying surrounding contexts, uses and users, both existing and anticipated. Streets designed to respond to their functional roles and adjacencies will be more animated, comfortable, and complete.

Streets that reduce transportation network gaps. Connected and complete pedestrian and cycling networks will support healthier communities, provide first and last mile connections, make streets safer, and offer mobility choices reducing car dependence.

Sustainable and resilient streets. Integrating green infrastructure within the design of streetscapes can lead to resilient street trees with larger canopies. Treat stormwater runoff, increase water percolation, and improve the micro-climate. Integrating large trees existing within the private setbacks in street design, will also enhance the user experience.

Streets as 'places'. Streets support several activities in addition to providing links from one place to the other. Streets are also spaces for public art and curbside patios.

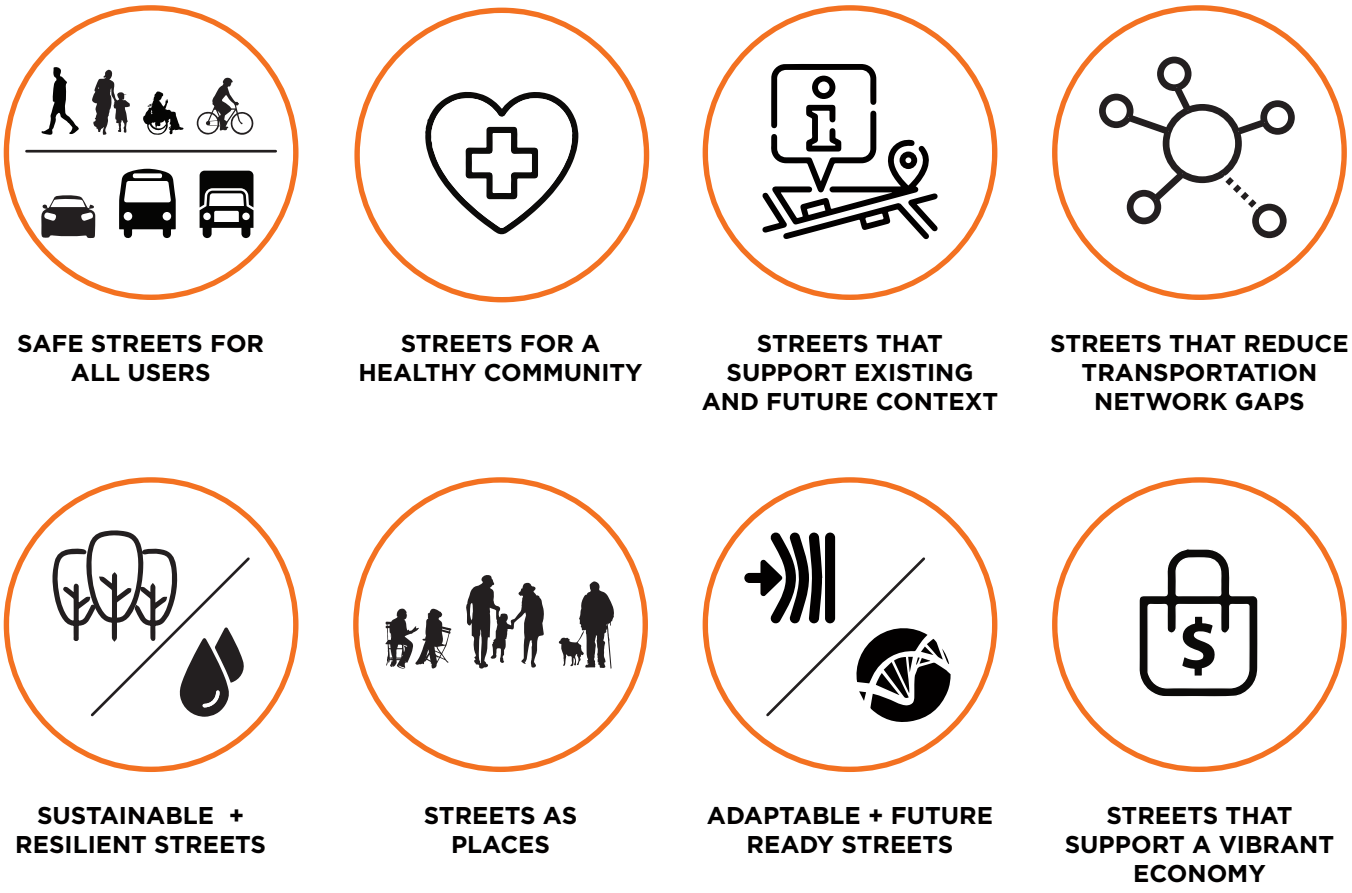


Figure 1.7. Guiding Principles for every street project in the City of Vaughan.

In some cases, they can reflect the neighbourhood's unique identity based on its context or heritage. Vibrant streets will invite visitors, facilitate commerce, and strengthen a sense of community, enhancing Vaughan's public realm.

Adaptable and future-ready streets. There has been an increase in app-driven rideshares and zero-emission automated vehicles (EVs) on the streets. Use of 'third-speed' micromobility modes of travel (e-bikes, e-rollerblades, etc.), which are faster than pedestrians, but slower than vehicle traffic, is on the rise. Street design and planning processes need to recognize the changing users and plan and adapt designs to accommodate the same.

Streets that support a vibrant economy. Efficient and context-sensitive street designs will incorporate multimodal transportation systems, attracting people and businesses. Investment in such streets will boost the local economy.

1.5 APPLICATION OF THE GUIDE

All types of street design projects afford an opportunity to make streets more complete, from planning to construction to maintenance.

The City aspires to make all streets as complete as possible.

Large projects, such as Environmental Assessments (EAs), new construction and reconstruction, offer the opportunity to apply the Guide more comprehensively. They tend to have higher budgets, a broader scope, and a longer timeline.

Small projects offer tremendous potential for making streets more complete since they frequently take place in every part of the city and can often achieve project objectives with few and relatively simple measures.

Table 1.1 identifies the types of street projects in Vaughan that Complete Streets will apply to.

Table 1.1 Street Design Projects, Applying the Guide

	Capital/ Operational Projects	Development Applications
New Construction	X	X
Reconstruction	X	
Retrofits	X	
Corridor Reviews	X	
Environmental Assessments	X	
Integrated Road Projects	X	
Transit Infrastructure	X	
Neighbourhood/Area Traffic Study	X	
Water/Sewer/Stormwater Management	X	
Utility Cut Rehabilitations	X	
Safety/Local Improvements	X	
Traffic Calming	X	X
New Sidewalk Construction	X	X
Sidewalk Improvements	X	X
Bikeway Construction/Markings	X	X
Street Furniture Installations	X	X
Street Tree Planting, Protection and Preservation and Green Infrastructure Installations.	X	X
Site Plan Installations		X
On-street Parking Facilities	X	X
Public Art/Streetscape Enhancements	X	X

1.6 GUIDANCE FOR PRACTITIONERS

The Vaughan Complete Streets Guide is a document to provide direction for planning, design, and implementation of street projects in Vaughan.

The Guide recognizes that all streets are different, requiring different planning approaches, design solutions, and implementation strategies. The Guide establishes a range of minimum and/or preferred values for elements to provide flexibility in street design and incorporates sound engineering practices. The document includes other tools and references providing additional detail wherever necessary.

The Guide builds on the direction provided in provincial, regional, and municipal policies, standards and guidelines, along with sources from non-governmental organizations (Ontario Ministry of Transportation (MTO), Professional Engineers of Ontario (PEO), Ontario Provincial Standards (OPS), Transportation Association of Canada (TAC), Institute of Transportation Engineers (ITE), National Association of City Transportation Officials (NACTO), and other relevant sources. The document is a result of coordination between the City Staff and experts in the design and planning profession and is based on best practices from similar contexts.

The Guide is a living document. It will need to be reviewed and updated periodically. Readers and practitioners are urged to consider recent and relevant research and practices.

The Guide is not prescriptive, as it cannot cover all scenarios. It encourages innovative design solutions. Field experience, local knowledge, and good engineering judgment are all essential in deciding what to do in the absence of specific direction, and in selecting design variations from other street design references. To assist practitioners in implementation, the Guide articulates the need to document the rationale early on for the decision-making process.

The Guide includes guidance for city street projects, including new construction, reconstruction, retrofits, maintenance, and operations.

1.7 GUIDE STRUCTURE

This is a quick overview of the overall Guide structure.

The Guide will direct the reader to various best practices, policies and programs, and design, planning and implementation techniques.

References to additional resources and hyperlinks are listed wherever applicable.

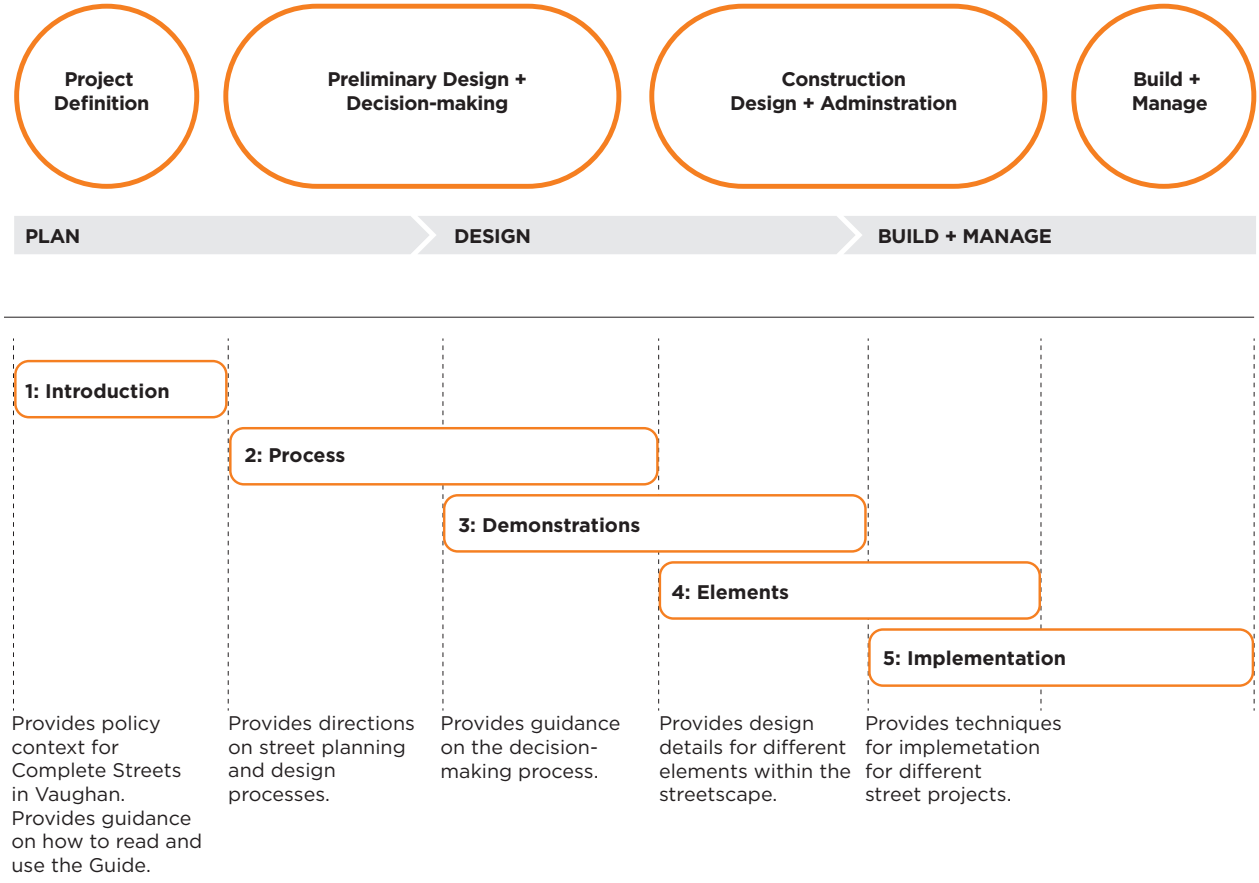


Figure 1.8. Overall structure of the Guide.

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CHAPTER 2
PROCESS

2

Chapter 2 defines the street design process and how to make decisions to achieve Complete Streets in Vaughan.

2.1 ROLES AND RESPONSIBILITIES

All City of Vaughan staff divisions working in street design, street construction, and street operations and maintenance have a role in the application of Complete Streets.

The following table summarizes the roles and responsibilities of key City departments, divisions, and external agencies when designing and operating Vaughan streets.

The table may require updates to reflect changes over time. Note that this is not an exhaustive list of all who may participate on an as-needed basis.

Table 2.1 Roles and Responsibilities- City Departments, Divisions and External Agencies

	City-initiated Streets (Retrofit and New)	Development-led Streets
City of Vaughan: Infrastructure Development Portfolio		
Infrastructure Planning and Corporate Asset Management	• Identify the need for new or improved streets through Master Plans. • Determine street horizontal and vertical alignment, intersection configurations and cross-section elements (above and below grade) in discussions with SME departments during Environmental Assessments (EA) or other design feasibility studies. • Determine water, wastewater, and stormwater infrastructure requirements through Master Plans. • Create Low-Impact Development guidance for stormwater infrastructure.	• Identify the need for new or improved streets through Master Plans. • Determine street horizontal and vertical alignment, intersection configurations and cross-section elements (above and below grade) in discussions with SME departments during Environmental Assessments or other design feasibility studies. • Determine water, wastewater, and stormwater infrastructure requirements through Master Plans.
Infrastructure Delivery	• Lead, coordinate and complete all detailed design activities for new or improved streets. • Monitor construction and conduct inspections for City-initiated streets.	• Coordinate City projects with development projects to ensure proper alignment.
Development Engineering	• Highlight impacts and coordinate potential integration of active development proposals for the design and/or construction of City-initiated streets.	• Identify new streets needed to support development in areas without Secondary Plans. • Identify street, intersection and cross-section requirements based on City policies and criteria, as well as development applications. • Ensure development-led streets to follow Engineering Design Criteria and Standard Drawings.
City of Vaughan: Planning and Growth Management Portfolio		
Policy Planning and Special Programs	• Designate improved streets through Official Plan and Secondary Plans.	• Designate new or improved streets through Official Plan and Secondary Plans.
Development Planning (Urban Design)	• Based on Streetscape Master Plan and District Plans, define streetscape design requirements for Detailed Design and EA. • Identify streetscape design requirements based on surrounding land uses and proposed development interfaces during detailed design. • Monitor construction and inspect streetscape elements to ensure compliance with approved plans. • Identify streetscape Levels of Service through Master Plans and City-Wide Streetscape Implementation Manual.	• Through Streetscape Master Plan and District Plans, define streetscape design requirements for development applications. • Identify streetscape design requirements based on surrounding land uses and proposed development interfaces during detailed design. • Monitor construction and inspect streetscape elements to ensure compliance with approved plans. • Identify streetscape Levels of Service through Master Plans and City-Wide Streetscape Implementation Manual.

Table 2.1 Roles and Responsibilities- City Departments, Divisions and External Agencies

	City-initiated Streets (Retrofit and New)	Development-led Streets
City of Vaughan: Public Works Portfolio		
Transportation and Fleet Management Services	• Identify operational and safety-related improvements for existing streets. • Maintain pavement portion of the right-of-way.	• Identify operational and safety-related improvements for existing streets. • Maintain pavement portion of the right-of-way.
Parks, Forestry and Horticulture Operations	• Maintain boulevard portion of the right-of-way, including many (but not all) Regional Roads.	
Environmental Services	• Identify lane width and turning movement requirements for garbage collection vehicles.	
City of Vaughan: Vaughan Fire and Rescue Service		
	• Identify lane width and turning movement requirements for fire and rescue vehicles.	
Region of York		
York Region Transit	• Identify lane width and turning movement requirements for transit vehicles. • Identify boulevard requirements for transit stops and other transit-supportive elements.	
York Region Natural Heritage and Forestry	• Review existing and proposed street trees, green infrastructure, and low impact development on Regional rights-of-way. • Monitor construction, and inspect street trees and supporting infrastructure to ensure compliance. • Maintain street trees within Regional rights-of-way.	• Review existing and proposed street trees, green infrastructure, and low impact development associated with development plans that impact Regional rights-of-way. • Monitor construction, and inspect street trees and supporting infrastructure to ensure compliance. • Maintain street trees within Regional rights-of-way.
Infrastructure Asset Management (Transportation Planning, Streetscape, Sustainable Mobility)	• Review and comment on designs that impact Regional Roads, i.e. city streets that intersect with arterial roads.	• Review and comment on development plans that front or impact Regional Roads.

Table 2.1 Roles and Responsibilities- City Departments, Divisions and External Agencies

	City-initiated Streets (Retrofit and New)	Development-led Streets
Other Regional Agencies		
Conservation Authority (TRCA)	• Comment on watershed resource impacts, and consider stormwater runoff. • Advocate for low impact development techniques.	
Provincial Agencies (Ontario)		
Metrolinx	• Review planning and operational requirements and impact to Metrolinx projects.	
Other		
Landowners	• Adjacent landowners may be involved if land is required for street improvements. These may be negotiated as land purchase (or expropriation), land swap, easement agreements, or other realty arrangements.	• Landowners play a key role by dedicating public rights-of-way to ensure orderly development as parcels are constructed at different times.
Business Improvement Areas	• Undertake streetscape beautification projects, to enhance unique area character, boost local economy and advocate for street needs in their areas.	
Transit Providers operating in Vaughan	• Identify and comment on operating needs, if any.	
Neighbouring Municipalities	• Identify areas of coordination on collaborative projects (e.g., transit corridors). • Comment on projects around shared municipal boundaries. • Collaborate on street improvement and rehabilitation along boundary.	

2.2 PROJECT DELIVERY PROCESS

Making streets more complete requires a comprehensive process that considers all stages of a project.

All projects may not go through all the specified stages, including smaller projects like developer-led and retrofits. However, every street project, no matter how big or small, will improve and contribute to the overall goal of making Vaughan Streets more complete.

The Vaughan Project Delivery Process (PDP) is shown in Fig. 2.1. It includes a step-by-step description of how the project team will integrate Complete Streets into each stage of the project. Refer to the following pages for an elaboration of the project delivery process from conception till up to construction (Tasks 1-12). Refer Section 2.3 for a more detailed breakdown of review and compliance.

This PDP is intended for Capital and Development Projects but is helpful for practitioners involved in all project types to understand what to consider during each stage of work- initiation, conceptual design, detailed design and construction and maintenance.

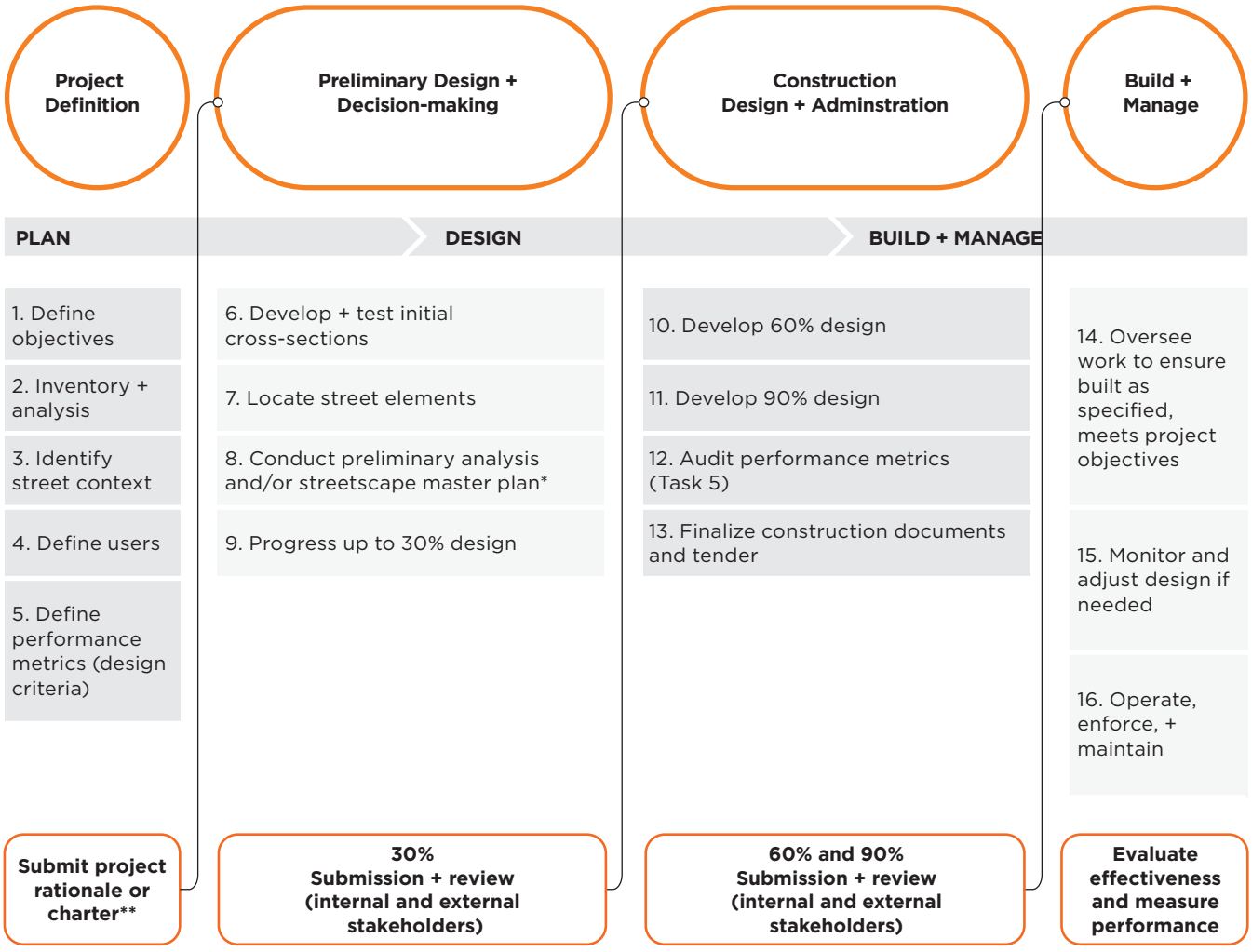
This workflow draws on existing processes, such as the 30%/60%/90% design and review process and the Environmental Assessment (EA) process currently used in Vaughan and represents an ideal circumstance. This workflow may not apply to all projects and situations. For instance, Corridor Reviews may only go up to 30% design (Task 9).

The PDP includes a review and compliance process to ensure that this Guide is being applied.

The level of detail for each step will require adjustment based on the complexity of the street project. Design teams shall continually seek to improve the completeness of every street no matter the budget or level of intervention.

This Guide focuses on the first three stages of the PDP where significant opportunity exists to best integrate the Complete Streets approach.

The completion of tasks 1 to 13, including any additional public and stakeholder input, should provide enough rationale to select the design option that best matches the context and future expectations relative to the street project. Performance Metrics required during the Design through to the Operations and Maintenance stages are also discussed in Chapter 5.



Notes:

*City to confirm when streetscape masterplans are applicable.

**City to confirm if and when project charters are used.

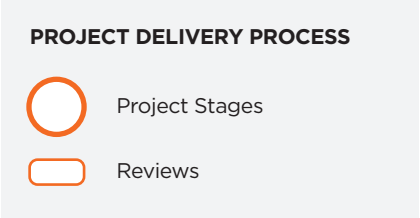


Figure 2.1. Vaughan Project Delivery Process (PDP). Refer to the following pages for a detailed breakdown of each of the 13 tasks up to construction stage. This PDP is intended for Capital and Development Projects but practitioners can also refer to the process for other types of street projects. However, not all projects will go through all stages depicted in the PDP.

PROJECT DEFINITION

1. Define Objectives

Identify project type, vision, objectives and needs.

Define the project budget. For projects located within Intensification Areas or Heritage Conservation Districts identify the level of service based on the City-Wide Streetscape Implementation Manual and Financial Strategy.

Important questions to consider:

- Why this street now? Is this project a scheduled upgrade or repair? Is it earmarked as a special project, community request, part of a Secondary Plan or long-range plan? Is it part of accessibility improvements? Are there safety issues?
- How does this street project address the city's long-term goals. E.g., climate resiliency, equity, economic development, etc.?
- Does this street project offer multiple benefits? I.e., are there synergies with other needs, objectives, or issues? E.g. climate resiliency, equity, economic development, etc.?
- Is sufficient funding available?
- Is potential for additional cost related to addition of different elements, enhanced materials, operations, and maintenance considered?

2. Inventory and Analysis

Gather and review all available information regarding the project. If information is not available, but required, identify how best to collect the outstanding data.

Gather and review existing utility records and determine if the commissioning of detailed utility plans is required. Accurate utility information will confirm what is possible with regards to green infrastructure, tree planting or low impact development (LID).

Review the City's current standards, policy, and guidance.

Define design criteria and/or design values. **Design criteria are the explicit goals that a project must achieve to succeed.**

Important questions to consider:

- What are the above and below-grade physical constraints along the street; is the right-of-way limited, are there mature trees to save, etc.?
- Is a subsurface utility engineering (SUE) survey required?
- What jurisdictions are the street located within? Who are the interested parties, and what are their design requirements? This is particularly important for City projects that intersect with York Region streets.

3. Identify Context

Recommend the street context, based on the process defined in Section 2.5. This process includes using the Vaughan Official Plan to identify the street class and assess overlays such as link and place type, cycling network, transit network, or other contextual factors. The street's context and its key objectives will inform decision-making throughout all stages of a project.

Document the rationale behind the recommended street context. This step may include a recommendation for any necessary adjustments to the land use and/or transportation policies for the streets' surrounding area. Subsequent land use and transportation decisions must recognize and support the street context resulting from this step.

Street context will inform the necessary elements for users (Task 4), such as cycle lanes, transit priority infrastructure, transit stops, signalized intersections, roundabouts, crosswalks, parking, and green infrastructure.

Important questions to consider:

- What are the link characteristics? E.g., O-D, volumes, speeds, desire lines, transit service, cycle routes, on-street parking, are there goods movement routes, congestion?
- What are the place characteristics? E.g., what are the existing and future land uses? What is the built form context?
- What additional inputs will inform the street design process, assist in setting the design priorities, and inform decision-making? E.g., what is the existing and forecasted population growth? Are there cultural heritage resources? What are the demographics of the area? What safety data and analysis has been undertaken?

4. Define Users

Prepare a user profile to identify who uses the streets today, who you want to use the street in the future, when and where.

Identify priority users. The most vulnerable users, such as pedestrians, are always the default priority, but overlays such as network plans for transit or goods movement may suggest how to approach the design of the roadway and intersections.

Important questions to consider:

- Are there schools, seniors housing, or other cultural institutions located within or adjacent to the project area?
- What does this street design project hope to accomplish and who will it benefit?
- Is there a mode that should be particularly emphasized for this street?

5. Define Performance Metrics

The Project Manager prepares the Project Rationale/Charter and reviews the Performance Metrics (Section 5.3) and Design Checklist (Appendix A). The CS Review (role or team, see Section 5.2.2) reviews and signs off the Project Rationale. The CS Review (role or team) will make a final decision on street context, overlays, or priority users, if needed.

Important questions to consider:

- How will we measure success?

>>Initial Compliance Check<<

Develop a Project Rationale and high-level cost estimate.

Review Project Rationale before moving to the next stage.

PRELIMINARY DESIGN + DECISION-MAKING

6. Develop + Test Cross Sections

Using the techniques defined in Chapter 4, define, and assemble the street elements to create the initial mid-block cross-sections. Start with a cross-section closer to the intersections and work towards the midblock so any spatial constraints are more evident.

Develop different cross-sections for different street segments if the street context varies along its length.

Test the initial cross-sections against the defined project objectives (Task 1), street context (Task 3), user profile (Task 4) and identify any conflicts or constraints.

Refer to Section 2.8 for guidance related to identifying exceptions and Section 2.7 for resolving trade-offs. The project team may have considered many of these constraints earlier in the process. However, this step should clearly identify which constraints may prohibit the use of the initial defined cross-section.

Review the initial cross-section, conflicts, and constraints with stakeholders.

If the initial, "ideal" cross-section can be applied, then this step is easy: the initial cross-section is the preferred cross-section. However, refinement is often necessary to satisfy the project objectives and the design team is usually faced with making trade-offs during or after the initial cross-section is developed. These refinements are often related to the trade-offs, requirements of each group of stakeholders, or the variety of design elements. See Section 2.7 for guidance to navigate the trade-off process.

Once the trade-offs are resolved, develop refined cross-sections.

Review the refined cross-section with stakeholders. This is a critical step to demonstrate transparency and clearly understand the decision-making process that has led to the recommended cross-section.

Important questions to consider:

- Are there existing or planned conditions that will inform or constrain the cross-sections? Like underground or overground utilities, catch basins, grading, topography, location of existing light poles, existing trees or other environmental features, locations, and number of driveways.

7. Locate Street Elements

Refer to Chapter 4: Elements. Incorporate into the schematic plan elements such as pedestrian facilities (walkways, benches), and cycling facilities (e.g., parking, bike share stations), transit priority infrastructure, transit stops, transit station entrances, green infrastructure (e.g., trees or low impact development), major utilities (e.g., signal controller boxes, telecommunication boxes, and hydrants), and curbside management elements (e.g., parking or laybys).

Tasks 7 & 8 should take place in parallel.

8. Conduct Preliminary Analysis

Review the plan and identify the areas of the street where different users interact and intersect; and identify where street elements may create conflicts and potentially obstruct safe movement. These areas will generally include the following:

- Junctions of all types (all users).
- Secondary access points (e.g., rear lanes and parallel streets in network- all users).
- Transit stops and cycling parking areas (pedestrian and cycle).
- On-street parking (vehicles and cycle).
- Crossings (pedestrian, transit, cycle, and motor vehicle).
- Goods movement.

Consider all conflicts as they relate to each other, as each potential solution will result in street design variations.

9. Progress up to 30% Design

Advance the design to 30% level of detail.

Undertake a cost estimate.

>>30% Compliance Check<<

Submit 30% design and cost estimate for review and compliance by internal and external stakeholders (TAC).

CONSTRUCTION DESIGN + ADMINISTRATION

10. Develop + Test Cross Sections

Arbitrate competing issues identified in 30% design.

Advance the design to 60% level of detail for the street.

Undertake a cost estimate.

>>60% Compliance Check<<

Submit 60% design and cost estimate for review and compliance by internal and external stakeholders (TAC).

11. Develop the 90% Design

Arbitrate competing issues identified in 60% design.

Advance the design to 90% level of detail for the street.

Undertake a cost estimate.

>>90% Compliance Check<<

Submit 90% design and cost estimate for review and compliance by internal and external stakeholders (TAC).

12. Audit Performance Metrics

Assess to what degree the street design satisfies the overall vision and guiding principles stated in Step 1.

Arbitrate competing issues identified in 90% design.

Undertake value engineering, if needed.

2.3 REVIEW AND COMPLIANCE

Project review plays an important decision-making role, ensuring consistency across different projects, assisting in making holistic decisions regarding the future of Vaughan's streets, expediting project delivery, and assisting staff in applying lessons learned from one project to another.

REVIEW AND COMPLIANCE PROCESS

Complete Streets (CS) review and compliance is intended to build upon and enhance existing review and coordination procedures. It does not replace existing City procedures and Environmental Assessment (EA) procedures.

Figure 2.2 establishes an escalation framework and shows the key points in a project when reviews and oversight happen.

Once the CS approach is ingrained into the culture of street delivery, Project Teams will have learned how to resolve issues in advance of submitting a project for review. The intent is that the number of decisions that require escalation to a Standards Committee decisions is minimal.

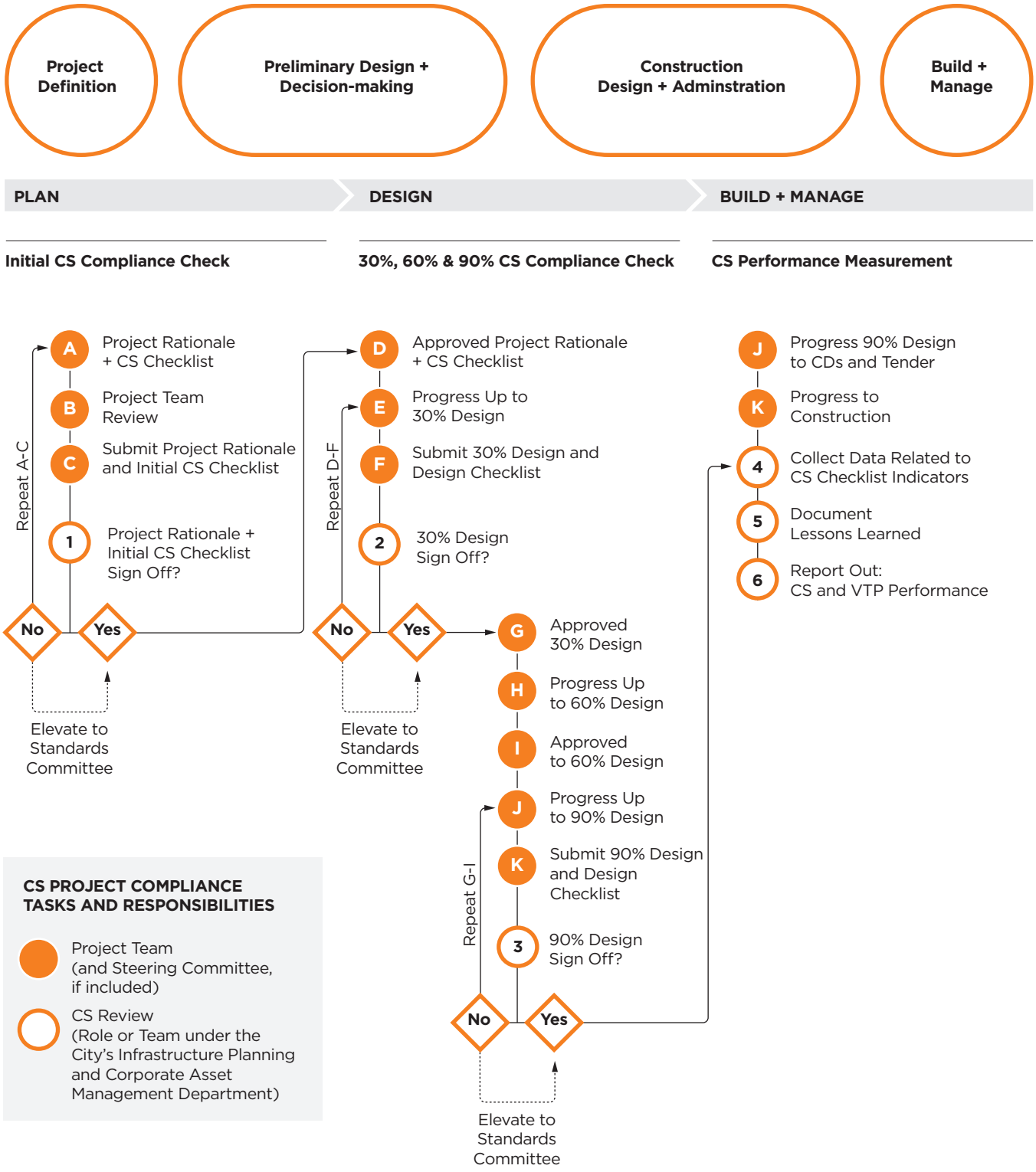


Figure 2.2. Review and compliance points during the Vaughan Project Delivery Process (PDP).

2.4 COORDINATION AND ENGAGEMENT

Coordination between City departments and external agencies, and engagement with public stakeholders, should occur at important planning and technical milestones.

Street projects in Vaughan will be implemented in accordance with the principles and direction provided in this Guide. An inclusive and transparent project delivery process involving all stakeholders will lead to informed decision-making and address the community's needs.

The methodology and level of engagement will depend on the nature and scale of the street project. Projects of larger scale and influence, having significant capital investment, will require exhaustive engagement efforts. Smaller, less impactful projects will typically need less coordination and engagement.

The City should make conscious efforts to include participants who are not usually involved by initiating innovative engagement techniques- pop-up stations at schools to engage parents and children, interactive workshops during public events or site walks. The City should ensure that participants have easy access to such events. Agencies conducting the engagement should ensure that participants are made aware of what aspects of the project can be influenced by them. Pilot projects of varied scopes and scales should be undertaken by the City to examine the community's response.

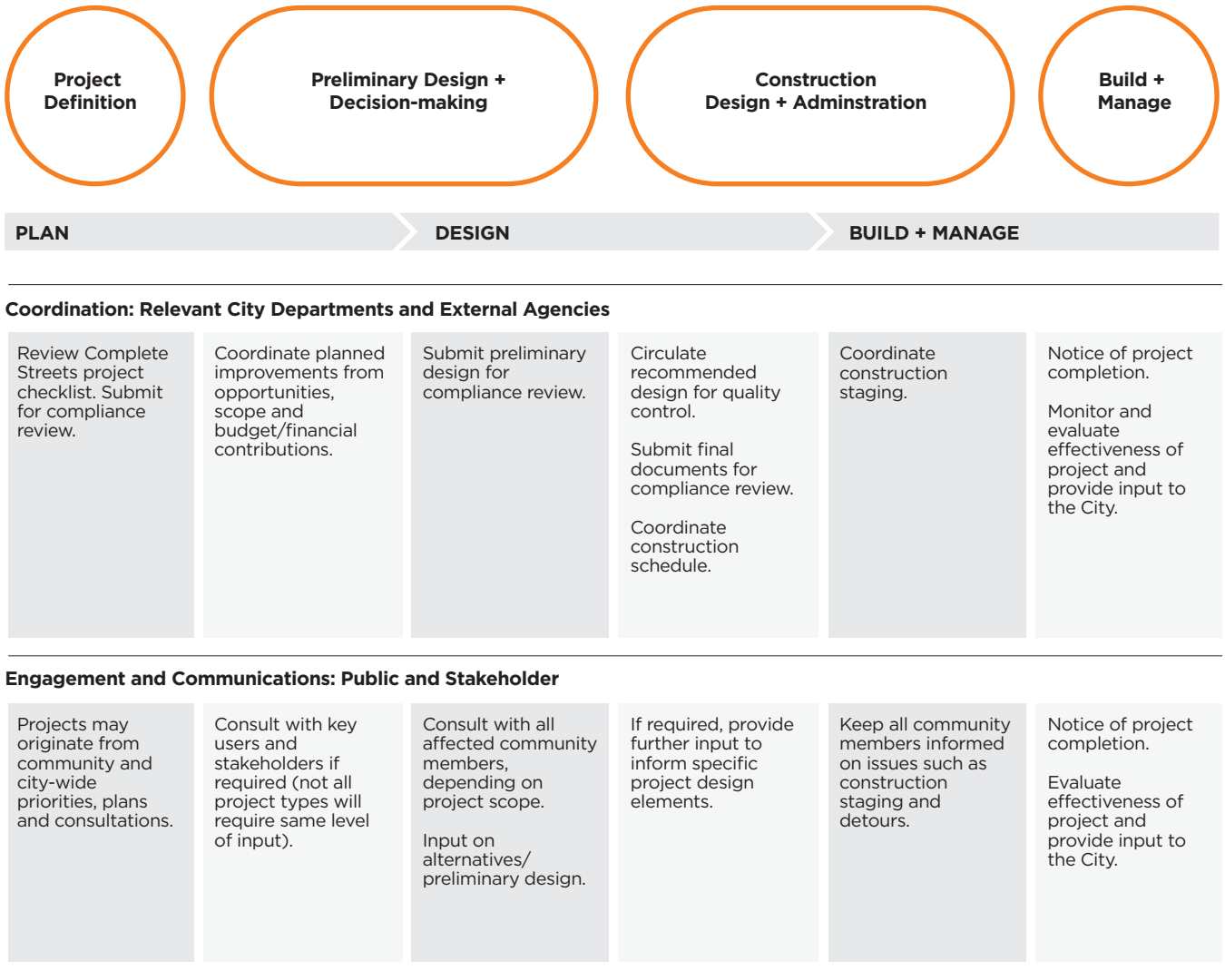


Figure 2.3. Coordination and Engagement Process between various stakeholders and agencies for delivery of street projects in Vaughan.

2.5 STREET CONTEXT

Defining street context happens in the early stages of a street planning and design process. In this section, is a description of how to define street context using various inputs.

Streets are classified hierarchically as per their functional role in the overall street network and place within the City's Urban Structure. The Guide informs on how to interpret the classification system with corresponding overlays and user profiles to define street context. Figure 2.4 shows where defining the context fits in the overall Project Delivery Process.

In addition to the street classification, contextual overlays (heritage, natural areas, etc.) contribute towards determining the street's functional role and place within the larger network.

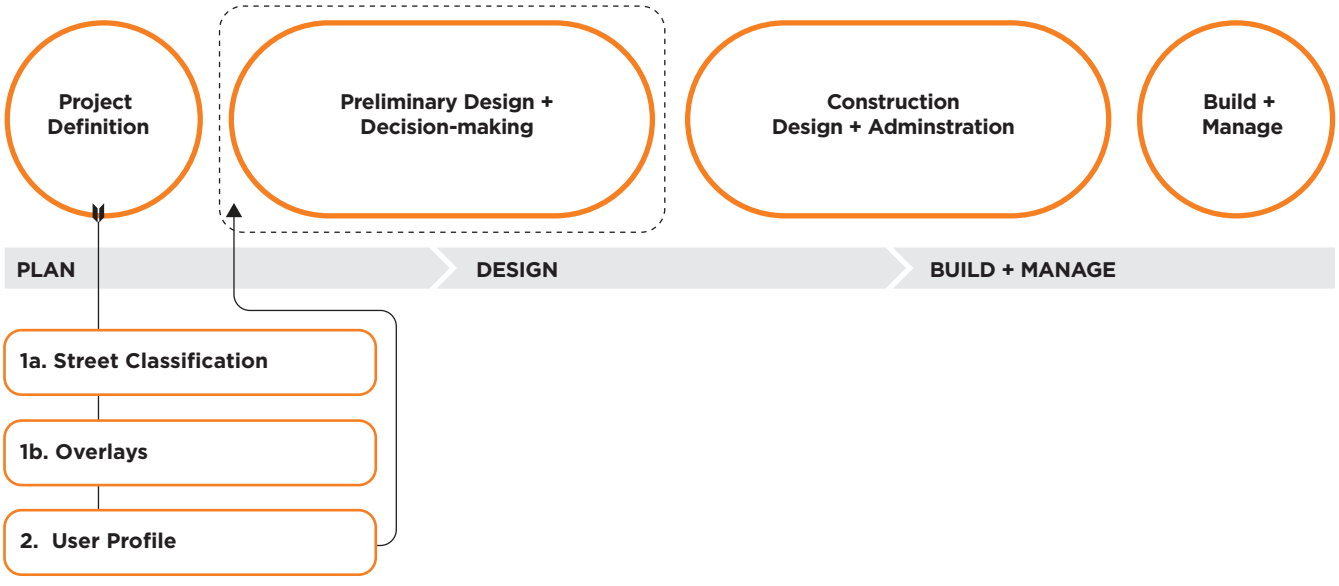


Figure 2.4. Defining street context as part of the Project Delivery Process (PDP).

2.5.1 Street Classes

Integrating the Complete Streets approach with different street classes.

The Guide builds upon the street classes and rights-of-way (ROW) identified in the Vaughan Transportation Plan (VTP) to inform context sensitive guidance in Chapter 4. Guidance provided in area or corridor specific plans (such as Secondary Plans) takes precedence, so long as it follows CS principles established in the Guide.

The Vaughan Transportation Plan identifies a 10-street classification (Fig. 2.5), based on their functional roles (arterial, major collector, minor collector and local) and their surrounding urban context (intensification, community, employment, and natural areas).

While some streets will have a single classification, many will change function and/or context along their length. This ordering system is intended to assist designers in adjusting street design accordingly.

Necessary linkages through natural and countryside areas will be developed as scenic routes.

Urban Structure

Functional Classification	Natural Areas	Community Areas	Employment Areas	Intensification Areas
Arterial	Arterial - Natural (36m ROW)	Arterial - Community, Employment, Intensification (36m ROW)		
Major Collector	Major Collector - Natural, Community (30m ROW)		Major Collector - Employment (30m ROW)	Major Collector - Intensification (30m ROW)
Minor Collector	Minor Collector - Natural, Community (24m ROW)		Minor Collector - Employment (24m ROW)	Minor Collector - Intensification (24m ROW)
Local	Local - Natural, Community, Employment (20m ROW)			Local - Intensification (21m ROW)

Figure 2.5. Street classification based on functional role and surrounding urban context in Vaughan.

2.5.2 Link and Place: The Starting Point

Every street is both a 'link' facilitating movement and connections; and a 'place' for people, activities, and businesses.

The Guide's vision and guiding principles emphasize the significance of streets as both 'link' (mobility) and 'place' (experience). This is informed by the contextual and functional role of the street in the overall urban structure. Different policy documents (Fig. 2.6) provide inputs to help determine the street character (link and place).

This Guide will reflect updates to the York Region Official Plan (ROP) and Vaughan Official Plan (VOP).

DESIGNATED RIGHT-OF-WAY (ROW): STREET 'CONDITION'

The ROP and VOP, or their successor(s), establish ROW widths in Map 11 (Street Network) and Schedule 9 (Future Transportation Network) respectively.

ROW widths are determined by the City. They allow for diverse, multimodal transportation corridors. They include boulevards, pathways, cycling facilities, roadways, transitways, on-street parking, street trees, lighting, utilities, transit shelters, and curbside activities.

ROW widths are protected to accommodate future transportation networks to address anticipated growth in Vaughan. They also identify upcoming development areas and land required to be acquired for it.

LINK INPUTS: FUTURE TRANSPORTATION NETWORK

ROP Map 11 and VOP Schedule 9 establish existing and planned street network and hierarchy. The hierarchy and function of street informs land use. For example, arterial streets provide the basis to locate and connect intensification areas, and residential areas are encouraged to front on minor collectors.

PLACE INPUTS: URBAN STRUCTURE, LAND USE

ROP Map 1A (Land Use Designations), VOP Schedule 1 (Urban Structure) and Schedule 13 (Land Use) define existing and future land use and built environment along the streets in the city. The relationship between the street and the surrounding built form and uses, existing and aspirational, inform its place.

As per the City's Transportation Demand Management Development (TDM) guidelines, all new developments should provide diverse mobility options from early stages, supporting safe, active, and sustainable movement for the community. The characteristics of each place input are described in Table 2.2.

Table 2.2 Place Inputs

Place	Characteristics	ROP and VOP Reference
Intensification areas	• Underutilized areas identified for intensification and growth, already served by existing or planned higher order transit. • Include a hierarchy of mixed-use centres and corridors: Downtown (Vaughan Metropolitan Centre), Regional and Primary Intensification Corridors and Primary (around planned subway stations) and Local Centres. • Generally, contain built forms with active at-grade uses interacting with streets, contributing towards vibrant streetscapes.	ROP Map 1A (Land Use Designations) and VOP Section 2.2, Schedule 1 (Urban Structure) and Schedule 13 (Land Use)
Community areas	• Contain planned and existing residential land uses in stable neighbourhoods with predominantly low-rise housing. • Can include community infrastructure and amenities. • Changes in these areas to be sensitive to the neighbourhood's existing and planned character.	
Employment areas	• Are stable areas that support economic activities including a mix of industrial, manufacturing, warehousing, transit facilities and other office uses. • Non-employment uses within these areas are allowed only through a municipal comprehensive review. • Planned infrastructure to support goods movement and facilitate active transportation.	
Natural areas and Countryside	• Contain conservation areas for wildlife habitat, agricultural lands, and rural hamlets. • Include scenic routes along public streets. • When additional linkages through these areas are required, their ecological functions are to be preserved or restored.	

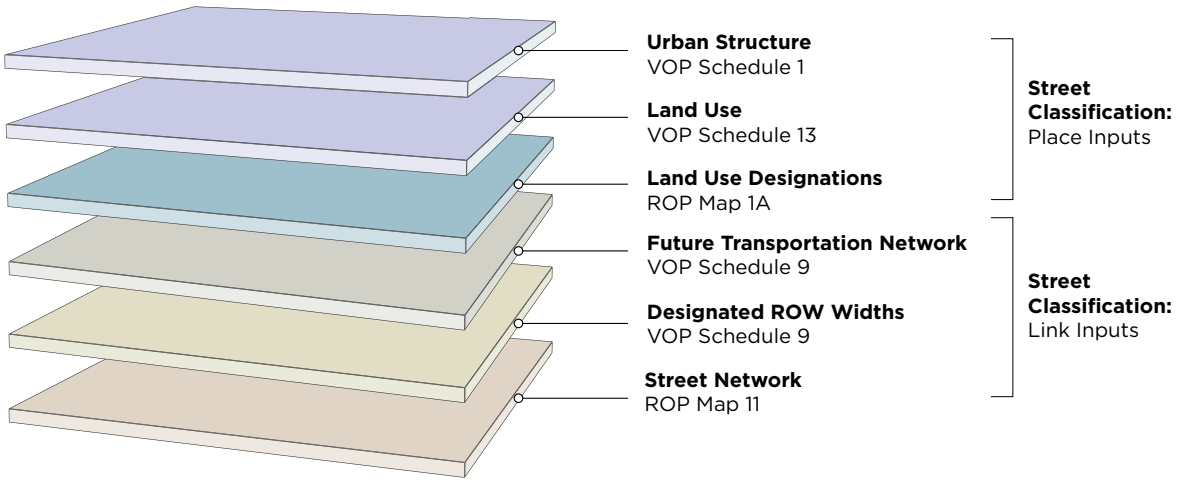


Figure 2.6. Street classification based on function and urban context in Vaughan.

2.5.3 Overlays

Overlays are data layers that provide further information in addition to the base classification of a street.

There are three categories of overlays shown in Fig. 2.7 that project teams will need to consider. The number of overlays for a particular street can change, with some overlays applying to some segments of a corridor but not necessarily all. Overlays can also change, with new ones being created and others being edited or removed. The project team needs to ensure that all possible place and link inputs are included to define street context.

LINK OVERLAYS

Map 10 (Rapid Transit Network) from the ROP and Schedule 10 (Major Transit Network) from the VOP identify existing and planned transit network.

The Vaughan Transportation Plan identifies the existing and recommended Priority Cycling Network.

Other overlays include plans and studies that inform street design, such as, TDM Initiatives for Development Applications, York Region Transportation Master Plan, the Metrolinx Regional Transportation Plan, and so on.

Inter-municipal and inter-regional transit services such as GO Transit, TTC, and York RegionTransit help maintain a continuous network.

PLACE OVERLAYS

Secondary and Site-specific Plans in VOP Schedule 14A-C, that provide detailed policy direction specific areas (Downtown, Primary Corridors and Centres, Local Centres, Precinct Plans, Streetscape Design Master Plans and Heritage Conservation Districts (HCDs)).

The City's Pedestrian and Cycling Master Plan (Table 4.1) identifies sidewalk implementation policies based on street class and place and land use context.

OTHER OVERLAYS

Other inputs, in addition to link and place overlays can inform design priorities and objectives, along with the decision-making process. These include:

- Existing and forecasted growth in pedestrians, cyclists, transit riders, and motor vehicles.
- Trip generators.
- On-street parking.
- Demographics.
- Safety data and analysis.
- Goods movement routes.
- Equity indices.
- Cultural Heritage Resources.
- Business Improvement Areas (BIAs).
- Cultural Districts.
- Pedestrian pathways.
- Vaughan Metropolitan Centre (VMC) Parking Strategy.
- Green infrastructure.
- Public Art Strategy.

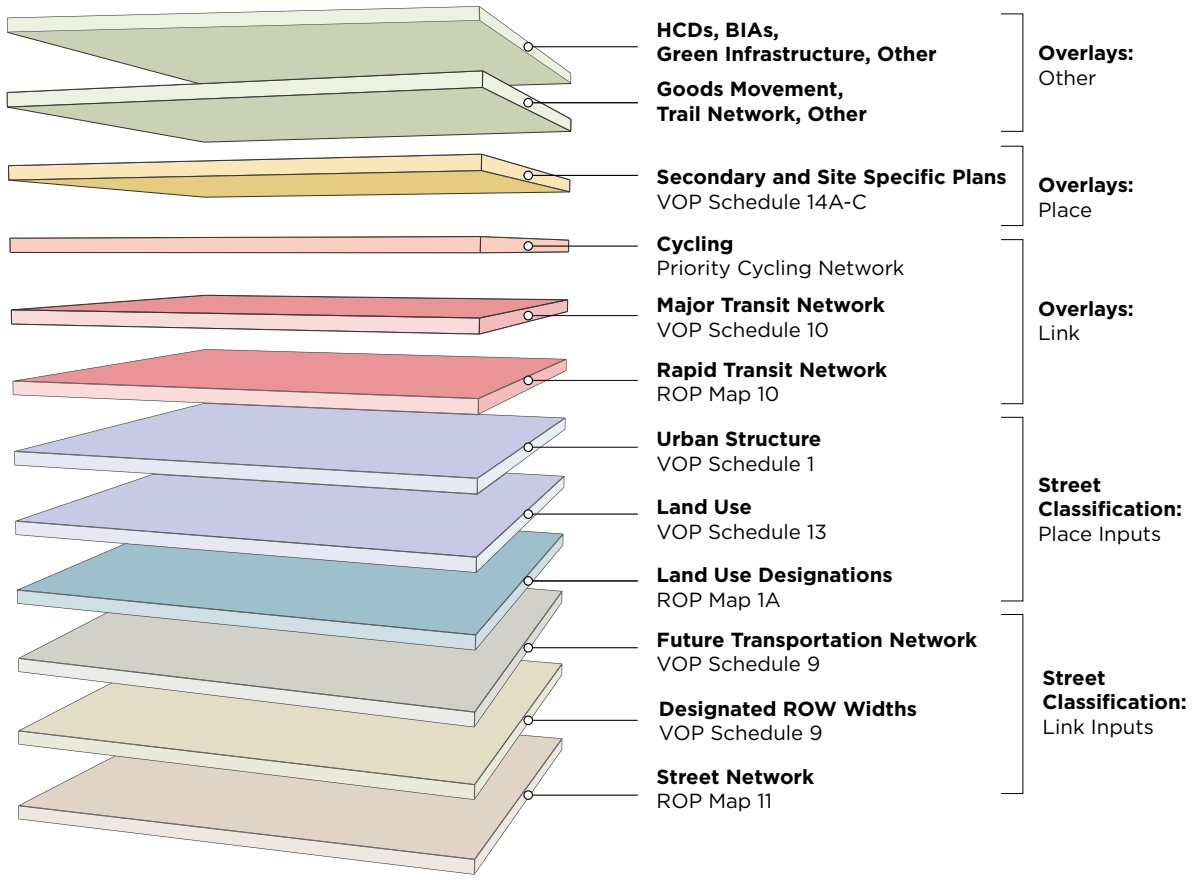


Figure 2.7. Street overlay examples (overlays included in the figure are not exhaustive).

2.5.4 Street Classification Matrix

Table 2.3 summarizes the link and place objectives for each street class. Appendix B includes contexts, descriptions, and aspirational cross-sections for each of the classes.

Table 2.3 Street Classification Matrix- Link and Place Objectives

	Intensification	**Community**	**Employment**	**Natural**
Places	Downtown, Corridors and Centres	Neighbourhoods	Industrial and other Office Uses	Wildlife Habitat, Agricultural Lands and Rural Hamlets
Arterials				
Link Objectives	• Move the highest volume of people. • Include surface transit routes and priority bus corridor routes. • Focus of active transportation facilities.	• Move medium to high volume of people. • Include surface transit routes and priority bus corridor routes.	• Move frequent large vehicles and goods. • Include higher-order transit lanes and priority bus corridor routes.	• Link surrounding urban areas to natural areas. • Include transit connectivity between cities and regions.
Place Objectives	• Vibrant mixed-use destination streets. • Support higher density transit-supportive development. • Wider boulevards.	• Wide boulevards, improved street tree planting and stormwater control measures.	• Landscape frontages. • Wide boulevards, improved street tree planting and stormwater control measures.	• Landscape frontages.
Major Collectors				
Link Objectives	• Move medium to high volumes of people. • Focus of AT facilities. • Often near major transit hubs and include surface transit routes.	• Move medium to high volumes of people. • Include surface transit routes and priority bus corridor routes.	• Serve as major links through Employment Areas. Includes surface transit routes and priority bus corridor routes. • Accommodate frequent large vehicles and goods movement.	• Link surrounding urban areas to natural areas. • Include transit connectivity between cities and regions.

Table 2.3 Street Classification Matrix- Link and Place Objectives

	Intensification	**Community**	**Employment**	**Natural**
Places	Downtown, Corridors and Centres	Neighbourhoods	Industrial and other Office Uses	Wildlife Habitat, Agricultural Lands and Rural Hamlets
Place Objectives	• Vibrant mixed-use destination streets. • Supports higher density transit-supportive development.	• Wide boulevards, improved street tree planting and stormwater control measures.	• Landscape frontages. • Wide boulevards, improved street tree planting and stormwater control measures.	• Landscape frontages.
Minor Collectors				
Link Objectives	• Move low to medium volumes of people. • Focus of AT facilities. • Often near major transit hubs and include surface transit routes.	• Move low to medium volumes of people. • Include transit routes.	• Move low to medium volumes of people. • Accommodate frequent large vehicles and goods movement. • Includes surface transit routes.	• Provides access to rural residential and natural areas. • Link rural and natural areas to major collectors.
Place Objectives	• Vibrant mixed-use destination streets. • Support higher density transit-supportive development. • Street tree planting.	• Wide boulevards, improved street tree planting and stormwater control measures.	• Wide boulevards, improved street tree planting and stormwater control measures.	• Landscape frontages. • Rural settlements.
Locals				
Link Objectives	• Move low volume of people at slow speed. • Pedestrians typically have the highest priority. • May or may not be designed as shared streets.	• Move low volume of people at slow speed. • May or may not be designed as shared streets.	• Provides access to industrial or commercial businesses.	• Provides access to rural residential and natural areas.
Place Objectives	• Vibrant mixed-use destination streets. • Support higher density transit-supportive development.	• Pedestrian and cycle safety is a priority. • Support active neighbourhood activities.	• Balance elements for maneuverability of large trucks and transit with elements that create a safe and comfortable public realm.	• Landscape frontages. • Rural settlements.

2.5.5 Defining Street Element Priorities

Different streets have different priorities informed by their functional role and land use context.

Building on the previous street context discussion, Table 2.4 lists the priority for a range of street elements by street type. This is a helpful tool when defining the initial cross-section.

The matrix considers a range of factors like uses, users and a street's role in the overall network to assign priority levels for different elements, ranging from high to medium to low.

The potential arrangement of the elements based on priority is demonstrated in Chapter 3, which also includes a decision-making process for each element when applied to both retrofit and reconstruction scenarios.

Following is a brief discussion to illustrate how some streets are of higher priority for different users and elements than others. This is not an exhaustive list, only examples, but it will help to inform understanding of priorities and assist with the decision-making process.

Transit is of the highest priority on arterials and major collectors aligning with the VTP's vision to provide wider public transit connectivity.

On streets with higher vehicle volume and operating speeds, cycling facilities adjacent to the travelway are discouraged and assigned the lowest priority (refer Section 4.3.1 for cycle Level of Traffic Stress).

Traffic calming is a high priority along minor collectors and locals that are in intensification and community areas, to foster a secure commuting experience for pedestrians and cyclists. Refer to Section 4.4.6 for traffic calming measures.

Goods movement is a high priority along all street classes in employment areas. This informs lane widths (refer Table 4.6, Section 4.4.3).

Planting and furnishing zones are assigned high and medium priority for all streets, to align with the vision of the Region's recent Forest Management Plan. See (Table 4.8).

REFERENCES

- City of Vaughan: Vaughan Transportation Plan (2023).
- City of Vaughan: Pedestrian and Bicycle Master Plan (2020).
- OTM Book 18: Cycle Facilities (2021).
- TAC's Geometric Design Guide for Canadian Roads (2017).
- City of Vaughan: City-Wide Streetscape Implementation Manual and Financial Strategy (2014).
- York Region: It's in our Nature. Management Plan for the York Regional Forest (2019).

Table 2.4 Street Element Priorities based on Street Class and Land Use Context

Street Elements	Arterial				Major Collector				Minor Collector				Local			
	Intensification	Community	Employment	Natural	Intensification	Community	Employment	Natural	Intensification	Community	Employment	Natural	Intensification	Community	Employment	Natural
Goods Movement*	2	3	1	2	2	3	1	3	2	3	1	3	2	3	1	3
On-street Parking	3	3	3	3	3	3	3	3	2	2	2	3	2	2	2	3
Left-turn Lanes	2	2	2	2	2	2	2	3	2	2	3	3	3	3	3	3
Transit Priority Lanes	1	1	1	1	1	1	1	1	2	2	2	3	3	3	3	3
Wider Pedestrian Clearways	1	2	3	3	1	2	3	3	1	2	3	3	1	2	3	3
Frontage Zone	1	2	3	3	1	2	3	3	1	2	3	3	1	2	3	3
Multi-use Path (MUP)	3	3	3	1	3	3	3	1	3	3	2	1	3	3	2	1
Cycle Facility-Clearway Adjacent**	1	1	1	1	1	1	1	1	3	3	2	2	3	3	2	2
Cycle Facility-Travelway Adjacent***	3	3	3	3	3	3	3	3	2	2	2	2	2	2	2	2
Traffic Calming	3	3	3	3	2	2	2	2	1	1	1	1	1	1	1	1
Transit Stops	1	2	1	3	1	2	1	3	1	2	2	3	1	2	2	3
Wider Crosswalks	1	1	2	3	1	1	2	3	1	1	2	3	1	1	2	3
Planting and Furnishing Zone	1	1	1	2	1	1	1	2	1	1	1	2	1	2	2	2
Green Infrastructure	1	1	2	3	1	1	2	3	1	2	2	3	1	1	2	3

Street Element Priority Legend:

1 High Priority
2 Medium Priority
3 Low Priority

Note:
*Goods movement indicates impact on travel lane widths for large trucks (WB-20).
**Clearway adjacent cycle facilities are separated from the clearway by a buffer (min. 0.6m, see OTM Book 18) and are separated from travelway by planting and furnishing zone.
***Travelway adjacent cycle facilities are designated or protected.

2.6 FRAMEWORK FOR DECISION-MAKING

Making decisions for Complete Streets requires all involved in the planning and design process to understand and consider a wide range of subjects for every project, from beginning to completion, no matter the scale or complexity.

The guidance that follows will form the decision-making framework for Complete Streets. This framework builds upon the guiding principles stated in Chapter 1 and the fundamental concept of street context discussed in Chapter 2.

The decision-making framework will help to ensure that Vaughan streets can achieve and satisfy official policy direction from the Province of Ontario, York Region, and Vaughan City Council, as well as implement the latest best practices and industry trends.

To achieve Complete Streets, design teams will take on the challenge of rebalancing the limited space available in a public right-of-way. Enhancing and accommodating new activities on a street requires moving away from an auto-centric approach that privileges drivers over all others. Design teams will consider the full range of users, uses, issues and details. Sometimes it is clear how to satisfy project objectives and deliver a Complete Street. Other times it is challenging, particularly when competition arises for available space and between the optimal needs of each user. This chapter will inform the design process and assist with the sometimes-difficult decisions that arise when assembling a street.

This section introduces 17 key directives under five categories: safety, link, place, greening, and life-cycle and maintenance. Each directive includes an introductory statement with elaboration, guidance to consider when designing streets, and sources for more information.

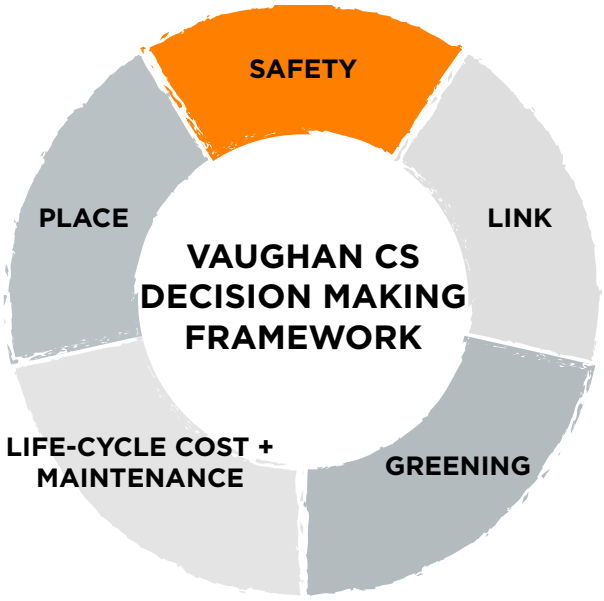


Figure 2.8. Categories for the CS decision-making framework.

Table 2.5 Key Directives for Decision-making

Safety	Link	Place	Greening	Life-Cycle and Maintenance
Prioritize vulnerable users	Understand and accommodate desire lines	Respect context	Street trees	Understand the total cost
Reduce and manage vehicle speed	Design for person throughput and mobility	Ensure pedestrian comfort	Stormwater management	Support four-season use of streets
Accommodate the smallest possible design vehicle	Design Complete Streets to support a complete network		Preserve existing vegetation	Select robust materials
Minimize exposure risk	Enhance network connectivity			
Maximize predictable and self-regulating design				

2.6.1 Safety Directives

Safety is of paramount importance in CS design. All decisions will first consider, without compromise, the safety of all road users. The key directives to inform safer street design are to prioritize vulnerable users, manage vehicle speed along corridors and at intersections, minimize risk, and improve predictability.

Figure 2.9. Pedestrians are the most vulnerable road users.

Figure 2.10. Cyclists are also vulnerable road users and have a high risk of injury and mortality during a collision with motor vehicles.

PRIORITIZE VULNERABLE USERS

Vulnerable users such as pedestrians, especially children, the elderly, individuals with disabilities, and cyclists, are at greater risk of injury and mortality during a collision than vehicle occupants are. All users do not always feel safe on Vaughan streets.

Design and operate streets to accommodate a wide variety of users and uses while prioritizing the safety of the streets most vulnerable. The mass differential between street users results in more serious injuries to the lighter of the two colliding bodies. The force of the collision increases as weight and speed increases.

Reducing speed is a critical aspect to improve safety for the most vulnerable. Street design will not exclude any one user or put them in harm's way because they are too small, too young, or too slow. The practitioner will consider the safety of vulnerable users throughout every stage of the street project delivery process.

Street design that prioritizes vulnerable users will consider:

- Lower speeds to reduce severe injuries and deaths.
- Fewer and narrower travel lanes to slow speeds, shorten crossing distances and exposure.
- Curb extensions and tighter corners to slow turning speeds.
- Separation between different users, and greater separation with increasing speeds.
- Cycle facilities that respond to street context and inputs such as vehicle volumes and operating speeds.
- Making cyclists and pedestrians more visible at conflict points (for example, while turning vehicles at intersections).
- Fewer and narrower driveways with proper ramps to privilege people on sidewalks.

REFERENCES

- TAC's Geometric Design Guide for Canadian Roads (2017) Part 1, 1.2.5.2 - 1.2.5.4.
- NACTO Urban Street Design Guide (2013).
- Good Practice Manuals. Global Road Safety Partnership, World Bank Group (2015).

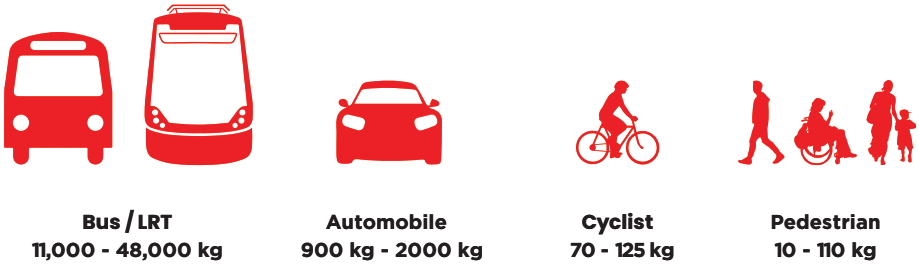


Figure 2.11. Mass of Various Street Users.

The severity of a crash increases as the mass and/or the speed increases. The lighter of the two objects will always sustain the more severe injuries or damage.

source: Adapted from NACTO Urban Street Design Guide; DTAH

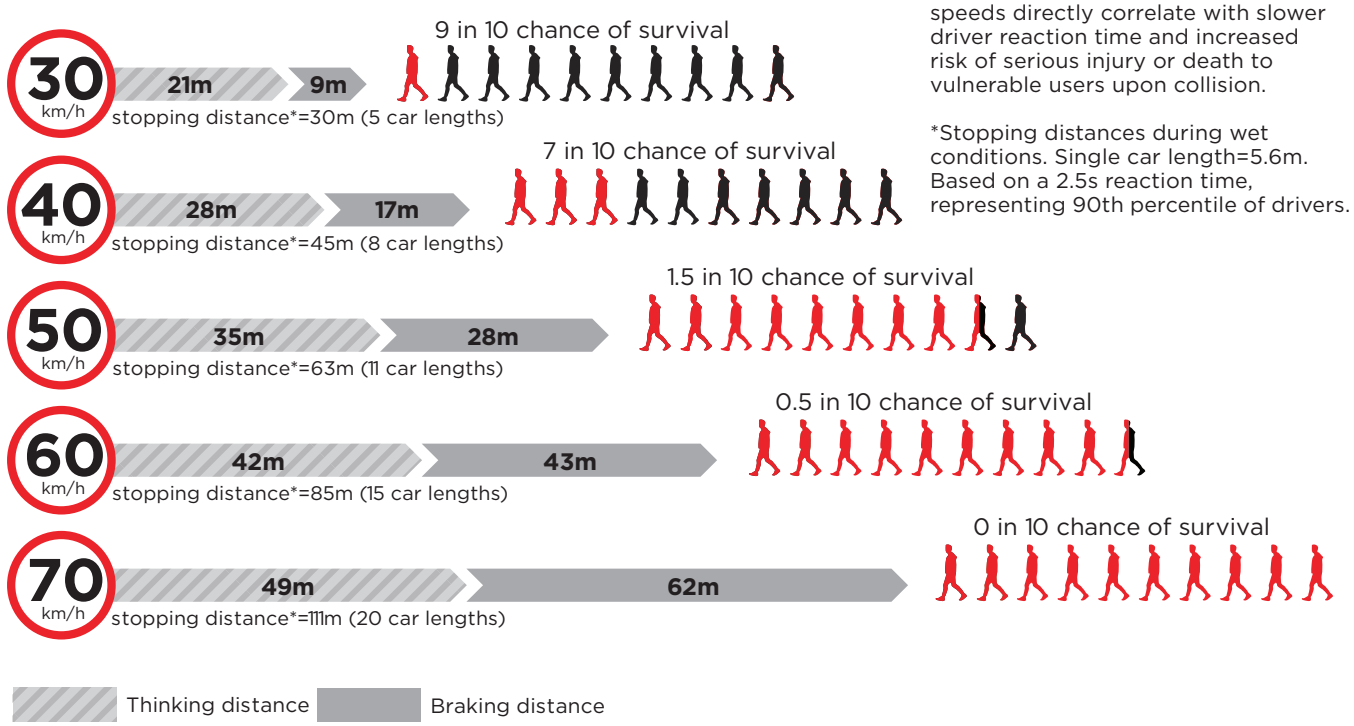


Figure 2.12. Vehicle Speed, Stopping Distance, and Chance of Survival. Higher motor vehicle speeds directly correlate with slower driver reaction time and increased risk of serious injury or death to vulnerable users upon collision.

*Stopping distances during wet conditions. Single car length=5.6m. Based on a 2.5s reaction time, representing 90th percentile of drivers.

source: Adapted from World Health Organization, 2008. Speed management: a road safety manual for decision-makers and practitioners; Transportation Association of Canada, 2017. Geometric Design Guide for Canadian Roads Figure 2.3.1.; DTAH

REDUCE AND MANAGE VEHICLE SPEED

Reducing vehicle speed is the single most important design control. Simply, lower speeds lead to safer streets, better places, and improve opportunities to support a wider range of users and uses. A well-designed street will inform users of the speed they should travel through their visual and psychological interpretation of their surroundings.

Vehicle speed is a significant factor of crash severity; higher speeds bring exponentially higher risks. Vehicle speeds are critical at points of conflict, such as driveways, intersection, off-ramps, and midblock crossings. While speed is often desired to shorten trip travel time, it must logically respect local context. For example, high speeds on a highway are appropriate; high speeds on urban arterials or collectors are not. Lower vehicle speeds lead to a broader range of design options.

Design speed is a selected speed used to determine the various geometric design features of the street. Design speed influences the choice of many features such as lane width, shoulder width, median width, lateral clearance, sightlines, and curb radii. For example, features such as clear zones are well suited for highways and rural arterials, but their use is not applicable, practical or desirable for urban streets, as stated in the Transportation Association of Canada's Geometric Design Guidelines (2017), Section 7.7.

Many jurisdictions use a design speed that is 10 or 15 kilometres above the actual posted speed for that street. This results in an inferred speed (the speed drivers sense they should travel based on cues from the street design) of 25 or 30 kilometres per hour greater than the posted speed.

Environmental cues influence driver speed far more than posted signage. Design streets to convey an inferred speed to the driver- the target speed for that street. Target speed is the speed you want people to travel. In most cases, target speed should match the posted speed on a given urban street. Best practice in urban areas is to ensure posted speed, design speed and inferred speed are all the same. Conversely, establishing a posted speed that is artificially low relative to the design of the street will only result in operating speeds that are higher than desirable and that are difficult to enforce.

The design of Complete Streets will start with the selection of a target speed, which is then applied to geometric design elements. Numerous jurisdictions in Canada now employ the target speed approach in their Complete Street guidelines and road engineering standards, with Brampton, Toronto, Mississauga, Calgary, Edmonton, Kitchener and York Region using the target speed approach for urban streets that have operating speeds of 50 to 60km/h or lower.

Streets designed to reduce and manage vehicle speed will consider:

- A target speed informed by the street context.
- The application of design elements that limit the maximum vehicle speed to the target speed.
- The smallest practical curb radii and lane width to serve the necessary design vehicle.
- Designing streets without super elevation.
- The exclusion of shoulders, except for cycle lanes or rural roads.
- Eliminating or modifying channelized right-turn lanes to reduce turning speeds and improve safety.
- Setting signal timing for moderate speeds.

REFERENCES

- TAC's Geometric Design Guide for Canadian Roads (2017) Part 1, 1.2.5.2 - 1.2.5.4.
- NACTO Urban Street Design Guide (2013).
- Institute of Transportation Engineers and Congress for the New Urbanism (2010). Designing Walkable Urban Thoroughfares: A Context Sensitive Approach.

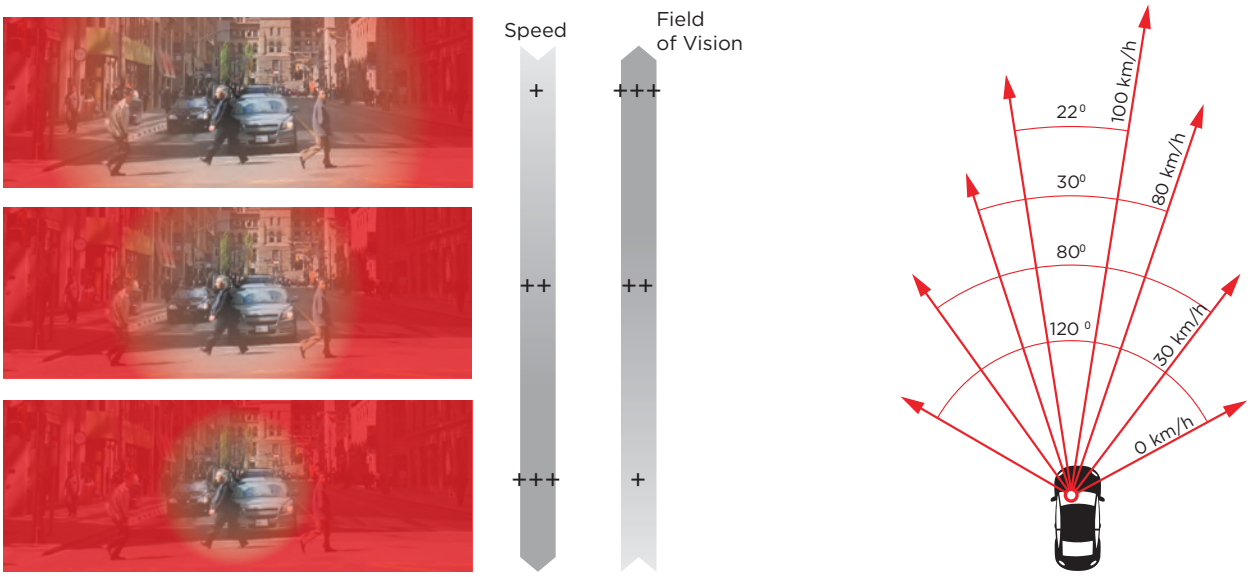


Figure 2.13. Speed and Field of Vision
Speed is especially lethal to vulnerable users like people walking or riding a cycle. The risk of severe injury increases as a driver's field of vision narrows and misses potential hazards. Field of vision is the area a person sees when their eyes are fixed in one position.

source: base image: mark.watmough flickr: cc.2.0; Federal Motor Carrier Safety Administration; DTAH

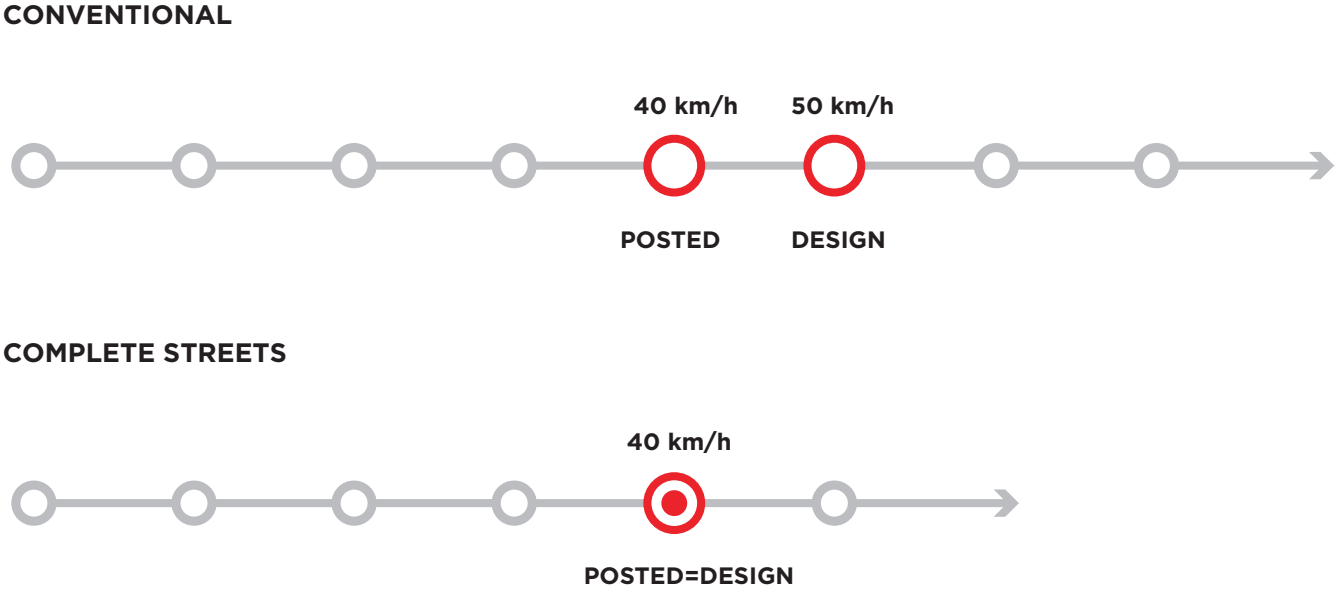


Figure 2.14. Target Speed
Conventional street design considers a posted maximum speed as lower than the design speed. Complete Streets design promotes that the street includes elements so that both are the same, so that drivers are not comfortable exceeding the intended posted speed.

source: NACTO; ITE; FHWA; DTAH

ACCOMMODATE THE SMALLEST POSSIBLE DESIGN VEHICLE

Select the most frequent large vehicle as the design vehicle to inform street geometry, not the occasional larger vehicle.

While street design must accommodate the occasional larger vehicle- especially emergency vehicles- it must not subordinate or degrade the safety or comfort for most daily users. The selection of a design vehicle dictates the physical characteristics of the street (such as curb radii and lane width) which, in turn, affect the safety and operations of a roadway by informing the turning speed of vehicles. Best practice suggests that Complete Streets should design "for" the most common vehicle and "accommodate" the most common large vehicle.

The most common vehicle is the design vehicle, with the largest being the control vehicle. Design vehicles are typically the largest frequent vehicle type manoeuvring a right turn at an intersection corner. The turning movement of design vehicles are frequent, and the intersection design should allow for turning with relative ease. Control vehicles are typically the largest vehicle type required to manoeuvre a right turn at an intersection corner. Control vehicles make up a small fraction of all vehicles and manoeuvre turns at intersection corners at a relatively low frequency. Control vehicles use more space than design vehicles to manoeuvre right turns. Designing a street using the control vehicle leads to oversized intersections, wider lanes and larger curb radii than necessary for local conditions.

For the majority of Vaughan streets, which are local and within residential neighbourhoods, the design vehicles are either Passenger (P) or Light Single Unit Vehicle (LSU). At these intersections, the turning of large trucks is uncommon. For these same streets, accommodation of control vehicles– such as Medium Single Unit Vehicle (MSU), garbage trucks (HV607), snow plows, or tractor trailer (WB-20)– can include use of multiple lanes and full stoppage of the corridor or intersection given the relative rarity of such encounters. As the volume, operating speed, and frequency of large trucks increases so should the design and control vehicles for different intersection types. For all street and intersection types, apply aerial fire trucks as additional control vehicles.

More guidance related to design and control vehicles for each street and intersection type and curb radii is provided in Chapter 4.

Streets that accommodate the smallest possible design vehicle will:

- Identify a design vehicle that may differ from the control vehicle.
- Define for intersections a crawl speed instead of using a design speed; this will provide more flexible turning for large vehicles at slower and safer speeds.
- Design intersections and curb radii based on the design vehicle turning to the receiving street.

REFERENCES

- TAC's Geometric Design Guide for Canadian Roads (2017) Part 1, 1.2.5.2 - 1.2.5.4.
- NACTO Urban Street Design Guide (2013).
- Institute of Transportation Engineers and Congress for the New Urbanism (2010). Designing Walkable Urban Thoroughfares: A Context Sensitive Approach.

Figure 2.15. Design vehicles are the most common large vehicles that use city streets, similar to a Canada Post or other courier trucks.

Figure 2.16. Control vehicles, like fire trucks, are the largest vehicles that use city streets. They use more of the street to manoeuvre.

Table 2.6 Design Vehicles and Control Vehicles in Other Municipalities

	Toronto		Kitchener		Edmonton	
Road Types	**Design**	**Control**	**Design**	**Control**	**Design**	**Control**
Arterial	WB-20/MSU	WB-20/MSU	Transit bus	Heavy single-unit truck, medium single-unit truck	B-12	WT,FT
Arterial (Main Street)	MSU	MSU	Passenger car	Snow plow/ Transit bus	WB-21	WB-36
Arterial (Industrial)	WB-20	N/A	Heavy single-unit truck	WB-19, WB-20, A-Train Double, B-Train Double	WB-21	WB-36
Collectors (Industrial)	WB-20/MSU	WB-20/MSU	Passenger car	Snow plow/ Transit bus	WB-21	WB-36
Collectors	LSU	MSU	Passenger car	Snow plow/ Transit bus	B-12	WT, FT
Local (Industrial)	WB-20/MSU	WB-20/MSU	Passenger car	Snow plow	WB-21	WB-36
Local	P	MSU	Passenger car	Snow plow	P	WT, FT, MSU

MINIMIZE EXPOSURE RISK

All street design will minimize the exposure of all users to the risk of collision- especially the most vulnerable- pedestrians and cyclists.

The factors that inform risk exposure are speed, time, distance, and vertical separation.

Safety is often measured by exposure risk– the time that one is exposed to the risks of vehicle traffic. Small increases in maximum pedestrian crossing distance and time can lead to a significant increase to the risk of pedestrian fatality. People are exposed to less traffic when crossing a two-lane street as opposed to a four-lane street.

A street design can lower exposure risk by separating users and/or movements and minimizing speeds (which allows more time for users to see one another and react).

Street design to minimize exposure risk will consider:

- Reduced vehicle speed.
- Shortest possible pedestrian crossing distance.
- Vehicle lanes as narrow as possible.
- For wider streets (typically more than four lanes wide or 13m pedestrian crossing distance), introduce medians or pedestrian safety refuges at intersections.
- Increased vertical separation between users.
- Provide a dedicated traffic signal or phase that allows the subject user or users to proceed without conflict.

REFERENCES

- Welle, Ben (ND). Cities Safer by Design: Guidance and Examples to Promote Traffic Safety through Urban and Street Design. World Resources Institute. WRI.org
- NACTO Urban Street Design Guide (2013).

Figure 2.17. Curb extensions increase the overall visibility of pedestrians by reducing the crossing distance for pedestrians.

Figure 2.18. Median crossing reduces the crossing length and exposure to vehicle traffic for pedestrians.

Figure 2.19. Trees and other vertical elements create visual friction between users.

MAXIMIZE PREDICTABLE AND SELF-REGULATING DESIGN

All street users need to know what to expect. A well-designed street should provide clear choice and well understood expectations and create an environment where all users are focused and alert.

Many traffic-related collisions result from user uncertainty or unintended behaviors that "self-regulating" or self-explaining design could diminish. These behaviours often occur at "decision points" with a high level of risk exposure such as turn lanes and pedestrian crosswalks.

Streets are generally safer if the actions of all users are more predictable. A classic example occurs at intersections without designated left turn lanes- if a user must guess if a vehicle is going to turn left or continue through an intersection, this could lead to movements that increase risk. Other examples where users can predict with a high level of certainty the actions of others include the use of brake lights (which notify to other users the intention of a vehicle to slow down and/or stop) and at roundabouts (where everyone yields-on-entry). On streets and at intersections with lower speeds, different users can make eye contact and communicate their intentions.

Street design that considers predictability and self-regulating design will:

- Minimize complexity for each user- especially at intersections.
- Naturally regulate all speed factors (approach speed, turning speed, decision-point speed).
- Accommodate desire lines across streets to key destinations such as transit stops.
- Put users where they can see one another.
- Provide adequate sightlines between different users to increase predictability. Target speed should inform the sightlines. If satisfactory sightlines are not available given the surrounding context (buildings, vertical elements, etc.) then reduce speeds accordingly. This highlights that speed is an output, rather than the defining element of street design.
- Not rely on signage to tell the user how to behave, although the street may include supplementary signs and other traffic controls.

REFERENCES

- Welle, Ben (ND). Cities Safer by Design: Guidance and Examples to Promote Traffic Safety through Urban and Street Design. World Resources Institute. WRI.org
- NACTO Urban Street Design Guide (2013).
- NYC DOT: Making Safer Streets (2013).

Figure 2.20. Midblock crosswalks facilitate crossing along desire lines across streets to transit stops, parks or schools.

Figure 2.21. Protected intersections increase driver visibility of people in the crossride and crosswalk by setting back the crossride from the motor vehicle travel lane.

2.6.2 Place Directives

Understanding and considering the place of a street is foundational and critical to making streets more complete. The two key directives are respect the context and ensure the comfort of pedestrians.

RESPECT CONTEXT

Design Vaughan streets to respond to and respect their context- the land uses, buildings and open spaces that are adjacent to and shape the street itself. This context will inform the street design, and project objectives and priorities.

Traditional roadway design focused on a "centreline-out" approach where the basis of street design began from the center of the roadway and designed outwards, meeting the transportation needs first without an understanding of the place that the street exists within.

A "building-in" approach emphasizes local context as a critical input. The land use, building scale, level of pedestrian activity, and place within the city all inform context. These outside realms include various spaces used by residents, business storefronts, people walking, cyclists, and plantings. Context will inform the scale of non-auto portions of the street, choice, and quality of materials, need for furnishings and user amenities, and planting schemes.

Street designers should consider how to enhance and support the social and cultural richness of a place. Local character is highly important. Seek opportunities to provide spaces and places for respite, not just movement, such as curb extensions at side streets where seating and plantings adds to local character. Distinct furnishings, pedestrian scale lighting, and public art will also contribute to the identity of a street. Business Improvement Areas (BIAs) introduce identity and wayfinding elements and other streetscape improvements to create visual interest and support the local economy, which for the most part is supported by those on foot and cycle, the shorter trips from within the neighbourhood.

In Section 2.5.3, overlays were introduced to inform street type by understanding an area's context. Additional overlays may further inform street design considerations and trade-offs. For example, street trees and health maps may reflect the degree to which practitioners should add to the existing tree canopy.

Streets that respect context:

- Respect the edge condition first- land uses, buildings, and needs of the pedestrian- and still provide a well-functioning transportation network.
- Use street types and the overlays to inform land use context.
- Seek opportunities to improve local character and support the local economy.
- Use this information to assist in the preparation of a user profile.

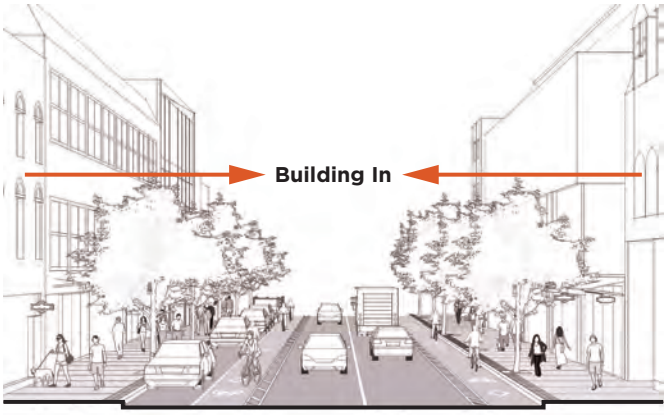
REFERENCES

- NACTO Urban Street Design Guide (2013).
- People for Project Spaces. Streets as Places: How Transportation Can Create a Sense of Community (2014).

Figure 2.22. Enhancing the quality of city sidewalks not only attracts more pedestrians, but also helps to create enjoyable public spaces where people want to spend their time.

FOCUS OF TRADITIONAL APPROACH

Auto-Mobility
Automobile Safety



COMPLETE STREETS APPROACH

Multi-modal Mobility + Access
Public Health/Safety
Economic Development
Environmental Quality
Livability/Quality of Life
Equity

Figure 2.23. "Centreline-out" Approach to "Building-in" Approach.

ENSURE PEDESTRIAN COMFORT

Design streets to offer a comfortable pedestrian environment, with enough space to support walking and reduce crowding of sidewalks and crosswalks. Streets should also provide suitable microclimatic conditions to reduce cooling winds in winter, provide shade in summer, and protection from rain and snow where possible.

Walking is a free, enjoyable, and healthy way to move about the city. Streets should encourage and support walking, no matter the street type.

In certain parts of the city with higher pedestrian volumes, design sidewalks and pedestrian clearways with enough width to accommodate the existing and anticipated volumes without crowding. Crosswalks should also align with the primary path of movement and have suitable capacity to support the number of people who use them.

Provide Furnishing and Planting Zones for every street suitable to its context and anticipated use. In higher volume pedestrian areas, this zone may include areas for gathering, street trees in hard surface boulevards or raised planters, seating, public art, and decorative lighting. In settings with higher vehicular volume and fewer pedestrians, this zone may include trees planted in a grass verge to serve as a physical and psychological buffer for pedestrians and cyclists. Street trees in any context will offer microclimatic benefits such as shade, filtered light, and reduced wind speed. Transit stops in any context should consider shelters for protection from the elements with safe crossings in proximity to pedestrian desire lines.

Further, design streets to drain water effectively from walking surfaces and reduce pooling at curbside, especially at ramps used by people in wheelchairs.

Streets that ensure pedestrian comfort will:

- Make informed decisions based on existing and anticipated pedestrian volumes and an understanding of the experience as one walking down the street.
- Understand the demands on the street for different times of day and days of the week, possibly as part of a multimodal assessment for street users.
- Provide unobstructed Pedestrian Clearway Zones that relate to street context.
- Include Furnishing and Planting Zones (benches, shade trees, buffer from moving cars) that support pedestrian activities.
- Provide level walking surfaces and smooth grade transitions in pedestrian clearways and crosswalks at intersections.

REFERENCES

- City of Vaughan: City-Wide Streetscape Implementation Manual and Financial Strategy (2014).

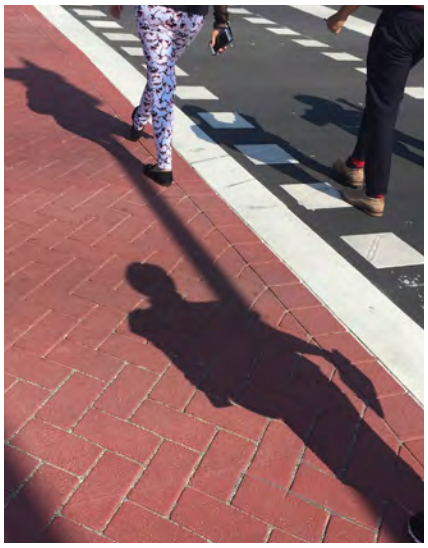


Figure 2.24. Designing streets to ensure pedestrian comfort will encourage more people to walk. Providing weather protection, safe, and inclusive sidewalks and crosswalks, and opportunities to stop, rest and linger will make a more active and healthy city.

2.6.3 Link Directives

Complete Streets are corridors for movement that consider the functional needs of all users, but do not, as a default, privilege vehicle operations over the needs of others. The key directives to ensure that streets in Vaughan are complete are to understand and accommodate desire lines, design for person (not just vehicle) throughput and mobility, and develop a network of complete and connected streets.

UNDERSTAND AND ACCOMMODATE DESIRE LINES

Safe streets are easier to use. To understand and accommodate desire lines- how pedestrians or cyclists move or want to move in an environment- will contribute greatly to safe street design and inform the placement of elements and features.

The thoughtful location of pedestrian crossings should support the walking network and walking patterns. At intersections, crossings should align with the corresponding sidewalks and consider nearby places of importance. At midblock locations, crossings should align with the primary desire line (potentially a building entrance or path). Likewise, consider the actual movements that cyclists want to make when designing an intersection.

There are several possible techniques to better understand desire lines. Tracking surveys are simple mapping exercises that illustrate actual movements by pedestrians and cyclists over several hours (or longer) at intersections and mid-block locations, including where they go and how they get there. The survey can record volume and direction of movement. This data can inform decisions about the installation of new crossings or signals, where traffic calming measures are best placed, and how to best design an intersection to accommodate cyclist behaviour. Other techniques include photo or video recordings, noting paths made in the snow or mud, identifying cuts in fences and other obstacles, and plotting origins and destinations.

Street design that considers desire lines will:

- Assess the existing context and identify key destinations and routes.
- Provide simple and clear paths with minimized complexity and waiting time for pedestrians and cyclists.
- Include clearly marked pathways and routes for each movement and user.
- Separate conflicting movements between vehicles and other users, with each given their own space and time for movement.
- Make informed decisions about accommodating desire lines that may challenge the primacy of vehicle operations over all other factors.

REFERENCES

- OTM Book 15: Pedestrian Crossing Treatments (2016).
- Gehl, J, and Svarre, B. (2013). How to Study Public Life.
- NYC DOT (2013). Making Safer Streets.
- William H. Whyte (1980). The Social Life of Small Urban Spaces.

Figure 2.25. This image demonstrates how to consider the desire lines of trail users who want to cross a busy street. Providing a signalized junction with markings makes the connection more safe and convenient.

Figure 2.26. Missing crosswalks when recreational trails meet major roads.

Figure 2.27. Midblock crosswalks facilitate crossing along desire lines across streets to recreational trails, transit stops and schools.

Figure 2.28. Left turn bike box is an example of preventing conflicts arising from cyclists queuing in a cycle lane or a crosswalk.

DESIGN FOR PERSON THROUGHPUT AND MOBILITY

Street ROWs are limited and finite. Optimizing their use requires that designers evaluate alternatives based on the maximum use and throughput by persons rather than vehicles. Street design should support and encourage travel by higher volume and more space efficient modes.

Streets can change and become more efficient when we consider how to move people rather than vehicles. In conventional design, when assessing vehicle delay for a bus or a private automobile, both count as a single vehicle even though the bus may be carrying 50 times as many people as the car. Further, streets designed to accommodate the peak hour demands above all else do not take advantage of all the excess capacity during the rest of the day. In the off-peak times of day, vehicles tend to move faster which reduces overall safety for all users. Design approaches that evaluate person through-put equally value the mobility demands of all individuals whether they choose to travel by car, transit, foot, or cycle.

Good examples of the efficient use of space to increase person capacity and improve operations exist throughout Ontario and across Canada. Converting travel lanes to cycle lanes or reassigning space within an existing ROW to introduce dedicated transit infrastructure can lead to a dramatic increase to overall person capacity, improve safety and operations.

Multi-Modal Level of Service (MMLOS) is a tool to assess the overall suitability of a street to meet the mobility needs of all users, not just vehicles. The Ontario Traffic Council's MMLOS Guidelines are a helpful resource to uderstand and apply this methodology.

Streets designed for person throughput and mobility will:

- Make efficient use of available space within the ROW.
- Accommodate and provide choice for all users and increase opportunities for non-auto travel.
- Allocate the public ROW to anticipated multimodal transportation demand.
- Apply a Multi-Modal Level of Service (MMLOS) assessment to determine the mobility needs of all users.
- Prioritize non-auto travel and include a broader set of objectives such as equity, public health, and sustainability.
- Use the fewest travel lanes, narrowest lane width and tightest curb radii as possible based on the identified design vehicle.
- Understand the actual demand for parking, both on and off the street, to meet corridor needs through a broader strategy.

REFERENCES

- Ontario Traffic Council (2022). Multi-Modal Level of Service Guidelines. Dillon Consulting.
- Litman (2015). Evaluating Complete Streets: The Value of Designing Roads For Diverse Modes, Users and Activities. Victoria Policy Transport Institute.
- Victoria Transport Planning Institute (2015). Multi-Modal Level-of-Service Indicators: Tools For Evaluating The Quality of Transport Services and Facilities.
- AARP (2015). Evaluating Complete Streets Projects: A Guide for Practitioners.
- Dumbaugh, E., Tumlin, J., and Marshall, W. (2014). "Decisions, Values and Data: Measuring Bias in Transportation Performance Measures". ITE Journal, August.
- NACTO Urban Street Design Guide (2013).
- CEQA Guidelines Update (2018).

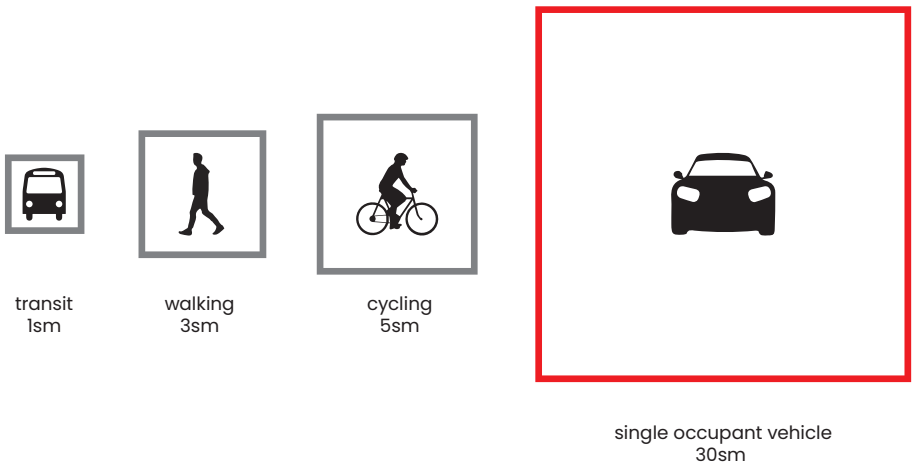


Figure 2.29. Road space required per passenger for various travel modes.

Road space requirements increase with vehicle size and speeds (faster vehicles require more distance between them and other objects), and declines with more passengers per vehicle.

Single occupant automobile travel on arterials requires many times more space than people who are walking, cycling and taking public transport.

source: Adapted from Litman (2015). Victoria Policy Transport Institute; DTAH

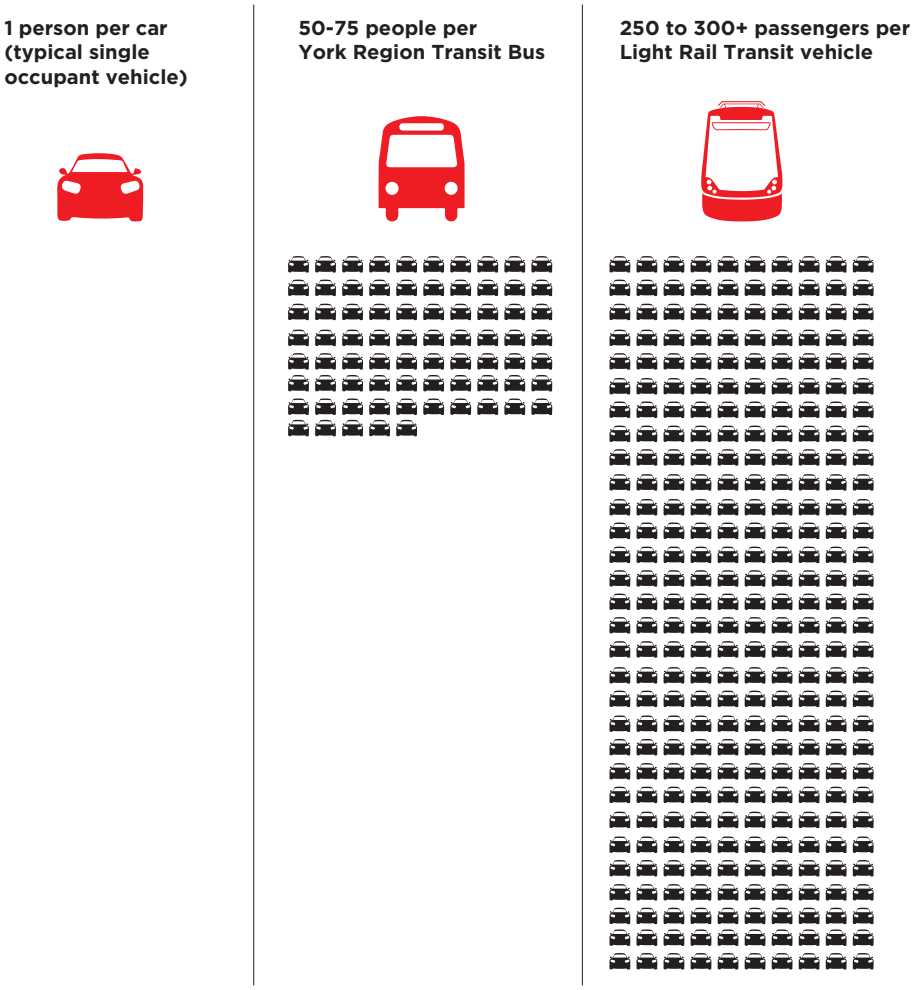


Figure 2.30. Mode Priority and Person Capacity.

For longer trips, transit can move far more people and with greater efficiency than single occupant vehicles.

source: Metrolinx; York Region Transit; DTAH

DESIGN COMPLETE STREETS TO SUPPORT A COMPLETE NETWORK

It is well established that Complete Streets are designed to meet the needs of all users. However, some streets may emphasize and enhance one mode of travel over others. Streets identified as critical links in a modal network- such as the priority transit, cycle, pedestrian, or freight networks- may have enhancements to privilege movement of the identified mode.

In the early stages of every project, the design team will identify the street context and any existing or planned mode priority networks (such as surface transit or cycling).

Warrants for elements like traffic controls and pedestrian crossings are driven by existing conditions and data to support proposed measures. This can limit prioritizing and planning for future conditions. Thus, warrants should also include additional recommendations based on significant anticipated changes in the street context to ensure user safety and advance mobility.

In Vaughan, as with many other jurisdictions that have developed and evolved in a similar way, many of the city's corridors are considered a priority for several networks. Yet few streets have enough space to accommodate the ideal facility for each, thus leading to a collaborative trade-off discussion (see Section 2.7 – Making Decisions And Assessing Trade-offs). The design team should use data driven decision making to inform the initial cross-section, refine design preferences, and inform standards and required quantities (for example, existing or anticipated volumes for the different users, collision data).

Designing streets to support a complete network will:

- Respect adjacent existing and planned land uses and intensity of use.
- Accommodate the intended uses and mobility for all permitted modes.
- Not compromise the safety of vulnerable users.

REFERENCES

- City of Vaughan: Vaughan Transportation Masterplan (2023).
- City of Vaughan: Pedestrian and Bicycle Master Plan (2020).
- A Report of Medical Officers of Health in the GTHA (2014). Improving Health by Design in the Greater Toronto-Hamilton Area. Second Edition.

Figure 2.31. Streets with transit routes will be designed to enhance operations and mobility that respects adjacent existing and planned land uses and intensity of use.

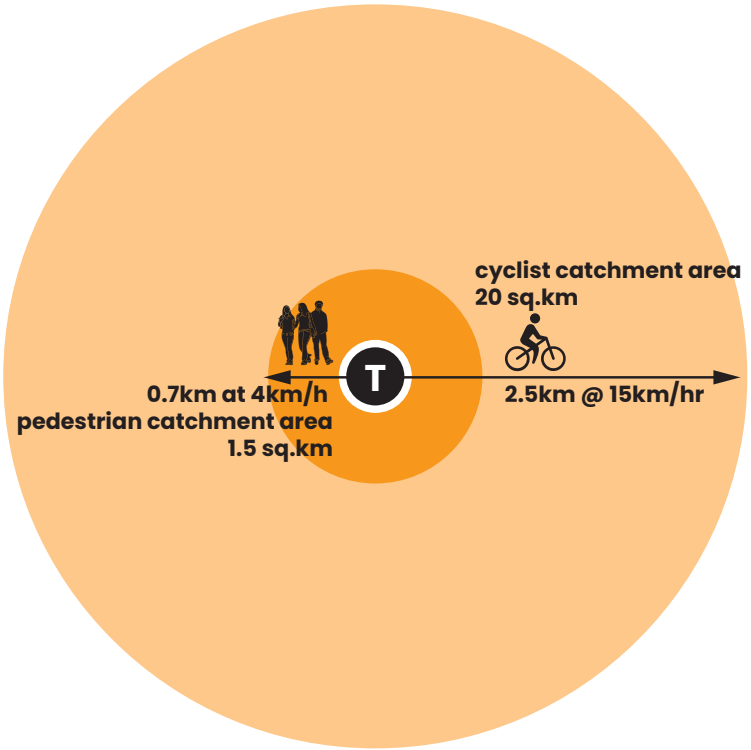


Figure 2.32. 10 Minute Catchment Area From Transit Station Or Stop.

Networks for different modes of travel work best if coordinated and supplemented by one another. The quality of a public transit system is enhanced greatly if the pedestrian and cycling network is complete and convenient.

source: trendy-travel.eu, DTAH

ENHANCE NETWORK CONNECTIVITY

A well-functioning and connected street network is a fundamental framework for creating safe, livable, legible, and efficient communities. A fine-grained network of streets provides greater flexibility and redundancy, more direct routes for travel, better distribution of travel demands and enhanced access to land uses and destinations. Modal networks must have continuity and seamless, accessible connections between segments and across intersections.

Vaughan has street network patterns that range from a tighter grid of connected blocks (Woodbridge, Vaughan Metropolitan Centre) to large blocks and few street connections for much of the City. Limited street network connectivity results in a concentration of travel demands on a limited number of streets increasing the risk of conflict and collision and decreasing overall network efficiency. In these areas, look for opportunities to complete missing links and connect disconnected segments.

While it is preferred that connected networks accommodate all modes of travel, it is essential to serve pedestrian connectivity as this is the basic unit of travel that serves all other modes. Connectivity is essential. Plan and design streets as continuous routes and corridors, not as isolated or interrupted segments. Ensure that all users can move safely and efficiently from their origin to destination in the network without lengthy detours or elevated risk.

Streets that strengthen network connectivity will:

- Emphasize walking as the fundamental unit of design, which in turn will improve connectivity for other users.
- Contribute to higher intersection density and link to node ratio, two measures for calculating the scale and connectedness of the street network.
- Make use of parallel streets to develop a corridor.

REFERENCES

- Congress for the New Urbanism. Sustainable Street Network Principles.
- Congress for the New Urbanism. Street Networks 101.
- Congress for the New Urbanism. Resources: Street Networks.
- Institute of Transportation Engineers and Congress for the New Urbanism, Federal Highway Administration and US Environmental Protection Agency (2010). Designing Walkable Urban Thoroughfares: A Context Sensitive Approach, "Chapter 3 – Network and Corridor Planning".

Figure 2.33. Block Pattern and Network Connectivity.

Examples from different parts of Vaughan. Note the higher amount of possible routes in some parts of the city than others. The greater the number of intersections in a given area, the more connected and complete the network.

source: DTAH

2.6.4 Greening Directives

Beyond their role as places and corridors for movement, streets have a critical contribution to the sustainability, resilience, identity, and beauty of Vaughan. Greening streets will enhance safety, help to expand the overall urban forest, efficiently manage stormwater, help Vaughan mitigate and adapt to climate change, and improve placemaking. The key directives for greening include street trees and managing stormwater.

PLANT STREET TREES TO SUCCEED

Street trees are a highly desirable element for making pleasant, comfortable, and sustainable streets.

Street trees have numerous benefits related to safety, micro-climate, land value, and well-being. Their presence can lead to slower vehicle speed and serve as a buffer between users traveling at different speeds. When they can reach a healthy size, trees offer shade to the roadway and sidewalk, which can reduce speeds, make more comfortable walking environments, improve air quality, and intercept rainwater.

Trees are part of the city's infrastructure along with gas, hydro, and water, and are an integral component of our streetscapes along with other elements such as sidewalks, street lights, benches, and cycle racks.

To successfully plant trees within a streetscape comprised of so many elements, it is essential that the design team consider the required conditions for tree planting as integral to the design, planning and construction of all projects. Particularly important is the early coordination between the tree planting plan and utilities.

Street design that considers tree preservation and planting for healthy growth and positive contribution to the vibrancy of streets will:

- Ensure protection, retention and maintenance of existing trees of a useful size and exhaust all options before tree removal.
- For street reconstruction projects, include street tree planting with available space and suitable growing conditions. Ensure suitable tree planting budget is included in the overall cost and consider impact on operations and maintenance.
- For other street projects, seek opportunities to introduce street trees and improve growing conditions (for example, in curb extensions or rain gardens).
- Select native tree species for planting to enhance the local ecosystem.
- Provide non-compacted soil volume targets, typically between 30 cubic metres per tree.
- Introduce open tree planters wherever possible, providing the best possible streetscape growing condition for trees and an opportunity for further greening and stormwater management.
- Coordinate utilities to minimize impact on the root zone.
- Ensure trees have adequate water for the first 5 years of establishment.
- Take advantage of resurfacing projects to upgrade planting conditions.
- Seek opportunities to introduce planting by piggybacking on ongoing City initiatives such as Neighbourhood Traffic Calming Plan and other safe street initiatives.

REFERENCES

- City of Vaughan: City-Wide Streetscape Implementation Manual and Financial Strategy (2014).
- Green Directions Vaughan (2019).
- York Region: Street Tree and Horticultural Design Guidelines (2022).
- York Region: Street Tree and Forest Preservation Guidelines (2022).
- York Region: Acceptable Tree Species for Regional Road Allowances (2022).

Figure 2.34. Different street tree planting details are available to ensure healthy growth: the most common are the soil trench (top left), soil cells (top right) and open planters (bottom). Further, each can provide stormwater management opportunities.

MANAGE STORMWATER

Streets play a major role in stormwater management and can help to reduce point source volumes, improve water quality, help to mitigate the urban heat island effect, support human health and well-being, create ecologically important streetscapes, and enhance the streetscape environment.

This section outlines the Complete Streets approach to stormwater management. Several Ontario cities and agencies have prepared technical guidance for green infrastructure that Vaughan can learn from.

In Vaughan, a "green street" is a ROW that through a variety of design and operational treatments, manages stormwater at-source through green infrastructure and low impact development (LID) techniques and achieves the broad objectives of Green Directions Vaughan (2019). Green streets provide a wide range of benefits: they enhance local ecology, provide a more aesthetically pleasing street environment, and help to reduce hard infrastructure cost. Green street measures can serve a traffic calming role as well when combined with bulb outs, chicanes, and medians.

Streets that consider green infrastructure for managing stormwater within the public ROW will:

- Seek to introduce green infrastructure as part of every street reconstruction project.
- Combine green design into traffic calming elements.
- Include trees and other plantings in curb extensions, chicanes, planting strips, medians, and islands as part of on-street stormwater collection.
- Maintain sightlines at intersections and driveways.
- Incorporate stormwater management and landscape features that aim to maximize permeable surfaces.

REFERENCES

- City of Vaughan: City-Wide Streetscape Implementation Manual and Financial Strategy (2014).
- Green Directions Vaughan (2019).
- York Region: Street Tree and Horticultural Design Guidelines (2022).
- York Region: Street Tree and Forest Preservation Guidelines (2022).
- NACTO Urban Street Stormwater Guide (2017).

Figure 2.35. Stormwater management techniques are possible in many different street types and parts of the ROW, and can contribute to placemaking and traffic calming.

2.6.5 Life-cycle and Maintenance Directives

The value of Complete Streets is far beyond the money it takes to build and retain streets in a state of good repair. The key directives for understanding the life-cycle and maintenance of Complete Streets are to understand the total cost, support four seasons of use, and select robust materials.

UNDERSTAND THE TOTAL COST

Complete Streets are necessary to safely accommodate existing and future users. They need not cost more than in-Complete Streets, can lead to new funding opportunities, and will add lasting value. Defining and addressing maintenance and operations needs should happen at the beginning of the street design process to ensure overall success.

Design teams should analyze the full cost of Complete Streets in the context of the economic and societal impact of in-Complete Streets, not simply capital and maintenance costs. Many Complete Street improvements are modest in size and cost.

Even if a Complete Street design increases the upfront cost of a project, it can reduce total life-cycle cost and have larger community economic benefits by supporting more sustainable modes of travel, lessening roadway wear and maintenance, reducing congestion, improving air and noise quality, reducing crashes and fatalities, and improving local property values.

Beyond the immediate capital costs are the costs to the well-being of our broader society. Physical inactivity is a major health issue in Ontario. Neighbourhood and city walkability are fundamental inputs to the health of our communities. Providing opportunities for people to increase their daily activity levels through walking and biking will have a considerable impact on overall public health levels and add value to our cities, reduce the burden on our health care systems for treating illnesses such diabetes and cardiovascular disease that are influenced by low levels of activity, improve mental health, reduce the number and length of absences from work due to illness, and strengthen our collective sense of wellness.

A Complete Street that understands the total cost will:

- Evaluate the economic and health benefits of Complete Streets.
- Seek opportunities to make improvements of any scale for street users.
- Coordinate improvement projects where possible to reduce total capital cost.
- Look ahead for opportunities to make improvements.
- Examine life-cycle costs when comparing project alternatives and the difference between complete and incomplete Streets.
- Make coordinated decisions for all users up front in the process leading to reduced overall construction schedule.

REFERENCES

- TAC Bulletin, January 22 (2019). “Framework for Life Cycle Assessment of Complete Streets Projects”. UC Davis: National Center for Sustainable Transportation. Retrieved from https://escholarship.org/uc/item/0vw335dp
- National Complete Streets Coalition. Safer Streets, Stronger Economies (2015).
- Complete Streets Coalition (ND). Complete Streets: Guide to Answering the Costs Question. Smart Growth America.

Figure 2.36. Designing streets that consider four season use means ensuring clear and accessible facilities for all users, and providing enough space for snow storage while maintaining suitable pedestrian clearway.

SUPPORT FOUR-SEASON USE OF STREETS

Complete Streets safely accommodate all users during all seasons. This increases their value. Convenient, comfortable and safe facilities will experience use for the entire year, contribute to an active and healthy lifestyle, improve accessibility and equity, and help to manage congestion beyond the warmer months.

Complete Streets are four season streets. Cities around the world with climates like Vaughan have high rates of walking and cycling in the winter. What they all have in common is a connected network and well-maintained facilities to support winter cycling, and clear and comfortable sidewalks and crosswalks.

Following a snow event, clear sidewalks, transit stops and cycle facilities first to indicate that they are priority street users. Reduce salt use for ice clearance on sidewalks and roadways to minimize impact on street trees and other planting, degradation of materials and infrastructure, and to improve overall water quality.

Streets that consider all seasons will:

- Improve cycling and pedestrian infrastructure to invite accessible and equitable use during less-than-ideal conditions.
- Maintain sidewalks, cycle facilities, and the roadway so they are clear and safe all year.
- Clear snow and ice from sidewalks, crosswalks, and cycle facilities first.
- Ensure that sidewalk ramps are clear of ponding, ice, and snow.
- Clear snow and ice from transit stops so customers can comfortably access transit vehicles.
- Include suitable space for snow storage or negotiate snow removal on streets when storage is not possible.
- Define winter maintenance service levels and costs for the entire street network. This includes priority to clear the sidewalks, transit stops, and cycle facilities.

REFERENCES

- City of Edmonton: Winter Design Guidelines (2016).
- City of Edmonton: For the Love of Winter: Winter City Strategy Implementation Plan (2013).
- City of Saskatoon: Winter City YXE: Saskatoon's Winter Strategy (2020).

Figure 2.37. Material selection should consider context along with durability and life-cycle cost.

SELECT ROBUST MATERIALS

Vaughan streets will use durable, cost effective, high-quality materials that are context sensitive, safe, inviting, and comfortable.

Material selection is important for all parts of the street. The longevity of all construction and maintenance in the public realm is directly related to the quality of the materials and methods of installation. Weigh the impulse to achieve short-term cost savings against the potential higher maintenance costs if inferior materials are used.

Streets that consider materials will:

- Select materials based on durability, life-cycle cost and suitability for street type, zone of the street, user group and context.
- Ensure minimal grade differences between adjacent materials unless the intent is to indicate a grade or texture change for safety and accessibility purposes.
- Include consistent materials along a street from a limited palette, and on both sides, for clear legibility
- In areas where different users interact, use contrasting colours to indicate a change in use.
- For roadways and intersections, a well-designed base with smooth surface that drains water quickly is essential for the safe travel of pedestrians, cyclists, and vehicles.
- For sidewalks, level and well-drained surfaces are also important but further technical factors will influence their completeness.
- All materials for the sidewalk should improve universal accessibility.
- Select unit paver sizes relative to their application. This will inform paver type such as planks, slabs, cobbles, and the paving pattern.
- Select materials that minimize cracking which can lead to unsafe conditions. Further, use techniques and materials to minimize damage from tree roots and snow clearance.

REFERENCES

- ASTM International Standard E3028. Standard Practice for Computing Wheelchair Pathway Roughness Index as Related to Comfort, Passability and Whole Body Vibrations from Longitudinal Profile Measurements.
- Federation of Canadian Municipalities and National Research Council (2004). Sidewalk Design, Construction, and Maintenance: A Best Practice by the National Guide to Sustainable Municipal Infrastructure.
- NACTO, Transit Street Design Guide. Chapter 5, Transit Lanes and Transit Ways, Pavement Materials (2016).
- David K. Hein, P.Eng. (2016). "Pavement Design For Large Element Paving Slabs". Paper Offered for Presentation at the Innovations in Pavement Management, Engineering and Technologies – Design Applications Session, Transportation Association of Canada Conference, 2016.

2.7 MAKING DECISIONS AND ASSESSING TRADE-OFFS

Street ROWs in the City often have constraints. Each project requires collaboration between all stakeholders during the initial stages of design to establish project objectives. This would determine the elements and dimensions best suited to its uses and users.

Prioritization of various design elements within the street will differ based on several factors– functional role of the street, available space, existing and future users and so on. Some elements will benefit one user group over the other, however, the need of the most vulnerable user is to be prioritized. There may be different perspectives on the design of the best cross-section. Therefore, it is necessary to ensure alignment with the Complete Streets processes, techniques, and performance metrics established in the Guide.

The recommended method for evaluating the trade-offs is like the Ontario Municipal Engineers Association (MEA) Municipal Class Environmental Assessment (MCEA) Process. Similar to an EA, the design team can establish a robust multi-variable set of criteria informed by the project and design objectives in the Context Definition Stage. The evaluation of each option should include qualitative and quantitative measures for each criterion. Criteria should include social and environmental factors as related to the project or context-specific objectives. If required, consult the Standards Committee if the stakeholders from all departments cannot reach consensus or if the mitigation solutions result in adverse impacts to social, environmental, or cultural characteristics.

The design team can also consider applying a MMLOS (Multi-Modal Level-of-Service) assessment as part of the evaluation. This step is not necessary with each project, but such a tool can assist with the trade-off discussion to ensure that priorities are optimized, and the needs of vulnerable users are met sufficiently. While this process can assist in addressing mobility inputs, it requires balance alongside other design objectives for the specific street class identified in Chapter 2. For example, wide boulevards with street tree planting are a key design objective for Arterial Intensification areas, whereas balancing pedestrian safety and goods movement is a key design objective along Arterial Employment Streets.

The following two scenarios, common in Vaughan, enlist a range of possible trade-offs, assisting in allocating space for the most desired uses within the cross-section.

Trade-off decisions should be taken simultaneously with the project delivery process to best address competing considerations. Considering context and user definition will assist in resolving prioritization of elements.

All trade-offs need not be applied to all projects, i.e. road retrofit projects do not involve modifications to the boulevard.

While assembling the cross-sections, decision-makers should ensure alignment with the vision of the Guide- creating a safe street for the most vulnerable users. Thus, the pedestrian clearway (Chapter 4) within the boulevard, takes precedence over others.

The potential trade-offs suggest reviewing a range of decisions before modifying dimensions of an element or altogether eliminating it.

Table 2.7 Common Street Project Trade-offs in Vaughan

Faster transit (e.g., higher order transit) vs. reduction of general-purpose lanes with limited occupancy	Cycle lanes vs. wider sidewalks
Vehicle delay vs. longer crossing time	Rural clear zones vs. urban lateral offsets
Vehicle delay vs. active transportation needs	Transit shelter vs. cycle facilities
High speed roadways vs. context sensitive urban streets	Lead vs. lag turns, and impacts on pedestrian/cycle movements
Centre median vs. driveway access	Curb-side bus queue jump lane vs. shorter crossing distance for pedestrians
Right turn on red vs. cycle lanes through intersection	Parklets and other temporary curbside animation vs. on-street parking to help reduce traffic speeds
Left turn lane vs. cycle lane through intersection	Emergency vehicle access vs. speed reduction
Streetscape corridor vs. cycling infrastructure or on-street parking	Use of on-street parking as a buffer for cyclists vs. curbside vehicle travel lane
Street trees vs. below-grade utilities	Street trees vs. cycle facilities

SCENARIO 1

Constrained Right-of-Way

The first scenario addresses rights-of-way having inadequate space to accommodate needs of all users- existing and potential.

Potential Trade-offs

Travel lanes, medians and edge zones can be reduced to minimum dimensions.

Storage space can be reduced along with tapers at the near-side and far-side. Midblock bus stops with bus bays can be reduced to 15m at most, to include other elements like street trees, green infrastructure (GI), active transportation facilities or on-street parking.

Frontage zone can be reduced if it lies within the right-of-way. However, in intensification areas, which have at-grade retail, it can affect the local businesses and the overall experience of the space.

The number of travel lanes can be reduced, narrowing the roadway. Alternatively, they can be converted to cycle lanes or dedicated transit infrastructure, increasing overall users, and improving operations and safety.

Transit lane and platform widths can be reduced, keeping in mind both consumer and operational safety.

The width of on-street parking can be reduced to minimum requirements. The necessity of parking can be evaluated to eliminate it entirely.

Two-sided on-street parking can be reduced to parking on one side or removed completely.

In intensification areas with at-grade retail, space for projected parking demand can be provided, but not on all streets.

Planting and furnishing zone can be reduced to minimum required dimensions, to ensure healthy street trees. In case the minimum dimensions are not met, it can be removed. It is, however, not recommended to reduce/ remove this zone on streets with higher speeds and traffic volumes, for comfort and safety of pedestrians and cyclists.

Refer Section 4.5.2 Green Infrastructure (GI) for ways to assign more space for GI.

A separate sidewalk and cycle track can be combined to an in-boulevard multi-use path which accommodates both pedestrians and cyclists. Cycling facility dimensions can be reduced only after other elements (except the sidewalk) are reduced. Promote active transportation infrastructure.

Refer Section 4.4.1 Rightsizing Streets (Road Diets) for additional techniques for reorganizing the roadway.

SCENARIO 2

Wide Right-of-Way

Streets with wide rights-of-way are not always effectively utilized, resulting in speeding of vehicles and safety concerns. They can be rearranged to use the available space to the advantage of other users.

Potential trade-offs will vary based on the project objectives and context. For instance, requirements for cycling facilities for change in every project.

Potential Trade-offs

On-street parking can be maintained on one side or both depending on the context and demand for it.

Furnishing and planting zone can be widened, resulting in bigger and healthier street trees, and improving the overall streetscape experience.

Pedestrian clearways can be widened, especially in areas with active grade uses.

Edge zone can be widened to increase separation between the travelway and the pedestrian. It will also provide a wide snow storage area.

The frontage zone can be widened to allow for a variety of uses.

Additional space can be added to bus stops, improving transit facilities.

Median widths can be increased, if required and permitted, to accommodate planting.

Chapter 3 elaborates on the possible decision-making process to assess trade-offs based on the functional role of the street and scope of the project.

2.8 EXCEPTIONS

Not making a street more complete is the exception.

Consider street projects which cannot be designed with the techniques and the range of values provided in Chapter 4, as exceptions. However, these will require require justification and review as these will be unique circumstances.

Exceptions will receive final approval only following compliance review (Fig. 2.2).

Following are typical exceptions. However, scenarios other than the ones listed below can also be considered as exceptions.

- Limited access highways.
- pedestrian-only streets.
- Constrained ROWs on bridges and at underpass, tunnels.
- The estimated costs do not justify the need or purpose.
- Exception is specific to a certain portion only.
- Sound rationale that all modes/elements will not be needed, even in the future.

Projects identified as exceptions should have the necessary documentation compiled and reviewed in the early stages of the overall process- Project Definition (Fig. 2.1).

A submission for an exception review should include:

- Analysis of existing and future context- ROW widths, adjacent land use, constraints, planned development, etc.
- Justification of why an exception is required.
- Proposed cross-section option/s and demonstrations.
- Best practices/precedents, in comparable contexts.
- Description of any proposed variations/innovations in street elements and how the overall design satisfies the Complete Streets direction and intent.
- Explanation for why the proposed exception will serve as a better solution.

c: Bas Peperzak, Unsplash

CHAPTER 3
DEMONSTRATIONS

3

Chapter 3 illustrates applications of the Complete Streets approach to different intersection types. Each intersection contains an analysis of existing conditions and ideas for its retrofit and reconstruction. These demonstrations are for illustrative purposes, a starting point and not the only solution.

3.1 WHAT IS A DEMONSTRATION?

The following illustrations 'demonstrate' common scenarios of how the Complete Streets (CS) approach can help reimagine common street intersections along City-owned streets in Vaughan.

This chapter illustrates CS possibilities via five representative intersection types commonly found in Vaughan. The exercise intends to exemplify how the CS approach can lead to different outcomes and help satisfy broader city building goals.

Each of the demonstrations includes a brief description and illustration of the existing condition, noting challenges and opportunities. Next are retrofit suggestions, then ideas for a full reconstruction. The retrofits are consistent with the reconstruction scenarios, so that the former may serve as pilots or demonstrations.

Vaughan's street network is largely built out, so many projects will fit in the retrofit category. New builds fit into the reconstruction category.

Each of the five demonstrations:

- Notes challenges and opportunities with the existing conditions.
- Explains the decisions taken in both the retrofits and reconstructions.

A Retrofit includes lower cost elements such as paint and bollards. It applies when it is not desirable or feasible to move curbs or reconfigure a street's drainage. It is often combined with state-of-good-repair improvements. Retrofits establish essential geometric adjustments prior to reconstruction.

A Reconstruction provides the opportunity to make a street more complete by relocating curbs and drainage. Often reconstructions are paired with major utility upgrades. For the purpose of the exercise, it is assumed that reconstruction projects will maintain the existing ROW.

3.2

COMMUNITY: LOCAL TO LOCAL

The intersection of two local community streets is the most common condition in Vaughan. It is designed to promote slow speeds and minimize pedestrian crossing distances. People of all ages and abilities walk or cycle in the neighbourhood for activities such as getting to and from school or transit stops or visiting nearby destinations.

EXISTING TYPICAL CONDITIONS

Lane width. Although unmarked, the "lane" widths range from 4.25m to 4.5m. Lanes on local streets should be 3m wide or less, depending on the assembly of all elements within the roadway.

Corner radii. The corner radius is large. In most instances, they were built to accommodate the ocassional truck; however, it leads to higher turning speeds, less yielding, longer crossings, and more impervious surface.

Cycle facilities. There are typically no dedicated cycle facilities. On certain low speed/volume streets, cycle lanes may not be required (see OTM Book 18); however, cyclists will benefit from positive guidance at intersections, and traffic calming to manage driver speeds. It is also good to remind drivers that cyclists belong.

Traffic calming. There are no traffic calming devices.

Crosswalks. There are no marked crosswalks. Marked crosswalks are not always "warranted" on low volume neighborhood streets and ladder type crosswalks may be seen as excessive. However, having at least two striped lines establishes priority. Crosswalks also visually break up long stretches of street.

Accessibility. Detectable warning strips (DWS) and/or curb ramps are not always present.

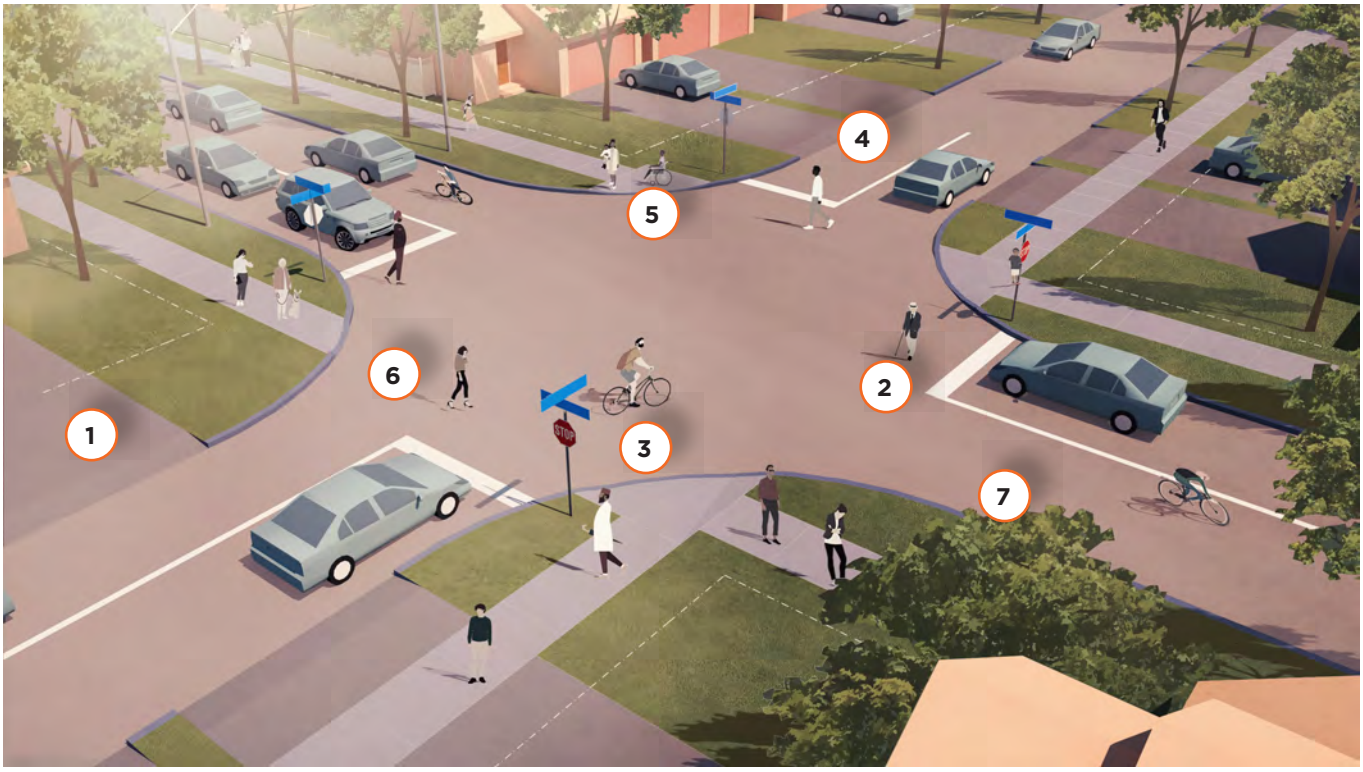
Intersection control. There are stop lines, but they are not always aligned with the stop signs.

Sidewalks. There is no sidewalk in one block. In some contexts, this is due to the lack of active frontages and at-grade uses. The property may have been developed at a time when sidewalks were not required. In either case, sidewalks form a network of walkways. To break the network means people must either walk in the road or cross the street.

Representative Intersections. The intersection of Hudson Drive and Cherokee Drive in Vaughan, is an example of two local streets in a community context.

EXISTING TYPICAL CONDITIONS

1. No sidewalk
2. No marked crosswalks
3. No DWS
4. Wide lanes
5. Large corner radii
6. No traffic calming
7. No cycle facilities



RETROFIT

Lane width. Striped curb extensions are added with parking on one side. Parking reduces the lane widths to about 3.3m.

Corner radii. Corner radii are tightened with striping and flexible bollards. Bollards, or some other type of physical barrier like a planter, are necessary because drivers will cut the turn.

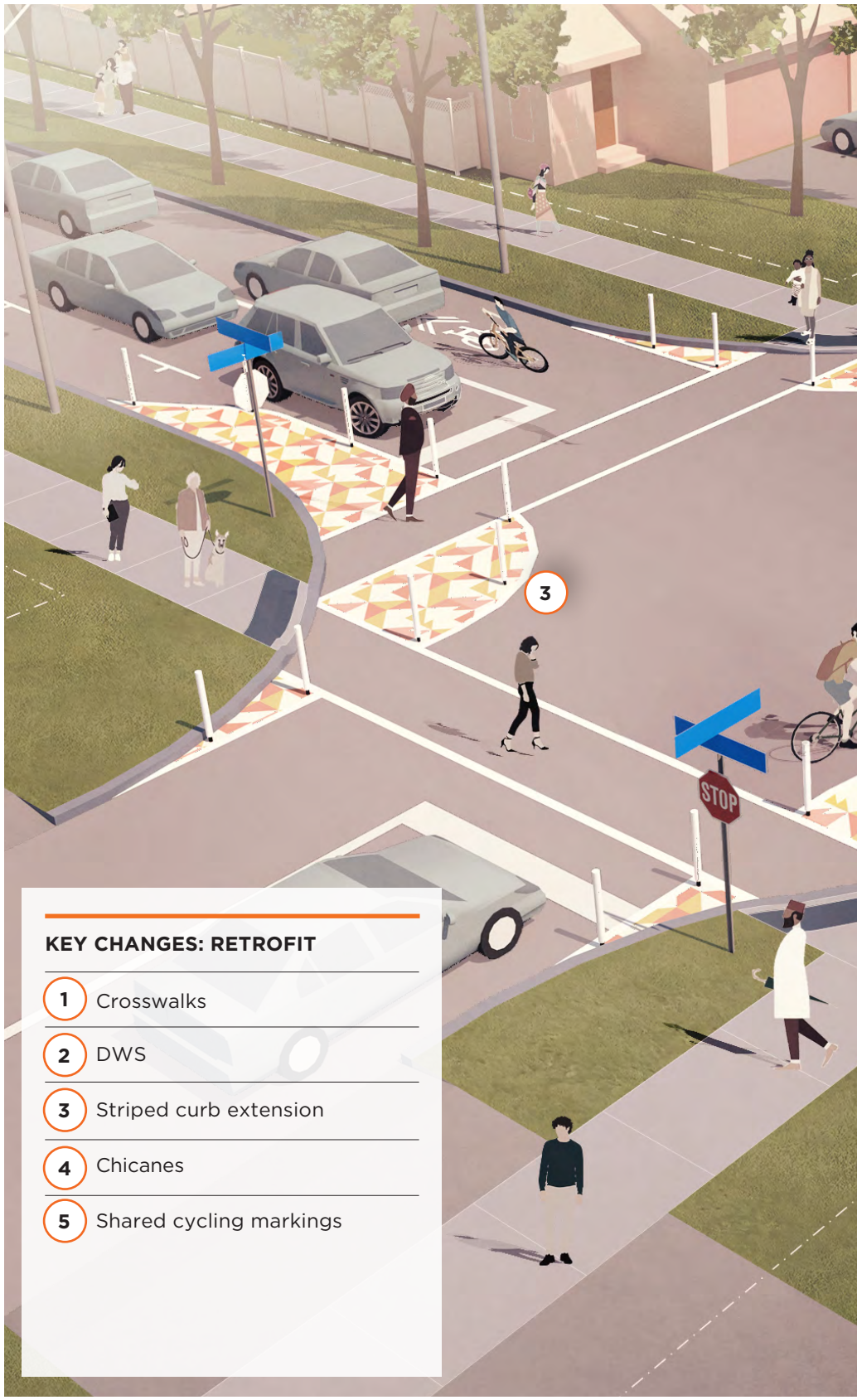
Cycle facilities. Cycle symbols are added on one street, indicating that cyclists may ride in the center of the lane. This is only possible on narrow, low speed and volume streets. Add necessary signage as per OTM book 18.

Traffic calming. Chicanes are added on one street, which will help manage driver speed.

Crosswalks. Marked crosswalks are added to each leg of the intersection. The crosswalks are aligned with the sidewalks so that people do not have to deviate from their path.

Accessibility. Curb ramps with detectable warning strips (DWS) are added at all corners.

Intersection control. The intersection retains its all-way stop signs. Stop lines are set back from the crosswalk (refer Section 4.6.10), and the stop signs are aligned with them. This space may also be used by cyclists to queue ahead of vehicles.



KEY CHANGES: RETROFIT

1. Crosswalks
2. DWS
3. Striped curb extension
4. Chicanes
5. Shared cycling markings


1
2
4
5
STOP

RECONSTRUCTION

Lane width. The curb extensions are made permanent. The section near the crosswalks is paved, while the balance is landscaped, perhaps as rain gardens. The parking lane may be made over with permeable pavement to aid in stormwater management.

Corner radii. The corner extensions are made permanent.

Traffic calming. The intersection is raised. Landscaped intersections with recessed planting facilitate sight triangle visibility and integrate green infrastructure. Landscaped chicanes on one street help slow down vehicles. Other options include mini-roundabouts and off-set curb extensions which alternate parking, to slow drivers.

Crosswalks. The crosswalks are reconstructed with special pavement. They retain their white stripes for visibility and are clearly defined as crosswalks.

Accessibility. The curb ramps are altered to meet the raised intersection.

Sidewalks. A sidewalk is added where there is none. The intersection of two sidewalks is chamfered in recognition that people do not normally turn with precision.


3
4
STOP

3.3 INTENSIFICATION: LOCAL TO ARTERIAL

Arterial connections are not preferred, however they do exist in Vaughan.* In the Complete Streets approach, it is the receiving street that informs the geometric design of the intersection.

EXISTING TYPICAL CONDITIONS

Lane width. The lanes on both streets are wider than necessary.

Corner radii. The corners, especially for turning into a local street, allow higher speed turns and promote poor yielding behaviour.

Cycle facilities. None.

Traffic calming. None.

Crosswalks. While there is technically a crosswalk at the local street, it is not striped. Thus, drivers have no indication to expect people. There is no crossing at the arterial.

Accessibility. There are no detectable warning strips (DWS) at the pedestrian ramps.

Intersection control. There is a stop sign for the local street, but the arterial is free flow. Turning left from the local street is problematic at best.

Sidewalks. Sidewalks exist but may be too narrow for an area designated Intensification.

Transit. None.

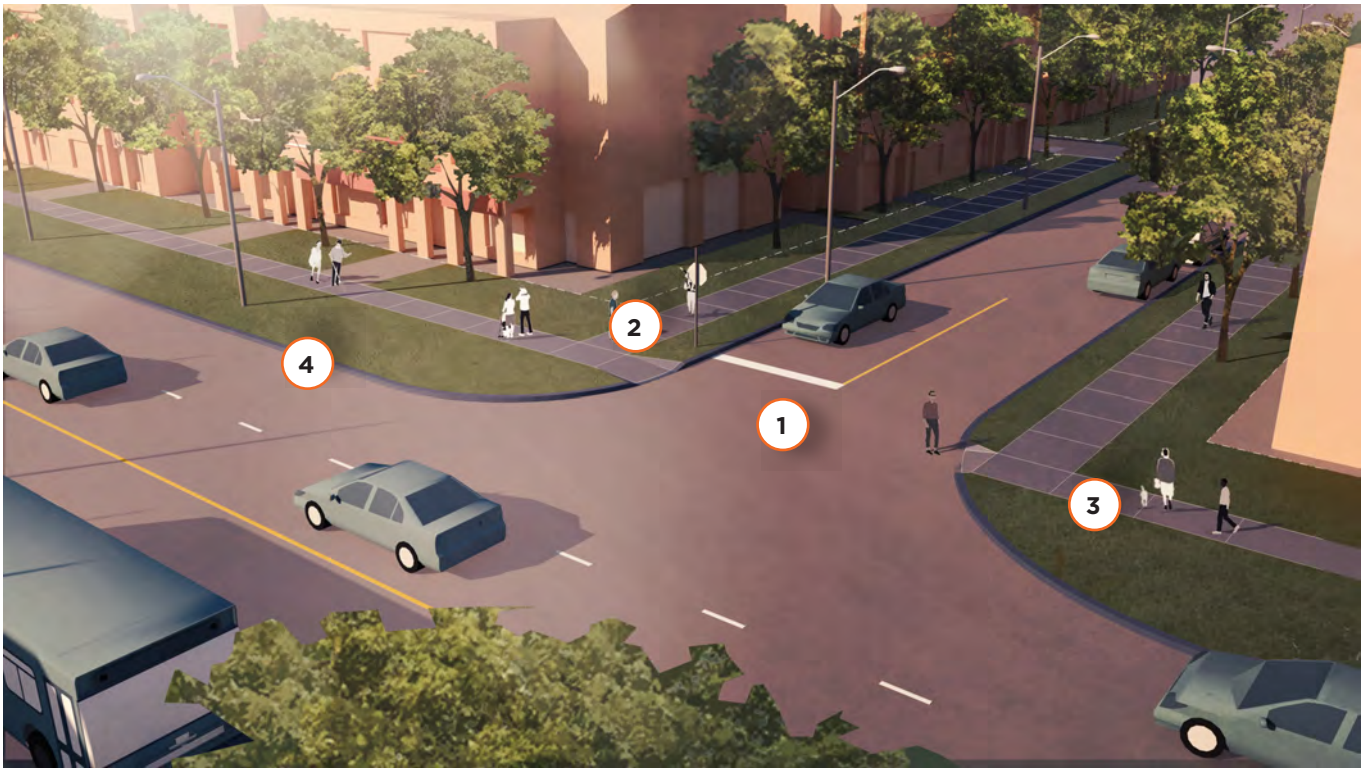
Street Trees. Existing street trees and green infrastructure (GI) along regional arterials as per York Region standards.

Representative Intersections. The intersection of Major Mackenzie Drive W and Jackson Street in Vaughan, is an example of a local and arterial street in an intensification context.

*Arterial to local connections require approval from the City.

EXISTING TYPICAL CONDITIONS

1. No marked crosswalks
2. No DWS
3. Large corner radii
4. No cycle facilities



RETROFIT

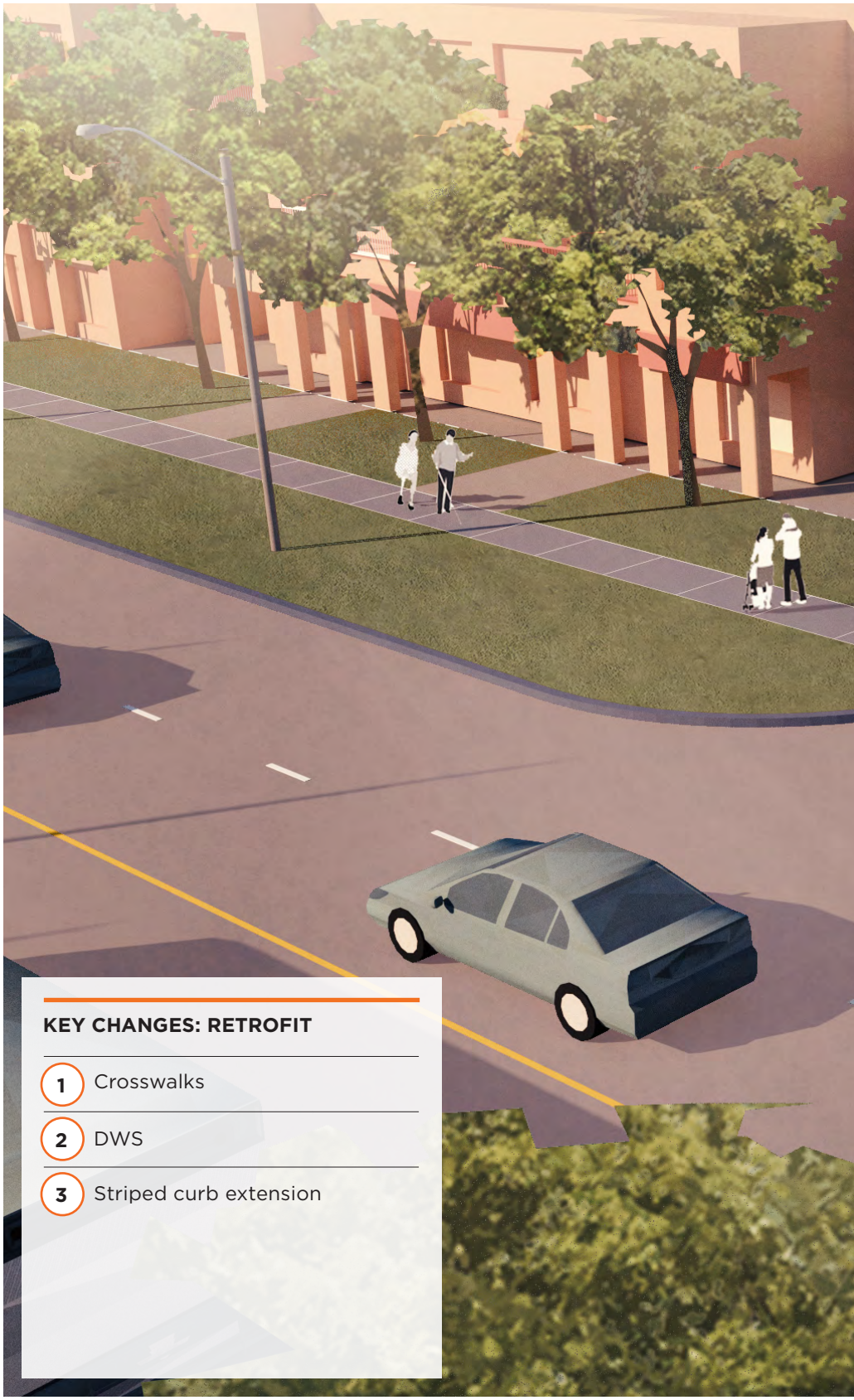
Lane width. A curb extension is added to one side of the local street, formalizing the parking lane.

Corner radii. The corners are tightened via striping and bollards. This will force drivers to slow their turns and will increase yielding.

Crosswalks. The crosswalk at the local is upgraded to the ladder style. The stop line is set back to allow cyclists to queue ahead of other vehicles.

Accessibility. Detectable warning strips (DWS) are added to the pedestrian ramps.

Street Trees. Existing street trees retained and protected where possible.



KEY CHANGES: RETROFIT

1. Crosswalks
2. DWS
3. Striped curb extension


1
2
3

RECONSTRUCTION

Lane width. The curb extension is reconstructed and landscaped. A median with median tips is added to the arterial.

Corner radii. The striped area is reconstructed and landscaped. It is integrated with the cycle track.

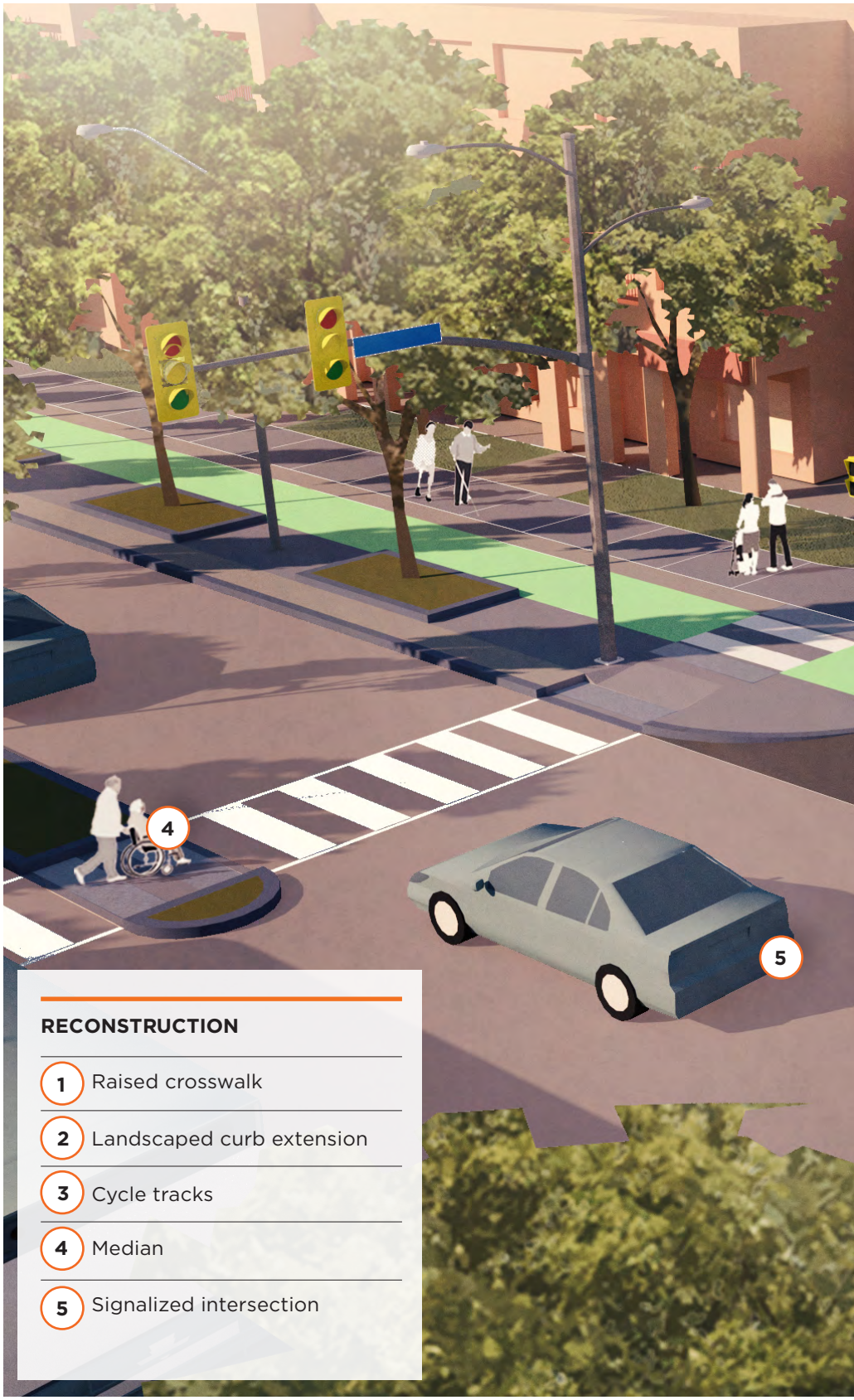
Cycle facilities. Cycle tracks are added along the arterial.

Crosswalks. The crosswalk at the local street is converted to a raised crosswalk. This creates an uninterrupted walkway along this major street.

Accessibility. Detectable warning strips (DWS) are added throughout.

Intersection control. A traffic signal is added. It includes a leading pedestrian interval (LPI) in both directions, with a leading bike interval (LBI) along the arterial. Left turns into the local street may be restricted.

Sidewalks. The sidewalk along the arterial is widened. The sidewalk corners are chamfered.



RECONSTRUCTION

1. Raised crosswalk
2. Landscaped curb extension
3. Cycle tracks
4. Median
5. Signalized intersection


1
2
3

3.4 INTENSIFICATION: COLLECTOR TO COLLECTOR

The intersection of two collector streets is common in Vaughan. Usually, a collector is the primary route out of a neighbourhood, and it is used by all ages, abilities, and modes.

EXISTING TYPICAL CONDITIONS

Lane width. One street has a typical 4-lane cross section, while the other has a four lanes plus a left turn lane. Both seem oversized for collectors.

Corner radii. The corners were probably designed to allow large but infrequent trucks to turn into the curb lane.

Cycle facilities. None.

Traffic calming. None.

Crosswalks. The crosswalks are just two striped lines, which may be faded from age and winter weather. The stop line is too near the crosswalk.

Accessibility. The crosswalks meet at the apex of the sidewalk, so there is only one pedestrian ramp with detectable warning strips (DWS).

Intersection control. There is a typical traffic signal with a leading left-turn signal and Right-Turn-On-Red (RTOR).

Sidewalks. The sidewalks are not of sufficient width to support anticipated pedestrian volume.

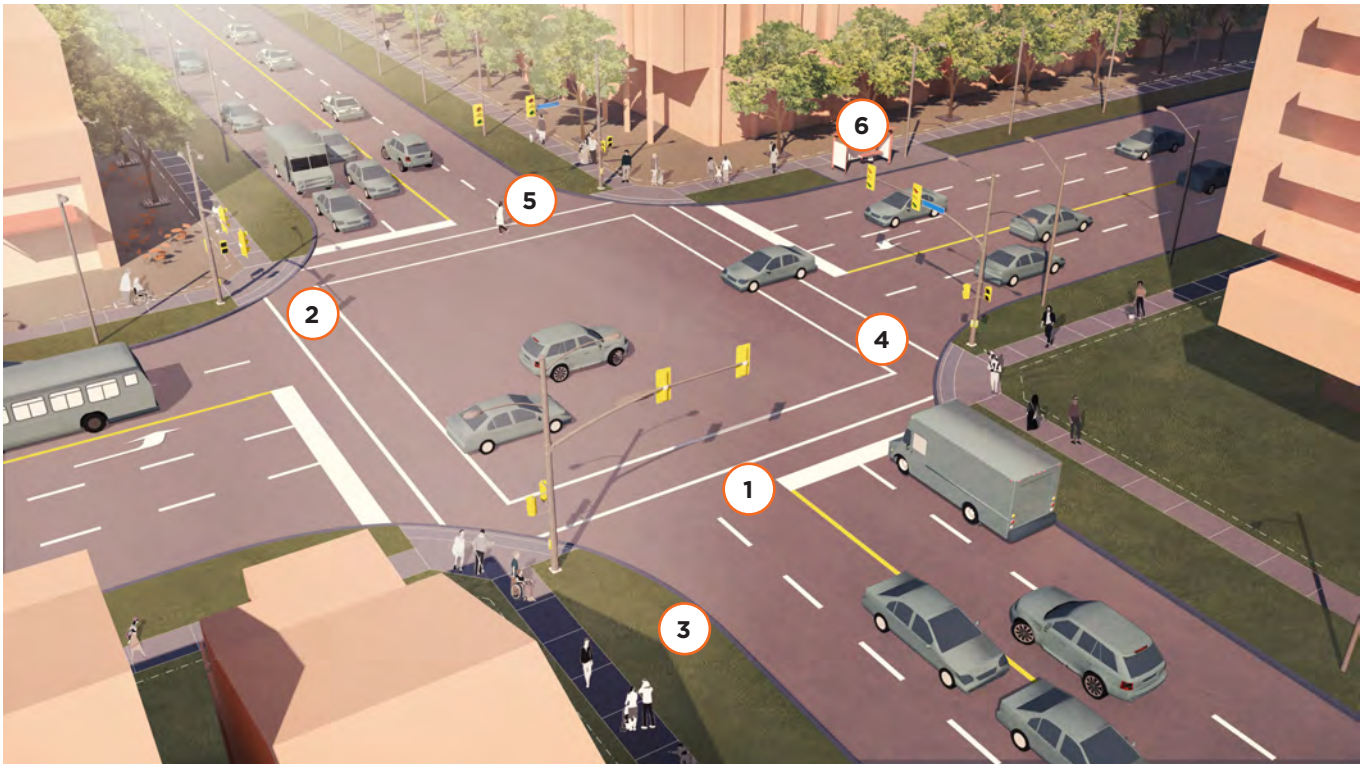
Transit. The bus stop is near-side.

Street Trees. Existing street trees and GI along regional major collectors as per York Region standards.

Representative Intersections. The intersection of New Westminster Drive and Brownridge Drive/W Promenade in Vaughan, is an example of a major collector and minor collector street in an intensification context.

EXISTING TYPICAL CONDITIONS

1. 4+ lanes
2. Large corner radii
3. Typically no cycle facilities
4. Simple crosswalks
5. Typical traffic signal
6. Near-side bus stop



RETROFIT

Lane width. The 4-lane street is converted to three lanes with cycle lanes. The 5-lane street is converted to four lanes with cycle lanes. The left lane may become a left turn lane as warranted. The lane widths are reduced so that buffer can be added adjacent to the cycle lane.

Corner radii. With the addition of cycle lanes, turns are farther from the corner. A striped section is added with bollards to keep drivers from cutting the turn and out of the bike box.

Cycle facilities. Protected cycle lanes are added. Turning pockets are placed at the corners to allow cyclists to wait as they complete a 2-stage turn. The cycle lanes are dashed through the intersection.

Crosswalks. The crosswalks are relocated to allow for the cycle lanes. They are striped with "ladders". The stop lines are set back.

Intersection control. Right-Turn-On-Red (RTOR) is removed. The leading left turn signal is replaced with leading pedestrian and cycle indicators, which is consistent with legally required yielding by turning drivers. There may be a lagging left turn.

Transit. A shelter is added to the bus stop. A queue-jump may be added.

Street Trees. Existing street trees retained and protected where possible.

KEY CHANGES: RETROFIT

1. Road diet
2. Slower turns
3. Protected cycle lanes
4. High visibility crosswalks
5. No RTOR + Leading Pedestrian Interval (LPI) and Leading Bike Interval (LBI)


5
2
1
3

RECONSTRUCTION

Corner radii. Landscaped curb extensions are installed. This further codifies the changes of the retrofit.

Cycle facilities. The cycle lanes are converted to cycle tracks. The bike boxes are converted to a protected intersection.

Crosswalks. With the curb extensions and cycle tracks, the crosswalks are shortened. There are mini crosswalks at the cycle tracks.

Accessibility. Pedestrian ramps and detectable warning strips (DWS) are added at each crosswalk (not at the apex of the corner).

Intersection control. No change from retrofit.

Sidewalks. The sidewalks are widened.

Transit. Consider moving bus stop to far-side as shown.

KEY CHANGES: RECONSTRUCTION

1. Landscaped curb extensions
2. Cycle tracks
3. Far-side bus stop


1
2
3

3.5

EMPLOYMENT: ARTERIAL TO COLLECTOR

The junction of an arterial and collector is challenging. Most of the traffic from the collector turns onto the arterial, whereas most of the traffic on the arterial continues through the intersection. In contrast, most people walking or cycling prefer to cross the arterial to access a transit stop or the neighbourhood on the other side.

EXISTING TYPICAL CONDITIONS

Lane width. The number of lanes and widths thereof should be analyzed to see if they align with VOP goals.

Corner radii. The corners were probably designed to allow large but infrequent trucks to turn into the curb lane.

Cycle facilities. The arterial has sharrows, which is sub-standard for this type of street.

Traffic calming. None.

Crosswalks. The crosswalks are lengthy and not protected by median tips.

Accessibility. There are pedestrian ramps, but they lack detectable warning strips (DWS).

Intersection control. There is a typical traffic signal with a leading turn signal and Right-Turn-On-Red (RTOR).

Sidewalks. One side of the collector lacks sidewalks.

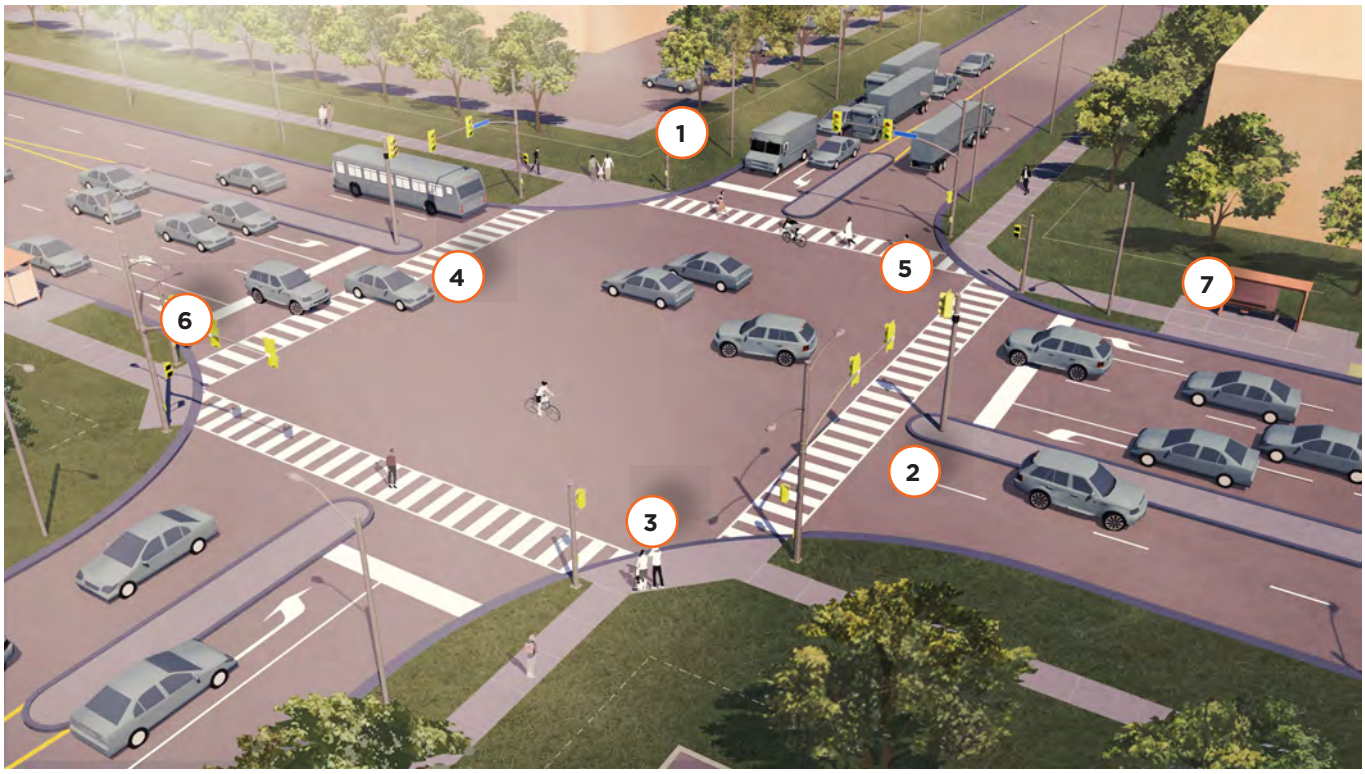
Transit. The bus stop is near-side.

Street Trees. Existing street trees and GI along Regional arterials as per York Region standards.

Representative Intersections. The intersection of Jane Street and Courtland Avenue in Vaughan, is an example of an arterial and minor collector street in an employment context.

EXISTING TYPICAL CONDITIONS

1. No sidewalk
2. 4+ lanes
3. No DWS
4. No median tips
5. Large corner radii
6. No cycle facilities
7. Near-side bus stop



RETROFIT

Lane width. The vehicle lanes remain the same. The median tips extends through the right turn lane. This directs drivers to turn right, as opposed to unexpectedly continuing straight.

Corner radii. The corners are tightened with paint and bollards. This shortens the crosswalk. Trucks and buses can still make the turn, albeit more slowly and using all the receiving lanes.

Cycle facilities. The sharrows are removed.

Crosswalks. Median tips are added. These provide a waiting area for people in the crosswalk.

Accessibility. Detectable warning strips (DWS) are added.

Intersection control. Right turn on red (RTOR) is removed. The leading left turn signal is replaced with leading pedestrian and cycle indicators, which is consistent with legally required yielding by turning drivers. There may be a lagging left turn.

Sidewalks. A sidewalk is added where missing and converted to multi-use path (MUP). Normally this would not occur until the reconstruction phase, but this is designated *employment.*

Transit. A queue-jump may be added.

Street Trees. Existing street trees retained and protected where possible.

KEY CHANGES: RETROFIT

1. MUP
2. DWS
3. Median tips
4. Slower turns
5. Right-turn lane markings
6. No RTOR + Leading pedestrian Interval (LPI) and Leading Bike Interval (LBI)


1
5

RECONSTRUCTION

Lane width. The right turn lane is removed.

Corner radii. The corners are reconstructed as per the retrofit.

Cycle facilities. Cycle tracks are added to both streets. They continue through the intersection protected by the reconstructed corner.

Crosswalks. The median tips are reconstructed as per the retrofit. Crosswalks are added at the cycle tracks.

Accessibility. Detectable warning strips (DWS) are added throughout.

Sidewalks. The sidewalks are widened, and more street trees are added.

Transit. The bus stop is moved to the far-side.


3
1
2

3.6 NATURAL: TRAIL TO ARTERIAL

The lack of crossings where trails and paths meet arterials is all too common in Vaughan. Providing safe crossings for pedestrians and cyclists at these points will create more complete networks and connect neighbourhoods.

EXISTING TYPICAL CONDITIONS

Lane width. None.

Corner radii. None.

Cycle facilities. There are gates at the entrance to the trail. These are the cause of numerous cycle crashes, create trail congestion, and there are better ways to restrict motorized access.

Traffic calming. There is no indication to drivers of the presence of the trail nor that people might be crossing.

Crosswalks. The trail does not cross the road and there is no facility for cyclists or walkers to continue their journey.

Accessibility. There is no accessible route to cross the street.

Intersection control. None.

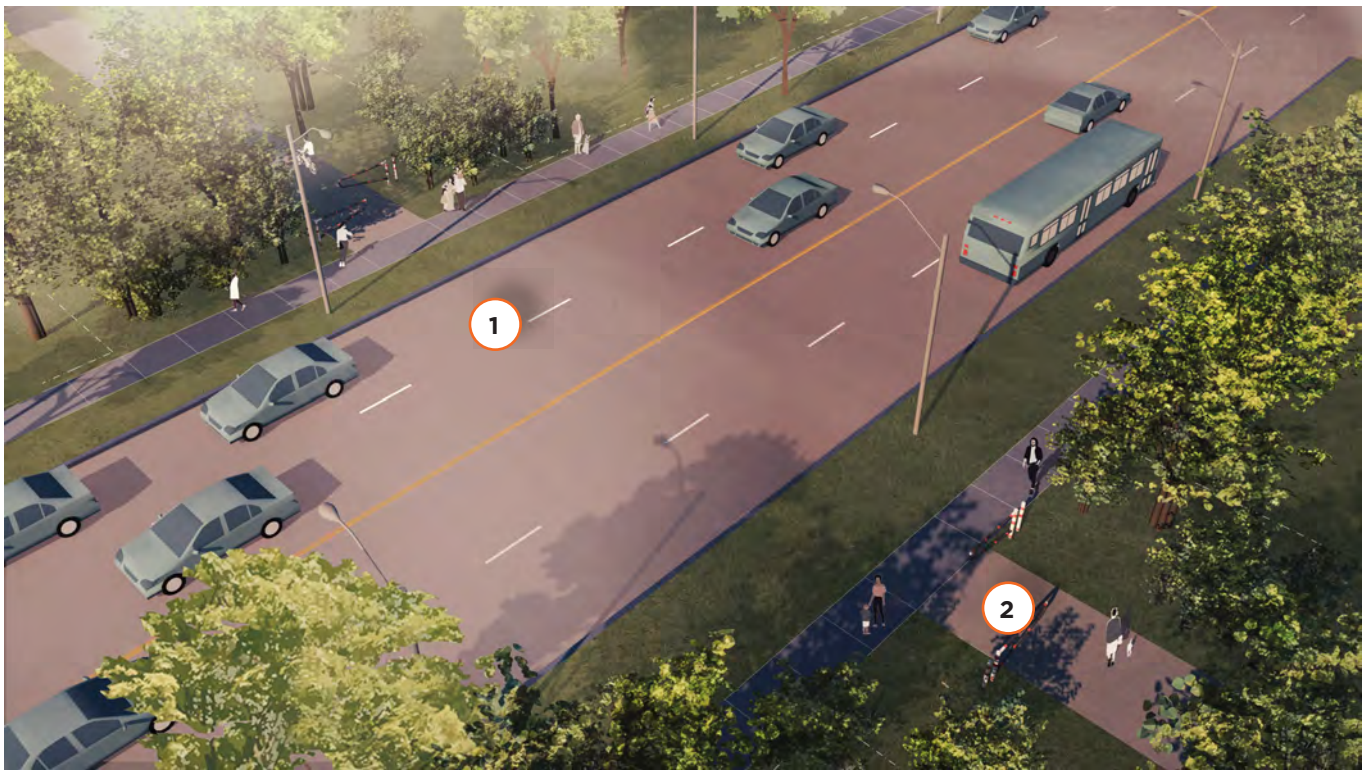
Sidewalks. There is no indication of the trail crossing the sidewalk.

Street Trees. Existing street trees and GI along Regional Arterials as per York Region standards.

Representative Intersections. The intersection of William Granger Greenway and Rutherford Road in Vaughan, is an example of a trail and arterial street in a natural context.

EXISTING TYPICAL CONDITIONS

1. No trail crossing
2. Gates block trail access



RETROFIT

Lane width. The lanes are narrowed at the trail crossing to install a safety island.

Cycle facilities. The gates are removed and replaced with flexible bollards. A minimum of 1.8m clear is provided for cycles with and without trailers. A center line leading up to the crossing is added.

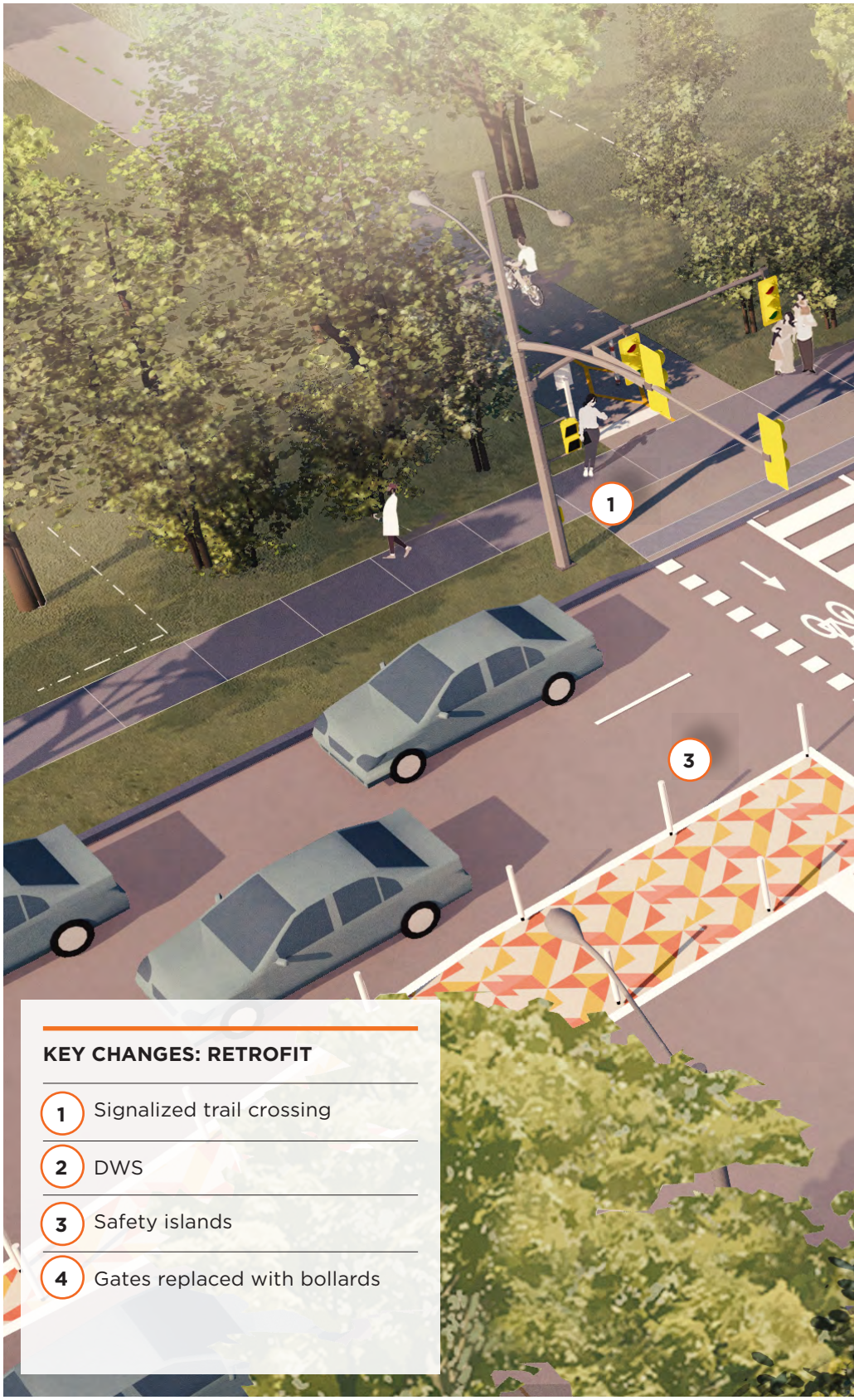
Traffic calming. Safety islands with bollards are added.

Crosswalks. A crosswalk and crossride are added.

Accessibility. The crosswalk included ramps and detectable warning strips (DWS).

Intersection control. A traffic signal is added. The signal either changes quickly for people crossing the street or is timed with other signals. Additional lighting is included to ensure safety and night-time visibility.

Street Trees. Existing street trees retained and protected where possible.




2
4

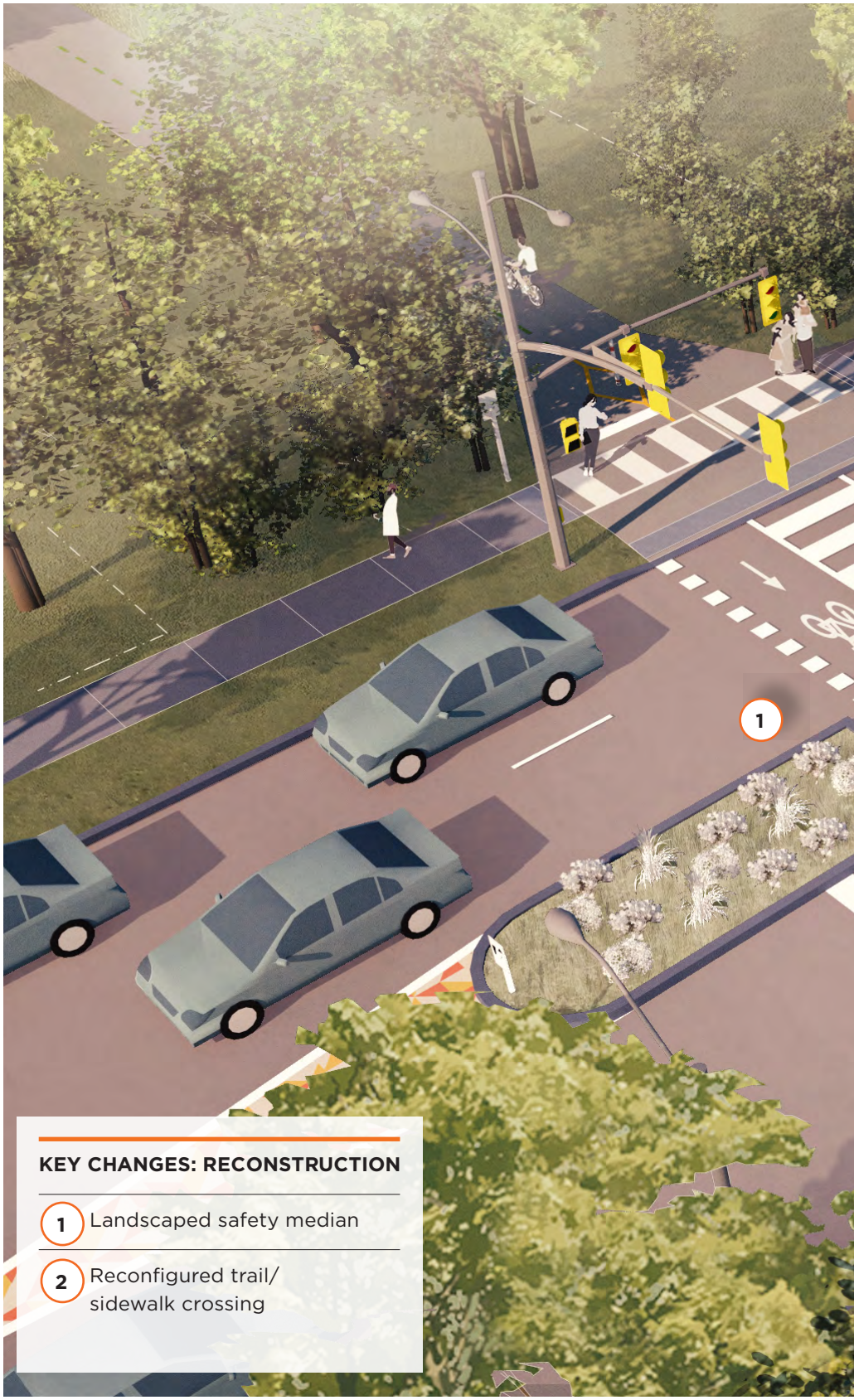
RECONSTRUCTION

Traffic calming. The safety islands are landscaped.

Crosswalks. None.

Accessibility. Detectable warning strips (DWS) are added to the sidewalk where it crosses the trail.

Sidewalks. The sidewalk is replaced with a crosswalk where it crosses the trail.

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CHAPTER 4
ELEMENTS

4

Chapter 4 provides guidance for the typical elements that make up a Complete Street. The elements are organized to focus on the most vulnerable users first to support the guiding principles stated in Chapter 1 and "outside-in" approach in Chapter 2.

4.1 OVERVIEW

Chapter 4 is primarily written for two audiences: the street designer and the street design reviewer. It describes the general techniques for Complete Streets design.

The guidelines within this chapter supplement rather than replace existing sources of detailed engineering guidance. Much of the guidance is informed by TAC's Geometric Design Guide for Canadian Roads (TAC 2017), Ontario Traffic Council Manuals (OTM), best practice from numerous jurisdictions throughout Canada and the US, and recent Vaughan efforts. References are provided for techniques where established City guidance is already provided.

All street projects will follow these guidelines.

Not all elements are required for each street in Vaughan. For example, certain streets do not have Frontage/Marketing Zones given the land uses that address the street, and not all streets have formal or dedicated cycling infrastructure. The applicability of each element per street classes is discussed in this chapter.

These guidelines are not perscriptive. Designers have agency and discretion to do their best work.

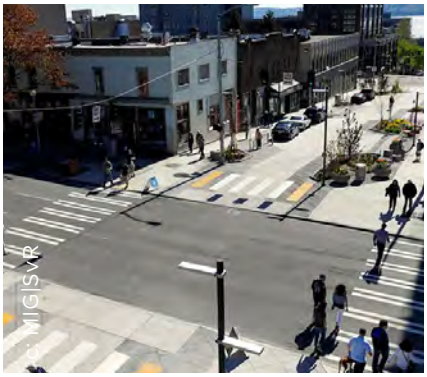


Figure 4.1. Elements of Complete Streets.

4.1.1 Organization

This chapter is organized into the five components common to all streets in Vaughan.

4.2 Pedestrian Realm and Placemaking provides Complete Streets guidance for elements typically found in the boulevard, such as the pedestrian clearway, the planting and furnishing zone, the edge zone, and other curbside management or placemaking opportunities.

4.3 Cycling Infrastructure focuses on where people cycle. Depending on the context, cycle infrastructure can either be part of the boulevard or part of the roadway.

4.4 Travelway provides complete streets guidance for the design of the parts of the street where transit infrastructure, trucks, vehicles, emergency vehicles, on-street parking and curbside management are located.

4.5 Infrastructure provides guidance for green infrastructure, street trees and landscaping and utilities.

4.6 Intersections provides techniques for designing more complete intersections.

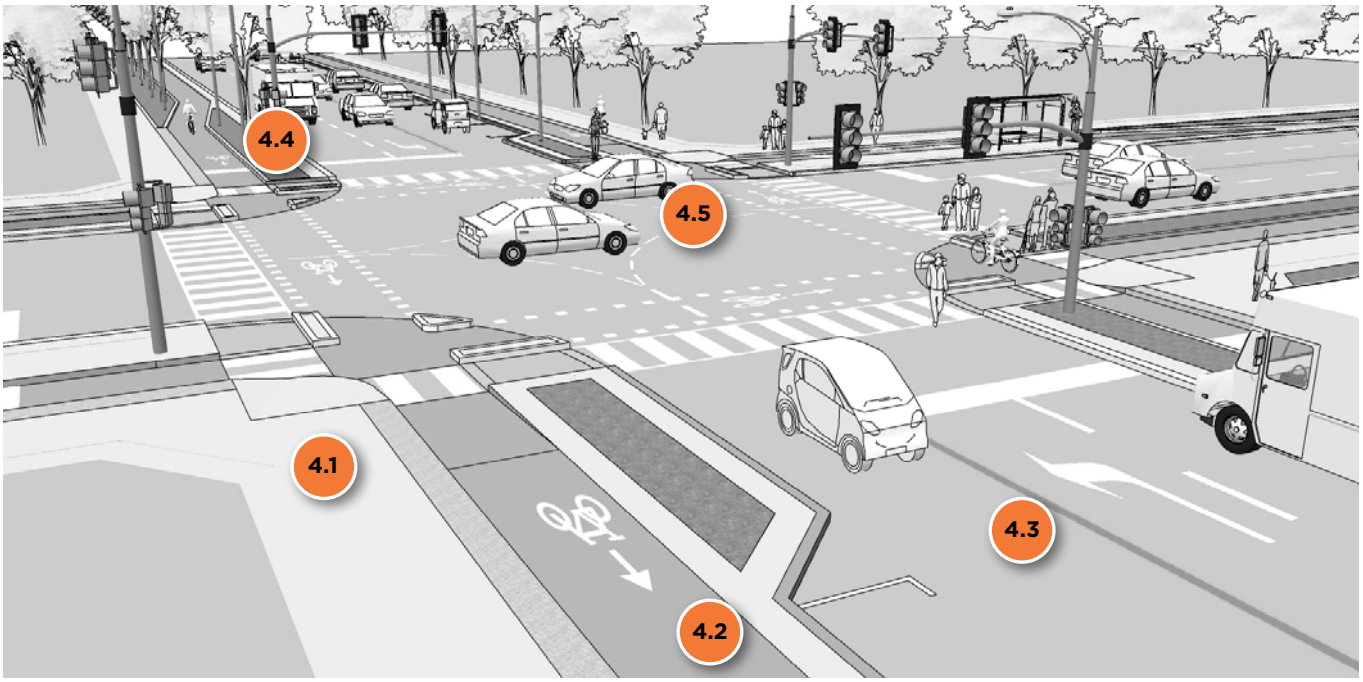


Figure 4.2. Chapter 4: Organization of elements and techniques by street component.

4.1.2 Page Structure

The guidance in Chapter 4 follows a consistent page structure, as illustrated in the figure below.

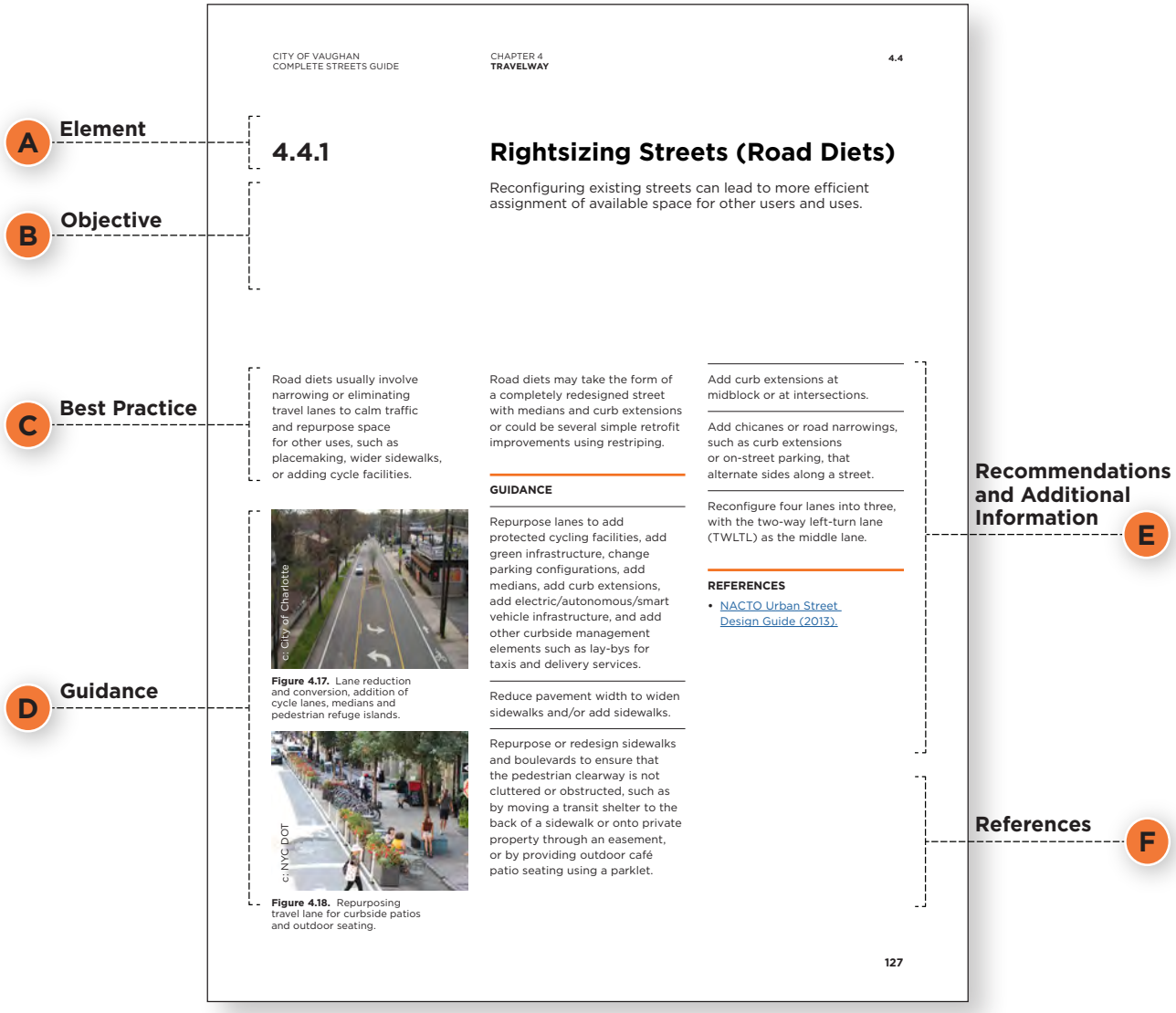


Figure 4.3. How to use Chapter 4: example of typical page structure.

4.2 PEDESTRIAN REALM AND PLACEMAKING

The pedestrian realm is an integral part of Vaughan's transportation system. Space within the ROW should first and foremost be allocated to protect pedestrians, encourage walking, and support placemaking. Once this is accomplished, all other required modes of travel, including cycling, transit, and automobiles are accommodated.

PRINCIPLES

Accessibility and Mobility. The top priority in boulevard design is to provide safe and inclusive sidewalks for all users regardless of physical abilities or age. Ensure clear, unobstructed continuous paths of a suitable and context sensitive width to serve existing and anticipated pedestrian flow.

Provide Continuous Sidewalks. Places that support walking are healthier, more successful, and resilient. Enhance walkability and the overall network by providing clear and continuous sidewalks on both sides of the street with dedicated space for pedestrians safely separated from vehicles.

Design for Comfort. Provide comfortable, efficient, and four-season sidewalks, with street trees offering shade and relief from sun, space for snow storage, and protection from rain and wind.

Design for Resiliency. Incorporate green infrastructure such as permeable surfaces, stormwater management systems, vegetated curb areas and street trees. These green streetscape design elements work together as part of a system to provide ecological, hydrological, and placemaking functions.

Placemaking. Sidewalks are as much social meeting places as they are movement and infrastructure corridors. Design sidewalks to provide comfort and be inviting, with seating, cafés, trees, public art, and places to gather. Create opportunities for placemaking.

Flexibility. Design sidewalks to evolve with changing demands. Consider the street's context for current and future uses.

Design for Efficient Maintenance. Well-considered sidewalks are durable and easier to maintain. Provide adequate access to utilities. Coordinate upgrades where possible to minimize impact to pedestrian movement caused by damage and repairs. Provide sufficient soil and water for street trees to reach maturity.

4.2.1 Boulevards

Boulevards play a critical role in the character, function, and inclusivity of streets.

The boulevard is where people walk and linger, sit under the shade of trees, dine at outdoor cafes, wait for the bus, and more. It is defined by the following four sub-zones. The sub-zones are listed in order of primacy, i.e. the pedestrian clearway is most important.

The width and design of each zone varies based on street class in accordance with Table 4.1.

Pedestrian Clearway/Sidewalk. This is the most important area within the ROW. It is where people walk, interact, and wait to cross the travelway.

Furnishing/Planting Zone. This is the space typically between the pedestrian clearway/ sidewalk and the edge zone or cycle facility. Street trees, street lighting, street furniture and public wayfinding are located within the furnishing and planting

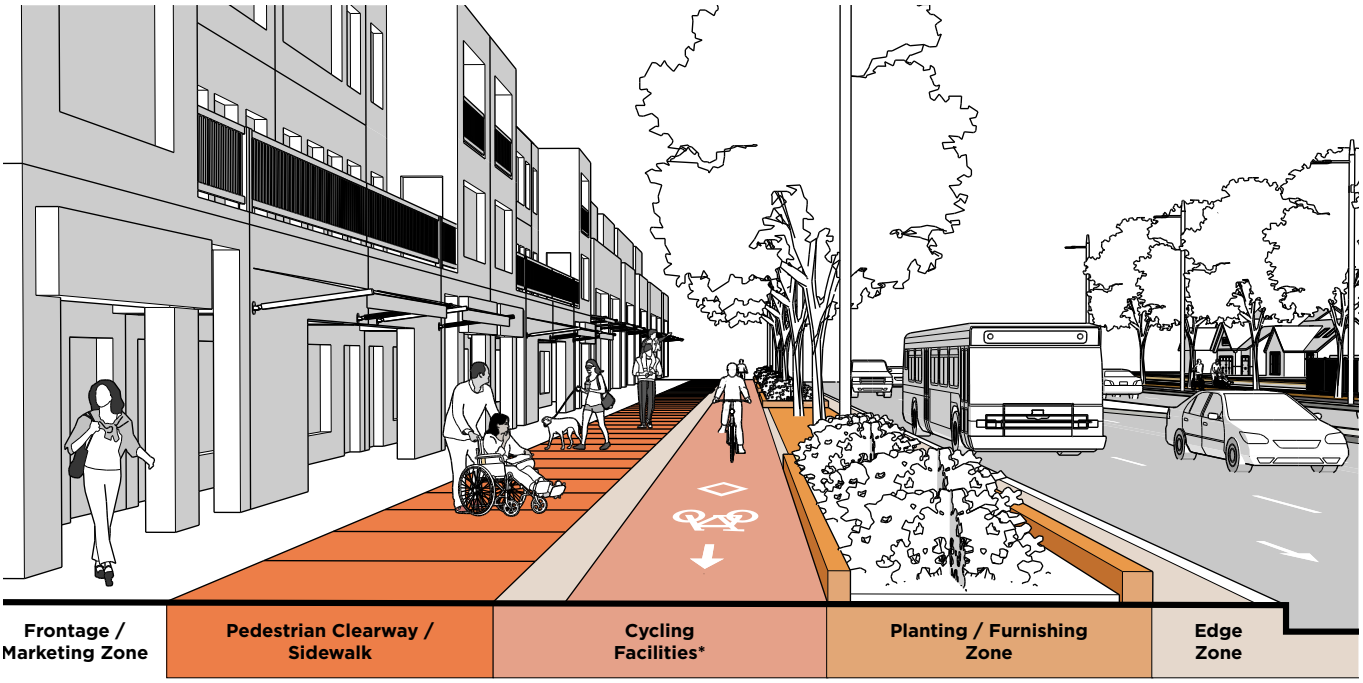


Figure 4.4. Sub-zones in boulevards. *Boulevards may or may not include cycle tracks.

zone. Refer Section 4.5.1 for street tree planting and Section 4.5.2 for green infrastructure elements guidance within the furnishing and planting zone.

Edge/Curb Zone. This is the space that typically occupies from the face of curb to the edge of the Furnishing and Planting Zone. The edge zone is a hard surfaced area to accommodate door swings, salt splash and snow storage.

Frontage/Marketing Zone. The frontage zone is the area between the pedestrian clearway/ sidewalk and the building face. This area includes building entrances, doorways, gates to front yards, stoops, space for window shopping, vending, café seating, and building-related utilities such as gas meters. In Vaughan, this area is often on private property. The dimensions of this area will vary and often increases only after other space requirements are met, particularly the pedestrian clearway.

Table 4.1 Sub-zones within a Boulevard

Street Classification		Pedestrian Clearway (m)		Planting/Furnishing Zone (m)		Edge/Curb Zone (m)	
		Minimum	Target	Minimum	Target	Minimum	Target
I	Arterial	2.0	3.0	2.0	2.5	0.8	1.0
C		1.8	2.0	2.0	2.5	0.8	1.0
E		1.8	2.0	2.0	2.5	0.8	1.0
N		1.8	2.0	2.0	2.5	0.8	1.0
I	Major Collector	2.0	3.0	2.0	2.5	0.6	0.8
C		1.8	2.0	2.0	2.5	0.6	0.8
E		1.8	2.0	2.0	2.5	0.6	0.8
N		1.8	2.0	2.0	2.5	0.6	0.8
I	Minor Collector	1.8	2.0	2.0	2.5	0.5	0.6
C		1.8	2.0	2.0	2.5	0.5	0.6
E		1.8	2.0	2.0	2.5	0.5	0.6
I	Local	1.8	2.0	2.0	2.5	0.5	0.6
C		1.8	2.0	2.0	2.5	0.5	0.6
E		1.8	2.0	2.0	2.5	0.5	0.6

Note:
I- Intensification Areas; C- Community Areas; E- Employment Areas; N- Natural Areas
In the Vaughan context, the frontage zone is typically not included in the ROW.
All cross sections require a buffer area between public and private ROW. (Buffer minimum 0.5m, target 0.5m, maximum 1.0m).

REFERENCES

- City of Vaughan: Pedestrian and Bicycle Master Plan (2020).
- City of Vaughan: Inclusive Design Standards (2020).
- Accessibility for Ontarians with Disabilities Act (AODA) 2005. Design of public spaces standards (accessibility standards for the built environment).

Figure 4.5. Boulevard in mixed-use areas to have wider pedestrian clearway to accommodate higher pedestrian volumes.

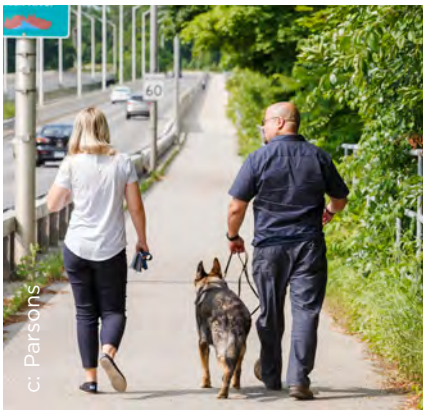


Figure 4.6. Pedestrian clearways in constrained contexts.

Figure 4.7. Boulevard with planting zones in community/residential areas.

4.2.2 Placemaking and Amenities

Streets in Vaughan are more than just corridors for movement. They shape the experience and memory of the city and are unique places to interact and enjoy.

Retrofits and new streets provide opportunities to add placemaking in concert with improving street function. Street designers shall consider how to enhance and support the social and cultural richness of the streetscape. The City of Vaughan recognizes that a high-quality public realm benefits public health, generates economic activity, fosters social connections, and makes the city more exciting and inspiring.

GUIDANCE

Street furniture includes transit shelters, benches, cycle parking, information and wayfinding signs, litter and recycling bins, kiosks, poster boards and poles, parking meters, electric vehicle and automated vehicle equipment, and automated public toilets. Ensure street furniture does not obstruct intersection sightlines or the pedestrian clearway by locating them in the furnishing and planting zone or on private property using building setbacks and easements. Target seating opportunities every 40m along streets within Intensification Areas.

Street trees and planters provide shelter from the sun, absorb noise from vehicles, provide urban cooling, and add variety to the street. Decorative hanging baskets, planters for trees and landscaping, and other visually attractive initiatives by local businesses and communities help to improve the public realm and create a sense of place. These are possible within the furnishing and planting zone or frontage and marketing zone. Placing hanging baskets, planters or landscaping in the ROW requires coordination and approval with the City.

Street lighting supports safety, activity, sense of place, and economic vitality. It includes roadway lighting and pedestrian-scale lighting. Lighting at crosswalks ensures pedestrians are visible to motorists. Lighting along walkways benefits cyclists as well.

Outdoor cafés and streeteries are seating/dining areas located on the sidewalk or in temporary curbside patios that are operated and maintained by an adjacent restaurant or café owner. Outdoor cafés or marketing displays must not impede the pedestrian clearway.

Figure 4.8. Main street lined with shops and outdoor cafés in Kleinburg, Vaughan.

Figure 4.9. Outdoor patios around street trees and open planters in Kleinburg, Vaughan.

Figure 4.10. Binder Twine festival in Kleinburg is an example of flexible boulevard.

Figure 4.11. Wide boulevards in new mixed-use developments with GI.

Public art, culture and heritage help to celebrate the identity, history, and sense of place that makes Vaughan's neighbourhoods unique. Public art, culture and heritage features enhance the sense of enjoyment and well-being of people using city streets. These elements can include street art, sculptures, plaques, painted traffic controller boxes, murals, and heritage features, structures, or sites.

Animated building façades include elements such as glazing, doors on the street, or canopies to create a welcoming microclimate or connect the inside of a building to the life of the street.

Flex Boulevards. A 'Flex Boulevard' extends the boundary of the boulevard into a parking lane to read as one space and provide flexibility in use. During winter months parking can be provided and during the summer, parking can be given over to pedestrian uses and the sidewalk occupied by outdoor seating, café patios, parklets, bike parking and bike share. This flexible zone is indicated through changes in paving materials and implemented through a system of both permanent and removable bollards, patio fences and seasonal planters. Flex Boulevards can be framed by a mountable or semi-mountable curb, depending on the context. Flex Boulevards typically support retail and commercial land uses and are located within Intensification Areas. See Section 4.4.5 for curbside management.

Adaptable Streets. Adaptable streets are typically designed without raised curbs to define the travelway, with all parts of the street blended as a single grade or surface. All modes of travel are welcome but move at extremely low speeds. Buildings are generally located close to the property line and clearly define the street edges. Adaptable Streets can support a variety of land uses, including commercial, entertainment, dining, and residences. Adaptable Streets can have a flexible design to support different uses and seasons. Adaptable Streets are located along short blocks to enable the street to be closed for temporary events such as markets, street parties, or winter festivals.

REFERENCES

- City of Vaughan: City-Wide Streetscape Implementation Manual and Financial Strategy (2014).

Table 4.2 Placemaking Opportunities by Land Use and Street Classification

Street Class	Street Furniture	Street Trees & Planters	Street Lighting	Outdoor Cafés & Streeteries	Public Art & Heritage	Animated Building Facades	Flex Boulevard*	Adaptable Streets
Intensification- Arterial	x	x	x	x	x	x		
Intensification- Major Collector	x	x	x	x	x	x		
Intensification- Minor Collector	x	x	x	x	x	x	x	x
Intensification- Local	x	x	x	x	x	x	x	x
Community- Arterial	x	x	x	x	x	x		
Community- Major Collector	x	x	x	x	x	x		
Community- Minor Collector	x	x	x	x	x	x	x	x
Community- Local	x	x	x		x	x	x	x
Employment- Arterial		x	x	x	x			
Employment- Major Collector		x	x	x	x			
Employment- Minor Collector		x	x	x	x			
Employment- Local	x	x	x	x	x			
Natural Areas- Arterial		x	x		x			
Natural Areas- Major Collector		x	x		x			

Note:
*Flex boulevards not possible in case of in-boulevard cycle tracks are present. They are only possible where active transportation is part of the roadway such as cycle lanes, and in case of dedicated parking lanes.

4.2.3 New Streets in Major Development Areas

New development is an opportunity to extend and connect Vaughan's street network.

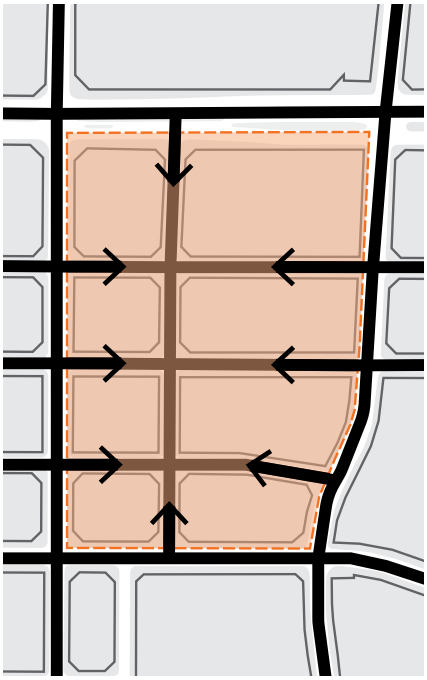


Figure 4.12. New streets to follow the existing city grid.

Vaughan's street network is largely built-out and most street design projects will occur on existing city streets. However, in some locations, new streets will become part of major new development areas.

GUIDANCE

New streets are to adhere to the guidelines.

Locate and design new streets to extend Vaughan's existing street grid wherever possible. Subdivide larger sites by streets and/or pedestrian routes with a high level of permeability for public circulation. Larger sites are defined as development sites with the capacity for several buildings.

Within larger sites, design new streets with minimal on-street parking, taking into account off-street parking provided as part of the development.

Design new streets to create a multimodal system that prioritizes walking, cycling, and transit use over private automobile use.

Connect the streets and paths to the City's larger pedestrian, cycle, and transit networks.

Integrate streetscape features such as street trees, lighting, stormwater facilities with new utilities and infrastructure.

Minimize curb cuts, using consolidated driveways for service and access functions.

New streets present the opportunity to create meaningful and unique places or designs. Large sites require a streetscape master plan to guide the design and selection of streetscape elements. Streetscape materials palettes should be internally consistent, and complement the character of surrounding areas. Streetscape elements should come from a City-approved palette.

4.3 CYCLING INFRASTRUCTURE

Cyclists are vulnerable road users and are often seriously injured in even minor collisions with vehicles. It is critical to ensure low-stress conditions to make cycling an attractive option for a wide range of ages and abilities.

PRINCIPLES

Safety: prioritize the most vulnerable road user. Cyclists and pedestrians are more vulnerable than motorists or transit riders because they are not enclosed and protected in a vehicle. Prioritizing vulnerable users means providing protection between motor vehicles and cyclists and pedestrians. In designing cycling facilities consider how to mitigate conflicts between users with design treatments and elements that respond to both pedestrian and cycling speeds.

Context appropriate. Select the appropriate cycle facility type and design elements based on street type, speed, and volume and adjacent context.

Figure 4.13. Separated cycle lanes provide better protection to cyclists.

Figure 4.14. Shared lane markings on low traffic volume streets.

Faster, busier streets require more protection, while quieter streets with low traffic volumes and low speeds may provide a comfortable cycling experience without a dedicated facility.

Design for present and future users. Cycling ridership will grow if a cycling facility is provided in a place where it was previously uncomfortable for cycling. *Build it and they will come.*

Continuous, visible, and intuitive cycling facilities. Clear delineation of the cycling path of travel and wayfinding can improve the safety of all road users. Use pavement markings, signage, grade changes between users to provide cyclists with intuitive guidance. This guidance should extend for the length of a corridor through intersections and crossings and connect with Vaughan's broader off-street cycling network.

Supply adequate cycling-supportive facilities. Support and encourage cycling by providing conveniently located and reasonably secure cycle parking especially in mixed-use, institutional, and commercial areas and around transit. Consider adding cycle repair stations (e.g., secured pumps and tools) in locations with high usage.

Provide a comfortable experience. Provide smooth riding surfaces with regular maintenance. Ensure catch basin covers are bike-friendly (refer OTM Book 18 (2021), Section 7.4), and that debris, water and ice do not accumulate where people will be cycling. Ensure routes are cleared of snow.

4.3.1 Cycling Facility Types

Design cycle facilities to minimize exposure risk, create a more comfortable cycling environment, and welcome cycling in Vaughan.

The City of Vaughan has a vision to make cycling safe, convenient and comfortable for all ages and abilities, including families with children, seniors, and new riders. A fundamental component is implementing a connected network throughout the city.

Practitioners should refer to the Ontario Traffic Manual (OTM) Book 18 (2021) facility selection process and the City's Pedestrian and Cycling Master Plan (2020), in addition to the direction provided in this Guide.

Careful attention is needed to organize interactions between cycling, transit stops, on-street parking, and curbside uses like outdoor cafes or parklets.

Vaughan's cycling network consists of a variety of facility types, see Table 4.3.

GUIDANCE

Select and design cycle facilities for an All Ages & Abilities cycling environment, based on a street's context, posted speed, and volume in accordance with Table 5.1 in City's Pedestrian and Bicycle Master Plan (2020). Separated and protected facilities are preferred.

Design the street to minimize cycle Level of Traffic Stress. Target LTS1 on local streets and collectors and LTS2 on arterials. See Fig. 4.16.

Design multi-use trails, cycle tracks and cycle lanes at bus stops in accordance with York Region's Pedestrian and Cycling Planning and Design Guidelines (2018).

Consider using on-street parking to provide a buffer between the travelway and cycling lane.

Design cycle track width to enable cyclists to pass safely, i.e. 2.2 m wide. Cycling speeds vary greatly from individual to individual and cyclists often pass each other. Wider widths are recommended in areas where there are high volumes of cyclists, cargo bikes and/or cycle trailers.

Incorporate traffic calming measures, landscaping, and other design features to encourage driver compliance with the posted speed.

When a cycle track is adjacent to a pedestrian clearway/ sidewalk, use a 600mm tactile and colour-contrasting band to provide separation between these facilities. Alternatively, a short 50–75mm height curb may be used to separate the facilities.

In retrofit scenarios, consider an on-road separated or designated facility. These facilities can often be implemented cost-effectively if space between the curbs can be reallocated from other uses. By separating cyclists from vehicle traffic, cycle tracks can offer a higher level of safety than cycle lanes and are attractive to a wider spectrum of the public.

During street retrofits consider the following strategies to address sources of cycling stress:

- **Change Design.** Change the cross-section of a street to provide dedicated space for cycling.
- **Change Operation.** Incorporate speed reduction, signalization, and curbside management.
- **Change the Network.** Divert motor vehicle traffic from a street, change travel direction, (dis)allow specific types of curbside access, and make other changes to the role of a street.

REFERENCES

- City of Vaughan: Pedestrian and Bicycle Master Plan (2020).
- OTM Book 18: Cycle Facilities (2021).
- York Region: Pedestrian and Cycling Guidelines (2018).
- NACTO Designing for All Ages & Abilities Contextual Guidance for High-Comfort Bicycle Facilities (2017).
- NACTO Urban Bikeway Design Guide (2014).

Figure 4.15. Existing cycling facilities in Vaughan.

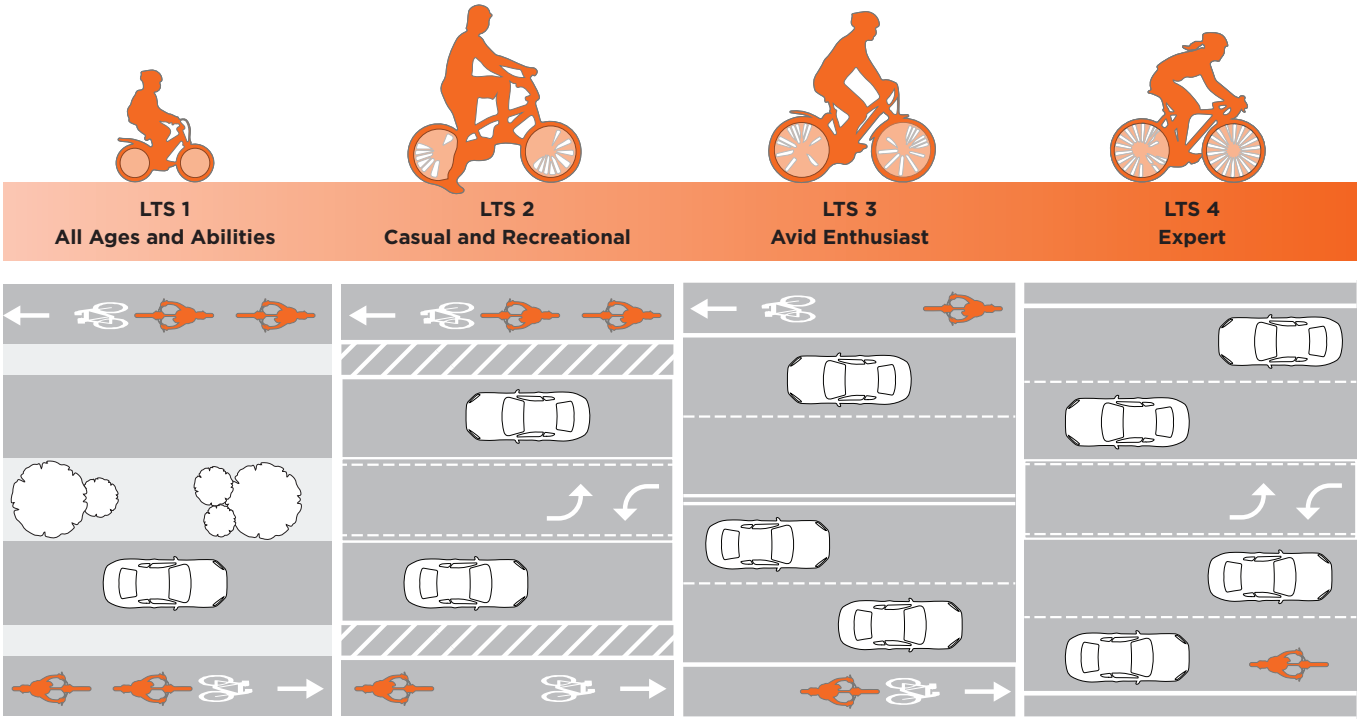


Figure 4.16. Levels of Traffic Stress (LTS) for types of cycling experience. Local streets and collectors to have LTS1 whereas arterials can have LTS2.

What is the Level of Traffic Stress (LTS)?

The level of traffic stress is a way to evaluate the stress a cyclist will experience while cycling on the street. It is used to categorize streets by the types of cyclists who are willing to use them based on the number of travel lanes, speed of traffic, number of vehicles, presence of safe cycling facilities, width of cycle lanes and presence of a physical barrier or separation.

Table 4.3 Cycle Facility Types in Vaughan

Location	Type	Description
In Boulevard	Cycle Track Facility	Designated space for cyclists, with adequate buffer from pedestrians and physically separated from motorists.
	Multi-use Pathways	Designated space shared between cyclists and pedestrians, and physically separated from motorists.
On Road	Buffered or Conventional	Designated space for cyclists, physically separated from pedestrians but no physical separation from motorists (pavement markings only).
Off-Road	Multi-use Recreation Trail	Shared space for pedestrians and cyclists, within parks and open spaces.

4.4 TRAVELWAY

The City of Vaughan recognizes the need to further rebalance its transportation network to ensure the safe and efficient movement of all forms of transportation, including pedestrians, cyclists, emergency services, transit riders, motorists, and freight haulers.

PRINCIPLES

Design streets to provide reliable, convenient, and attractive mobility choices. Encourage non-driving modes in an effort to reduce congestion.

Prioritize and protect street users (cyclists, persons with disabilities, people on foot) who do not have the benefit of a motor vehicle enclosure. Seek ways to reduce their exposure risk (e.g., rightsize travel lanes, repurpose underused road space and separate pedestrians from cyclists). Provide visible, clear, and predictable travel paths for all road users.

Create a safe environment by using design to facilitate the intended speed of travel for drivers based on the street's context. Safe speeds and driver behaviours result in fewer incidents on the roadway that can cause delays and congestion, which negatively impact emergency access and goods movement.

Consider existing and planned land uses, urban form, and the different uses of the street (e.g., social and economic activities) when making decisions about competing demands for space on the street. Seek ways to provide space, for example, through building setbacks and/or repurposing underused roadway space for streetscaping, street trees, street furniture, café or marketing areas, parklets, bicycle parking, pedestrian lighting, snow storage and removal, etc.

Limit the area of impervious materials. Seek ways to integrate street trees, landscape features, as well as water retention and treatment strategies and snow storage.

Promote non-motorized modes to reduce greenhouse gas emissions and air and noise pollution. Use materials that contribute to sustainability, life cycle performance and reduce the urban heat island effect.

4.4.1 Rightsizing Streets (Road Diets)

Reconfiguring existing streets can lead to more efficient assignment of available space for other users and uses.

Road diets usually involve narrowing or eliminating travel lanes to calm traffic and repurpose space for other uses, such as placemaking, wider sidewalks, or adding cycle facilities.

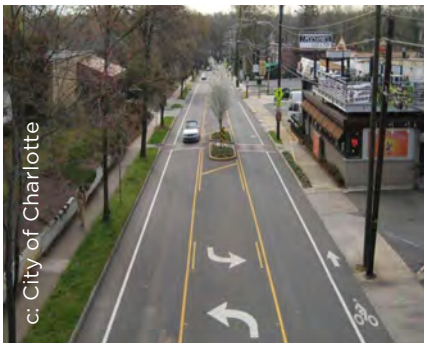


Figure 4.17. Lane reduction and conversion, addition of cycle lanes, medians and pedestrian refuge islands.

Figure 4.18. Repurposing travel lane for curbside patios and outdoor seating.

Road diets may take the form of a completely redesigned street with medians and curb extensions or could be several simple retrofit improvements using restriping.

GUIDANCE

Repurpose lanes to add protected cycling facilities, add green infrastructure, change parking configurations, add medians, add curb extensions, add electric/autonomous/smart vehicle infrastructure, and add other curbside management elements such as lay-bys for taxis and delivery services.

Reduce pavement width to widen sidewalks and/or add sidewalks.

Repurpose or redesign sidewalks and boulevards to ensure that the pedestrian clearway is not cluttered or obstructed, such as by moving a transit shelter to the back of a sidewalk or onto private property through an easement, or by providing outdoor café patio seating using a parklet.

Add curb extensions at midblock or at intersections.

Add chicanes or road narrowings, such as curb extensions or on-street parking, that alternate sides along a street.

Reconfigure four lanes into three, with the two-way left-turn lane (TWLTL) as the middle lane.

REFERENCES

- NACTO Urban Street Design Guide (2013).

Figure 4.19. Rightsizing Hillsborough Street (City of Raleigh, NC) resulted in a 23% decrease in vehicle crashes. It involved reducing four travel lanes to two, adding on-street parking, cycle lanes and a median, and widening sidewalks.

Table 4.4 Rightsizing Opportunities by Land Use and Street Classification

Land Use and Street Classification	Repurpose Lanes	Reduce Pavement	Redesign Sidewalks	Curb Extensions	Road Narrowing	Review Corner Radii
Intensification- Arterial	x	x	x	x	x	x
Intensification- Major Collector	x	x	x	x	x	x
Intensification- Minor Collector	x	x	x	x	x	x
Intensification- Local	x	x	x	x	x	x
Community- Arterial	x	x	x		x	x
Community- Major Collector	x	x	x	x	x	x
Community- Minor Collector	x	x	x	x	x	x
Community- Local	x	x	x	x	x	x
Employment- Arterial	x	x	x			x
Employment- Major Collector	x	x	x			x
Employment- Minor Collector	x	x	x			x
Employment- Local	x	x	x			x
Natural Areas- Arterial	x	x	x	x	x	x
Natural Areas- Major Collector	x	x	x	x	x	x

4.4.2 Design Speed

Lower speeds lead to safer streets, better places, and improved opportunities to support a wider range of users and uses.

Design speed is the maximum vehicle operating speed for which streets are designed. Vehicle speed is a significant factor in crash severity- higher speeds bring exponentially higher risks. Reducing vehicle speed opens a range of design options that allow a street to function and feel like part of a city, rather than a highway.

c: Guelph Today

Figure 4.20. Posted Speed Limit.

GUIDANCE

Plan and design streets to manage speed to the intended maximum as per Table 4.5. The design speed on arterials may exceed the posted by 10 km/h, otherwise the design is to equal the posted speed. This is consistent with best practices in Canada and elsewhere.

New and reconstructed streets shall adhere to the values in Table 4.5.

Design the street to discourage speeds above the design speed and to promote a safe mixing of multiple modes. There is extensive evidence that design treatments, such as narrow lanes, traffic calming measures, on-street parking, street-oriented buildings, and trees located closer to the street, result in drivers traveling at lower operating speeds. As a result of lower speeds, drivers are more cautious on streets designed in this manner. Self-regulating design is critical. Refer to traffic calming measures, Table 4.7.

Monitor and adjust Vaughan's Time of Day (TOD) signal timing to support variations of pedestrian, cycle, and vehicle demand by direction and during different times of the day and night. As an example, a street in the morning may carry mainly vehicle, cycle, and transit commuters in the peak direction, while at midday or evening the street may accommodate a greater number of pedestrians. Based on this daily rhythm, adjust traffic signal timing to meet various modal and directional demands.

Consider including Automated Speed Enforcement (ASE) as a speed management approach for traffic calming. Refer to the City's Speed Compliance Program.

'...Vaughan citizens have identified speeding as one of the City's key traffic issues..'

#SlowDownVaughan Program 2021, City of Vaughan.

REFERENCES

- ITE Technical Resources. Setting Safe Speed Limits.
- NACTO City Limits: Setting Safe Speeds Limits on Urban Streets (2020).
- World Sustainable and Safe: A Vision and Guidance for Zero Road Deaths. World Resources Institute, Global Road Safety Facility (Ben Welle et al 2018).

Table 4.5 Range of Recommended Design and Posted Speeds, based on Street Classification and Land Use

Street Classification	Design Speed (km/h)	Posted Speed (km/h)
Arterial- Intensification	40-70	40-60
Arterial- Community	40-70	40-60
Arterial- Employment	40-70	40-60
Arterial- Natural	40-70	40-60
Major Collector- Intensification	40-50	40-50
Major Collector- Community	40-50	40-50
Major Collector- Employment	40-50	40-50
Major Collector- Natural	40-50	40-50
Minor Collector- Intensification	40-50	40-50
Minor Collector- Community	40-50	40-50
Minor Collector- Employment	40-50	40-50
Minor Collector- Natural	40-50	40-50
Local- Intensification	30-40	30-40
Local- Community	30-40	30-40
Local- Employment	30-40	30-40
Local- Natural	30-40	30-40

Note:
City of Vaughan to collaborate with York Region on the design and posted speed for roads under Regional jurisdiction.

4.4.3 Lane Width

The City of Vaughan intends to narrow existing lane widths, reduce excessive pavement, and eliminate highway-like features such as shoulders and acceleration lanes.

Global best practice and current national policy promotes narrower lane widths to influence lower vehicle operating speed and make streets safer for all users. For all streets, no matter the context, avoid wider lanes than necessary. This will help to minimize roadway crossing distance for pedestrians, improve available space for other users and uses, advance sustainability, and reduce life cycle cost. Apply the same lane width guidance for all street project types.

Figure 4.21. Narrower lane widths make safer streets without impacting traffic operations.

GUIDANCE

Use Table 4.6 to establish lane widths based on design speed.

Narrow lanes where current width is more than the widths in Table 4.6.

Prioritize narrowing of lanes on streets with speeding or safety concerns.

Prioritize narrowing of lanes in areas with a higher probability of vulnerable users like school zones.

Provide wider dimensions for the curb lanes along multi-lane streets with transit or goods movement in accordance with Table 4.6.

In certain constrained conditions, narrower lane widths are possible when considering the entire design domain as defined in TAC 2017, Table 4.2.3. For example, on streets with lower design speeds (60km/h and less), 2.7m is the practical lower limit.

'Side impact- and turn-related crash rates are lowest at intersections where average lane widths are between +/-3 to 3.2m, according to a study presented at the Canadian Institute of Transportation's annual meeting in June 2015. This challenges the long-held, but often disputed, assumption that wider lanes are safer.'

The following describes the lane types listed in Table 4.6.

- **Through Lane.** Through lanes are primarily used for through traffic. They are usually closest to the centre of the roadway in the direction of traffic and also used to make left turns where dedicated lanes are not provided. Through lanes within transit routes or goods movement corridors are typically wider.
- **Curb Lane.** Curb lanes are the travel lanes closest to the curb, except for at intersections with dedicated right turn lanes or parking lanes. Curb lanes on transit routes or goods movement corridors are typically wider.
- **Left-turn Lane.** A one-way left turn lane is a marked lane for the exclusive use of left-turning vehicles at an intersection. A TWLTL is located between through lanes of opposing directions.
- **Parking Lane/Lay-by.** A dedicated parking lane or lay-by is located between the curb lane and the curb. A dedicated parking lane does not facilitate vehicule travel and is only used for parallel parking.

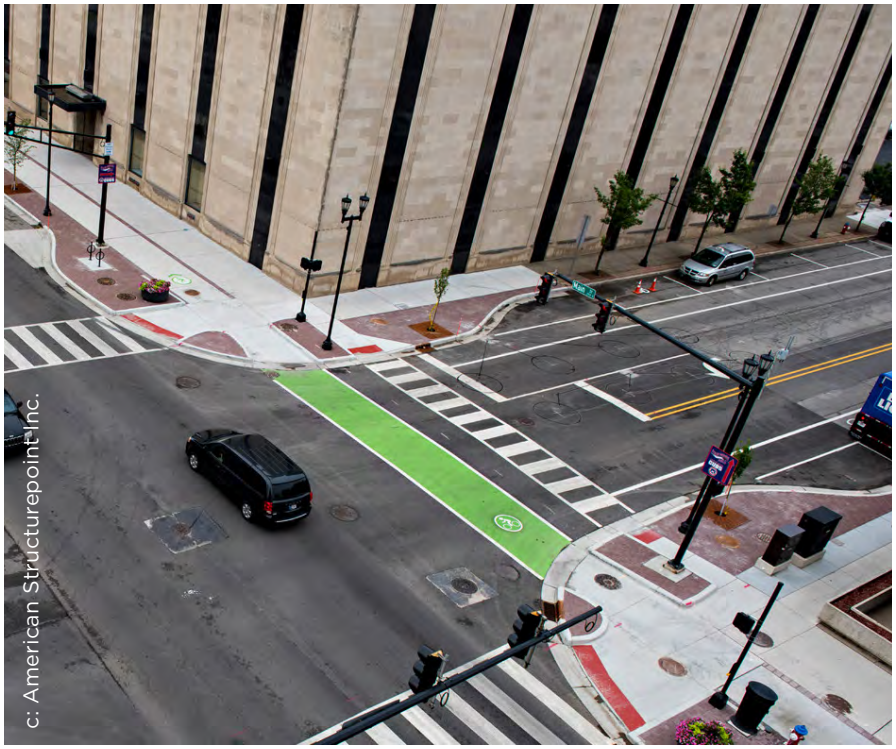


Figure 4.22. Narrower lane widths reduce crossing distances for pedestrians.

The following design considerations and assumptions will help determine lane widths.

- **Speed Limit.** Lane widths will vary based on design speed limits. In Vaughan, the target speed approach is applied, where posted speed = design speed. Roadways with higher design speeds may have wider lanes.
- **Transit Routes.** Curb lanes are typically wider on designated transit routes.
- **Strategic Goods Movement Routes.** Curb lanes are typically wider on designated truck routes.
- **Horizontal Alignment Curves.** Lanes may widen along roadways with horizontal alignment curves. Generally, buses and large trucks require more space while travelling along hortizontal curves.

Figure 4.23. Narrower lane widths improve available space and provide safer experience for other uses and users.

HOW TO ASSEMBLE A CROSS-SECTION FOR THE TRAVELWAY

It is not always possible to achieve target lane widths for all streets and all lanes. In these cases, the practitioner will need to make informed decisions when assembling the cross-section.

Following is a list of lanes and their widths, organized by priority. Begin at the first and work through the order of operations until the cross-section is assembled. No lane can increase in width beyond the **minimum** unless space for all other elements with higher priority are accomodated.

1. Curb lane (minimum).
2. Through lane (minimum).
3. Turn lane (minimum).
4. Curb lane (3.3m wide).
5. Cycling facility (minimum).
6. Curb lane (3.5m wide on 60km/h roads).
7. Curb lane with dedicated cycling facility (target).
8. Through lane (target).
9. Cycle lane (target).
10. Curb lane (target).
11. Turn lane (target).

REFERENCES

- TAC's Geometric Design Guide for Canadian Roads (2017).
- NACTO. Urban Street Design Guide (2013).
- Global Designing Cities Initiative. Global Street Design Guide (2016).
- York Region. Road Design Guidelines (2023).
- York Region. Designing Great Streets (2017).
- City of Toronto: Road Engineering Design Guidelines. Chapter 2- Lane Widths Guidelines (2017).

Table 4.6 City of Vaughan Lane Widths by Design Speed

	Design Domain		
	Recommended Lower Limit*	**Recommended Upper Limit***	**Target***
Streets with design speed 60km/h and greater**			
Through Lane	3.0m	3.3m	3.0m
Curb Lane	3.3m	3.5m	3.5m
Through Lane: Transit/GM***	3.3m	3.3m	3.3m
Curb Lane: Transit/GM***	3.5m	3.7m	3.5m
Streets with design speed 50km/h			
Through Lane	3.0m	3.3m	3.0m
Curb Lane	3.0m	3.5m	3.5m
Through Lane: Transit/GM***	3.3m	3.5m	3.3m
Curb Lane: Transit/GM***	3.5m	3.7m	3.5m
Streets with design speed 40km/h and lower			
Through Lane	3.0m	3.3m	3.0m
Curb Lane	3.0m	3.3m	3.0m
Through Lane: Transit/GM***	3.3m	3.3m	3.3m
Curb Lane: Transit/GM***	3.5m	3.5m	3.5m
Left Turn Lane: Two-way	3.0m	3.3m	3.0m
Left Turn Lane: One-way	3.0m	3.3m	3.0m
Parking Lanes/Lay-by****	2.0m	2.6m	2.4m

Note:
*Lanes are measured from the centre of stripe and/or to face of curb. Include gutter dimension within the curb lane dimension.
**City of Vaughan to collaborate with York Region on lane widths for roads under Regional jurisdiction.
***Lane width accommodating transit will vary depending on street class, route frequency, and consider existing and future transit service plans.
****2.0m wide parking lane is typical in Community areas, 2.6m wide parking lane is typical in Employment areas, 2.4m wide parking lane is typical in Intensification areas.

4.4.4 Lateral Offsets for Vertical Elements

Traditionally, clear zones are provided on highways and higher speed rural roads throughout Canada. Design and retrofit of Vaughan streets to prioritize the safety of vulnerable users is one of the key goals of the City. In urban context, clear zones are neither desirable nor applicable.

TAC 2017 (Section 7.3) defines a clear zone as an unobstructed, relatively flat area beyond the edge of the traveled way that allows a driver to stop safely or regain control of a vehicle that leaves the traveled way. This guidance was initially developed for higher speed roadways such as controlled access highways and rural roads.

Based on TAC 2017 (Section 7.7.2, page 77, "Roadside Design in Urban Environments"), the use of a clear zone ..."is not applicable, practical, or desirable for urban arterial, collector, and local streets. This is due to the typical conditions along urban streets with lower target operating speeds, denser development, limited right of way, closely spaced intersections, and multimodal street users."

Lateral offsets for utilities, while existing in the same space, are not clear zones. They are meant to ensure an adequate, function distance between the roadway and utilities. The offset between certain elements (e.g., water mains and sanitary sewer) and the roadway are legislated at the Provincial level. The offsets to street lighting, poles, traffic-related cabinets, and trees are informed by TAC 2017 (Section 7.3) and best practices.

BENEFITS

Vertical elements (curbs, barriers, bollards) located between the roadway and boulevard help to keep errant vehicles in the roadway and protect people on the boulevard.

Lateral offsets reduce conflicts with vehicle mirrors and other protruding objects.

Lateral offsets provide space to exit a parked vehicle.

In urban environments, approximately 80% of roadside collisions involve objects with a lateral offset from the curb face equal to or less than 1.2m and approximately 90% of urban roadside collisions have lateral offsets less than or equal to 1.8m. An enhanced lateral offset of 1.2m to 1.8m is therefore desirable.

APPLICABILITY

All Vaughan streets.

GUIDANCE

The guidance that follows is consistent with TAC 2017 Section 7.7. "Roadside Design in Urban Environments".

- Clear zones are not desirable or applicable for all Vaughan streets given the urban setting and recommended design speeds.
- Place vertical fixed objects at a desirable lateral offset between the roadway and boulevard elements to increase safety of vulnerable users and reduce exposure to errant vehicles.
- For streets with curbs, which is most Vaughan streets, provide a minimum lateral offset of 0.5m for all vertical elements.

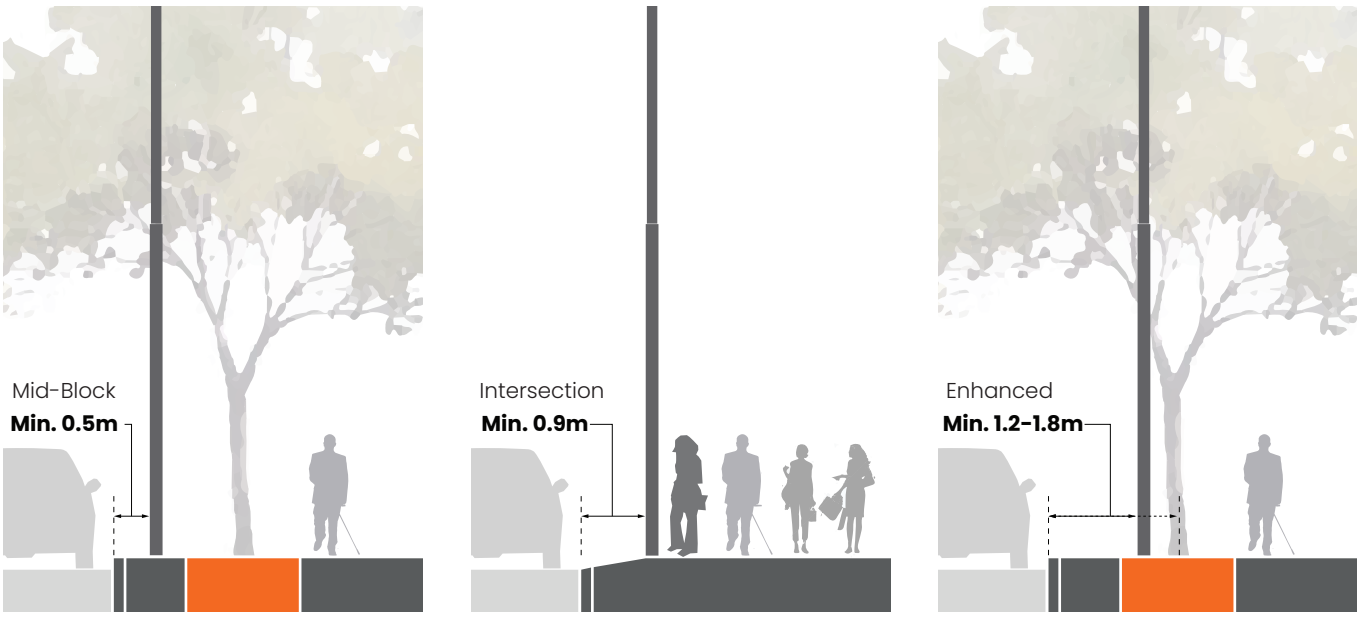


Figure 4.24. Lateral offsets for Vaughan streets, based on TAC 2017 Guidance. All measurements from face of curb. Midblock: minimum 0.5m; intersections: minimum 0.9m; enhanced offset for Urban Streets where space permits: 1.2m to 1.8m.

- At intersections provide a minimum lateral offset of 0.9m to reduce the risk of overhanging trucks hitting objects.
- Expand lateral offsets only where the needs of other users are met. A greater lateral offset is possible for most of Vaughan's street types given the width of ROWs and boulevards.
- Coordinate the lateral offset of vertical elements in the Edge Zone and Furnishing and Planting Zone.
- Locate utility fixtures and appurtenances to not interfere with the Pedestrian Clearway.
- If a greater lateral offset is desired for higher speed streets but is not practical, the design team should identify and treat critical urban roadside locations (TAC 2017, 7.3.4.1).
- Locations prone to increased collision risk on higher speed urban or rural-urban transition area corridors include the following:
  - » Objects located on the outside of horizontal curves.
  - » Objects near lane merge points (e.g., lane drop, termination of an acceleration lane, etc.).
  - » Objects at driveway and intersection locations and on the inside of tight horizontal curves that create sightline obstructions.
  - » Objects too close to the corner of an intersection.
  - » Objects obstructing sightlines of pedestrians at intersections.

REFERENCES

- Chapter 7, TAC's Geometric Design Guide for Canadian Roads (2017).
- NACTO Urban Street Design Guide (2013).
- AASHTO (2018). A Policy on Geometric Design of Highways and Streets, 7th Edition. Chapter 4, Cross Section Elements, Section 4.6 Roadside Design.

4.4.5 Curbside Management

Curbsides are the space between the sidewalk and the travel lane. They support activities such as parking, transit stops and driveway entrances and are one of the biggest public spaces in Vaughan. This makes curbside space an important asset– one that needs to be strategically managed.

Future-proofing Vaughan streets requires the curbside zone to actively support adjacent land uses, encourage newer forms of mobility, and continue to support the transit and cycling network. Potential curbside activities in Vaughan include loading and courier zones, temporary uses (e.g., construction), green infrastructure, traffic calming elements (e.g., curb extensions, chicanes), streeteries, parklets, cycling facilities, and transit priority infrastructure.

GUIDANCE

Consider designated delivery, short-term drop-off, and ride-sharing drop-off locations to assist in limiting blocked vehicle lanes.

Survey local businesses and institutions to identify delivery and private passenger loading needs, potentially finding patterns to minimize curb space allocation.

Incentivize app-driven ride-shares, zero-emission electric vehicles (EV) by reducing parking spaces for private cars and allocating more curbside space for pick-up/drop-off. This could improve access to restaurants, cafes, and shops during peak periods.

Incentivize electric-assist or pedal-only cargo bikes to replace larger vehicles for last mile delivery trips. Cargo vans and bikes take up less curbside space and are inherently safer than large delivery trucks because they have smaller blind spots and less inertia, making it easier for them to slow down and stop.

Manage parking proactively. This can include variable pricing to influence on and off-peak periods, removing on-street parking in the peak direction, and other regulatory measures. Within Intensification Areas and where there is an anticipated high use of commercial sidewalk activity, encourage side street or off-street parking to free up curbside space for other uses such as seating, greenscape or parklets.

Consider EV docking, EV charging points and smart parking equipment and technologies. Care should be taken to locate charging points away from busy locations within civic spaces.

Provide transit stop amenities and cycling infrastructure at transit stops to enhance the customer experience (e.g., larger heated shelters, cycle rings).

Provide sufficient buffer space between cycling facilities and on-street parking.

Ensure that on-street parking does not obstruct critical sightlines at intersections.

Target on-street parking occupancy rate of 80%-90%. This represents an optimal balance between supply and demand.

As the transition to AV use matures, consider and evaluate opportunities to reallocate curbside space to pedestrians, cyclists, transit, pick-up and delivery, and other functions.

Examples of other uses for the curbside lane include:

- **Modal Priorities:** wider sidewalks, cycle lanes, rush hour or cycle/walk lanes, dedicated transit lanes, transit shelters with with seating and digital schedules.

- **Commerce:** weekend markets, art installations, outdoor dining areas, queue zones outside small businesses, morning or overnight freight deliveries, lunch hour street cafes, food trucks.
- **People:** parklets, temporary animations, public art.
- **Greening:** street trees, landscaping, rain gardens. **Storage:** lay-bys, delivery areas, on-street parking.

REFERENCES

- NACTO, Curb Appeal: Curbside Management Strategies for Improving Transit Reliability (2017).
- Institute of Transportation Engineers (ITE) Curbside Management Practitioners Guide (2018).

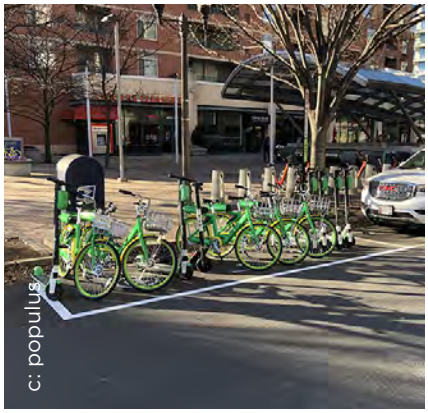


Figure 4.25. E-bike parking and charging station within parking lane.

Figure 4.26. Parking reserved for app-reserved ride-share.

Figure 4.27. EV charging in parking lane.

Figure 4.28. Functional public art on street.

Figure 4.29. Parklets and outdoor dining areas on street.

Figure 4.30. Curbside lanes as temporary parking for delivery trucks.

4.4.6 Traffic Calming

Traffic calming techniques assist in reducing vehicle operating speeds, minimize conflicts between street users, improve general road safety, and provide opportunities for placemaking.

In all cases, maintain emergency vehicle access and ensure that traffic calming projects do not significantly impact transit service. Consider pedestrian and cycle movement alongside vehicle movement when designing traffic calming projects. Avoid diverting traffic to non-arterial roadways.

Traffic calming in Vaughan includes vertical or horizontal measures and speed reduction measures. However, preference to be given to horizontal measures wherever possible.

Horizontal calming measures, such as curb extensions, pinch points, median refuge islands, on-street parking, and chicanes, physically narrow the roadway and reduce the crossing distance for pedestrians and cyclists.

Vertical measures, such as speed cushions, raised crossings and raised intersections, have a physical effect on motor vehicles and are typically the most effective measure at reducing vehicle speeds.

Speed reduction measures
Other measures such as narrower lanes, traverse markings, signage, and textured pavement may calm traffic slightly. Preference is given to horizontal and vertical measures.

Traffic calming elements are often combined with green infrastructure elements to provide increased opportunities for planting and stormwater management.

Figures 4.29 to 4.34 show different potential traffic calming measures and Table 4.7 lists them as per street class.

GUIDANCE

Design and maintain traffic calming elements as per winter maintenance requirements.

Allow cyclists to travel safely and comfortably through traffic calming elements.

Consider horizontal deflection measures for all street types.

Consider physical vertical deflection on neighborhood streets.

Figure 4.31. Lawn signs from Slow Down Vaughan program.

Figure 4.32. Raised crosswalk at intersection.

Figure 4.33. Chicane.

Figure 4.34. Midblock curb extension.

Figure 4.35. Textured crosswalk at intersection.

Figure 4.36. No right-turn on red.

Consider opportunities for placemaking, such as green infrastructure or public art, within the traffic calming elements.

Remove channelized right-turn lanes (also known as slip-lanes) where possible. If removal is not possible, provide an urban smart channel. Urban smart channels incorporate a sharp angle of entry into the cross street and delineate a narrow turning path for motor vehicles using pavement markings. Control the pedestrian crossing with either stop signs and a raised crosswalk, or traffic signals with a NO TURN ON RED prohibition and exclusive pedestrian signal phase, to assist pedestrians to safely cross. Refer to Fig. 4.36.

REFERENCES

- OTM Book 18: Cycle Facilities (2021).
- TAC's Geometric Design Guide for Canadian Roads (2017).
- TAC's Canadian Guide to Traffic Calming – Second Edition (2018).
- City of Vaughan: Traffic Calming Measures.
- Slow Down Vaughan Program (2021).

Table 4.7 Traffic Calming Measures

Traffic Calming Measures	Applicability			
	Arterial	Major Collector	Minor Collector	Local
Horizontal Deflection or Lane Narrowing				
Curb extensions/chokers	X	X	X	X
Chicanes			X	X
Centre medians	X	X	X	
Speed kidneys		X	X	X
Centreline flexible signs and curbside flexible posts		X	X	X
Vertical Deflection				
Speed cushions/table/humps/bumps			X	X
Raised crosswalk			X	X
Intersection Treatments				
Raised intersection		X	X	X
Left-turn centreline hardening	X	X	X	
Roundabout/mini-roundabout/traffic circle		X	X	X
Curb radius reduction or curb extensions		X	X	X
Pavement markings or Surface Treatment				
On-road messaging	X			
Edge lines	X	X	X	
Textured pavement	X	X	X	X
Textured/custom crosswalk			X	X
Rumble strips				
Access Restrictions				
Directional closure/modal filter/access control island			X	X
Full closure				X

4.5 INFRASTRUCTURE

Street trees, stormwater management (through the application of green infrastructure and low impact development facilities) and above and below ground utilities are critical parts of street design. Coordinate the location and positioning of these various elements of green infrastructure and utilities when planning and designing streets in Vaughan.

PRINCIPLES

Trees and green infrastructure are as much a part of the City's infrastructure as below-grade utilities.

Street trees and landscaping. Seek ways to incorporate and provide healthy growing conditions for trees and/or landscaping to improve air quality, mitigate urban heat-island effect, enhance ecosystem health, and contribute to community character. Select planting locations, spacing and design details (e.g., adequate soil volume, water, and sun access) so that trees and landscaping will flourish. Trees can frame and define streets, calm traffic by visually narrowing the roadway, and add texture, shade, and visual interest.

Stormwater management. Use a variety of "Low Impact Development" techniques to minimize stormwater load on Vaughan's sewer system and improve water quality through natural filtration. Reduce stormwater runoff and potential flooding of streets and natural areas. Strategies include minimizing impervious surfaces and promoting infiltration of rainwater and stormwater runoff.

Visibility and safety. Ensure adequate visibility is maintained, especially at street corners, traffic lights, traffic signs, transit stops and driveways. Where there is vegetation, ensure maintenance programs maintain appropriate sightlines. Clear sightlines are important to the safety of all road users. Design to promote universal accessibility, such as through the selection of materials and elements, to accommodate people of all ages and abilities. While people may walk across landscaped areas when the walkway is crowded or blocked, tree pits, openings and grates on the sidewalk are not considered part of the pedestrian clearway.

Figure 4.37. Existing mature street trees.

Figure 4.38. Stormwater management system: bioswale.

Operations and maintenance. Design for ease of maintenance, such as through passive irrigation, selecting context-sensitive native plant species and planning for safe access to maintain green infrastructure. Coordinate green infrastructure with utilities during design, construction and for the long term. Seek opportunities to partner with Business Improvement Areas (BIAs) and other local stakeholders to assist with the design and maintenance of green elements.

Achieving multiple environmental objectives. Combine environmental design, such as tree canopy expansion, stormwater retention, and microclimate moderation into single street features like rain gardens.

Sustainable energy. Consider energy generation, use and management by selecting, designing, and siting street elements such as solar lighting, parking machines, bike share stations, and street furniture to contribute to an energy efficient city.

Climate comfort. Green infrastructure provides shade, soaks up pollutants, and produces oxygen- all of which increases comfort for people on the street.

4.5.1 Street Trees

Street trees contribute to pleasant, comfortable, and sustainable streets. Street trees are an integral component of Vaughan's infrastructure. Street trees should have non-compacted soil volume and growing conditions to grow to be healthy and mature.

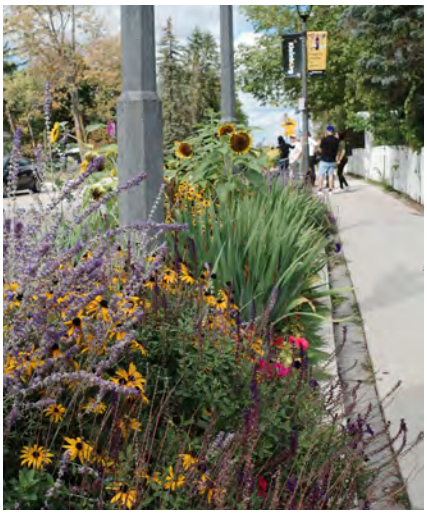


Figure 4.39. Open tree planters, City of Vaughan.

Figure 4.40. Soil cells at Highway 7 West, City of Vaughan.

The City's five-year plan to is expand the urban forest from 17% canopy cover at present to 20 to 25%. The more recent York Region Forest Management Plan identifies a recommended range for the urban tree canopy cover in Vaughan to be between 25 to 35 percent. Street tree planting within the ROW will assist the City in meeting this target.

Street trees have numerous benefits related to safety, microclimate, land value, and well-being. Their presence can lead to slower vehicle speed and serve as a buffer between users of travelling at different speeds. When they are able to reach a healthy size, trees offer shade to the roadway and sidewalk, which can make more comfortable walking environments, improve air quality, and intercept rainwater.

GUIDANCE

All street projects in Vaughan provide the opportunity to introduce street trees and improve growing conditions.

Introduce open tree planters wherever possible, providing the best possible streetscape growing condition for trees and an opportunity for further greening and stormwater management.

Coordinate utilities to minimize impact on the root zone.

Coordinate street tree locations with above ground utilities to avoid conflicts.

Ensure sufficient budget for ongoing maintenance.

Within Intensification Areas and Heritage Conservation Districts, refer to the City-Wide Streetscape Implementation Manual and Financial Strategy (2014) for street tree and planting guidelines.

Provide adequate root space, high quality soil, aeration, enough water and sunlight, protection from pedestrian traffic, and regular maintenance.

Provide appropriate tree spacing to allow for healthy tree height and canopy.

Figure 4.41. Street trees with adequate spacing and soil volume.

Provide ample uncompacted, well-draining soil volume, 30m3 per tree. When adequate soil volumes are not achievable, use details to increase soil volumes and connect root zones under paving.

Protect trees from road salt, and ensure proper soil flushing every spring, prior to bud break.

Strategically plan plantings for maximum public and ecological benefit and to provide a "sense of place" critical to the vitality of neighborhoods and their business districts.

Tree species diversity is encouraged by selecting a mix of trees for individual projects. No single species representing more than 5% of the tree population, no genus representing more than 10% of the tree population, and no family representing more than 20% of the tree population is recommended.

Develop canopy and soft landscape ROW cover requirements by street class for all new street projects.

Use open planters for tree planting where space and maintenance agreements permit. 5m2 is desired per tree pit, with a minimum of 2m2.

The value of street trees to the urban environment is enhanced when they are combined with understory planting and additional landscaping such as shrubs, grasses, and herbaceous plants.

On Regional streets select street trees and plants as York Region's acceptable tree species list. Design tree pits and planting details in accordance with York Region guidelines.

REFERENCES

- City of Vaughan: City-Wide Streetscape Implementation Manual and Financial Strategy (2014).
- Green Directions Vaughan (2019).
- York Region: Street Tree and Horticultural Design Guidelines (2022).
- York Region: Street Tree and Forest Preservation Guidelines (2022).

4.5.2 Green Infrastructure (GI)

Incorporate green infrastructure strategies within all new and retrofit street designs to improve the environmental health, comfort, and visual appearance of Vaughan streets.

Street improvements offer an opportunity to incorporate GI, such as permeable surfaces, stormwater management systems, vegetated curb areas, urban forests, and street trees into the public ROW.

Implementing GI requires some changes to public works maintenance schedules, the general skills and equipment are most likely already available to municipal staff. Most ROW design elements can be installed without the use of specialized equipment, and the implementation costs can be reduced, if these projects are worked into regular maintenance or upgrading schedules.

Green streetscape design elements work together as part of a system to provide ecological, hydrological, and placemaking functions. Allocating more space in the ROW for GI is possible by:

- Narrowing the roadway through a road diet.
- Widening the median.
- Widening the boulevards.
- Incorporating quick-win solutions that don't significantly modify existing curb locations, drainage patterns and catch basin locations (e.g., adding rain gardens or tree planting).
- Requiring adjacent developments to incorporate deeper front yard setbacks with GI elements, such as tree planting or softscape.

WATER: REDUCE RUN-OFF AND FILTER

Maximize on-site infiltration and moisture retention (e.g., vegetated swales, absorbent landscape, infiltration planters and galleries, rain gardens and soil cells).

Reduce impervious areas by minimizing paved areas or using permeable pavements.

Slow, detain and filter run-off with GI (e.g., flow-through planters, rain gardens, vegetated swales, permeable pavements).

Figure 4.42. Permeable paving with rain garden in curb extension.

Figure 4.43. Retrofitting rain garden without modifying existing curbs and catch basins.

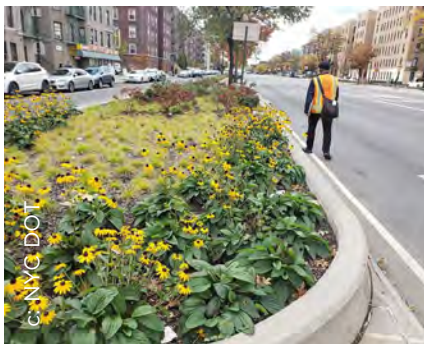


Figure 4.44. Landscaped median on major streets.

Table 4.8 Green Infrastructure Opportunities by Street Classification and Land Use

Street Classification	Street trees	Bio-retention planters	Swales	Bio-retention curb extensions/ rain gardens	Permeable paving: furnishing and planting zone	Permeable paving: lay-bys, parking
Arterial- Intensification	x	x		x	x	
Arterial- Community	x		x	x	x	
Arterial- Employment	x		x	x	x	
Major Collector- Intensification	x	x		x	x	
Major Collector- Community	x		x	x	x	
Major Collector- Employment	x		x	x	x	
Minor Collector- Intensification	x	x		x	x	x
Minor Collector- Community	x			x	x	x
Minor Collector- Employment	x			x	x	x
Local- Intensification	x	x		x	x	x
Local- Community	x			x	x	x
Local- Employment	x			x	x	x

Note: GI opportunities in natural areas to be identified based on the existing context and street class.

HABITAT: ENHANCE URBAN FOREST CANOPY

Improve biodiversity, reduce the urban heat island effect, and improve air quality (through diverse native vegetation and create a layered canopy).

Increase urban tree health and canopy (through mature trees and optimal growing conditions).

Increase habitat connectivity (through wildlife corridors, crossings, and passages).

AIR: MITIGATE CLIMATE CHANGE

Design networks and streets to prioritize walking and cycling.

Enhance the urban forest (through maximum tree planting and optimum growth conditions).

Reduce energy demand (through energy conservation and alternative energy systems).

Select and locate GI based on ROW width, street class and context. Streets within lower intensity areas, like Neighbourhoods, have a wide range of GI possibilities in different locations (e.g., the furnishing and planting zone, setbacks, medians and combined with traffic calming elements such as curb extensions). Streets within higher intensity areas, like Intensification Areas, are required to have furnishing and planting zones.

REFERENCES

- City of Vaughan: City-Wide Streetscape Implementation Manual and Financial Strategy (2014).
- Green Directions Vaughan (2019).
- York Region: Street Tree and Horticultural Design Guidelines (2022).
- York Region: Street Tree and Forest Preservation Guidelines (2022).

4.5.3 Utilities (Above and Below Grade)

Telecommunications, energy, water, waste water, and others, that place lines and equipment in the ROW.

Figure 4.45. Soil cells (Bloor Street, Toronto).

Figure 4.46. Stormwater channel.

Coordinate and consolidate above and below ground utilities to ensure operational and maintenance efficiency, the protection of undisturbed areas of street tree planting, and maximize space within the boulevard for pedestrian, cycling, and other uses.

Utilities in the public realm include utility cabinets, transformers, and hydro and gas meters. When carefully considered, these items can be effectively integrated into new developments, and/or screened from view, to minimize their impact on the public realm.

The space below grade is often congested and in high demand. The performance of the street above often relies on how elements are arranged beneath. Utility design and coordination needs to ensure operational and maintenance efficiency and protect for the needs of other users and uses such as green infrastructure and illumination.

GUIDANCE

At early stages of street projects:

- Procure an accurate existing utility plan based on physical locations to guide the design and determine the total cost of the proposed elements.
- Collaborate across departments to incorporate Complete Streets design guidance with utilities planning at the early stages of the design process and at critical review points.
- Coordinate the location and positioning of the various elements of below-grade infrastructure and access points with standards for street trees, soil cells and bio-swales, and consider practices for maintenance and repair of infrastructure.

Utilities should be buried underground wherever possible to minimize conflicts with street trees and GI, and reduce visual and physical clutter.

Where utilities cannot be located underground, they should be coordinated as much as possible, and located in areas where their visual and physical impacts can be minimized.

Where possible, utilities should be integrated into the design of new buildings.

Where utilities cannot be integrated and/or hidden, they should be treated as opportunities for public art through mural paintings, or attractive anti-graffiti wraps.

Wherever possible, locate hydro boxes and utility boxes on private property or buried within the boulevard.

Locate above-ground utilities away from intersections, daylighting triangles, and visual axes such as the end of T-intersections or other view corridors.

Where possible, screen street grade public utilities (e.g., transformer pads, telephone switching stations, junction boxes) using similar treatments to the surrounding context. Where appropriate, the municipality, in consultation with the appropriate utility authority, shall support the installation of visually appealing utility and telecommunications infrastructure.

Locate utilities to enable ease of access for emergency or maintenance services. Maintenance openings must remain accessible at all times.

Adhere to required offsets for all structures within municipal ROW.

Ensure all the City's stormwater and sewer infrastructure and the Region's existing water/ wastewater infrastructure service connections are identified and adequately protected.

The Region's input during the planning, design and construction phases is required.

Perform all relocations and protection of the Region's water/ wastewater infrastructure, if any, in conjunction with the Region of York's design standards for linear infrastructure.

As new technologies and data tracking become available, opportunities to discreetly display utility elements should be explored in conjunction with an educational component.

The use of a joint utility trench is encouraged to minimize the impacts of routine maintenance and repairs on the public realm.

Installation of new raised medians or curb extensions with stormwater features or trees must account for existing utility impacts.

4.6 INTERSECTIONS

Intersections are shared spaces where various modes of travel, uses, and users come together. They often serve as meeting places, gateways, transit hubs and transfer points. As a result, intersections generate many potential conflicts. People who travel along streets and through intersections of Vaughan should feel safe and comfortable, with reduced exposure to risk.

Safety for all users is the top priority when designing an intersection. Some of the factors that contribute to this complexity include the density of interaction, inherent conflict points, capacity restrictions, transit transfers, and the high number of nearby destinations.

This section identifies examples of common types of Vaughan intersections based on the adjoining street class and their considerations for Complete Streets design. Demonstration graphics of intersection typologies are included in Chapter 3.

PRINCIPLES

Start with Vulnerable Users. Design for the most vulnerable first, starting with those pedestrians who are most vulnerable: people with physical disabilities, those using mobility assistive devices, caregivers, seniors and children. The importance of other design aspects such as placemaking, areas dedicated to pedestrians, transit amenities, and capacity/efficiency, will depend on the specific context and type of intersection.

Keep it Compact. An overarching goal is to make compact intersections with the smallest corner radii. Compact intersections lead to lower operating speeds and provide more opportunities for eye contact between drivers, cyclists, and pedestrians, which increases safety. Reassign reclaimed space from vehicle traffic to facilities that support other users, such as pedestrian amenities, cycling facilities, transit facilities and street furniture.

Context Sensitive. Intersection design considerations include the context of the street, the presence of cycle facilities or transit stops, the form and function of the dominant corridor, and the network of adjacent intersections.

Figure 4.47. Inclusive intersection for users of different ages and abilities.

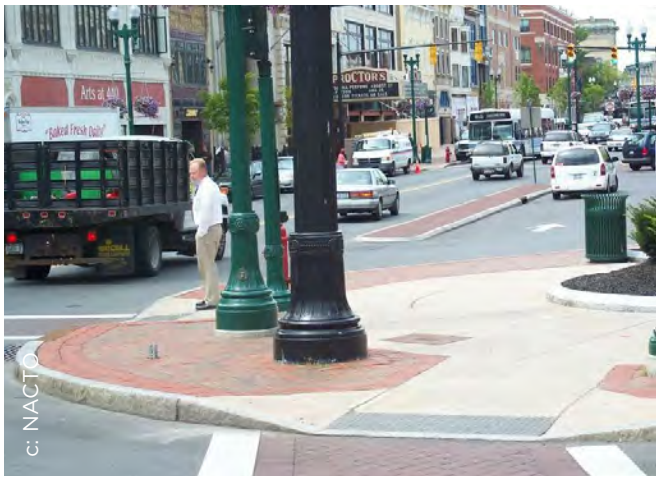


Figure 4.48. Compact corner radii at intersection.

Figure 4.49. Access to transit stop.

Figure 4.50. Traffic signals and signage for different users.

Accessible. Incorporate accessible design features, such as tactile walking surface indicators, curb ramps or depressed curbs, accessible pedestrian signals, walk speeds at crossings for all ages and abilities, and access to transit stops.

Minimize Delay. Traffic signal operations should be designed to minimize delay for all users and all approaches. Long cycle lengths which delay pedestrians or cyclists can result in non-compliance by those users, increasing the likelihood of unpredictable movements and reducing safety. Along transit corridors, minimizing transit delay should be a priority.

Network function. Intersections should be designed as part of larger environments and networks. Solutions for capacity or volumes may be found at the corridor or network level. Make trade-offs between the intersection and the network in terms of traffic volume and capacity. Use signalization to reduce speeds between junctions, prioritize transit, and increase safety. Include transit-priority, pedestrian, and cycles leading intervals, and manage left turns with dedicated signal phases.

4.6.1 Intersection Types

(Based on Receiving Street)
Intersections are categorized by the "receiving" or minor street.

Intersections are categorized by the minor street largely to ensure that the needs of users on the minor street are met. For example, people walking along a local street may need to cross an arterial to continue on their way. Limiting access is contrary to the aims of Complete Streets.

Intersection Between Two Major Streets (Major Collectors and/or Arterials)

The intersection of major streets is characterized by higher traffic volumes, higher approach speeds, bus stops, and higher intensity of cycling and pedestrian activity. At present, many of these intersections in Vaughan have large corner radii and wide lanes that encourage speeding.

The majority of arterial streets within Vaughan are under the jurisdiction of the York Region. Coordination between the City and the Region is required in the design of these intersections.

GUIDANCE

Analyze intersection capacity from a multimodal perspective and focus on users rather than single occupancy vehicles. For instance, balance delays experienced by passengers in buses with minimal pedestrian crossing delays and service provided to general traffic.

Use pedestrian refuges, crosswalk markings, crossrides, reduced corner radii, leading pedestrian signal intervals, and other measures to enhance pedestrian safety comfort.

Reduce turning radii and reclaim space at the corners to safely accommodate higher pedestrian volumes. This creates additional space for transit stops and street vendors.

Install pedestrian refuge islands to reduce crossing distances and provide a protected waiting space.

In reconstruction projects consider adding protected intersection elements, see Section 4.6.7.

In retrofit projects improve cyclist safety by marking cycle facilities through the intersection using bike boxes or queue boxes, bike yield lanes, and cycle lane crosswalk signs.

Provide designated cycle signal phases, and regulatory and warning signs for motorists where notable conflicts exist.

Figure 4.51. Intersection between major streets (arterials).

Figure 4.52. Intersection between arterial and local.

Figure 4.53. Crosswalk and crossride at major intersection.

Figure 4.54. Intersection between major collector and local.

Intersections between Locals and Major Streets (Collector or Arterials)

Intersections of local streets and major streets (major collectors or arterials) often lack the same definition of safety and predictability as same-scale intersections. Pedestrians often use these intersections to access the nearest bus stops along arterials from adjacent locals or minor collectors.

GUIDANCE

Define the transition and context using gateway treatments such as smaller corner radii, curb extensions or raised crossings. Use these design elements to prioritize walking and cycling and make vehicles aware that they are entering a slow-speed environment.

Clearly mark controlled pedestrian and cyclist crossings– on all legs of the intersection.

One-way streets provide opportunities for tight curb radii and curb extensions.

Analyze and design the intersection in a network context. It may not be possible or practical to always accommodate all movements (e.g., through or left-turn movements from the side street) at a two-way stop-controlled intersection.

The introduction of side street turn prohibitions may occur if there are heavy traffic flows on the arterial street or intersection design does not provide for safe maneuvers.

Move the stop bar back to achieve tighter corner radii. This allows larger vehicles (moving vans, fire, waste collection, snowplows) to use the entire intersection to turn into the local street.

Figure 4.55. Intersection between two local streets.

Intersections between two Local streets

Local street intersections are the most numerous intersection type in Vaughan. Local street intersections are characterized by lower traffic volumes and slower speeds.

GUIDANCE

Provide crosswalks, paving materials/textures, mini-roundabouts, curb extensions and reduced turn radii to calm traffic, reduce pedestrian crossing distances and improve sightlines for all users.

Include raised crossings to reduce the speed at which vehicles turn by bringing the vehicle crossing up to (or near) the sidewalk level. In addition, the raised crossing is a signal to turning drivers that through-moving cyclists and pedestrians have the right of way.

Minimizing delay for motor vehicles is not a primary design principle for these intersections. Due to the typically low volume and speed of motor vehicles through these intersections, cyclists can often be accommodated in a similar manner to motor vehicles.

Design so that larger vehicles (moving vans, fire, waste collection, snowplows) may use the entire intersection to turn.

REFERENCES

- OTM Book 18: Bicycle Facilities (2021).
- City of Vaughan: Pedestrian and Bicycle Master Plan (2020).
- NACTO, Don't Give Up at the intersections (2019).

4.6.2 Design and Control Vehicle

Select the most frequent large vehicle as the design vehicle to inform street geometry, not the occasional largest vehicle.

Figure 4.56. Examples of Light Single Unit (top), Medium Single Unit (centre) and YRT bus (bottom).

A design vehicle is the most frequent large vehicle. A control vehicle is the largest occasional vehicle. This approach will yield more compact intersections. Emergency vehicles responding to a call are control vehicles and are permitted to use the entire roadway per the Ontario Highway Traffic Act. Best practices recommend that in urban settings smaller corner radii are preferred, and that a large corner radius should not be used to facilitate a truck turning from the right lane into the right lane.

All too often intersections in Vaughan have been designed to accommodate the infrequent large vehicle. This results in excessively large intersections with large corner radii. Long pedestrian crossing distances, faster turning speeds, and extra pavement that produces more stormwater runoff. Smaller corner radii reduce the length of crosswalks, slow turning speeds, reduce the amount of impervious surfaces, and provide more space for people waiting at the corner.

GUIDANCE

Table 4.9 lists maximum design and control vehicle types per street class. It is based on the “receiving” street.

The design vehicle may use multiple receiving lanes where other traffic is controlled. Turns on red are not a justification to widen a corner.

The control vehicle may use the entire intersection.

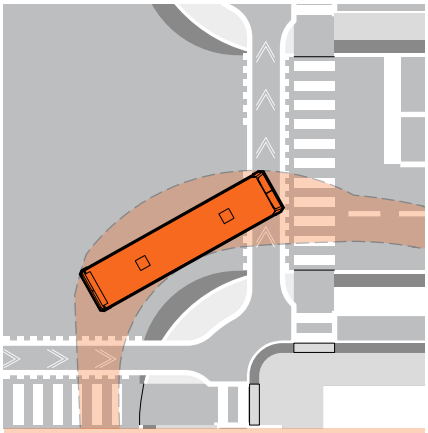
While not ideal, emergency vehicles are permitted to make full use of the ROW in both directions, including opposite lanes, especially in case of a tight corner radii.

Design and control vehicles shall maintain a minimum 300mm offset from the face of curb.

Historically, a 16 km/h turning speed was used to regulate intersections.

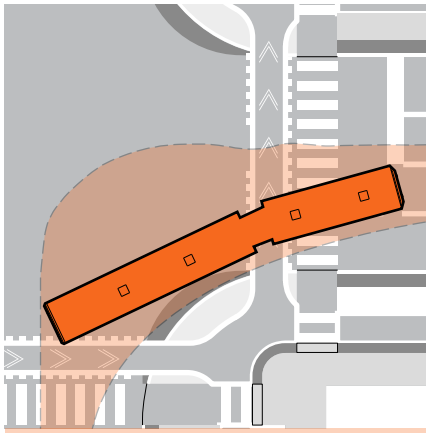
REFERENCES

- TAC's Design Vehicle Dimensions for Use in Geometric Design (2017).
- NACTO Urban Street Design Guide (2013).
- Institute of Transportation Engineers and Congress for the New Urbanism. Designing Walkable Urban Thoroughfares: A Context Sensitive Approach (2010).
- City of Toronto. Curb Radii Guidelines. Transportation Services (2018).



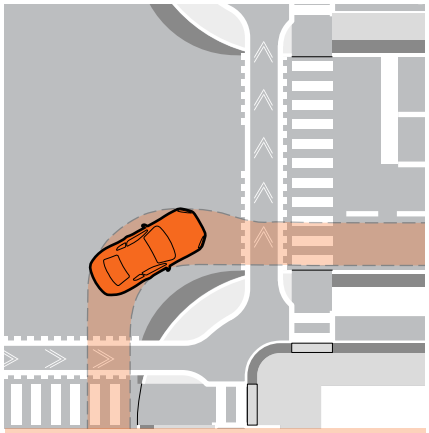
DESIGN FOR:
Design Vehicle

- Most frequent large vehicle.
- Often a moving van (LSU), city bus (B-12), or passenger vehicle (P).



ACCOMMODATE THE:
Control Vehicle

- Largest occasional vehicle.
- On neighbourhood streets this may be a garbage truck (HV607) or fire truck.



MANAGE THE SPEED OF:
Passenger Vehicle

- Most common vehicle.
- The goal for a passenger vehicle is to keep turn speeds between 5-10km/h.

Figure 4.57. Design and control vehicle types to inform turning radii at intersections.

Table 4.9 Maximum Design and Control Vehicle Types per Street Classification and Land Use

Intersection Corner Type (Most Restrictive)	Design Vehicle*	Control Vehicle**	Target Corner radii (m)***
Arterial: Intensification + Community	B-12: Vaughan Bus	WB-20: Tractor/ Trailer	9.0m
Arterial: Employment	HSU: Heavy Single Unit	WB-20: Tractor/ Trailer	9.0m
Major Collector: Intensification + Community	LSU: Light Single Unit	B-12: Vaughan Bus	6.0m
Major Collector: Employment	MSU: Medium Single Unit	WB-20: Tractor/ Trailer	9.0m
Minor Collector: Intensification + Community	LSU: Light Single Unit	B-12: Vaughan Bus	6.0m
Minor Collector: Employment	MSU: Medium Single Unit	WB-20: Tractor/ Trailer	9.0m
Local: Intensification + Community + Employment	P: Passenger Vehicle	LSU: Light Single Unit	4.0m

*On designated transit routes, transit vehicles (B-12: Vaughan bus) will be the design vehicle.
**Fire trucks shall be used as an additional control vehicle at all intersection corners.
***The final corner radii design will be confirmed using a swept path analysis.
The resultant radii are informed by what is included in the overall cross-section
(e.g., a cross-section with parking or cycle lanes may enable a tighter corner radii).
Corners where transit routes turn require a case-by-case analysis based on the Vaughan bus and its turning radius, as a design vehicle.

4.6.3 Corner Radii

Design corners with the smallest radii possible.

The shape and geometric design of corner radii significantly impact the overall operation and safety at an intersection. Use the smallest feasible curb radius for corner designs based upon the design vehicle's maximum effective turning radius. This will slow motorists, improve yielding and reducing stopping distance requirements. This strategy will help to increase the size of cycle and pedestrian queuing areas, reduce crossing distances and slow vehicle turning speeds.

The actual corner radius is not necessarily the effective turning radius. It may be similar where the corner radius is large, but in general the effective turning radius is larger. On-street parking, cycle lanes, and multiple receiving lanes all contribute to a larger turning radius.

GUIDANCE

Confirm corner radius with swept path analysis software based on design vehicle traveling at 10 km/h along maximum effective turning radius.

Measure the maximum effective turning radius from the turning lane to the centerline or median of the receiving street. The idea is to understand the largest/fastest potential turn.

Corner radii in excess of 9m require approval.

In retrofit conditions, use pavement markings and/or flexible bollards to tighten corner radii (refer Chapter 3: Demonstrations).

Corners where transit routes turn require a case-by-case analysis and should use a Vaughan bus as the design vehicle.

Where there are no turns, such as at intersections with one-way streets, corner radii can be as small as 1m.

At a signalized or all-way stop intersection, the design vehicle may use all receiving lanes. Additionally, the stop line may be recessed to enable the vehicle to use a portion of the entire width of the receiving roadway. Elsewhere, use other design treatments to maintain a smaller corner radius.

Right turns on red, left turns and other permissive movements are to be restricted if they cannot be safely accommodated with a smaller corner radius.

Within Employment Areas where frequent freight and truck use is anticipated:

- minimize the effective curb radius to slow turns while still accommodating larger vehicles.
- use a two or three compound curve to best match the pathway of a truck. This approach will allow for a tighter radius corner and minimize the need for additional roadway surface.

Figure 4.58. Curb extension at intersections to reduce corner radii.

Figure 4.59. Recessed stop line at receiving lane.

Figure 4.60. Mountable truck apron.

- install mountable aprons that reduce the turning radius for cars but provide sufficient space for trucks. The mountable surface should be visually distinct from the adjacent travel lane, sidewalk, and separated bike lane.

6.0m clear width is required to accommodate fire trucks at hydrants and intersections. This can include the width of opposing lanes.

Do not use acceleration/ deceleration lanes, turn lanes, and auxilary lanes.

REFERENCES

- OTM Book 18: Cycle Facilities (2021).
- TAC's Geometric Design Guide for Canadian Roads (2017).
- TAC's Canadian Guide to Traffic Calming – Second Edition (2018).
- City of Vaughan: Traffic Calming Measures.
- NACTO Transit Street Design Guide (2016).

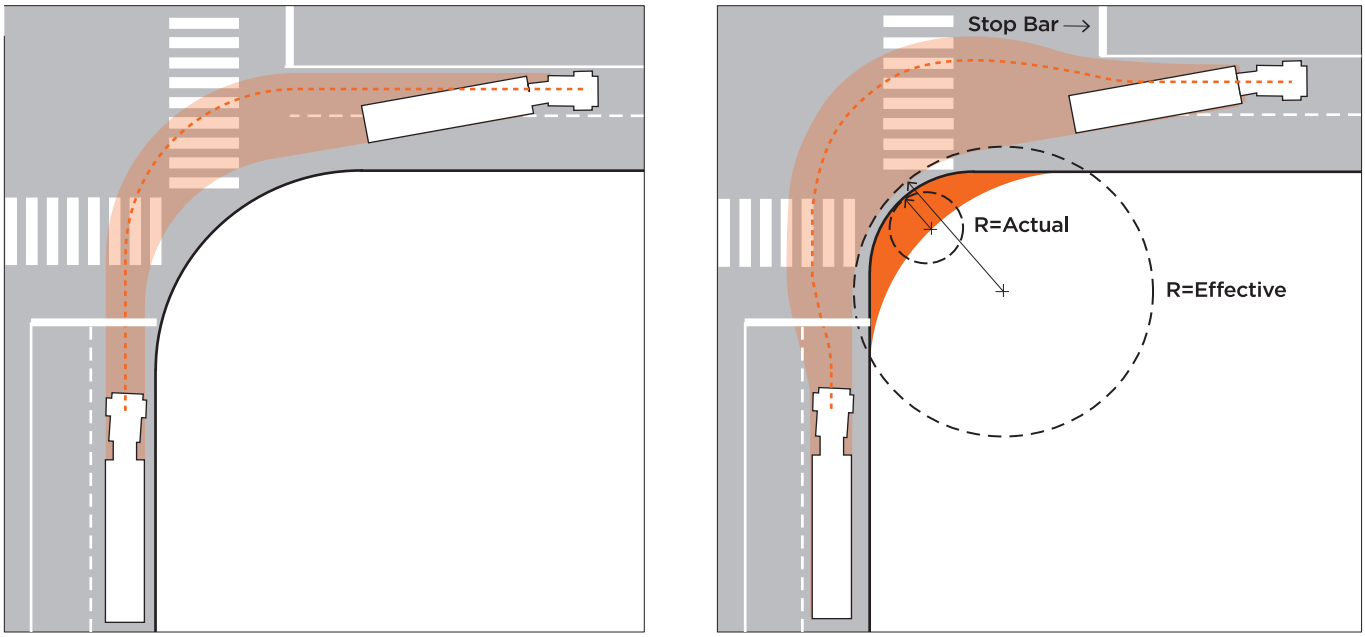


Figure 4.61. Narrowing corner radii can reduce vehicle turning speeds as well as reduce the length of pedestrian crossing distances. Accommodating for a vehicle allows encroachment of other lanes, shoulders, advance stop lines or other elements to complete the required maneuver. This allows for tighter corner radii with multiple safety benefits for vulnerable users.

Table 4.10 Actions for Rightsizing by Street Classification and Land Use

	Aterial: Intensification	Aterial: Community	Aterial: Employment	Major Collector: Intensification	Major Collector: Community	Major Collector: Employment	Minor Collector: Intensification*	Minor Collector: Community	Minor Collector: Employment	Local: Intensification	Local: Community	Local: Employment
Use a two or three compound curve	x	x	x	x	x	x	x		x			x
Restricting large truck movement							x			x	x	x
Redesign sidewalk	x	x	x	x	x	x	x	x	x	x	x	x
Curb extensions at intersections	x	x	x	x	x	x	x	x	x	x	x	x
Road narrowing at midblock	x	x	x	x	x	x	x	x	x	x	x	x
Review corner radii	x	x	x	x	x	x	x	x	x	x	x	x

Note:
*In some cases, large trucks (WB-20: Tractor/Trailer) may exit off the permissive route to aceess their destination using the shortest distance from the truck route possible from non-designated City roadways.

4.6.4 Driveways and Vehicle Access

Design driveways to provide a continuous pedestrian and cycling facility across the vehicular path to emphasize safe movement of vulnerable users above turning vehicles.

Driveways provide access across sidewalks to off-street parking, service and loading areas. They can be points of conflict between different users and require special treatment to create a safe and welcoming pedestrian environment. Regardless of the design, pedestrians on sidewalks and cyclists have priority over vehicles.

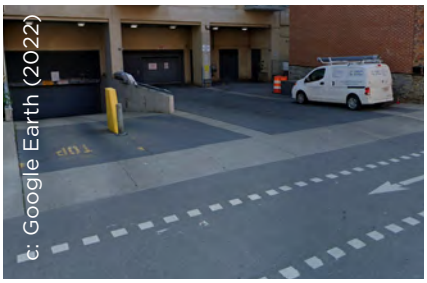


Figure 4.62. Raised driveway into parking garage.

Figure 4.63. Raised driveway and the continuation of the paving material over the driveway highlights crossing of different users.

GUIDANCE

Prioritize the continuity of pedestrian clearway and cycling facilities across all driveways by raising the vehicle portion to the same grade as the rest of the boulevard. Ramping will occur in the portion of the boulevard between the roadway and pedestrian clearway.

Continue paving materials and boulevard appearance for pedestrian clearway and cycling facilities across driveways.

Provide the minimum acceptable pedestrian clearway widths across all driveways.

Minimize turning radii of driveways to limit vehicle speed to a maximum of 10km/h. Use swept path analysis software to determine the maximum turn radii.

Reduce driveway widths to the smallest possible dimension to reduce the amount of time vulnerable users are exposed to turning vehicles. If more than two access lanes (in total) are required, provide a central median for pedestrian refuge.

Consolidate driveways that serve multiple buildings to minimize the number of interruptions on the sidewalk and reduce the number of potential conflicts with pedestrians and cyclists.

In constrained locations where the width of a sidewalk is insufficient for a fully raised crossing, consider an intermediate crossing with a partially raised roadway.

REFERENCES

- TAC's Canadian Guide to Neighbourhood Traffic Calming (Second Edition, February 2018)– pages 52-56.
- MassDOT. Separated Bike Lane Planning & Design Guide (2018). Chapter 4: Intersections, Section 4.4.2 Reduce Conflict Points.

4.6.5 Pedestrians at Intersections

Frequent and safe pedestrian crossings support a walkable environment.

Design crosswalks to make motorists aware of the potential interaction with pedestrians and cyclists.

GUIDANCE

Locate crosswalks at all legs of all intersections. Where a path multi-use path meets a street is considered an intersection.

Align pedestrian crossings to meet pedestrian desire lines and minimize crossing distance.

Align pedestrian crossings with the pedestrian clearway to the greatest extent possible.

Retrofit all crosswalks at all signalized intersections with ladder crosswalk markings and tactile walking surface indicators to increase the visibility of the crossing.

Introduce curb extensions at all intersections where a permanent parking lane exists to increase sight lines between pedestrians and drivers.

Place refuge islands in the centre of the street at high traffic volume locations and streets where pedestrians must cross more than three lanes of traffic (total).

Locate detectable warning strips (DWS) and drop curbs in accordance with OTM Book 15.

In Intensification Areas, or other areas where there is a high intensity of pedestrians, provide 5m wide crosswalks or wider to meet LOS-C as per the Highway Capacity Manual.

Provide LOS-C queueing areas at signalized intersections as per the Highway Capacity Manual. Curb extensions can be introduced to create extra space at the corner for pedestrian queuing, street furniture and landscaping.

In Neighbourhoods, provide 3m crosswalks or wider.

Setback stop lines at intersections with greater pedestrian traffic to enhance visibility (see Section 4.6.10).

Avoid right turns on red.

Remove channelized right-turn lanes as per Section 4.4.6.

REFERENCES

- OTM Book 15: Pedestrian Crossing Treatments (2016).
- TAC's Pedestrian Crossing Control Guide (2018).
- City of Vaughan: Pedestrian and Bicycle Master Plan (2020).
- Highway Capacity Manual, Sixth Edition: A Guide for Multimodal Mobility Analysis (2016).
- TAC's Emerging Practice Briefing: Continuous Sidewalks and Bike Paths (2023).

Figure 4.64. Intersection between street and a multi-use path.

Figure 4.65. Curb extension.

Figure 4.66. Raised crosswalk.

Figure 4.67. Pedestrian refuge island.

4.6.6 Midblock Crossings/Desire Lines

A midblock crossing is a designated area for pedestrians and cyclists to cross a street between other intersections.

Vaughan developed as a post-war city using a "superblock" structure. This results in large streets with long blocks. Consider midblock crossings where there are significant pedestrian desire lines, midblock bus stops, adjacent parks, plazas, or connections with multi-use paths. The importance of providing a pedestrian midblock crossing increases with the motor vehicle traffic volume, traffic speed and distance to the nearest pedestrian crossing.

GUIDANCE

NACTO advises that the location of midblock crossings should be informed by pedestrian behavior. If it takes a person more than three minutes to walk to a crosswalk or wait to cross the street before resuming their journey, they may decide to cross along a more direct, but unsafe or unprotected, route. Midblock crossings incentivise greater and safer pedestrian and cycling mobility and to improve transit customer access.

Features that warrant a midblock crossing include trail crossings, midblock transit stops, intersections spaced more than 160m apart or significant destinations located between intersections. Significant destinations include institutions such as hospitals or schools, attractions such as cultural or sporting venues, transit stations, or employment uses.

Provide pedestrian refuge islands on arterial and collector streets.

Add vertical elements to midblock crosswalks on lower speed and lower volume streets, to mark the crosswalk and increase sight distance at crosswalks.

The addition of traffic signals is especially important in high pedestrian and vehicle traffic volume areas.

Add traffic calming features, such as raised crossings and midblock curb extensions. Speed humps or raised tables may also be installed in conjunction with midblock crossings to provide traffic calming.

Align midblock crossings with the primary desire line (potentially a building entrance or path). Likewise, consider the actual movements that cyclists want to make when designing an intersection.

Sightlines, particularly between motorists and crossing pedestrians, must be considered in the design of midblock crossings adjacent to transit stops, as transit vehicles may obstruct these sightlines if the transit vehicle stops in a curb lane and the crossing is located downstream of the transit stop. Mitigating measures include shifting the crossing to upstream of the stop or ensuring a minimum distance between the stop and a crossing appropriate to the observed vehicle travel speed.

REFERENCES

- NACTO Urban Street Design Guide (2013).
- OTM Book 15: Pedestrian Crossing Treatments (2016).
- TAC's Pedestrian Crossing Control Guide (2018).
- City of Vaughan: Pedestrian and Bicycle Master Plan (2020).
- TAC's Emerging Practice Briefing: Continuous Sidewalks and Bike Paths (2023).

Figure 4.68. Pedestrian refuge with vertical elements and signage.

Figure 4.69. DWS at a median.

Figure 4.70. Curb extension.

Figure 4.71. Cyclists at midblock crossing.

4.6.7 Cycle Facilities at Intersections

Intersection designs should minimize conflicts between people walking, cycling, and driving by heightening visibility, denoting a clear right of way, and facilitating eye contact and awareness of different modes.

This section provides high level guidance to ensure that practitioners incorporate cycling accommodation at intersections. The type of accommodation will depend on many factors, including ROW width, form of intersection control, presence of dedicated turn lanes, motor vehicle travel speeds, crossing distance, and the volume of pedestrian, cyclist, transit, and motor vehicle movement.

Detailed guidance for the facility selection, use and placement of sign and pavement markings is included in OTM Book 18, and the Cycling Master Plan.

Intersections should be intuitive and provide directional messaging when needed. The level of intersection treatment required for all ages and abilities safety and comfort is context sensitive, depending on many factors. Potential complete street design elements for Vaughan intersections are listed below.

GUIDANCE

Consider a "protected" intersection at the junction of two or more major cycle routes.

Provide advance stopping areas to increase visibility of people cycling and help accommodate turns.

Incorporate green coloured treatment and elephant's feet at street crossings where cyclists have or sometimes have ROW over cross traffic.

Separate motor vehicle turn and through bike signal phases at complex intersections or where there are high turn volumes (>150/hr. across unidirectional lanes).

Include bike platforms at transit stops to accommodate protected cycle lanes.

At locations where there are transit stops:

- Clearly communicate desired yielding behaviour through signs, pavement markings and bend out/ins in advance of a stop.
- Provide sufficient transit user waiting space with consideration for peak period boardings and headways.
- Provide adequate sightlines between bus operators and approaching cyclists and between pedestrians and cyclists.
- Include DWS, and sufficient platform width for mobility device users.

REFERENCES

- City of Vaughan: Pedestrian and Bicycle Master Plan (2020).
- OTM Book 18: Cycle Facilities (2021).
- NACTO Designing for All Ages & Abilities Contextual Guidance for High-Comfort Bicycle Facilities (2017).
- NACTO Urban Bikeway Design Guide (2014).

Figure 4.72. Protected intersections.

Figure 4.73. Bike box at signalized intersection.

Figure 4.74. Bike two-stage left turn.

Figure 4.75. Midblock crossride and bike signal for trail access.

4.6.8 Transit at Intersections

Transit accommodation at intersections is essential for developing a transit-oriented city. Transit stop planning involves identifying the optimal transit stop location and configuration to increase passenger safety and reduce delays.

GUIDANCE

Place transit stops close to crossings.

Provide amenities such as shelters, seating, route information, system maps, real time next vehicle arrivals, tactile strips, sign poles and curb cuts and display panels. Provide higher levels of amenity at higher volume locations or at significant points of interchange within the system.

Provide bus bays only at locations where routes terminate or have scheduled wait times.

Provide transit signal priority with dedicated transit lanes or queue jump lanes and at locations where a transit vehicle enters an intersection from the minor approach.

Implement queue jump lanes at intersections where transit experiences significant delay.

Avoid midblock bus stops.

Limit multiple driveways and corner retail driveways (such as gas stations), which cause transit stops to be located away from the intersection (to midblock locations).

Provide a 3m min. setback from the front of the bus to stop line at intersections.

Curb radii should be designed as tightly as possibly to reduce pedestrian crossing distance without adversely affecting transit operations.

When considering curb extensions, the bus's effective turning radius may be accommodated by allowing the turning bus to use part of the oncoming travel lane to accommodate its wide sweep.

Consider bus bulbs (a curb extension that serves the function of a transit platform) on streets with permanent on-street parking. Bus bulbs help separate waiting passengers from pedestrian traffic and reduce pedestrian crossing distances. They eliminate the need for transit vehicles to change lanes to service a transit stop and can reduce transit delays from having to pull in and out of through lanes. They must have sufficient length to include a landing zone for all doors of any transit vehicles that serve the stop.

REFERENCES

- MTO Transit Supportive Design Guidelines (2016).
- NACTO Transit Street Design Guide (2016).
- York Region Transportation Master Plan (2022).

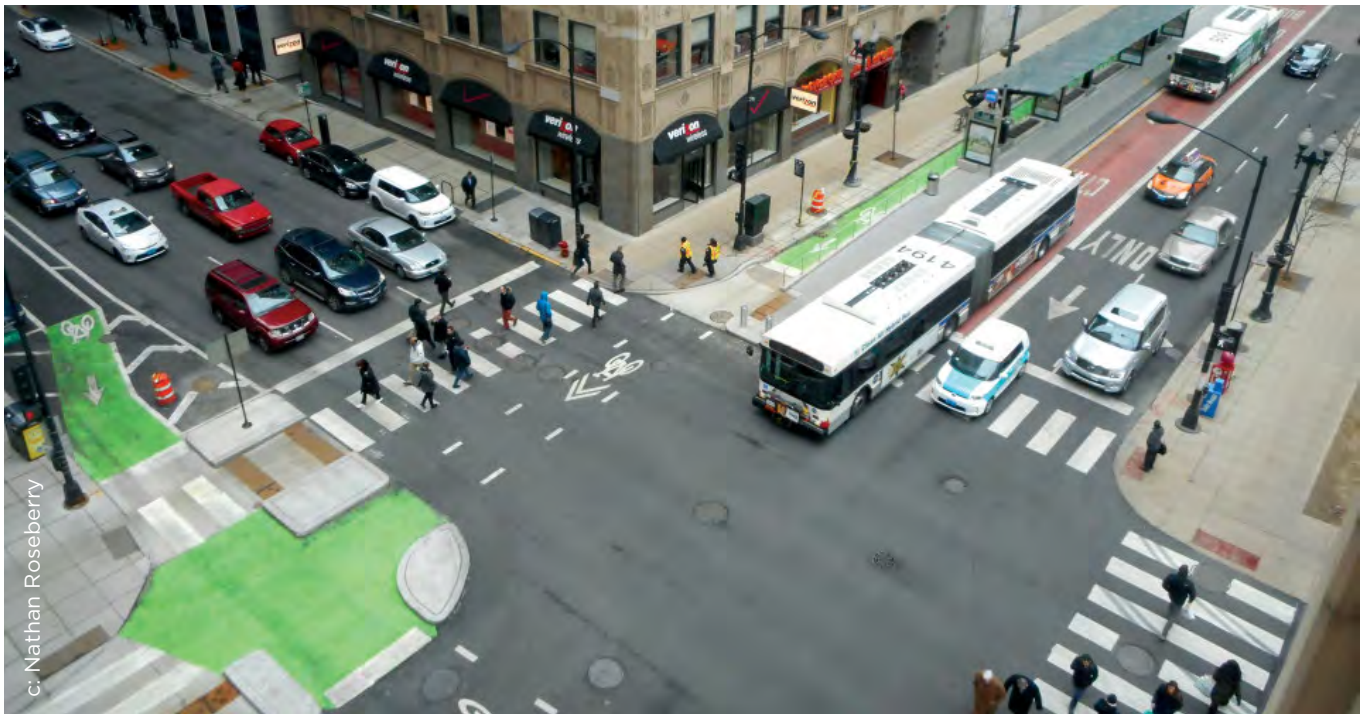


Figure 4.76. Transit stop at intersection.

Figure 4.77. Bus shelter with real-time arrivals display panel.

Figure 4.78. Bus bulb.

Figure 4.79. Signalization dedicated for transit.

4.6.9 Traffic Signals and Traffic Controls

Enhance street crossing safety and comfort for the most vulnerable street users by incorporating intersection signals and traffic control measures.

Figure 4.80. Rapid flash beacons.

Figure 4.81. Leading pedestrian intervals.

The choice of traffic control signal or device is informed by OTM Book 12, the Highway Traffic Act, the Manual for Uniform Traffic Control Devices for Canada and best practices. The practitioner must identify existing and aspirational pedestrian desire lines, active transportation networks or transit networks at the start of a project to identify opportunities to introduce and coordinate intersection controls. Enhanced street crossing protection afforded by these devices should focus on increasing the safety of people who are walking, cycling, using transit, and driving, and reducing overall person delay rather than vehicle delay.

GUIDANCE

Consider how to best accommodate slow walkers through the provision of the shortest possible crossing distance and adequate signal time. Calculate pedestrian delay using Average Pedestrian Delay Component as per Table 4.11. Pedestrians should never wait more than 30 seconds as their likelihood of not complying with signal indication increases at this point. See Table 4.11.

Provide pedestrian refuge in all instances where a pedestrian must cross more than three vehicle lanes.

90 second max signal cycles, with 2-phase signals are preferred as they facilitate regular crossings of the street, and generally minimize overall delay for all users (from all approaches). This practice enables city streets to function as a network, rather than a series of major corridors. Signal cycles over 90 seconds can make large avenues into barriers that separate neighborhoods and can make crossing the street or walking short distances frustrating or prohibitive.

Use signal priority tools, such as leading pedestrian intervals, synchronized signals for bicycles, or transit signal priority along corridors with desired modal priority and where heavy right or left turning volumes create consistent conflicts and safety concerns between vehicles and pedestrians or cyclists.

Average pedestrian crossing delay component. Source: Ottawa Multi-Modal Level of Service (MMLOS) Guidelines (2015). People walking generally begin to disregard signals after waiting 30 seconds.

Table 4.11 Average Pedestrian Crossing Delay Component

$$\text{Delay} = 0.5 \times \frac{(\text{Cycle length} - \text{Pedestrian effective walk time})^2}{\text{Cycle length}}$$

< 10 sec per intersection leg	LOS A
≥ 10 to 20 sec	LOS B
> 20 to 30 sec	LOS C
> 30 to 40 sec	LOS D
> 40 to 60 sec	LOS E
> 60 sec	LOS F

Depending on the crossing distance, provide pedestrians with a minimum head start of 3–7 seconds. A head start of up to 10 seconds may be appropriate in Intensification Areas and/or along arterials where pedestrian volumes are high or the crossing distances are long.

Consider no right turn when facing a red traffic light to reduce collisions of right-turning vehicles with vehicles proceeding on their green light, and between right-turning vehicles and pedestrians crossing with their WALK signal.

Adjust signal timing for peak and off-peak volumes to manage different levels of activity throughout the day. Consider Signal Progression to coordinate signal timing based on transit and cycle travel speeds, instead of free-flow traffic speed.

For local streets, consider the City's Slow Streets policy where signage can be placed in the middle of the street to slow down off-peak speeding.

Consider exclusive pedestrian phase or "scramble" at the intersection of Arterial-Intensification and Major Collector-Intensification streets where there is high intensity of pedestrian activity.

REFERENCES

- OTM Book 12: Traffic Signals (2012).
- OTM Book 15: Pedestrian Crossing Treatments (2016).
- Highway Traffic Act, R.S.O (1990).
- Manual for Uniform Traffic Control Devices for Canada.
- Average Pedestrian Crossing Delay Component. Source: Ottawa Multi-Modal Level of Service (MMLOS) Guidelines (2015).

4.6.10 Recessed Stop Line Locations

Increase visibility and make streets safer for vulnerable users at intersections with higher volume and frequent larger vehicles, by recessing stop lines.

A stop line/stop bar is a striped, white line (refer OTM Book 15) indicating the location for vehicles to stop at signalized and stop-controlled intersections.

OTM Book 15 recommends a minimum of 1m distance between crosswalk and stop line. However, at multi-lane crossings, 1m separation may not be sufficient as vehicles in one lane can hinder visibility of a motorist in adjacent lane, posing a threat to pedestrians.

Larger design vehicles such as SUVs, minivans, and pick-up trucks may not provide clear views of pedestrians crossing, especially vulnerable users, while turning at intersections. In some instances, motorists either stop too close to the stop bar or trespass on the crosswalk while turning, hindering the pedestrian (Fig. 4.82).

Recessed stop lines provide improved visibility for motorists (Fig. 4.83). They can be accompanied by RTOR restrictions to discourage encroachment by motorists making right turns.

Stop lines should be recessed 3m or more from crosswalks to accommodate bike boxes at signalized intersections, minimizing vehicular interference on cycle lanes (Fig. 4.84).

Recessed stop lines provide more space for turns within the intersection, thus facilitating tighter corner radii (Section 4.6.3) and slower turning speeds. They also provide space for turning of large vehicles such as buses, trucks, and emergency vehicles at intersections with tighter geometry.

Consider recessed stop lines at skewed intersections, midblock crossings, school zones, community safety zones, and senior homes. Stop lines can be supplemented with advanced warning signs as per OTM Book 6.

REFERENCES

- OTM Book 15: Pedestrian Crossing Treatments (2016).
- OTM Book 6: Warning Signs (2001).
- NACTO Transit Street Design Guide (2016).

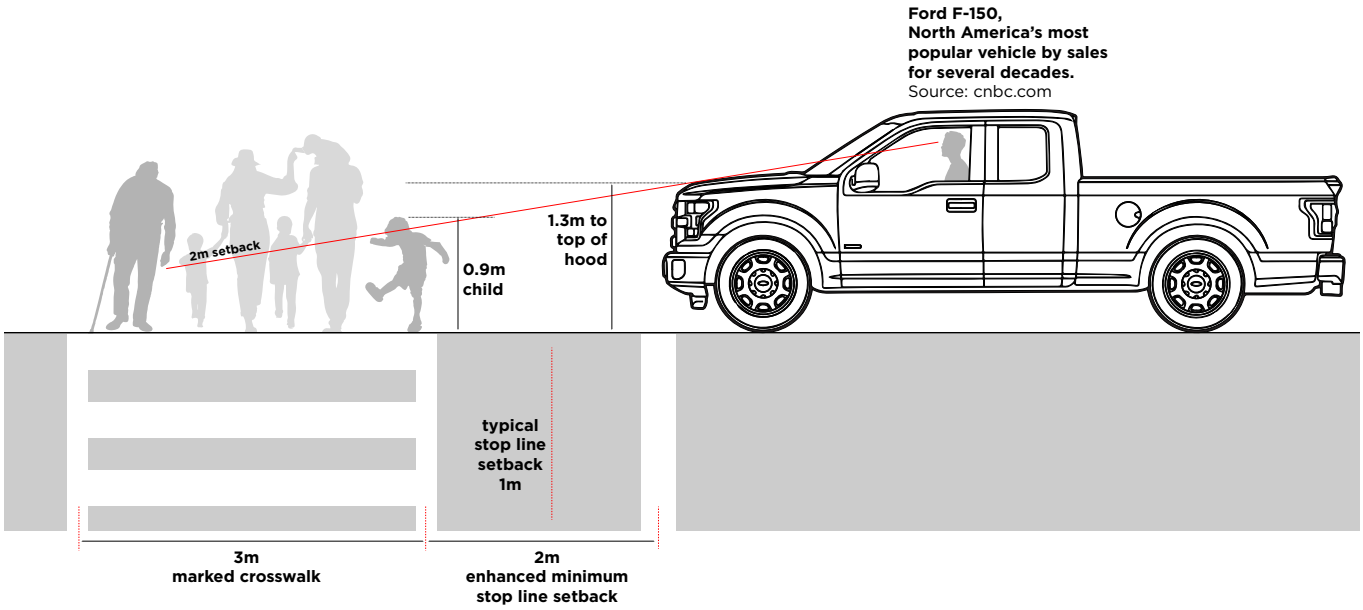


Figure 4.82. Recessed stop line location improves views of pedestrians at intersections for large design vehicles.

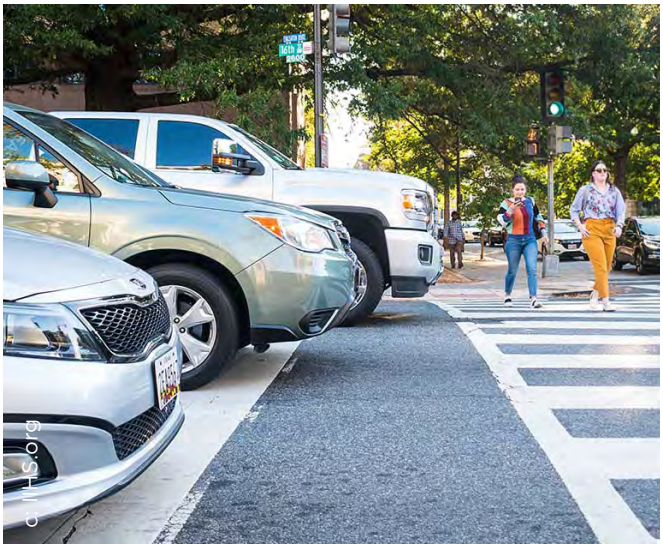


Figure 4.83. Large design vehicles encroaching on space between stop line and crosswalk.

Figure 4.84. Recessed stop lines accommodate bike boxes at intersection.

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CHAPTER 5
IMPLEMENTATION

5

Chapter 5 recommends steps to ensure the successful delivery of Complete Streets in Vaughan.

5.1 KEY STRATEGIES FOR IMPLEMENTATION

UNDERSTAND THE SCALE OF STREET NETWORKS

Streets contribute towards a city's spatial organization. However, they are finite and form a part of larger urban and regional networks like cycle, transit and goods movement routes, urban forest, and stormwater drainage systems. Street design needs to consider a street's context, users, scale, and role in the larger framework and assess elements that would best suit to making a street complete. Some elements are essential to complete a network. Conversely, in constrained scenarios, certain elements are prioritized over others, and still make a street complete.

LEVERAGE INVESTMENTS AND FUNDING SOURCES

Street improvements are costly and require creative design approaches, dynamic collaboration, strategic planning, and phasing to mitigate budget and time constraints.

Making existing and new streets complete relies on diverse funding sources- public and private, and coordination with various capital works programs and leveraging funding from different levels of government (Regional and Provincial). Funding for streets differs, based on the scope of each project. For instance, large-scale improvements are often combined with utility upgrades and development projects, to access multiple funding streams- public and private. The capital for constructing new streets is sourced from the Development Charges (DCs), a one-time fee collected from new development to help pay for new infrastructure related to intensification. Conversely, temporary fixtures like bollards and quick improvements like pavement markings can drastically improve the character of a street, at a relatively low cost.

Coordination between agencies and engagement with different owners and partners, helps integrate the CS approach within municipal processes. It also helps satisfy multiple CS objectives such as enhanced safety, inclusion, mobility, sustainability, and community health. Practitioners shall seek opportunities to leverage investment in the City's ROWs that ensure maximum performance of its streets.

PRIORITIZE THE SAFETY OF THE VULNERABLE USER

Vehicular speeding is a key concern in Vaughan. The City has initiated several programs and strategies to raise awareness about the impact of speeding on vulnerable users and mitigate high collision rates.

The City's Speed Compliance Program provides guidelines to identify 'Community Safety Zones'- areas with higher volume of communal activities such as schools, community centres, parks, and senior housing and long-term care facilities, that require enhanced traffic safety measures. The MoveSmart Mobility Management Strategy includes traffic calming pilot programs in select

neighbourhoods and campaigns aimed at reducing speeding and improving the safety of users.

Integrating a CS approach in all these initiatives will ensure safe and equitable movement and improve the overall user experience.

BEGIN WITH QUICK WINS

Recognizing opportunities for application of the Guide and delivering complete streets as part of the City's existing operations is a promising start. Quick wins can involve a wide range of actions such as implementing new policies or executing streetscape improvements, which prioritize the safety of vulnerable users. The City is already applying this approach to an extent. Under Vaughan's Speed Limit Policy, the posted speed limits are reduced in school zones, public laneways and select roadways and neighbourhoods. The City can always improve this initiative by further reducing speed limits based on recent best practices.

The City generally bundles streetscape projects with utility upgrades. This practice ensures effective management of timelines and costs and minimizes public disruption. The City of Vaughan's Infrastructure Planning and Corporate Asset Management department identifies the need for new street and streetscape improvement, and the Infrastructure Delivery department delivers them, after approval from Council. The Transportation and Fleet Management Services department identifies operational and safety-related improvements for existing streets such as initiating the Neighbourhood Traffic Calming Plan.

Other potential quick wins can include, but not be limited to:

- Road resurfacing
- Pavement markings
- Sidewalk, curb, and pothole repairs
- Catch basin repairs
- New sidewalks and pedestrian facilities
- New and enhanced cycling infrastructure
- Transportation infrastructure enhancements (e.g., intersection improvements)
- Streetscape enhancements and other neighbourhood improvements
- Geometric design and other safety improvements
- Improving maintenance programs to better align with Complete Streets

Simple and cost-effective quick wins in the short term can inform large scale improvements in the future. The practice of identifying these initiatives should recur and be implemented consistently.

PROMOTE TESTING WITH PILOT PROJECTS

Pilot projects or tactical urbanism involves implementing temporary, scalable interventions to improve the overall street experience. This action-oriented approach allows for experimentation with street concepts to make streets safer and more attractive. Several cities throughout the province have initiated and tested pilots with great success.

Pilots provide quick results; help evaluate successes and failures and can be implemented affordably. Additionally, pilots can foster positive public engagement and boost local businesses.

Keys to implement a successful pilot are:

- **Context-specific interventions.** Identify and assess the street context. Who are the priority users? Does the street have a unique character? Are there active at-grade businesses along the street? Context-specific pilots can substantially enhance safety, accessibility, inclusivity and attractiveness of the street and boost local economy.
- **Clear communication.** Ensure that everyone involved is aware of the purpose, objectives, and duration of the pilot and who to contact for concerns and feedback. Provide information based on the results of the pilot project to the public and stakeholders.
- **Defined evaluation measures.** Pilots are essentially quick experiments to test concepts, thus require set criteria for evaluation. Establish clear methodology and accountability for data collection prior to the pilot, based on its purpose and objectives.

As a part of the Neighbourhood Traffic Calming Plan, the City has selected five neighbourhoods to test and subsequently evaluate temporary traffic calming measures. The methods and results of this pilot will inform future efforts, and help to advance the application of the Complete Streets approach throughout Vaughan.

COLLECT ROBUST CONTEXT INFORMATION EARLY ON

During a street project, collecting data for elements such as utilities, tree planting, or possible future conflicts at preliminary design stage reduces cost and schedule impacts at advanced design and construction stages. This is especially vital for third party utlity providers, since they traditionally are not fully engaged until well later in the project delivery process.

5.2 ACTIONS

This Guide is the first step towards understanding and teaching the 'Complete Streets' approach in the design, delivery, and upkeep of all street projects (see Section 1.5) in Vaughan. Decisive action is needed to achieve the overall vision established in this Guide.

Policy. Establish or update the rules and regulations governing Complete Streets. Establish or update reference documents such as the Official Plan and Transportation Plan along with other standards and guidelines used to design, operate, and maintain Complete Streets. Additionally, refer to relevant area or corridor specific plans to provide further direction.

Process. Adapt existing operating procedures, practices, and organizational structures to align with the Guide. Invest in education, training, and outreach to bring in new skills and knowledge, and broader community engagement. Improve processes to document, share and implement lessons learned, to achieve higher levels of consistency and 'completeness' in every project.

Prioritization. Create an inventory of existing and future street projects which can be most impacted by CS techniques. This includes coordinating with existing initiatives, grouping various initiatives, and targeting quick wins (targeted projects in easy places with a short implementation time).

Collaboration and coordination between City Staff and the stakeholders involved is key to efficiently implementing recommendations from the Guide. The implementation guidance should go hand in hand with departmental workplans and funding strategies to ensure each action is successfully executed.

The following action lists involve 15 actions organized into three themes- policy, process, and prioritization. Lead and supporting City departments along with timing for each action is listed in the following sections. Whether the action is ongoing or will be initiated in the immediate future, with a short-term (within 5 years), medium-term (5- 10 years), and long-term (beyond 10 years) duration, is identified.

5.2.1 Action List: Policy

ACTION 1

Updates to Vaughan Official Plan (VOP), Policies, Plans and other Guidelines.
Include the updated CS definition, objectives, and formalized street classes in the VOP.

Review and update City guidelines, standards and tools required to manage design, construction, and maintenance of streets in Vaughan.

Review and update local area and corridor plans, character area policies and by-laws to include CS practices.

- **Lead:** Policy Planning and Special Programs
- **Support:** Infrastructure Planning and Corporate Asset Management
- **Timing:** Immediate/ Medium-term

ACTION 2

Formalization and application of the Vaughan Transportation Plan (VTP).
Apply street classifcations and directions established in the VTP and integrate the CS approach in all street projects.

Update the City-wide Streetscape Implementation Manual and Financial Strategy based on the VTP and the guidance in the CS Guide.

- **Lead:** Infrastructure Planning and Corporate Asset Management
- **Support:** Development Planning
- **Timing:** Immediate/ Medium-term

ACTION 3

Online Street Classification.
Consider creating a reference online for designers and reviewers. This could make use of a GIS-based system which links street location, functional class, broader policy and design objectives along with relevant initiatives.

- **Lead:** Infrastructure Planning and Corporate Asset Management
- **Support:** Project Management Office
- **Timing:** Short-term

ACTION 4

Update to other Plans and Standards.
An interim update to the City's Engineering Design Criteria and Standard Drawings is currently underway, based on the CS Guide recommendations.

Additionally, a complete update in future should also reflect best practice recommendations such as TAC 2017 and the Ontario Traffic Manual.

Coordinate the update with further studies identified in Action 12.

- **Lead:** Infrastructure Planning and Corporate Asset Management
- **Support:** Development Engineering
- Timing: Short-term

5.2.2 Action List: Process

ACTION 5

Use the Guide as a reference in all projects.
The guidance provided in the CS Guide applies to all street projects irrespective of their scope, scale, or complexity.

Start with integrating the Project Delivery Process (refer Section 2.2), apply the CS vocabulary, reference the street classes and techniques.

Apply Review and Compliance to all works. Use the CS Design Checklist (Appendix A) and Performance Metrics (Section 5.3) to ensure consistent application of the Guide.

- **Lead:** Infrastructure Planning and Corporate Asset Management
- **Support:** All planning and delivery departments, including Development Planning, Development Engineering, Transportation and Fleet Management Services, Infrastructure Delivery
- **Timing:** Immediate

ACTION 6

CS Review.
Based on the rationale, procedures and recommendations in the Guide, the Project Manager/ Project Management Team prepares terms of reference for the CS Review role or team under the City's Infrastructure Planning and Corporate Asset Management department.

- **Lead:** Infrastructure Planning and Corporate Asset Management
- **Timing:** Short-term

ACTION 7

Oversight and Compliance Role.
Prepare terms of reference based on the rationale, procedures and recommendations in the Guide for the Oversight and Compliance role. This is either a new Committee or an additonal responsibility assigned to an existing senior decision-making body.

- **Lead:** Infrastructure Planning and Corporate Asset Management
- **Timing:** Short-term

ACTION 8

CS Training.
Develop a CS Training Program to educate those involved in street design, reviews, operations, and maintenance, create awareness about the CS policy, and help overcome barriers in implementation.

Undertake CS Training in various stages- immediate, to highlight the key recommendations emerging from the plan, and medium-term upon completion of other updates to standards, policies and processes.

Training methodology can involve the use of different media to educate staff, share knowledge, improve existing and new skills, and foster teamwork.

- **Lead:** Infrastructure Planning and Corporate Asset Management
- **Support:** Office of the Chief Human Resources Officer
- **Timing:** Immediate

ACTION 9

Community Outreach.
Focus on tools such as digital and direct communication to spread CS awareness within the community. Make the Guide accessible and its influence on potential street design visible through the process.

Explore targeted outreach efforts reaching groups with distinct needs such as newcomers, new parents, post-secondary students to ensure maximum engagement resulting in positive public support. Additionally, undertake outreach with the developer community to ensure awareness regarding the Guide.

- **Lead:** Infrastructure Planning and Corporate Asset Management
- **Support:** Corporate and Strategic Communications
- Timing: Short-term/Ongoing

ACTION 10

Collaboration and Coordination.
Ensure efficient communication between different agencies and jurisdictions to ensure adherence to CS approach.

Coordinate CS improvements with infrastructure upgrades and other Capital projects, e.g., (transit infrastructure upgrades, municipal or regional servicing upgrades, spot repairs, road resurfacing or line repainting).

- **Lead:** Infrastructure Planning and Corporate Asset Management
- **Timing:** Ongoing

ACTION 11

CS Operations and Maintenance Review.
Review existing provincial legislation for directions on operations and maintenance activities (for example, levels of service for different facilities).

Develop an Operations and Maintenance Plan which establishes priorities based on street context. For instance, in case of streets with high volume of active transportation (AT) users and important public transportation links, maintain priority AT facilities as you would roadways.

Seek opportunities to develop partnerships with private owners/ developers for maintenance of elements within the boulevard.

Review budget allocation for operations and maintenance in the preliminary stages of design, for the intended outcome.

Integrating the CS vision requires coordination of design with operations, maintenance, life-cycle costs, and provisions for stewardship. Refer Section 2.6.5 for life-cycle and maintenance directives.

Create an inventory of existing and planned/proposed street elements and available equipment for maintenance. Plan for potential upgrades to the equipment.

Aim to improve consistency and efficiency in operations and maintenance, by installing suitable infrastructure. This includes (GI) alongside conventional municipal infrastructure and third party utility providers.

- **Lead:** Transportation and Fleet Management Services, Parks, Forestry and Horticulture Operations
- **Support:** Infrastructure Planning and Corporate Asset Management
- **Timing:** Short-term/Ongoing

ACTION 12

Additional Studies.
The following studies were identified to support and achieve CS goals for Vaughan.

- **City-wide GI Strategy and updates to Tree Planting and Preservation Standards**. Green Directions Vaughan establishes objectives for enhancing GI management standards and improving urban canopy. Develop city-wide standards, design criteria, details and specifications for GI and tree planting and preservation, based on the directions provided in the CS Guide (see Section 2.6.4 and Section 4.5). Coordinate with the full update to the City's Engineering Standards.

- **Lead:** Development Planning
- **Support:** Parks, Forestry and Horticulture Operations
- **Timing:** Short-term

- **Curbside Management Strategy.** Green Directions Vaughan establishes objectives to reduce carbon footprint by promoting low carbon mobility options and establish the infrastructure required by them. Develop strategy and guidelines for curbside management based on the guidance provided in Section 4.4.5. Aim to support multimodal access and safety, support local businesses, and enhance placemaking.

- **Lead:** Infrastructure Planning and Corporate Asset Management
- **Support:** Development Planning, Transportation and Fleet Management Services
- **Timing:** Medium-term

- **Traffic Calming and Speed Allowance Standards (by Street Class and Land Use context).** Vaughan's existing Neighbourhood Traffic Calming Plan includes a toolbox of traffic calming and speed management measures to address safety concerns in pilot neighbourhoods. Based on the results of the pilots, further develop context-sensitive traffic calming standards and guidelines for various street classes established in the VTP. Involve community members and businesses to highlight traffic concerns on their streets. An update to the Plan is expected in 2024.

- **Lead:** Transportation and Fleet Management Services
- **Support:** Infrastructure Planning and Corporate Asset Management
- **Timing:** Short-term

- **CS Approach to Utilities.** Include robust and complete information regarding utilities (gas, hydro, water, sanitary, and/or stormwater) at the preliminary design stages to reduce impacts on budget and schedule, during implementation. Trade-off discussions are often influenced by utility conflicts, hindering delivery of complete streets. Combine streetscape improvements with utility upgrades wherever possible, to minimize public disruption. Coordinate with the Region and private utility providers such as telecommunication, to develop a CS approach to utilities.

- **Lead:** Transportation and Fleet Management Services
- **Support:** Infrastructure Planning and Corporate Asset Management
- **Timing:** Short-term

- **Resolving Funding Models for Streetscape Improvement.** Streetscape projects in Vaughan are often funded through multiple sources, primarily Development Charges (DCs). Funding sources often dictate the design, construction, and maintenance of streets. These sources differ based on the nature of projects- existing or new streets. They impact inclusion of certain elements and influence trade-off decisions in the delivery of complete streets. As the new provincial legislation limits the use of DCs, the City should identify and expand to newer ways of funding. Some of these opportunities might connect to land use, gas tax, transit investment, intensification, and/or other additional funding sources from regional, provincial or national partners.

- **Lead:** Development Planning
- **Support:** Financial Planning and Development Finance
- **Timing:** Short-term

5.2.3 Action List: Prioritization

ACTION 13

Priority 1. Apply CS to projects underway.
Start with exploring how the CS approach can be applied to existing operations in Vaughan.

Focus on improving coordination between various stakeholders and integrate a review and compliance framework.

Make project updates accessible to minimize public disruption.

- **Lead:** Infrastructure Planning and Corporate Asset Management
- **Support:** All planning and delivery departments, including Development Planning, Development Engineering, Transportation and Fleet Management Services, Infrastructure Delivery
- **Timing:** Immediate

ACTION 14

Priority 2. Create inventory of street retrofit projects.
As most of the street network in Vaughan has already been built, most streetscape improvement projects will involve retrofits.

Identify locations for simple and cost-effective retrofits that prioritize safety of the vulnerable user. Compile a list of locations and identify the retrofit measures that will be applied, along with duration and lead department managing the project (see Table 5.2).

Opportunities to identify locations for CS projects can be undertaken through Corridor Reviews and/or Network Screening (which will identify priority intersections and midblocks for road safety interventions).

The retrofit inventory can also link to the Online Street Classification (Action 3). Consistently update with the progress and results of the retrofits.

- **Lead:** Infrastructure Planning and Corporate Asset Management
- **Support:** Project Management Office
- **Timing:** Short-term

ACTION 15

Priority 3. Promote pilots/ tactical urbanism opportunities. Select locations within the City to apply the Guide in either a temporary, semi-permanent, or permanent way.

A pilot project can help to quickly test ideas, engage stakeholders, and transform spaces. If pilots are successful, they can become a program. It is possible to implement pilots at minimal cost. Additionally, pilots can generate positive public outreach.

The pilot may take place in an Intensification Area, Neighbourhood, or Employment Area to demonstrate the application of CS to different contexts.

Tie pilots into training and education (Action 8).

- **Lead:** Infrastructure Planning and Corporate Asset Management
- **Support:** Departments interested in pilot projects including but not limited to VMC, Transportation and Fleet Management Services, Development Planning
- **Timing:** Short-term

Table 5.1 Summary of Action List

Actions	Timing	Departments
THEME 1: POLICY		
Action 1: Updates to Vaughan Official Plan (VOP), Policies, Plans and other Guidelines.	Immediate/ Medium-term	• **Lead:** Policy Planning and Special Programs • **Support:** Infrastructure Planning and Corporate Asset Management
Action 2: Formalization and application of the Vaughan Transportation Plan (VTP).	Immediate/ Medium-term	• **Lead:** Infrastructure Planning and Corporate Asset Management • **Support:** Development Planning
Action 3: Online Street Classification.	Short-term	• **Lead:** Infrastructure Planning and Corporate Asset Management • **Support:** Project Management Office
Action 4: Update to other Plans and Standards.	Short-term	• **Lead:** Infrastructure Planning and Corporate Asset Management • **Support:** Development Engineering

Table 5.1 Summary of Action List

Actions	Timing	Departments
THEME 2: PROCESS		
Action 5: Use the Guide as a reference in all projects.	Immediate	• **Lead:** Infrastructure Planning and Corporate Asset Management • **Support:** All planning and delivery departments, including Development Planning, Development Engineering, Transportation and Fleet Management Services, Infrastructure Delivery
Action 6: CS Review.	Short-term	• **Lead:** Infrastructure Planning and Corporate Asset Management
Action 7: Oversight and Compliance role.	Short-term	• **Lead:** Infrastructure Planning and Corporate Asset Management
Action 8: CS Training.	Immediate	• **Lead:** Infrastructure Planning and Corporate Asset Management • **Support:** Office of the Chief Human Resources Officer
Action 9: Community Outreach.	Short-term/Ongoing	• **Lead:** Infrastructure Planning and Corporate Asset Management • **Support:** Corporate and Strategic Communications
Action 10: Collaboration and Coordination.	Ongoing	• **Lead:** Infrastructure Planning and Corporate Asset Management
Action 11: CS Operations and Maintenance Review.	Short-term/Ongoing	• **Lead:** Transportation and Fleet Management Services, Parks, Forestry and Horticulture Operations • **Support:** Infrastructure Planning and Corporate Asset Management
Action 12: Additional Studies.		
City-wide GI Strategy and updates to Tree Planting and Preservation Standards.	Short-term	• **Lead:** Development Planning • **Support:** Parks, Forestry and Horticulture Operations
Curbside Management Strategy.	Medium-term	• **Lead:** Infrastructure Planning and Corporate Asset Management • **Support:** Development Planning, Transportation and Fleet Management Services
Traffic Calming and Speed Allowance Standards (by Street Class and Landuse context).	Short-term	• **Lead:** Transportation and Fleet Management Services • **Support:** Infrastructure Planning and Corporate Asset Management
CS Approach to Utilities.	Short-term	• **Lead:** Transportation and Fleet Management Services • **Support:** Infrastructure Planning and Corporate Asset Management
Resolving funding models for Streetscape Improvement.	Short-term	• **Lead:** Development Planning • **Support:** Financial Planning and Development Finance

Table 5.1 Summary of Action List

Actions	Timing	Departments
THEME 3: PRIORITIZATION		
Action 13: Priority 1. Apply CS to projects underway.	Immediate	• **Lead:** Infrastructure Planning and Corporate Asset Management • **Support:** All planning and delivery departments, including Development Planning, Development Engineering, Transportation and Fleet Management Services, Infrastructure Delivery
Action 14: Priority 2. Create inventory of street retrofit projects.	Short-term	• **Lead:** Infrastructure Planning and Corporate Asset Management • **Support:** Project Management Office
Action 15: Priority 3. Promote pilots/ tactical urbanism opportunities.	Short-term	• **Lead:** Infrastructure Planning and Corporate Asset Management • **Support:** Departments interested in pilot projects including but not limited to VMC, Transportation and Fleet Management Services, Development Planning

5.3 PERFORMANCE METRICS

Defining performance metrics for different stages of the Project Delivery Process (see Section 2.2: Project Delivery Process), will establish a mechanism to evaluate successes and lessons learned.

Collection of 'before', 'during', and 'after' data informs better choices for other projects. Findings based on performance metrics help the City assess impacts on transportation budgets and track compliance with overall Complete Streets objectives.

The CS Review (role or team) will use the Performance Metrics (PMs) as an evaluation framework during review and compliance to:

- Monitor and evaluate the results of street projects.
- Assess to what degree street projects implement the Guide and CS goals.
- Document lessons learned.
- Report to Standards Committee (see Section 2.3).

The PMs are intended to supplement CS objectives, EA goals, policy directions and design criteria developed at the beginning of a project. The PMs are organized by four broader goals based on the guiding principles established in Section 1.4.

- **Goal 1:** Safety for all users
- **Goal 2:** Enhanced health and environment
- **Goal 3:** Sustainable and active transportation
- **Goal 4:** Social equity and inclusivity

Duration and operations-based metrics are applied:

- Short-term: assessed on a project-project basis by the Project Manager
- Long-term: assessed every 5 years by the CS Review (role or team).
- Operations: assessed annually the CS Review (role or team).

Table 5.2 Performance Metrics

CS Goals	Metrics					
	Short Term Assessed by Project Manager per project		**Long Term** Assessed by CS Review (Role / Team) every 5 years		**Operations** Assessed by CS Review (Role / Team) every year	
	About the Metric	**How it's measured**	**About the Metric**	**How it's measured**	**About the Metric**	**How it's measured**
GOAL 1: SAFETY FOR ALL USERS						
Speed	Percentage of drivers that comply with speed limits.	Before and after on-site surveys documenting the number of drivers at speeds over the posted limit.				
	Increase in traffic calming.	Measured from plan. Add total number by km and/or by total intersections.				
	Decrease in lane widths.	Measured from plan. Calculate difference between existing and proposed lane width. Multiply by number of lanes in cross-section.				
Vulnerable Spots					Percentage of safety spot improvements completed.	Breakdown by street, sidewalk, bicycle. Use Municipal records from Capital Projects.
					Number of intersections improved for safety.	Breakdown by intersection type as per Section 4.6.1. Use Municipal records from Capital Projects.

Table 5.2 Performance Metrics

CS Goals	Metrics					
	Short Term Assessed by Project Manager per project		**Long Term** Assessed by CS Review (Role / Team) every 5 years		**Operations** Assessed by CS Review (Role / Team) every year	
	About the Metric	**How it's measured**	**About the Metric**	**How it's measured**	**About the Metric**	**How it's measured**
Potential for Safety Improvement (PSI)			Decrease of all collisions. (Property Damage Only (PDO) to Fatal).	Factored for severity, controlled by population and Vehicle Kilometres Travelled (VKT). Measured by mode, controlled by modal split. Include: location, project, etc. as relevant. Use Municipal and Regional collision data.		
Mode split = Safety in Numbers			Percentage increase of people walking, cycling, using public transport or other non-single occupant vehicles (SOV).	Use data from York Region's Traveller Safety Plan (ongoing).		
Exposure Risk	Decrease in average crosswalk length.	Measured from plans.				
	Increase Leading Pedestrian Intervals (LPI), decrease lagging turns, decrease Right Turn on Red (RTOR).	Measured from plan: percentage of plan completed.				

Table 5.2 Performance Metrics

CS Goals	Metrics					
	Short Term Assessed by Project Manager per project		**Long Term** Assessed by CS Review (Role / Team) every 5 years		**Operations** Assessed by CS Review (Role / Team) every year	
	About the Metric	**How it's measured**	**About the Metric**	**How it's measured**	**About the Metric**	**How it's measured**
GOAL 2: ENHANCED HEALTH AND ENVIRONMENT						
Trees	Conduct tree health assessment of existing street trees to create inventory for tree preservation/ replacement.	Measure from Arborist Report.				
	Increase in number of trees.	Measure trees planted from plan at 2 year warranty period.	Percentage increase in tree canopy cover.	GIS database, LIDAR, aerial photography.		
	Number of tree pits that meet and/ or exceed minimum tree standards (soil volume).	Measured from plan.				
Stormwater	Number of LIDS installed.	Measured from plan.				
GOAL 3: SUSTAINABLE AND ACTIVE TRANSPORTATION						
Bike	Percentage of cycleways that are LTS1 and LTS2.	Low-Stress Bicycling and Network Connectivity per Guide (Fig. 4.16).				
					Linear metres cycling lanes and cycle tracks added.	Use Municipal records from Capital Projects, measured by facility type.

Table 5.2 Performance Metrics

CS Goals	Metrics					
	Short Term Assessed by Project Manager per project		**Long Term** Assessed by CS Review (Role / Team) every 5 years		**Operations** Assessed by CS Review (Role / Team) every year	
	About the Metric	**How it's measured**	**About the Metric**	**How it's measured**	**About the Metric**	**How it's measured**
Walk	Increase in percentage of crosswalks, bus stops, and paths.	Measure from plan: percentage increase from plans.				
					Linear metres of sidewalk added.	Percentage of plan completed.
Maintenance					Decrease in percentage of walking and cycling facilities. E.g., blocked, reported, snow.	Percentage reported.
Delay	Multi-Modal Level of Service (MMLOS) used to prioritize the needs of vulnerable users.	OTM MMLOS Guide. Document only on projects where MMLOS is used during design development.				
Parking	Parking utilization: on-street target: 85%.	Before and after surveys. Measure how much parking is provided in a specific area, how parking is being utilized, and demand exceeds capacity.				

Table 5.2 Performance Metrics

CS Goals	Metrics					
	Short Term Assessed by Project Manager per project		**Long Term** Assessed by CS Review (Role / Team) every 5 years		**Operations** Assessed by CS Review (Role / Team) every year	
	About the Metric	**How it's measured**	**About the Metric**	**How it's measured**	**About the Metric**	**How it's measured**
GOAL 4: SOCIAL EQUITY AND INCLUSIVITY						
Access to multimodal travel			Number of streetscape, active transportation and transit improvements within areas of greatest need and mobility deserts.	Percentage completed, measured from plans.		

c: Aaron Burden, Unsplash

APPENDIX A
DESIGN CHECKLIST

A

Use Design Checklists to evaluate and assess completeness of a project.

A.1 DESIGN CHECKLIST

This section provides a checklist template for all types of street projects- new, reconstruction and retrofit.

The Project Manager will complete the Design Checklists (the Checklists) at the end of 30%, 60% and 90% construction design document submission. This will allow for design modifications if an issue is identified and mitigate cost and time impacts.

The CS Review (role or team) will review the Checklists to confirm that submitted designs incorporate complete streets considerations.

The techniques identified in the checklist are not exhaustive. Additional items can be added based on the unique character and requirements of a project.

Figure A.1 (below) illustrates how to use the Checklists.

List of techniques and Guide references organized in 6 categories that follow the design process.

Use the 30%, 60% or 90% box to provide a '**Y**' or '**N**' answer. An '**N**' indicates a need to further evaluate the project for Complete Street techniques.

Identify or append (at the end of the checklist), any supporting information or documentation. List changes observed between 30% to 90%. E.g., budget, 3rd party information, etc.

Table A.1 Design Checklist

	Techniques	Notes	30%	60%	90%	Comments
1.0 Cross-sections						
1.1	Lane widths as per Guide Table 4.6.	• Measure lane widths to curb. • Avoid shoulders and edge lines. • Avoid excess pavement.				

Figure A.1. How to use Design Checklist

Table A.1 Design Checklist

	Techniques	Notes	30%	60%	90%	Comments
1.0 Cross-sections						
1.1	Lane widths as per Guide Table 4.6.	• Measure lane widths to curb. • Avoid shoulders and edge lines. • Avoid excess pavement.				
1.2	Number of lanes as per Guide Section 4.4.1.	• Avoid dedicated turn lanes except where there is a dedicated turn signal. • Avoid slip lanes. • Always err on the side of fewer lanes.				
1.3	Pedestrian clearway widths as per Guide Table 4.1.	• 2.0m wide in Community and Employment Areas. • 3.0m wide in Intensification Areas. • Wider walkways provided where necessary to meet LOS-C in peak hour.				
1.4	Furnishing and planting zone as per Guide Table 4.1.	• Intensification Areas: 2.5m minimum. • On streets with street trees: 2.5m minimum. • On streets without street trees: 1.2m minimum.				
1.5	Cycle facilities as per Guide Figure 4.16.	• Level of traffic stress (LTS): Local: LTS 1. Collector or Arterial: LTS 1 or 2.				
1.6	Cross-sections at constrained/ unique contexts.	• Constraints identified (e.g., structures, driveways, pinchpoints, change of ROW dimension, etc.).				

Table A.1 Design Checklist

	Techniques	Notes	30%	60%	90%	Comments
2.0 Plan: At Intersections and Midblock						
2.1	Avoid elements which decrease predictability as per Guide Table 4.6.	• Avoid unbalanced number of lanes at intersections. • Avoid unprotected turn signals. • Locate driver decision points away from crosswalks.				
2.2	Intersection traffic calming per Guide Section 4.4.6.	• Raised intersections, protected intersections, refuge islands, etc.				
2.3	Midblock traffic calming per Guide Section 4.4.6.	• Speed humps, chicane, roadway narrowing, raised crossings, etc.				
2.4	Corner radii as small as possible per Guide Section 4.6.2-Section 4.6.3.	• RTOR, left turns and other permissive movements are restricted if they cannot be safely accommodated with a smaller corner radius.				
2.5	Target turning speed 10 kph or less per Guide Section 4.6.3.	• Corner radii is not necessarily the same as effective turning radii.				
2.6	Design vehicle per Guide Table 4.9.					
2.7	Traffic signals to minimize delay for all users and all approaches per Guide Section 4.6.9.	• Signal timing and phasing minimize delay for all users and all approaches.				
2.8	Two-phase signals, with leading pedestrian/cycle intervals and lagging turn internals, preferred.	• All-ped phases ideal where there are heavy diagonal crossings.				
2.9	Fixed time signals	• Pedestrian and cycle activated signals require approval.				
2.10	Roundabouts limited to two circulating lanes per Guide Section 4.6.1.					

Table A.1 Design Checklist

	Techniques	Notes	30%	60%	90%	Comments
3.0 Plan: Crossings						
3.1	Crossings located at all legs of all intersections per Guide Section 4.6.5.	• Locations without crossings require approval from CS Review (role or team).				
3.2	Crossings at transit stops, greenways, paths, building entrances, and desire lines (as determined by UD) per Guide Section 4.6.5.	• Locations without crossings require approval from CS Review (role or team) or removal of transit stop.				
3.3	Crossings distance to opposite curb or median as short as possible per Guide Section 4.6.5.	• Crossing distances greater than three lanes require approval from CS Review (role or team).				
3.4	Crosswalks provide sufficient capacity for pedestrians per Guide Section 4.6.5.	• Minimum Width: »Intensification Areas: 5m. »Local Streets: 3m. • Meet LOS-C.				
3.5	Stop lines per Guide Section 4.6.10.	• Set back 3m.				
3.6	Crossings aligned with walkways per Guide Section 4.6.5.	• Deviation up to 1:5 permitted.				
3.7	Corners provide sufficient capacity for pedestrians per Guide Section 4.6.5.	• >0.6m2/person queuing area (LOS-C).				
3.8	Driveways prioritize vulnerable users per Guide Section 4.6.5.	• Level walkway, max 2 lanes without refuge, slope slows drivers. • Line markings per OTM Book 18.				

Table A.1 Design Checklist

	Techniques	Notes	30%	60%	90%	Comments
4.0 Urban Design and Placemaking						
4.1	Places to gather or per Guide Chapter 4.2.	• Parklets, flexible spaces, informal play areas, pocket parks, plazas, etc.				
4.2	Places of relief or rest per Guide Chapter 4.2.	• Shade, wind-breaks, seating (low walls and ledges, benches) every 40m, or as determined by UD.				
4.3	Street responds to adjacent built form per Guide Chapter 4.2.	• Building entrances, gates, window shopping, storefront window, streeteries, parklets, sidewalk cafés, etc.				
4.4	Walk/ride is interesting, not just efficient per Guide Chapter 4.2.	• Artistic crosswalks, colour, view corridors, landmarks, water-features, tactile elements, rhythm, etc.				
4.5	Connections to transit per Guide Section 4.6.8.	• Convenient and comfortable pedestrian access to transit. • Walkshed analysis to confirm walking times.				
4.6	Transit stop amenities per Guide Section 4.6.8.	• Shelter, seating, lighting, route info, cycle/scooter parking/share, etc.				
5.0 Green Infrastructure						
5.1	Existing street trees of useful size to be identified and preserved.	• Refer tree condition rating criteria as a starting point from York Region's Street Tree and Forest Preservation Guidelines.				
5.2	Street trees selected and spaced to maximize growth and height per Guide Chapter 4.4.	• Native species used. • 25% of ROW (or more) canopy cover. • 30m3 soil volume/ tree, 20m3 soil volume/ tree if shared.				

Table A.1 Design Checklist

	Techniques	Notes	30%	60%	90%	Comments
5.3	Utilities (above and below ground) coordinated with tree locations per Guide Chapter 4.4.					
5.4	Passive irrigation of trees and landscaping per Guide Chapter 4.4.					
5.5	Stormwater is managed and processed within ROW before it enters storm sewer per Guide Chapter 4.4.	• Rain gardens, permeable pavements, native species, etc.				
5.6	Traffic noise mitigation measures per Guide Chapter 4.4.	• Noise-dampening pavement, sound barriers, landscaping, absorptive materials. Target 60 dB at 15m from curb on local.				
5.7	Recycled and/or locally sourced materials per Guide Chapter 4.4.	• Glassphalt, recycled rubber				
6.0 Management						
6.1	Curbside management per Guide Section 4.4.5.	• Metered parking, taxi zones, delivery zones, etc.				
6.2	Minimize access impact to sidewalk per Guide.	• Combine driveways or rear/side access.				
6.3	Street flexes to meet various operating conditions per Guide Section 4.4.5.	• Rush hour bikeways, off-peak parking, off-peak lane reductions, off-peak signal timing adjustments, etc.				
6.4	Street flexes to accommodate temporary and seasonal events.	• Weekend markets, open streets, temporary animation, bike rides, cultural events, art installations.				

APPENDIX B
CROSS-SECTIONS

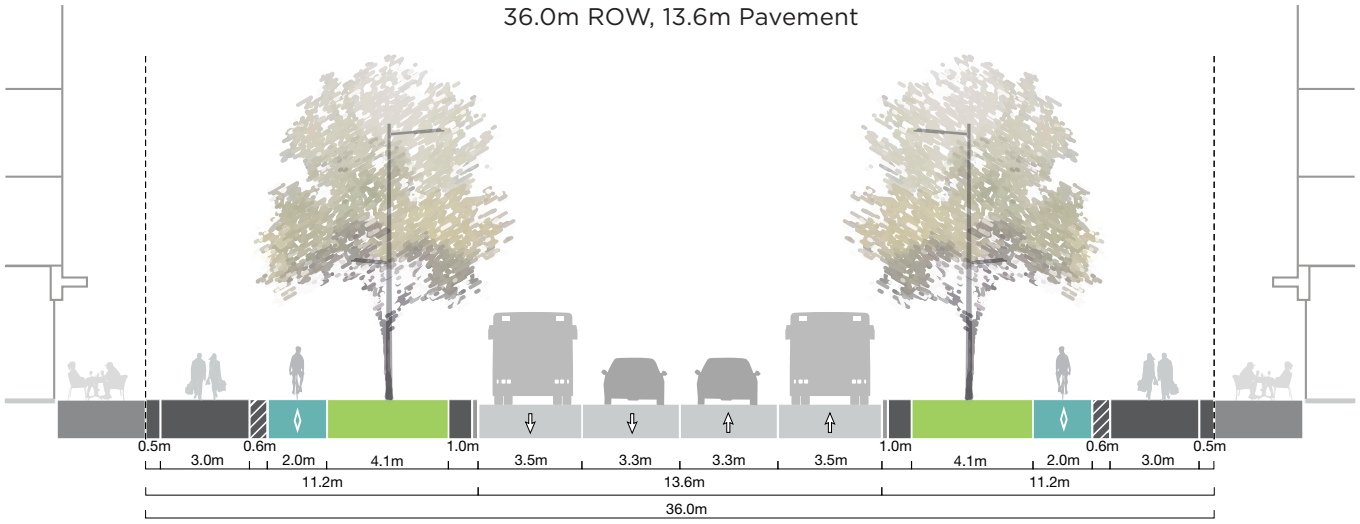
B

Complete Streets cross-sections build upon the street ROW and functional class listed in the Vaughan Transportation Plan (see Fig. 2.5).

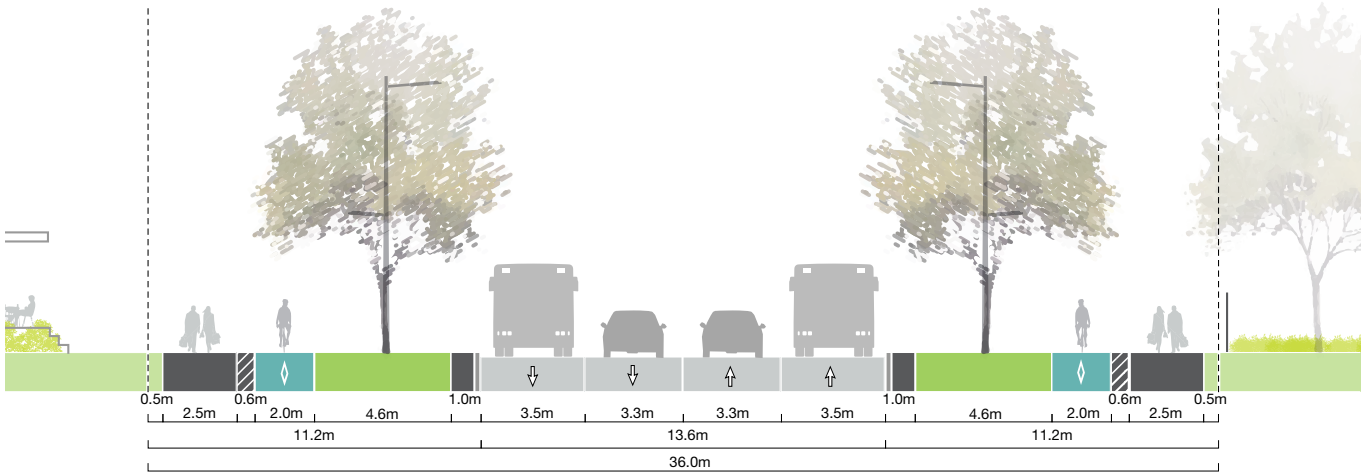
These cross-sections are aspirational and are included for illustrative purposes only. They show the best possible arrangement of CS elements within the available rights-of-way. Every project has to undergo a CS process for a solution.

B.1 CROSS-SECTIONS: ARTERIAL

Arterial (Intensification Area)
36.0m ROW, 13.6m Pavement

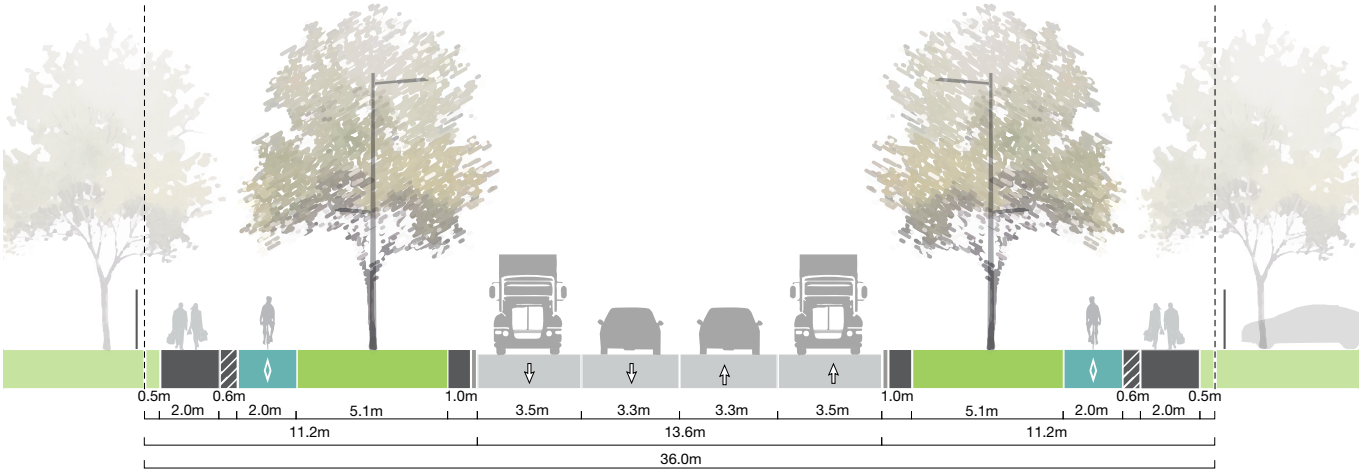


Arterial (Community Area)
36.0m ROW, 13.6m Pavement



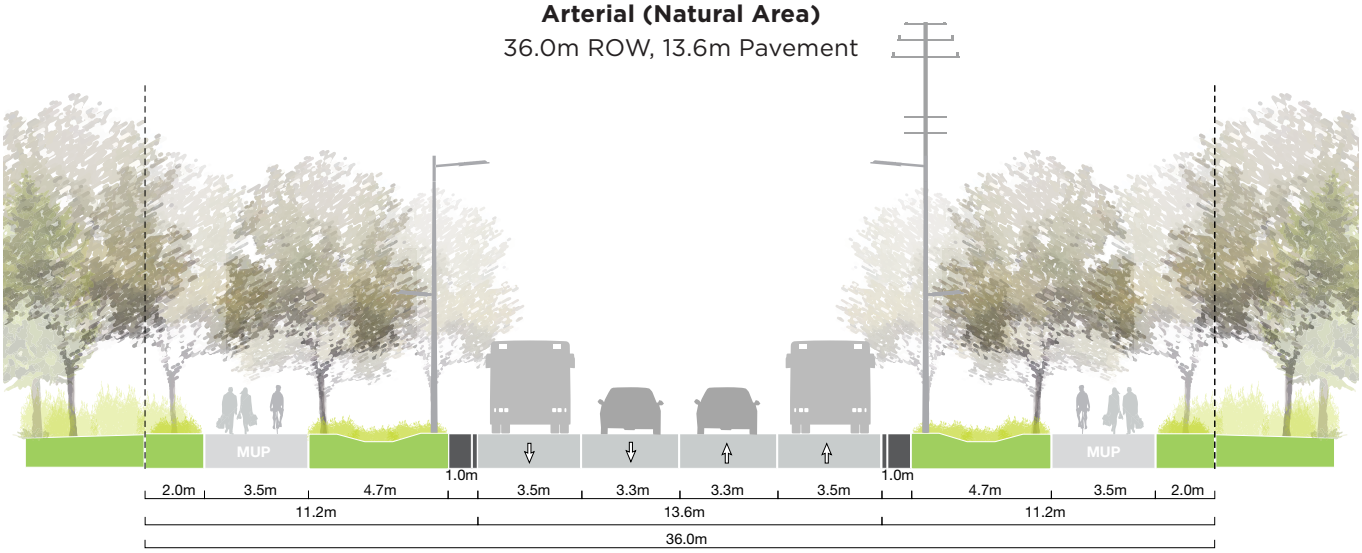
Arterial (Employment Area)

36.0m ROW, 13.6m Pavement



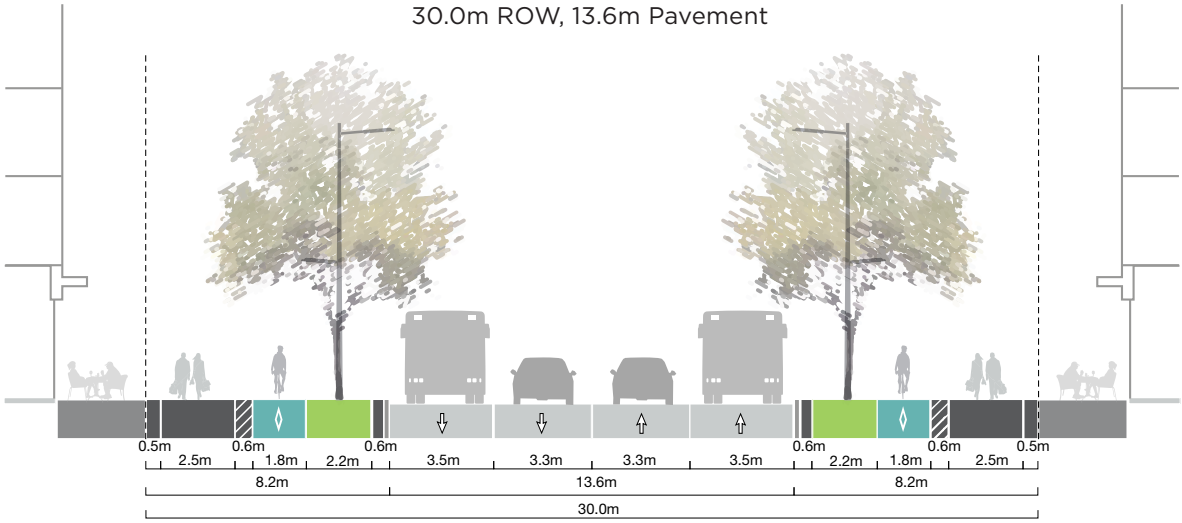
Arterial (Natural Area)

36.0m ROW, 13.6m Pavement

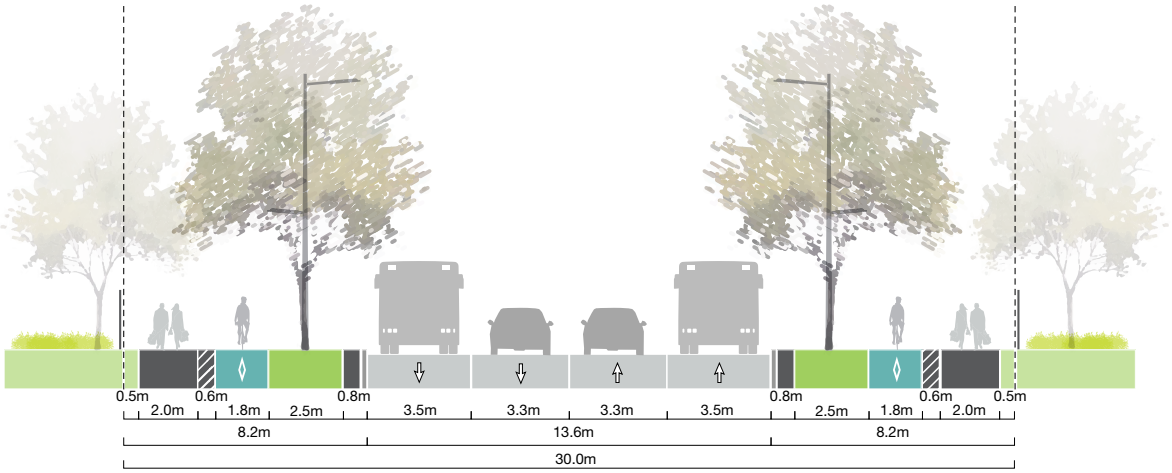


B.2 CROSS-SECTIONS: MAJOR COLLECTOR

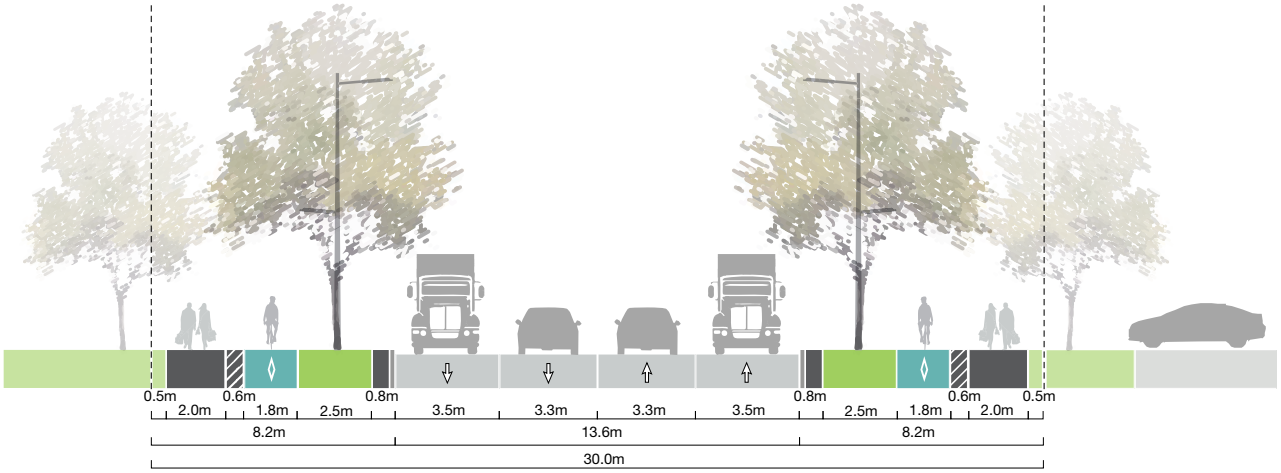
Major Collector (Intensification Area)
30.0m ROW, 13.6m Pavement



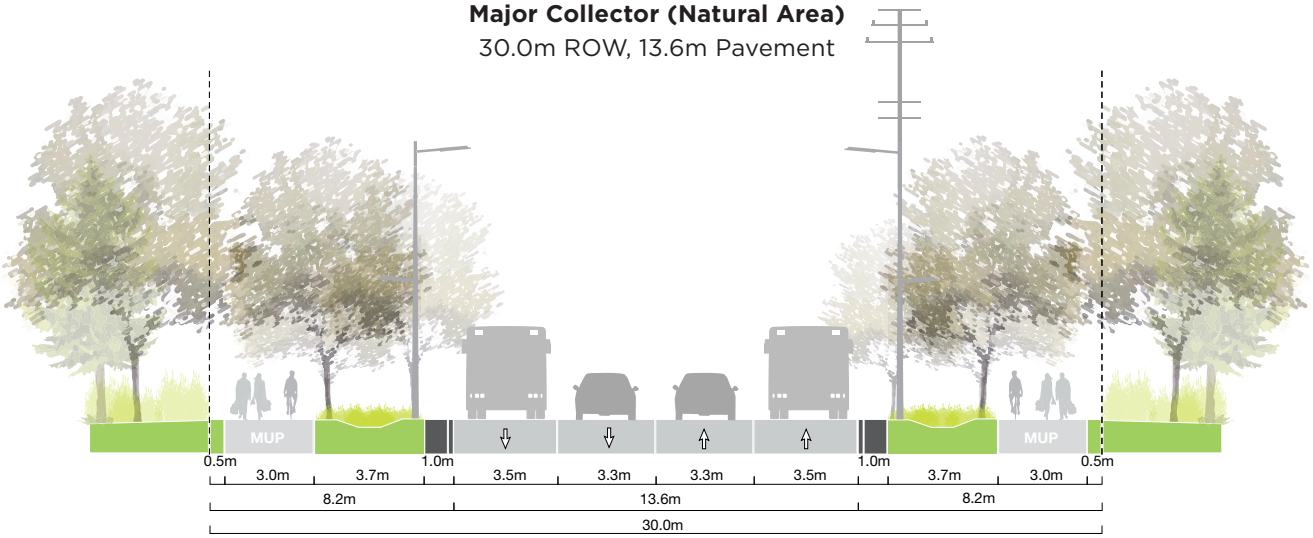
Major Collector (Community Area)
30.0m ROW, 13.6m Pavement



Major Collector (Employment Area)
30.0m ROW, 13.6m Pavement

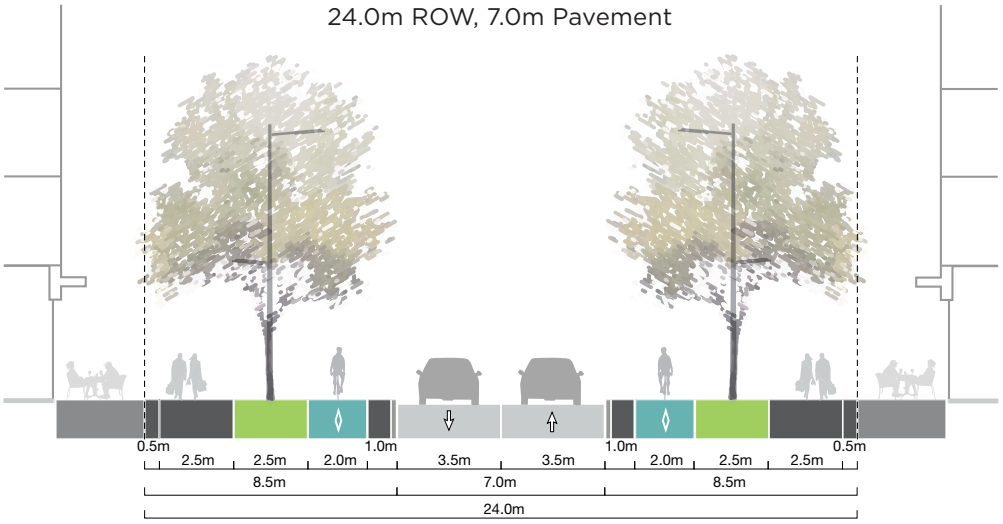


Major Collector (Natural Area)
30.0m ROW, 13.6m Pavement

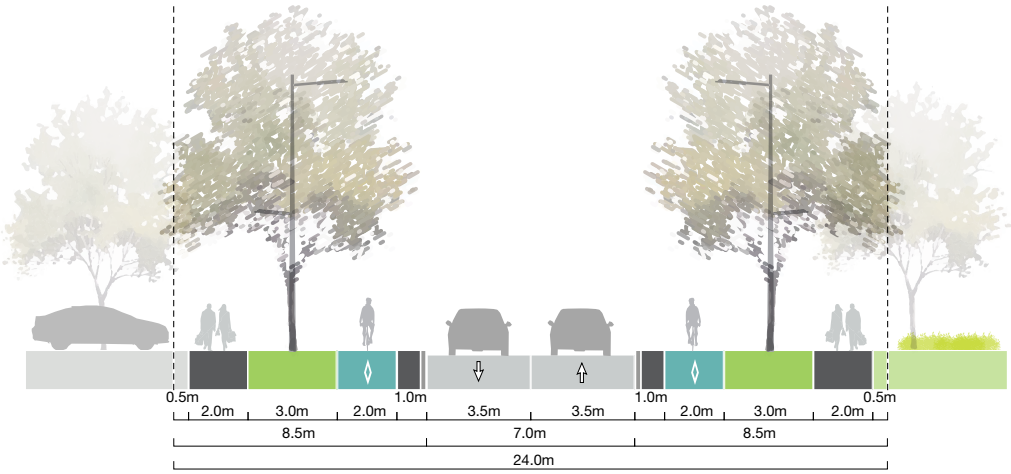


B.3 CROSS-SECTIONS: MINOR COLLECTOR

Minor Collector (Intensification Area)
24.0m ROW, 7.0m Pavement

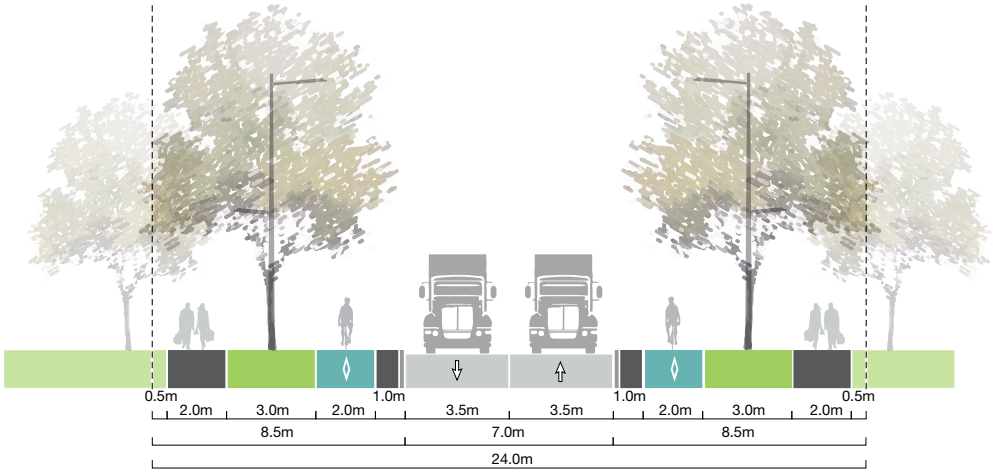


Minor Collector (Community Area)
24.0m ROW, 7.0m Pavement



Minor Collector (Employment Area)

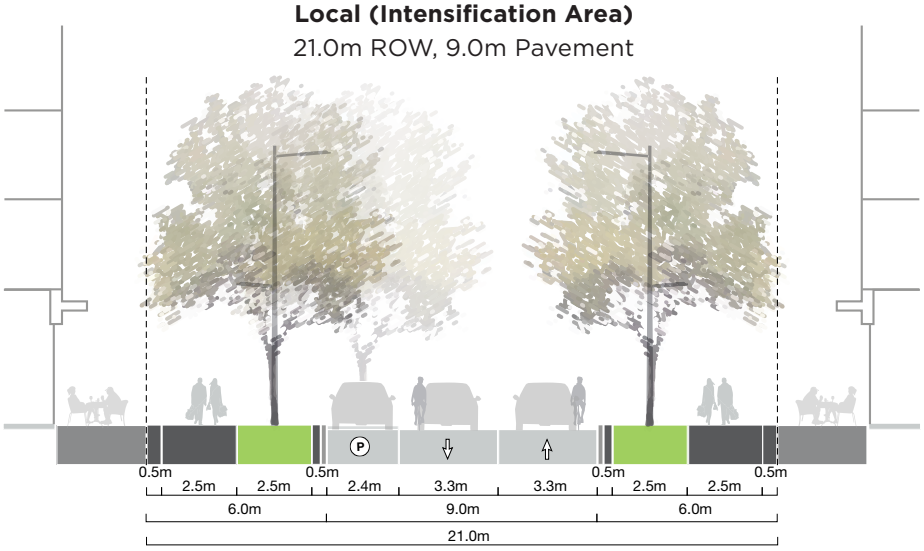
24.0m ROW, 7.0m Pavement



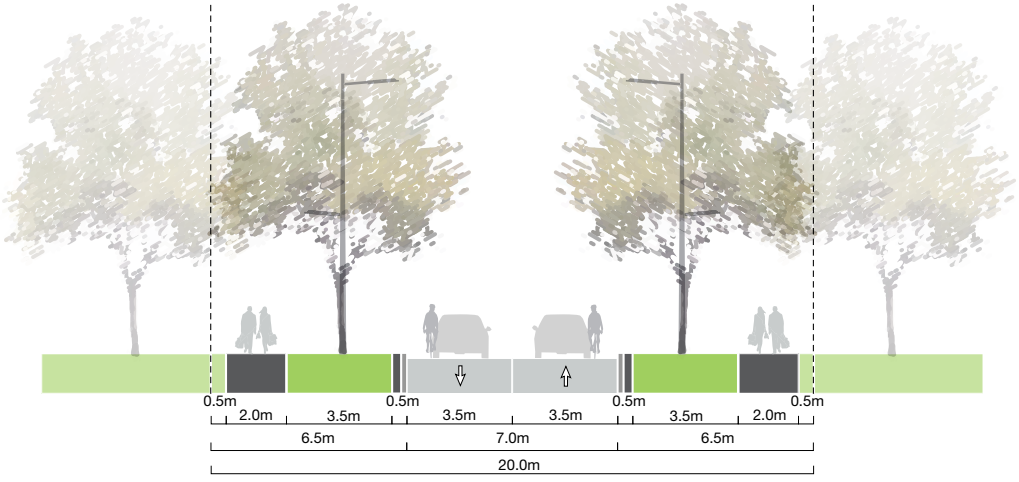
B.4 CROSS-SECTIONS: LOCAL

Local (Intensification Area)
21.0m ROW, 7.0m Pavement

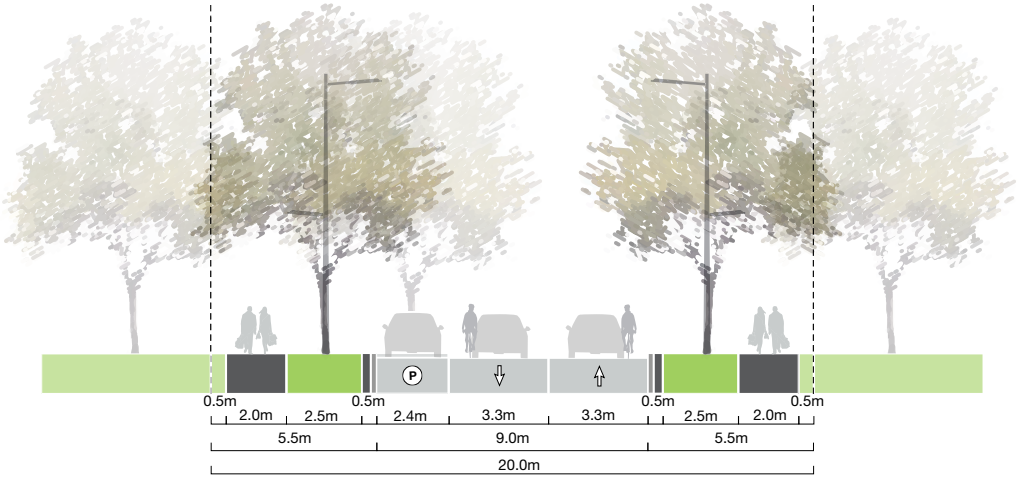
Local (Intensification Area)
21.0m ROW, 9.0m Pavement



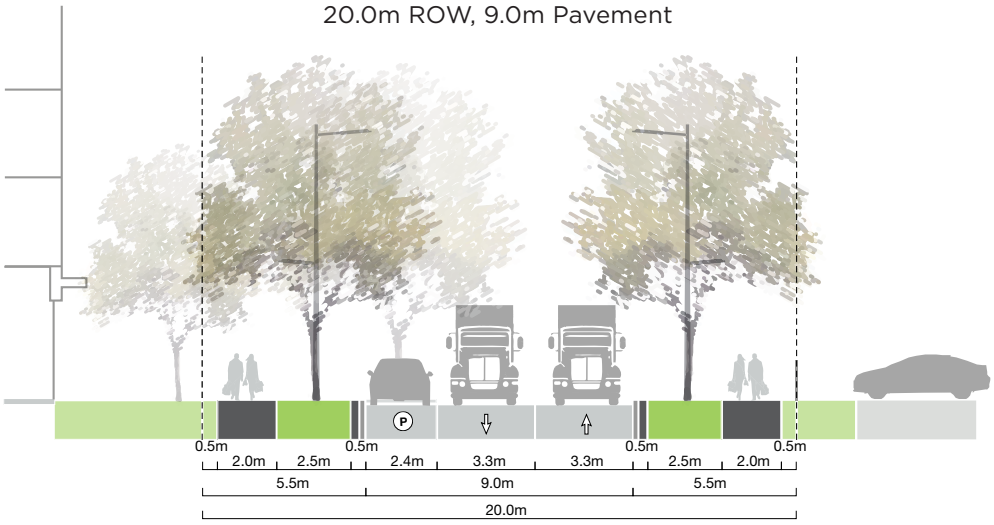
Local (Community Area)
20.0m ROW, 7.0m Pavement



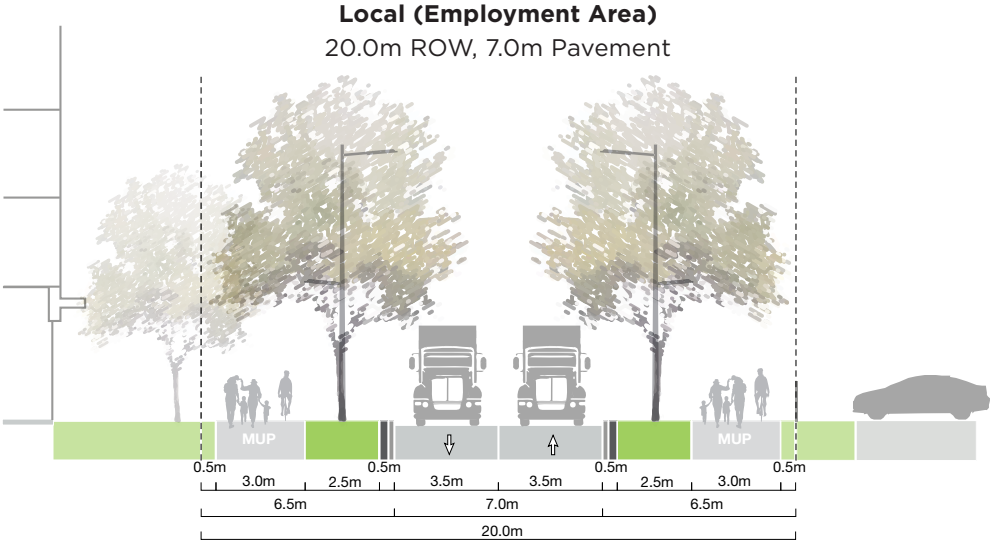
Local (Community Area)
20.0m ROW, 9.0m Pavement



Local (Employment Area)
20.0m ROW, 9.0m Pavement



Local (Employment Area)
20.0m ROW, 7.0m Pavement



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