THE CITY OF
CALGARY
TRANSPORTATION

February 29, 2012

COMPLETE STREETS TRANSPORTATION DEPARTMENT DIRECTIVE

The Transportation Department is in a time of transition. The Calgary Transportation Plan directs us to "Increase Mobility Choices" and "Create Complete Streets". It is from this direction that the Complete Streets Program and the development of a Technical Guide began.

The purpose of the Guide is to provide City Administration and the Development industry with the guidance to incorporate Complete Streets concepts into the planning, design, and construction of our city streets, including retrofitting existing streets.

On February 09, 2012, the General Manager and four Directors of the Transportation Department approved the 2011 Interim Complete Streets Guide. For its implementation, all **Transportation staff are directed to use these revised standards in their street planning, design, and construction projects**. These projects include, but are not limited to:

- Both new and retrofit major road/corridor projects
- Various Street Improvement projects
- Sidewalk & cycling retrofit program
- Local Improvement projects
- Street resurfacing/reconstruction projects

While the standards within the updated 2012 Design Guide for Subdivision Servicing continue to govern developer-built roads until design sheets are replaced, the **development industry is strongly encouraged to use the revised standards within the 2011 Interim Complete Streets Guide**.

If the 2011 Interim Guide does not have the design sheets for a particular project (e.g. collector street intersection plan), continue to refer to the 2012 Design Guide for Subdivision Servicing. The Guide is available at www.calgary.ca/completestreets

Mac Logan, General Manager,
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Don Mulligan, Director,
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Ryan Jestin, Director, Roads

Fred Wong, Director, Transit

2011 **Interim Complete Streets Guide**

THE CITY OF CALGARY TRANSPORTATION

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This Guide has been created to foster an understanding of the application of the Calgary Transportation Plan and Municipal Development Plan. Its purpose is to supplement the policies contained in the plans and facilitate the implementation of their concepts.

This living document is the second of 3 Interim Guides that ultimately form a Final Complete Streets Guide. Its purpose is to provide guidance to City Administration and the Development industry on how to incorporate Complete Street concepts (including enhancing the public realm) into the planning, design, and construction of streets, including reconstruction of existing streets. The 2011 Interim Guide introduces revised detailed design standards for the higher classification (e.g. Arterial) and lower classification (e.g. Collector) streets that differ from the current standards contained within the Design Guide for Subdivision Servicing. The revisions have been made to better accommodate pedestrians, cyclists, street trees, and low impact development (storm water collection and treatment at the source) while maintaining the existing right-of-way requirements.

Building upon the 2010 Interim Guide, the 2011 Guide discusses elements and design considerations within the street, and references related Corporate Guidelines, Policies, and Initiatives that should be referenced during the planning and implementation of Complete Street projects.

The latest version of this Guide can be found at www.calgary.ca/completestreets.

The completion of this Interim Guide could not be possible without the contributions of the following individuals. Thank you!

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"LOS ANGELES COUNTY MODEL DESIGN MANUAL FOR LIVING STREETS" AUTHORS

A special thank you to Los Angeles County and the expert authors for creating the "Model Design Manual for Living Streets", a comprehensive document covering all aspects of Complete and Living Streets available for use by any municipality involved in the development of a Complete Streets Policy or Guide. A full list of the Authors of this manual is below. The 2011 Interim Complete Streets Guide borrowed select content for the development of Sections 1.2, 1.3, 9.1, and 10.1.

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INTRODUCTION

I COMPLETE STREETS BACKGROUND

I.1 CALGARY MUNICIPAL DEVELOPMENT PLAN & CALGARY TRANSPORTATION PLAN

In 2007, City Council directed that an integrated Municipal Development Plan (MDP) and Calgary Transportation Plan (CTP) be created that aligned with the vision and goals of imagineCALGARY, an extensive community visioning process to shape the City's future over the next 100 years. The integrated process, known as Plan It Calgary, set out the long-term direction for sustainable growth to accommodate another 1.3 million people over the next 60 to 70 years in the city.

The MDP and CTP was approved by Council in September 2009. It sets out a vision and policies for sustainable growth: a more compact city form that promotes walking, cycling and transit, and preserves open space, parks and other environmental amenities. These plans provide a comprehensive and integrated land use and transportation policy framework, design guidelines and operational procedures that support planning, development and corporate growth decisions.

Specific to this Guide, objective #7 of the CTP:

> **"Complete Streets" aims to increase the attractiveness, convenience and safety of all modes of transportation by creating a new selection of multi-modal streets that emphasize walking, cycling and transit, incorporate elements of green infrastructure and function in the context of surrounding land uses.**

A Complete Street is a street for which the needs of all users (all ages, all income levels, all levels of ability) have been considered in its planning and design (or redesign). All users are not necessarily accommodated to the highest standards possible, particularly when right-of-way is limited. There is often the need for "trade-offs" between the users sharing the space to achieve the end design.

I.2 GUIDING POLICIES

Section 3.7 of the Calgary Transportation Plan includes 22 guiding policies for Complete Streets. These policies can be categorized into the following areas:

a) **Planning, Design and Maintenance of Complete Streets**

b) **Adaptability**

c) **Access**

d) **Green Infrastructure**

e) **Public Realm**

f) **Utilities and Line Assignments**

g) **River and Creek Crossings**

h) **Collaboration and Public Engagement.**

Refer to this section of the CTP for specific policy wording.

I.3 PRINCIPLES OF ROAD RIGHT OF WAY VARIANCE

In 2010, Council approved the following Principles of Road Right-of-Way Variance. The Principles guide decisions regarding the protection and allocation of Road Right of Way which may differ from current standards. All Principles align with CTP policies and Transportation Goals.

1. **Provide additional right-of-way for Regional and Primary Transit.**
2. **Protect existing right-of-way for upgrading of new complete street types.**
3. **The allocation of right-of-way must consider the safety of all users first.**
4. **The allocation of right-of-way must consider transportation function and adjacent land use.**
5. **The allocation of right-of-way must consider the priorities of all transportation modes.**
6. **Corridor redevelopment should be staged and tied to land use redevelopment.**
7. **Consider narrow travel lane widths on all streets (except Skeletal Roads) in Transit Oriented Developments (TOD) areas and Activity Centres/Corridors identified in Map 1, MDP.**
8. **Street design should promote slower automobile speeds, not increased automobile capacity on all streets (except Skeletal Roads) in TOD areas and Activity Centres/Corridors identified in Map 1, MDP.**
9. **Consider varying roads right-of-way when required to protect heritage resources.**

Though the following additional principle was not written into the original report to Committee and Council, it should be considered when protecting or allocating road right-of-way:

"The allocation of right-of-way must consider the projection of space for underground and/ or aerial utilities"

I.4 2010 INTERIM COMPLETE STREET DESIGN GUIDELINES

The 2010 Interim Complete Streets Guide was built upon content developed for the Draft and Final Council approved 2009 Calgary Transportation Plan (CTP). While approved guidelines were brought forward and reorganized in the 2010 Guide, cross-sections and geometric design standards could only be brought forward with the disclaimer that they were "Under Department Review" as they had not been approved by internal stakeholders. The 2010 Guide also contained guidelines on implementation, and referenced related guidelines and policies within the corporation. The 2010 Guide served as the template for the 2011 Guide.

II COMPLETE STREETS PROGRAM

II.1 PROGRAM CHARTER

A Program Charter was developed for the creation of a Complete Streets Guide in Spring 2010. After presentation and refinement, it was approved in May 2010 by the Transportation Leadership Team, which includes all Transportation Directors and the General Manager. The Charter provides the project mission, scope, phasing, funding, timeline, stakeholder group, and project team - all discussed in more detail in the following sections. This original charter was revised, and a Communications Plan added, in March 2011.

II.2 MISSION STATEMENT

Increase the attractiveness, convenience, and safety of all modes of transportation by creating a new selection of multimodal streets and processes to implement them. The new selection shall emphasize different modes of transportation, incorporate elements of green infrastructure, and function in the context of surrounding land uses with stakeholder involvement.

II.3 PROGRAM SCOPE

Create a Complete Streets Guide for The City of Calgary that will standardize the complete street elements and establish a process for implementing them. The Guide will provide a comprehensive set of tools for City of Calgary staff and the Development Industry for the **planning, designing, implementation, and funding** of Complete Streets.

II.4 PHASING & KEY DELIVERABLES

Phase 1: 2010 Interim Complete Streets Guide

Create an interim guide that introduces new street types and how to implement them. This document is the product of Phase 1 of the program.

Deliverable #1- 2010 Interim Complete Streets Guide

Phase 2: Critical Design Elements

Investigate and recommend minimum dimensions for lane width, curb & gutter width, sidewalk width, and landscaped boulevard in an effort to realize complete streets while minimizing the overall right-of-way requirements.

Phase 3: Local Streets

Where necessary, refine collector street, industrial street, residential street, and lane (alley) design details to meet the objectives of Complete Streets.

Phase 4: Skeletal Roads & Arterials

Where necessary, refine skeletal road, arterial street, and industrial arterial design details to meet the objectives of Complete Streets.

Deliverable #2 - 2011 Interim Complete Streets Guide

Phase 5: Liveable Streets

Develop the design details for the new streets: Urban Boulevards, Parkways, and Neighbourhood Boulevards.

Deliverable #3 - 2012 Interim Complete Streets Guide

Phase 6: Funding & Alignment

Identify funding strategies for the planning, design, construction, and maintenance of Complete Streets projects. Identify bylaws, policies, agreements that require revision to align with the Complete Streets Guide.

Phase 7: Final Complete Streets Guide

Combine the 2012 Interim Complete Streets Guide, the completed work of Phase 6, and the existing Design Guide for Subdivision Servicing into a single comprehensive document.

Deliverable #4 - Final Complete Streets Guide

II.5 PROJECT TIMEFRAME

Deliverable #1: 2010 Interim Complete Streets Guide	**Q1 2011**
Deliverable #2: 2011 Interim Complete Streets Guide	**Q1 2012**
Deliverable #3: 2012 Interim Complete Streets Guide	**Q1 2013**
Deliverable #4: Final Complete Streets Guide	**Q3 2013**

II.6 PROJECT STAKEHOLDERS

Internal Stakeholders (City of Calgary):

DEPARTMENT	BUSINESS UNIT	DIVISION(S)
Transportation	Transportation Planning	Development Services, Network Planning, Strategy, Solutions
	Roads	Development & Projects, Traffic, Maintenance, Construction
	Transportation Infrastructure	Roadway Design
	Calgary Transit	Transit Planning
Planning Development & Assessment	Land Use Planning & Policy	New Communities, Established Communities, Urban Design & Heritage
	Development & Bldg. Approvals	Urban Development, Corporate Planning & Applications Group (CPAG)
Corporate Services	Infrastructure & Information Services	Access Solutions
Utilities & Environmental Protection	Water Resources	Urban Water Management
	Waste & Recycling Services	
Community & Protective Services	Parks	Planning & Development
	Fire/EMS	
	Community & Neighbourhood Services	Policy & Planning

External Stakeholders & Committees:

ORGANIZATION	INTERESTS
Urban Development Institute (UDI)	Street Design Standard Revisions, Standard Development Agreement
Shallow Utilities (Enmax, Shaw, Telus, ATCO)	Public Realm Design Standard Revisions
Federation of Calgary Communities (FCC)	Community Planning & Resources
Sustainable Alberta Association (SAA)	Education, Design Process
Advisory Committee on Accessibility (ACA)	Universal Design & Barrier Free Accessibility
Calgary Pathway and Bikeway Advisory Council (CPAC)	Bicycle and Pedestrian Facilities
Bike Calgary	Bicycle and Pedestrian Facilities
Commercial Real Estate Development Association (NAIOP)	Street Design Standard Revision, Standard Development Agreement

II.7 PROJECT TEAM

The Project Team is made up of three levels: a Steering Committee, a Technical Committee, and Resources.

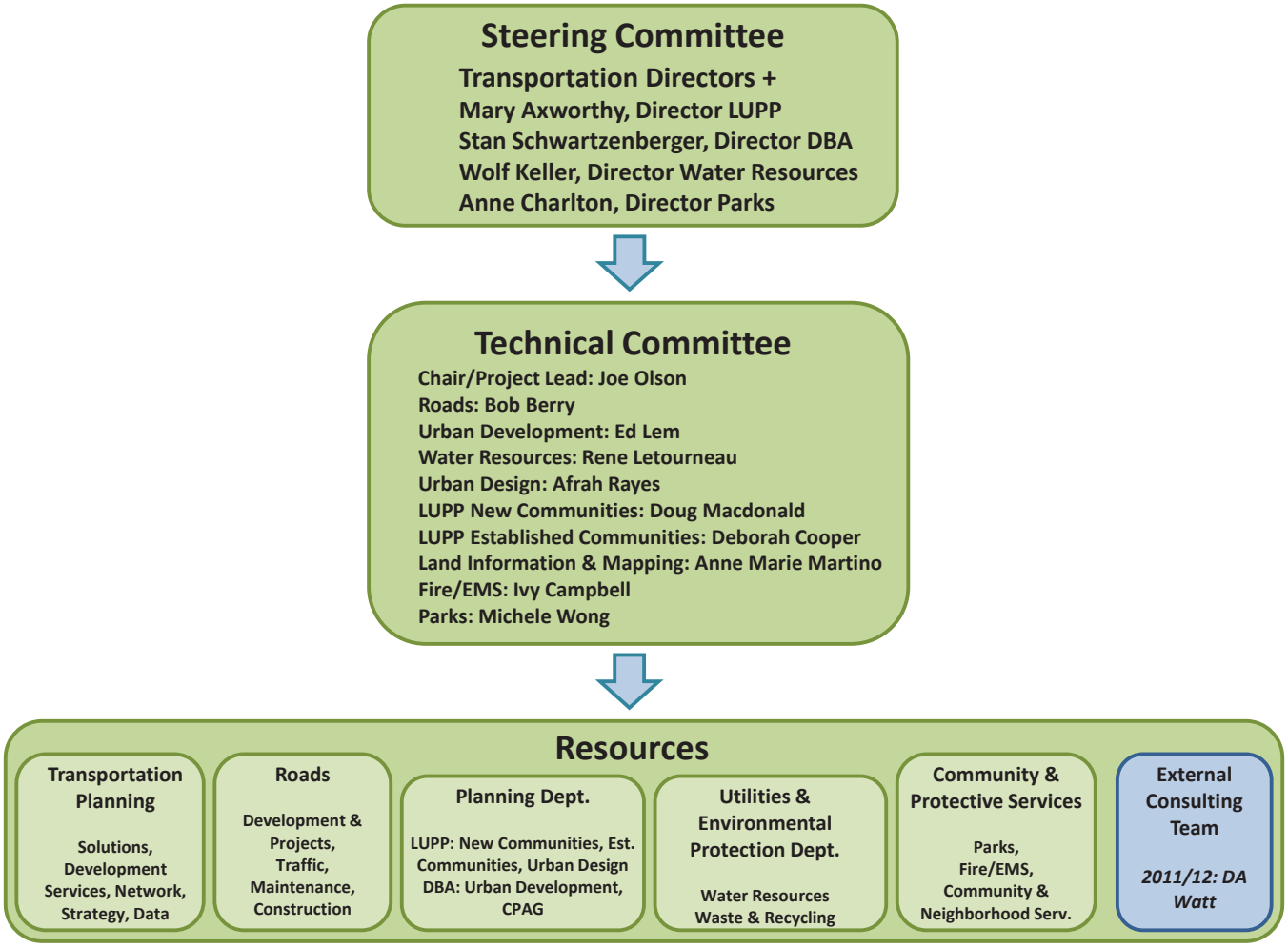
The Steering Committee is made up of the eight (8) Business Unit Directors and the General Manager of the Transportation Department. Their role is to approve the project charter, approve funding, and provide high level direction for the project.

The Technical Committee is made up of the Project Lead and senior / management level staff from key business units within The City. Their role is to provide technical direction to the project and ensure that the objectives of their own area of expertise are met.

The **Resource group** is made up of staff from several business units and includes an external consultant. Their role is to develop the technical and written content for the Guide.

FIGURE 1: COMPLETE STREETS PROJECT TEAM ORGANIZATION CHART

(From Attachment 8 of the Complete Streets Program Charter)



III 2011 COMPLETE STREETS INTERIM GUIDE

ABOUT THIS DOCUMENT

This living document is the second of 3 Interim Guides that ultimately form the Final Complete Streets Guide. Its purpose is to provide guidance to City Administration and the Development industry on how to incorporate Complete Street concepts into the planning, design, and construction of streets, including reconstruction of existing streets.

The 2011 Guide introduces revised detailed design standards for the higher classification (e.g. Arterial) and lower classification (e.g. Collector) streets that supercede current standards found in the Design Guide for Subdivision Servicing. The revisions have been made to better accommodate pedestrians, cyclists, street trees, and low impact development (storm water collection and treatment at the source) while attempting to maintain the existing right-of-way requirements.

Building upon the 2010 Interim Guide, the 2011 Guide discusses elements and design considerations within the street, and references related Corporate Guidelines, Policies, and Initiatives that should be referenced during the planning and implementation of Complete Street projects.

An indexed Adobe Acrobat (.PDF) format of the latest Guide is available on the City of Calgary website at: **www.calgary.ca/completestreets**

INTRODUCTION

The Introduction discusses the Calgary Transportation Plan, Policies and Principles around Complete Streets, and the details of the City of Calgary Complete Streets Program.

CHAPTER 1 - SUSTAINABLE STREET & NETWORK DESIGN

This Chapter discusses the philosophy of Complete Streets and the benefits of sustainable network design.

CHAPTER 2 - CTP & COMPLETE STREETS

As with the 2010 Interim Guide, this Chapter brings together critical content (including figures) from Section 3.7 of the CTP, "Complete Streets", most of the content from the 2009 Draft CTP appendix, and organizes them together in a meaningful way. Complete Streets Zones (roadway and public realm) and the elements within these zones, are presented. An expanded CTP street classification is introduced that includes the full palette of street types to be used in Calgary. This section provides a useful comparison between the existing street classifications and the new CTP street classifications shown in Figure 2-2. The Revised Road and Street Palette (Figure 2-1) is expanded to show these new classifications. This figure shows the thirteen (13) base street classifications from which all Complete Streets will be developed.

CHAPTERS 3-7 - PEDESTRIAN, BICYCLE, TRANSIT, TRAFFIC CALMING, AND ACCESSIBLE DESIGN

These chapters provide guidelines for street design from the perspective of different users. 5 supporting Policy and/or Guideline documents are referenced.

CHAPTER 8 - STREETSCAPE DESIGN

Street design from low impact development, urban forestry, shallow utility, and public realm perspectives have been combined into this single chapter as no one element can be designed without consideration of the other. Low impact development is concerned with the collection, treatment, and gradual release of stormwater within the street right-of-way prior to entering the traditional storm collection system.

CHAPTER 9, 10 - STREET AND INTERSECTION DESIGN

These chapters provides the general guidelines, base cross-sections, alternative cross-sections, detailed design sheets, definitions, and geometric design details. These chapters represent the bulk of the 2011 work and the detailed design sheets will replace those in the updated 2012 Design Guide for Subdivision Servicing. Those street types without detailed design sheets fall within the scope of work for 2012.

CHAPTER 11 - IMPLEMENTATION STRATEGY

This chapter discusses how to take the content from Chapters 1-10 and put them into practice. Section 11.7 summarizes a number of strategic actions that need to be undertaken to successfully implement the Complete Streets Guide.

APPENDICES

Appendix A: Case Studies

This section has a number of case studies showcasing the implementation of complete streets projects.

Appendix B: Related City of Calgary Guidelines & Policies

This section discusses a number of City of Calgary Guidelines and Policies directly related to the Complete Streets Program, from Transportation and other Departments.

Appendix C: Glossary of Terms

Appendix D: Key Issues Summary

Key stakeholder issues or concerns are addressed through revisions to the Guide as it develops into a Final Guide. This section summarizes those issues and responses.

CHAPTER 1

SUSTAINABLE STREET & NETWORK DESIGN

1.1 OBJECTIVES OF COMPLETE STREET DESIGN

A Complete Street is a street for which the needs of all users (all ages, all income levels, all levels of physical ability) have been considered in its planning and design (or redesign). All users are not necessarily accommodated to the highest standards possible, particularly when right-of-way is limited. There is often the need for trade-offs between the users sharing the space to achieve the end design. When making these trade-offs, the goals of Complete Streets philosophy should be the primary consideration.

A Complete Streets approach seeks to design a transportation network that will:

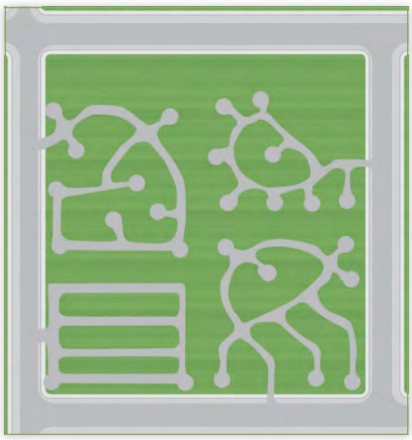
- Serve the land uses that are adjacent to the street; mobility is a means, not an end
- Encourage people to travel by walking, bicycling and transit
- Provide transportation options for people of all ages, physical abilities, and income levels
- Enhance the safety and security of streets, from both a traffic and personal perspective
- Improve peoples' health
- Create livable neighbourhoods
- Reduce the total amount of paved area
- Reduce streetwater runoff into watersheds
- Maximize infiltration and reuse of stormwater
- Reduce greenhouse gas emissions and other air pollution
- Reduce energy consumption
- Promote the economic well-being of both businesses and residents
- Increase civic space and encourage human interaction
- Promote attractive streetscapes

The 2011 Interim Complete Streets Guide seeks to achieve these goals through the design of the street network and the features of the specific roadways within that network.

1.2 BENEFITS OF COMPLETE STREET NETWORK DESIGN

Complete Streets philosophy begins at the highest level of planning detail: the overall arrangement of streets throughout a city, community, or region. At this level, the goal is to create a highly connected network of streets that allow all users to connect within and between neighbourhoods rather than allowing large vehicle throughways to be barriers between destinations. For the following reasons, a highly connected street network is a powerful tool for improving safety while creating beautiful places and efficient systems:

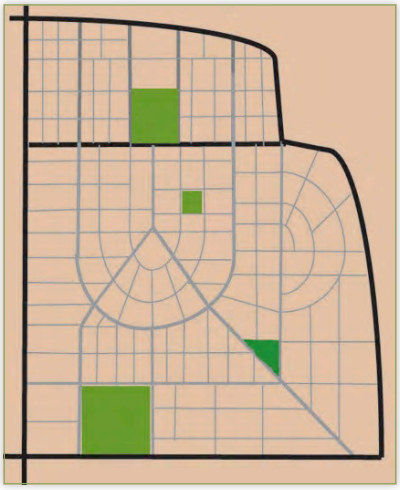
COMPLETE STREET NETWORKS IMPROVE TRAFFIC SAFETY. Hierarchical street patterns (arterial-collector-local) with cul-de sac subdivisions depending on arterials do not perform as well as complete street networks and cause more traffic collisions. Hierarchical street networks divert traffic to high-speed arterials that have large intersections. Most collisions occur at intersections. The speed at which motor vehicles move on these arterial streets increases the likelihood and severity of collisions. Conversely, grid networks reduce arterial size, volume speed and collisions.



Cul-de-sac developments break up connectivity and create longer trips (Credit: Michele Weisbart)

A 2011 study of 24 California cities found a 30 percent higher rate of severe injury and a 50 percent higher rate of fatalities in cities dominated by sparsely connected culs-de-sac compared with cities with dense, connected street networks *(Marshall, W. and Garrick, N., "Does the Street Network Design Affect Traffic Safety?" Accident Analysis and Prevention 43[3]: 769-781)*. A 2009 study from Texas found that each mile of arterial is associated with a 10 percent increase in multiple-vehicle collisions, a 9.2 percent increase in pedestrian crashes, and a 6.6 percent increase in bicyclist collisions *(Dumbaugh, E.R. Rae, "Safe Urban Form: Revisiting the Relationship between Community Design and Traffic Safety," Journal of the American Planning Association 75[3]:309-329)*.

COMPLETE STREET NETWORKS INCREASE THE NUMBER OF PEOPLE WALKING AND BICYCLING AND REDUCE VEHICLE MILES TRAVELED. Connectivity enables people to take shorter routes. It also enables them to travel on quieter streets. These shorter routes on quiet streets are more conducive to bicycling and walking. The California study cited above found that places with a dense, connected street network had three to four times more people walking, bicycling, or using transit to get to work. This in turn led to a 50 percent reduction in vehicle miles traveled per capita in these cities *(Marshall, W. and Garrick, N., "The Spatial Distribution of VMT Based upon Street Network Characteristics," 90th Meeting of the Transportation Research Board, Washington, D.C., January 2011)*. Such networks also tend to reduce the walking distances to transit stops, which can improve adoption of transit over private vehicle use.



Interconnected street network with small block (Credit: Marty Bruinsma)

COMPLETE STREET NETWORKS ALLOW MORE EFFECTIVE EMERGENCY RESPONSE AND MORE EFFICIENT DELIVERY OF SERVICES. Studies in Charlotte, North Carolina, found that when one connection was added between cul-de-sac subdivisions, the local fire station increased the number of addresses served by 17 percent and increased the number of households served by 12 percent. Moreover, the connection helped avoid future costs by slowing the growth of operating and capital costs; most of the cost to run a fire station is in salaries. Furthermore, Congress for the New Urbanism's report on emergency response and street design found that emergency responders favor well-connected networks with a redundancy of routes to maximize access to emergencies. Emergency responders can get stuck in culs-de-sacs and need options when streets back up *("Effect on Connectivity on Fire Station Service Area and Capital Facilities," 2009 presentation by the Charlotte, North Carolina Department of Transportation, charmeck.org/city/charlotte/citymanager/CommunicationstoCouncil/2009Communications/Documents/CNUPresentation)*. Research completed by Plan It Calgary noted that improved connectivity facilitated the routing of Calgary Transit, Waste & Recycling Services and emergency responders, improving efficiency and thereby reducing costs to provide these services.

These studies and others provide strong evidence that the benefits of a well-designed street network go beyond safety; they include environmental, social, and economic gains. Complete street networks shape land use markets and support compact development, in turn decreasing the costs of travel and providing utilities. Street networks like these accommodate changing technology, lifestyles, and travel patterns. Interconnected street networks can preserve habitat and important ecological areas by condensing development, reducing city edges, and reducing sprawl.

A sustainable and resilient street network fosters economic and social activity. It constrains traffic growth by limiting the number of lanes on each street while providing maximum travel options by collectively providing more lanes on more streets. By providing opportunities for all modes of travel, an ideal street network enhances social equity and provides an ideal setting for high quality design at all scales: building, neighbourhood, and region.

1.3 DESIGNING STREET NETWORKS TO SUPPORT COMPLETE STREETS PRINCIPLES

A street network designed to support Complete Streets principles has the following key features:

1. The public street network gives preference to trips by foot, bike, and transit because these are the most sustainable types of trips.
2. The public street network protects, respects, and enhances the city's natural features and ecological systems.
3. The public street network maximizes social and economic activity and is designed to support the adjacent land-uses over mobility for private vehicles merely passing through the area.
4. The public street network works in harmony with other transportation networks, such as the regional pathway system, separate right-of-way transit systems (such as Calgary's LRT network), and privately owned networks (e.g. roadways within Chinook Mall or the University of Calgary).

The street network works best when it provides a variety of street types. The variety is enforced by the

pattern of the street network itself but also by the design of individual street segments. Natural and built features, including topography and important community destinations, should be taken into account to create unique designs. In new subdivisions, integrating a network of shared use paths into the street network should be considered. This type of network allows people to circulate in their communities to schools, parks, stores, and offices while staying primarily on dedicated paths and trails, rather than travelling long distances. These networks can also link to paths and trails along waterways, utility corridors, rail rights-of-way, and other more common active transportation corridors which can provide additional active mode links between communities. High amenity connections allow pedestrians and cyclists to not only travel to their destinations efficiently and comfortably but to use the networks of open spaces, parks, trails and Complete Streets as recreational destinations.

For the City of Calgary, the types of streets to be used in the network are described in the design standards outlined in Chapter 2. The types differ in terms of their network continuity, cross-section design, and adjoining land use. The individual streets themselves will change in character depending on their immediate land use context. But regardless of the character of the individual streets, the arrangement of streets within the overall network can significantly assist or hinder the ability to achieve Complete Streets objectives.

Although the street network is constrained by a variety of factors, the following design principles provide a general guideline to good network design:

NETWORK DESIGN GUIDELINES

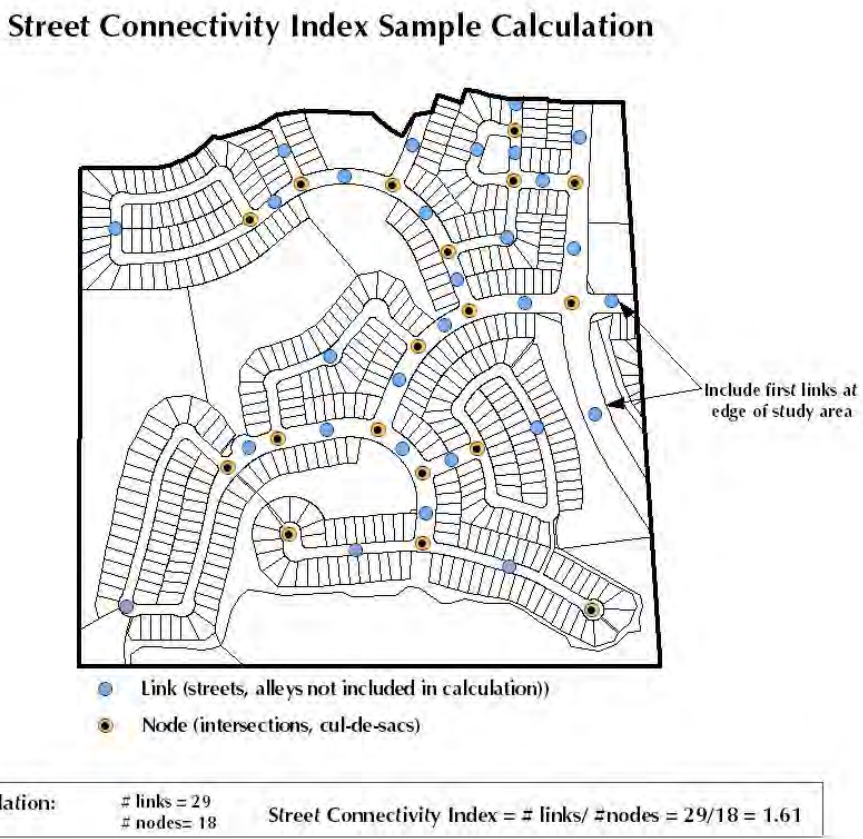
1. Establish a block size maximum of 500 linear meters (perimeter).
   - Ensure greater accessibility within the block through alleys, service courts, and other access ways
   - Where block size is exceeded, retrofit large blocks with new streets, alleys, pedestrian and/or bicycle connections
   - For existing street networks, do not allow street closures that would result in larger blocks
2. Require multiple street connections between adjacent neighbourhoods. This is achieved by having lower order streets that extend beyond the local area.
3. Provide separate connections over or under Skeletal Roads and other geographic barriers (rivers, bluffs, rail lines, etc.) so that pedestrians and bicyclists have links between neighbourhoods without having to travel along interchange ramps and roadways that are not suited to those modes.
4. Maintain network quality by accepting growth and expansion of the street network (including development, revitalization, intensification, or redevelopment) while avoiding increases in street width or in number of lanes where possible.
5. Provide on-street curbside parking on most streets. Exceptions can be made for very narrow streets, streets with bus lanes, high speed roads or where there is a better use of the space.
6. Prefer design speeds of 50km/h or less for most streets. These speeds promote safety for vulnerable users of the streetscape. For long straight streets, consider traffic controls, narrower lane widths, and boulevard features to reduce driver comfort at speeds over the posted limit.
7. Maintain network function by discouraging

- One-way streets
- Turn prohibitions
- Full or partial closures (except on bike boulevards, or areas taken over for other uses of public space)
- Removal of on-street parking (except when replaced by wider sidewalks, an enhanced streetscape, bus lanes, bike lanes, etc. rather than additional vehicle lanes)
- Gated streets
- Widening of individual streets
- Conversion of city streets to limited access facilities

8. Classify most streets using the common street and context types presented in Chapter 2. Recognize, however, that some streets are unique and deserve a special design that lies outside the common street network types. Unique approaches to cross section and other design features should be encouraged when these approaches serve to achieve the goals of the Complete Streets philosophy outlined in Section 1.

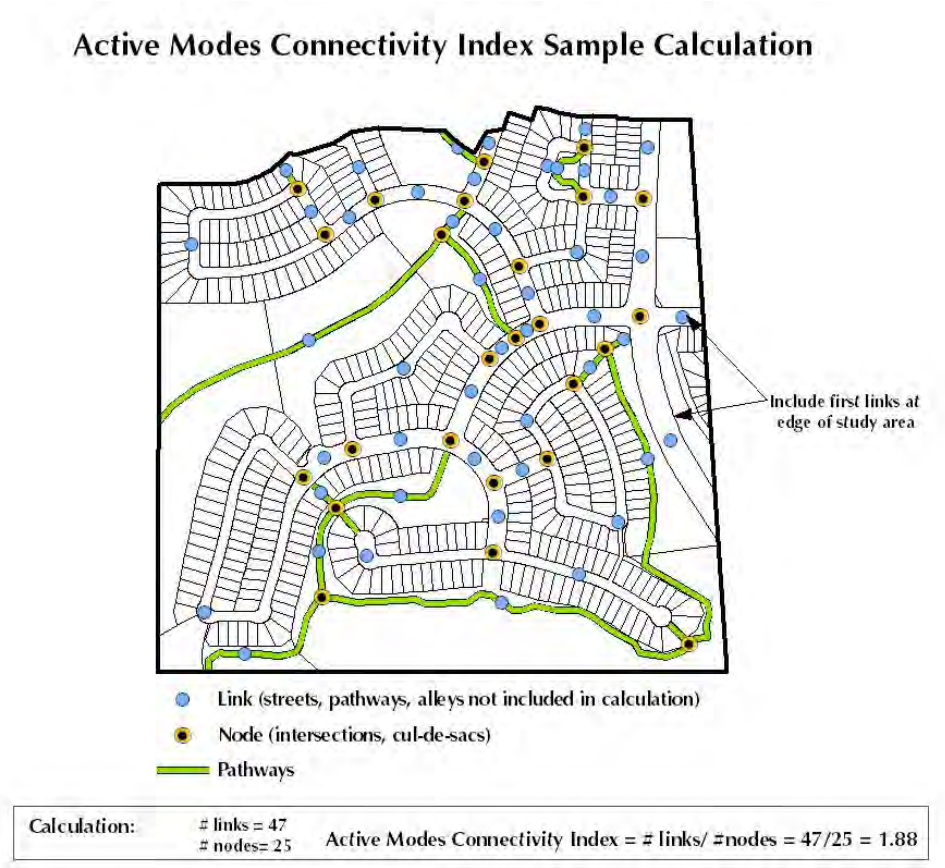
There are two tools available to evaluate the effectiveness of the network to achieve these principles: 1) The Street Connectivity Index and 2) The Active Modes Connectivity Index. The Street Connectivity Index, shown in Figure 1-1, is calculated as the ratio of street links (streets between intersections with three-or-more legs, or culs-de-sac) to street nodes (intersections with three-or-more legs, or culs-de-sac).

FIGURE 1-1: STREET CONNECTIVITY INDEX SAMPLE CALCULATION



The *Active Modes* Connectivity Index is calculated in much the same way as the Street Connectivity Index. *Active Modes* refers specifically to walking and cycling for the purposes of calculating this index. All development applications should demonstrate that the connectivity requirements have been achieved for both modes of transportation. An example of an *Active Modes* Connectivity Index calculation is shown in Figure 1-2. All types of *roads, streets*, walkways and pathways can be used in the *Active Modes* Connectivity Index calculation. Streets and culs-de-sac must have a sidewalk on at least one side to be included in the calculation. For *Active Modes* Connectivity, culs-de-sac are not counted as nodes if a walkway or pathway connection is available at the end of the cul-de-sac.

FIGURE 1-2: ACTIVE MODES CONNECTIVITY INDEX SAMPLE CALCULATION



By applying these calculations, a street network can be assessed at the planning level to ensure that the arrangement of streets and pathways in a broad area provide suitable transportation opportunities for all users of the network.

In general terms, grid pattern networks achieve Street Connectivity and Active Modes Connectivity Indices of 2.0. Conversely, curvilinear networks achieve indices of 1.3-1.4. **Target Indices for Activity Centers should be 1.7 for Streets and 1.9 for Active Modes. Target indices for Greenfield Residential Communities should be 1.4 for Streets and 1.6 for Active Modes.**

For more information, consult or download the City of Calgary Connectivity Handbook from **www.calgary.ca/ctp**.

1.4 STREET DESIGN ELEMENTS

Complete Streets consist of horizontal and vertical environments.

The horizontal environment of a Complete Street consists of three zones:

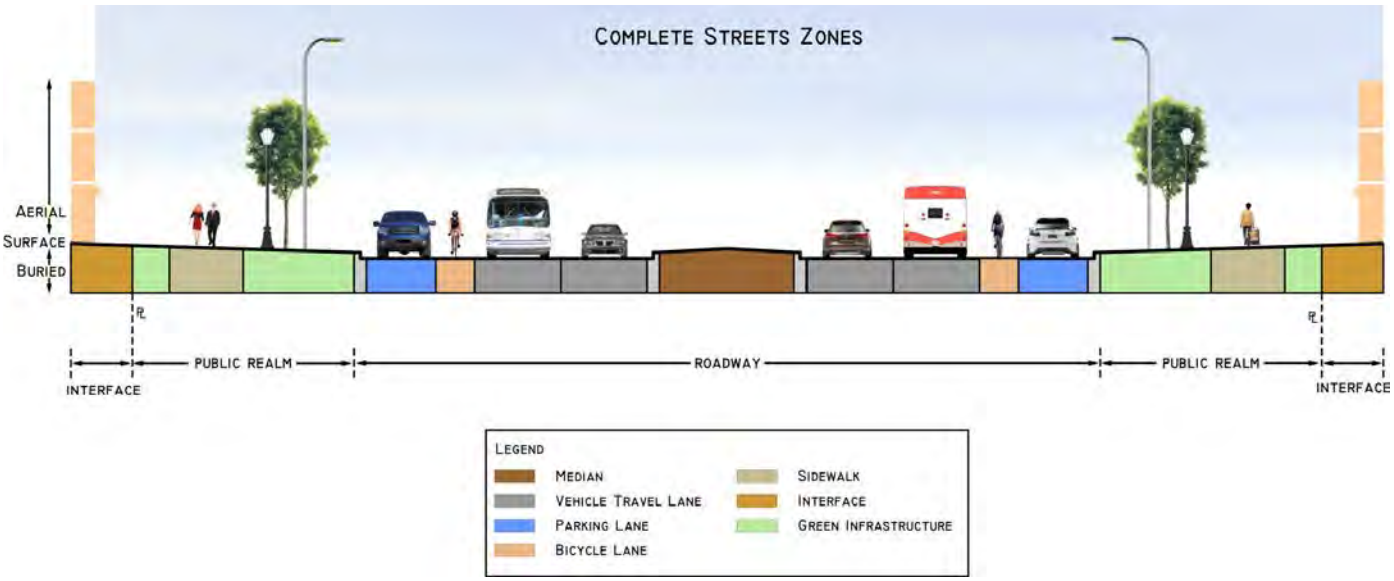
- **ROADWAY ZONE**: provides travel and parking lanes for motorized vehicles and bicycles in a mixed traffic environment.
- **PUBLIC REALM ZONE**: includes green infrastructure, street furnishings, and travel lanes for pedestrians and cyclists.
- **INTERFACE ZONE**: includes pedestrian-oriented land use and design. As this area falls within private ownership, more space can be created through the use of building set-back, Bylaw setbacks, and/or public access easements.

The vertical environment of a Complete street consists of three zones:

- **AERIAL ZONE**: includes street lights, signal heads, signs, tree canopy
- **SURFACE ZONE**: includes sidewalks, pathways, street furniture, curbs, bike racks
- **BURIED ZONE**: includes parkades, plant and tree trenches, deep and shallow utilities.

The horizontal and vertical environments and their respective zones are illustrated in Figure 1-3.

FIGURE 1-3: COMPLETE STREET ZONES



Green infrastructure and public realm elements are present in both horizontal and vertical zones. Tree plantings, for example, may be a component of all zones, but also contributes to the public realm. Complete Street elements for each zone should be selected based on the transportation facility function, adjacent land use context and the priorities set out in the revised Road and Street Palette (see Figure 2-1). The elements of each horizontal and vertical zone are shown in Figure 1-4.

FIGURE 1-4: COMPLETE STREET ZONE ELEMENTS

ZONE	INTERFACE	PUBLIC REALM			ROADWAY		
	Frontage	Throughway	Furnishing	Edge	Auxiliary Lanes	Travel Lanes	Median
Aerial	-Building overhang -Tree canopy	-Tree canopy	-Lighting -Tree canopy	-Lighting -Tree canopy	-Lighting -Tree canopy - Signal heads -Signs	-Signs -Signal heads	-Lighting -Signal heads -Signs
Surface	-Patios -Awnings -Entries -Plantings	-Sidewalk -Urban Braille -Multi-use pathways	-Lights, -Utility Poles -Transformers -Pedestals -Hydrants - Transit shelters -Containers -Bike racks -Benches -Trees -Plantings	-Curbs -Meters -Signs -Shoulders -Bollards -Snow storage -Drainage systems / catch basins	-Transit Lane -Shared Lane -Turn Lanes -Bike Lane -Parking -Loading zones -Curb extensions -Pavement markings -Drainage systems	-Through Lanes	-Raised plantings -Flush -Depressed -Turning Lane -Snow storage -Drainage
Buried	-Shallow utilities -Plant trenches -Parkades	-Shallow utilities	-Tree trenches -Shallow utilities -Vaults	-Shallow utilities	-Shallow utilities	-Deep utilities -Manholes	-Tree trenches -Shallow utilities

The zone elements in Figure 1-4 are related. Some elements need exclusive use of space (such as travel lanes on the surface in the roadway zone), while others could potentially share space in designated zones (e.g. shallow utilities). Not all elements of the roadway or public realm zones will be used in a design of a Complete Street, especially in a retrofit situation. Sidewalks, for example, would not be used in the design of a Skeletal Road, whose primary function is the mobility of vehicles, goods and services at high design speeds.

As part of the development of this guide, the project team conducted extensive consultation with many City departments and external stakeholder groups that have interests in specific elements within the street. The design criteria specified in this guide are intended to accommodate a number of demands on the space within the road right-of-way and strive to balance competing requirements in a way that is sensitive to the context and priority of specific street types.

CHAPTER 2

CALGARY STREET TYPES AND THE CTP

2.1 INTRODUCTION

The CTP provides a long range vision for the transportation network of the City as a whole. This vision is expressed in a series of maps which lay out the major features of the future street network and identify a series of functional requirements for specific streets within that street network. With the exception of the Primary Transit Network and the Downtown Transit Network, all seven of the CTP maps represent the vision of the street network in 60 years. The Transit Network is a 30 year vision. These maps can be found at the back end of the approved CTP:

Map 1: Primary Cycling Network

Map 2: Primary Transit Network

Map 3: Downtown Transit Network

Map 4: Conceptual Calgary Regional Transit Plan

Map 5: Primary Goods Movement Network

Map 6: Primary High Occupancy Vehicle Network

Map 7: Road and Street Network

For example, by comparing the various maps, it can be seen that Memorial Drive east of 36 Street E is intended to operate as an Arterial street. It is not included in the High Occupancy Vehicle network, the Primary Transit network, or the Primary Cycle network. This information would assist a designer of a hypothetical project along Memorial Drive to establish the appropriate long term design of this street using the alternate cross sections for Arterial streets presented in Section 9.2.

The first step of any Transportation project is to reference these maps to establish the function and context of the street. To better understand local contextual issues and other details not identified on these maps, functional studies and local area policy plans should be consulted for specific locations. Any project which involves development or redevelopment within the City of Calgary should respond to the intended long term function for affected streets, so that development implemented in the short term does not constrain future achievement of the vision laid out in the CTP.

2.2 PALETTE OF STREET TYPES

Prior to the implementation of this Complete Streets Guide, the Calgary transportation network was developed using a conventional hierarchical classification system that is based primarily on private vehicle function. This approach was reflected in the design standards applied to the various classifications of streets, as outlined in the current Design Guidelines for Subdivision Servicing manual. The CTP and MDP call for an updated approach to street design that embraces Complete Streets philosophy and provides designers with guidance on how to design for living streets in a context-sensitive manner.

The updated approach to street types described here provides mobility for all modes of transportation with a greater focus on the pedestrian, cyclist, and transit user. Designers should recognize the need for greater flexibility in applying design criteria, based more heavily on context and the need to create a safe environment for pedestrians, rather than strictly following the conventional application of functional classification in determining geometric criteria. Thus the classifications of streets applied below are

intended to provide guidance on design elements, but recognize that due to the context sensitivity of Complete Streets design, two streets of the same classification (two Arterial Streets, for example) may differ significantly in details ranging from rights-of-way and number of lanes to boulevard width and intersection treatments.

This guide, in keeping with the CTP and MDP approach, divides streets within Calgary into four main categories:

- **SKELETAL** – these roadways primarily serve to provide mobility between one area of the City and another. They are typically higher speed roadways focused on private vehicles and goods movement with limited support for active modes of travel.

- **ARTERIAL** – these streets serve to connect the majority of city streets to the Skeletal Road network. In this Guide, these streets have been redesigned to better accommodate all users within the available right-of-way. Their function represents a transition from the mobility of Skeletal Roads to streets whose primary function is to engage their immediate surroundings. Arterial Streets will typically be used in areas of the city with lower development intensity.

- **LIVEABLE** – these streets serve to provide higher capacity streets within communities and development areas where active modes and local commercial activity will take precedence over private vehicles and goods movement activities. A Liveable Street is a street with an emphasis on modes of travel that enable social interaction (e.g. walking, cycling, transit, parking). Liveable Streets are a destination as well as a facility to travel along. These street classifications are new, but a number of specific examples of streets that fit these descriptions already exist within the City. Based on the vision presented in the CTP and MDP, it is anticipated that these types of streets will become significantly more common in future development and redevelopment / revitalization projects.

- **LOCAL** – these streets are smaller scale streets that do not serve a city-wide role. They are streets that serve primarily residential areas, but also industrial subdivisions and activity centres. Designs are focused on serving local users only. Due to the significant proportion of City streets that fall within this class, special emphasis on green infrastructure is recommended.

From these four categories, comes thirteen specific classifications of streets defined on the following pages.

SKELETAL (1 CLASSIFICATION)

SKELETAL ROADS

Formerly known as Expressways and Freeways, these roads promote the movement of vehicular traffic over long distances and typically carry between 30,000 and 90,000 vehicles per day. They operate at high speeds and have limited direct access and interaction with adjacent land uses. Facilities within the Skeletal Road right-of-way for walking and cycling are not common, but sometimes vital to city-wide pathway connectivity. Crowchild Trail and Glenmore Trail are examples of Skeletal Roads.

ARTERIAL (3 CLASSIFICATIONS)

DIVIDED ARTERIAL STREET

Formerly known as Major Streets, Divided Arterial Streets provide a reasonably direct connection between multiple communities and major destinations and typically carry between 10,000 and 30,000 vehicles per day. They are typically spaced 800 to 1600 metres apart. Arterial Streets make up much of the Primary Transit Network. Green infrastructure strategies may include vegetated swales, rain gardens, filter strips, and native vegetation. Northland Drive near Northland Village Shoppes is an example of a Divided Arterial Street.

INDUSTRIAL ARTERIAL STREET

These streets place highest priority on the efficient movement of heavy trucks, but still accommodate all modes of travel. They are typically lower speed streets with a high percentage of truck volume, often as high as 30% of all traffic. Industrial Arterials typically carry between 10,000 and 30,000 vehicles per day. The size of the adjacent industrial lots dictates the level of connectivity or access. 114th Avenue SE near Southbend Business Park is an example of an Industrial Arterial.

LOCAL ARTERIAL STREET

Formerly known as Local Majors, Local Arterial Streets provide connections between communities and destinations where traffic volumes are at the low end for Arterials (typically 10,000 to 15,000 vehicles per day). These streets provide more opportunities for access than Divided Arterials and require less right-of-way. 85th Street SW in the community of West Springs is an example of a Local Arterial Street.

LIVEABLE (3 CLASSIFICATIONS)

URBAN BOULEVARD

Urban Boulevards form the backbone of higher-density Corridors and Activity Centres. Higher priority is given to walking, cycling, and transit patrons, while high volumes of vehicular traffic are expected. These streets are local and regional destinations, fully integrated with adjacent mixed land uses, and provide high levels of connectivity to surrounding communities. Urban Boulevards make up some of the Primary Transit Network. High quality urban design and green infrastructure are critical components of Urban Boulevards. A level of congestion appropriate for a dense urban area is acceptable on this street type. A current example of an Urban Boulevard is 49th Street NW near Market Mall.

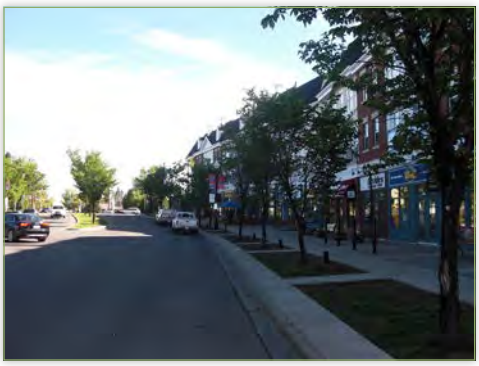
PARKWAY

Parkways focus on integration with natural areas. Adjacent land uses include large natural parks, waterways, or special public institutions. Natural vegetation and new forms of storm water management are integrated with the street. Parkways present opportunities to maximize water infiltration, slow and detain rainfall, enhance the urban forest, and preserve and enhance biodiversity. Walking and cycling modes are given higher priority. A current example of a Parkway is University Drive Drive NW near Foothills Athletic Park.

NEIGHBOURHOOD BOULEVARD

Neighbourhood Boulevards are similar to Urban Boulevards, but on a smaller scale. Though not a requirement, these streets support mixed-use retail and medium-density residential uses. Walking and cycling have higher priority. These streets are destinations for the local communities surrounding them, and provide the highest level of connectivity of all "Liveable" street types. As with Urban Boulevards, high-quality urban design and green infrastructure are important components.

A current example of a Neighbourhood Boulevard is Garrison Gate in the SW community of Garrison Woods.



LOCAL (6 CLASSIFICATIONS)

PRIMARY COLLECTOR STREET

Primary collector streets connect lower volume local streets to arterial streets and generally serve transit. Daily traffic volumes range from 5,500 to 12,500. Primary collector streets may be divided or undivided, include or restrict parking, and have two or four travel lanes. Direct access from adjacent properties is usually restricted. A current example of a Primary Collector is 5th Avenue NW in West Hillhurst.

COLLECTOR STREET

Collector streets collect and distribute traffic from arterial streets and primary collectors to other local streets. Typical daily traffic volumes are from 1,000 to 5,500. Transit and direct access to adjacent properties are permitted. A current example of a collector street is Lake Bonavista Drive SE.

ACTIVITY CENTRE STREET

This is a new street classification to provide a local street appropriate for activity nodes and corridors. These are streets that support major activity centres (e.g. TODs), commercial, and residential land uses. The existing alternative High Street is the closest approximation of this new street type. These streets will typically have parking on both sides with two travel lanes. Travel speeds are low. Adjacent land use will be medium to high density mixed-uses. As with Neighbourhood Boulevards, walking and cycling have high priority. Street furniture, street trees and other forms of green infrastructure are important elements. Current example is 33rd Avenue SE in the Marda Loop area.

INDUSTRIAL STREET

Industrial Streets provide direct access to adjacent industrial and commercial properties. They are lower speed two-lane streets designed with enough width to accommodate a high percentage of heavy vehicles. Though all modes are accommodated, goods movement has the highest priority. As industrial areas are served by transit to transport employees, sidewalks should be provided on both sides of the street.

RESIDENTIAL STREET

Residential Streets provide direct access to abutting low and medium density residential properties. Access is not permitted to commercial properties because they are high traffic generators. Residential Streets are low speed, low volume (less than 1,500 vehicles per day), two-lane streets, typically designed to provide on-street parking on both sides. Green infrastructure should be incorporated, though the limited right-of-way may create challenges in its implementation.

LANE (ALLEY)

The primary function of lanes is to provide direct rear access to abutting low to high density residential properties. They also provide a service access for garbage collection, deliveries, loading/unloading, and may serve as an alternate alignment for shallow, deep, or overhead utilities. Lanes will be explored further in 2012 for public realm and green infrastructure opportunities.

For each of the classifications identified above, this guide provides definitions and alignment details, a detailed design for a base cross section within the standard right-of-way, and concepts for alternates that respond to specific contextual situations (see Section 9.2). Regardless of the specific design applied in a given context, all streets of a given classification share a particular purpose within the City's transportation network. One way of expressing that purpose is to identify the priority given to different users for that particular type of street. Figure 2-1 expands on the original CTP figure to give a summary of the priority given to various user groups on each of the 13 street classifications.

FIGURE 2-1: REVISED ROAD & STREET PALETTE

CTP Classification		Transportation Modes					Current Examples
		Walking	Cycling	Transit	Goods	Autos*	
ROAD	Skeletal Road						Deerfoot Trail Glenmore Trail
ARTERIAL	Divided Arterial						Bow Trail Southland Drive
	Industrial Arterial						72 Avenue SE
	Local Arterial						85 Street SW
LIVEABLE	Urban Boulevard						16 Avenue NW
	Parkway						Memorial Drive
	Neighbourhood Boulevard						17 Avenue SW Kensington Rd.
LOCAL	Primary Collector						Acadia Drive SE
	Collector Street						Lk Bonavista Dr. SE
	Activity Centre Street						Shawville Blvd. SW
	Industrial Street						Manchester Rd. SE
	Residential Street						17th Avenue NW
	Lanes (Alleys)						

* Includes Light Commercial Vehicles, Waste & Recycling Vehicles, etc.

EMS/Fire Trucks are to be accommodated on all Street Classifications.

Accommodated with high standards (high quality facilities, low travel delay)

Accommodated with variable standards (average quality facilities, average travel delay)

Not required, or poor performance is acceptable (low quality or no facilities, high travel delay)

2.3 DIFFERENCES BETWEEN DESIGN GUIDE FOR SUBDIVISION SERVICING AND CTP STREET CLASSIFICATION

The previous Design Guidelines for Subdivision Servicing had 14 street classifications. This Guide has 13 with some previous classifications being eliminated and some new classifications introduced. The following Figure was developed to assist in translation from the previous street classification to the CTP street classification. For each of the CTP classifications, a variety of context-dependent alternate cross sections have been identified.

FIGURE 2-2: EXISTING & CTP STREET CLASSIFICATION

DESIGN GUIDELINES FOR SUBDIVISION SERVICING CLASSIFICATION	CTP CLASSIFICATION		ALTERNATE STREET
Expressway	Road	Skeletal Road	N/A
Major Street	Arterial	Divided Arterial	• Primary HOV • Primary Cycle A • Primary Cycle B • Roundabout Corridor • Constrained ROW • High Speed • High Volume • Enhanced Boulevard
Local Major Street		Local Arterial	• Wide Median
Major Industrial Street		Industrial Arterial	• High Speed
N/A (New to CTP)	Liveable	Urban Boulevard	*To be determined*
		Parkway	*To be determined*
		Neighbourhood Boulevard	*To be determined*
Primary Collector Street	Local	Primary Collector	• High Capacity / Commercial Frontage • Enhanced Boulevard • Undivided • Constrained ROW
Grand Boulevard		Collector Street	• Parking One Side • Constrained ROW • Residential Flankage
Collector Street			
Connector Street			
Avenue			
High Street		Activity Centre Street	• Urban Residential Street • Industrial Employment Street
Industrial Street		Industrial Street	• Sidewalk One Side • 12m Roadway
Residential Street		Residential Street	• Residential Entrance Street *Others to be determined*
Residential Entrance Street			
Lane (Alley)		Lane (Alley)	• 6m (Constrained) • 10m (Deep Utilities)

CHAPTER 3

PEDESTRIAN DESIGN

3.1 PEDESTRIAN POLICY (TP010)

The City of Calgary does not currently have a Pedestrian Design Guide. However, there is an approved Pedestrian Policy (TP010) and Needs Report that provides some pedestrian design guidance. The intent of this policy is to:

a) Re-affirm the importance of walking as an efficient, non-motorized choice of transportation

b) Establish broad, city-wide policies that provide direction and guidance on how to plan, design, build, operate and maintain a city where walking is a meaningful form of transportation for social and economic activities.

POLICY STATEMENT:

The City of Calgary will use the following policies to support walking as a year-round mode of transportation that is connected, convenient and obstruction-free, and accessible regardless of age, gender, income, culture or ability:

1. **Plan and build compact, mixed-used communities.**
2. **Give priority to the planning, design, implementation and operation of pedestrian routes and facilities with all land use and transportation planning and design.**
3. **Improve existing pedestrian routes and facilities and build missing links.**
4. **Design facilities, educate the public, and enforce laws to increase acceptance and understanding and decrease conflicts among the users of pedestrian facilities.**
5. **Give priority to pedestrian routes in everyday maintenance and facility improvements in yearly programs.**
6. **Provide pedestrian routes that are of engaging character, safe and feel secure.**

The Pedestrian Policy and Needs Report attached to this policy identifies the basic transportation needs of pedestrians and is based on best practices from North America and Europe. The policies and needs will be used in several areas including the development process, capital projects, pedestrian projects, maintenance and replacement activities, planning and prioritization. These policies should ultimately form a Pedestrian Design Guide.

This 2008 Council approved Policy and Needs Report can be found at **www.calgary.ca.** Search for "**Pedestrian Policy**".

3.2 PEDESTRIAN STREET DESIGN

Walking is the most basic mode of transportation. Certain areas generate high pedestrian activity, such as the downtown, residential, commercial, and entertainment areas, and schools. Yet even in areas of low pedestrian activity, pedestrian needs and safety must be addressed, since drivers usually don't expect pedestrians, and pedestrians are more vulnerable if a collision occurs. Much of this is due to vehicle speed. As speeds increase, drivers are less attentive to what is happening on the side of the street, reaction time is increased, and the pedestrian has a higher chance of severe injury or death.

Most pedestrian collisions occur when a person crosses the street, and the most common collision type is a conflict between a crossing pedestrian and a turning vehicle at an intersection.

Designing for pedestrians should not focus primarily on avoiding collisions. Rather, the goal of street and intersection design should be to create an environment that is conducive to walking, where people can walk along and cross the street, where the public realm becomes a place where people want to be. **The two most effective methods to achieve these goals are 1) to minimize the footprint dedicated to motor vehicle traffic and secondly, to slow down the speed of moving traffic.** This approach allows the designer to use many features that enhance the walking environment, including trees, curb extensions, and street furniture, which in turn slow traffic. All streets should have sidewalks except for rural roads and shared-space streets (vehicles and pedestrians share the same space).

The following are the sidewalk principles embedded in the Complete Streets Guide for the street palette:

PEDESTRIAN DESIGN GUIDELINES

1. Separated sidewalks should be a minimum 1.5m wide (all classifications).
2. Monolithic sidewalks should be a minimum 2.0m wide for improved pedestrian safety and to provide width for snow storage (1.5m permitted on residential and industrial streets).
3. Sidewalks should be provided on both sides of all street classifications (including most residential and industrial areas) with the exception of Skeletal Roads.
4. Wider (≥2.0m) sidewalks should be provided along transit routes and connections to transit hubs.
5. Wider (≥2.0m) sidewalks should be provided for connections to schools, within activity centers and near major pedestrian generators (e.g. stadiums).
6. If monolithic, sidewalks should be wider (>2.0m) to provide separation from traffic when
   a) truck volumes are > 10% of total volume
   b) design speed is >60 km/h
   c) traffic volume is >20,000 vehicles per day. (Note: does not apply to industrial streets)
7. Sidewalk width should be chosen based on surrounding land uses (higher density requires wider sidewalk).
8. Two directional wheelchair ramps should ideally be installed at ALL street intersection corners (if corner radii and catch basin locations permit). As a minimum, all Arterial, all Liveable, Primary Collector, Collector, and Activity Center Streets should have two wheelchair ramps at each corner (See Section 10.1.8).

CHAPTER 4

BICYCLE DESIGN

4.1 BICYCLE POLICY (TP011)

A Bikeway Design Guide is currently being developed by Transportation Planning and Roads and will be completed in 2012. Development of the Design Guide is an action (C4) from the City of Calgary Cycling Strategy. In the meantime, there is an approved Bicycle Policy (TP011) and Needs Report that provides some bicycle design guidance. The intent of this policy is to:

a) Re-affirm the importance of cycling as an efficient, non-motorized choice of transportation

b) Establish broad, city-wide policies that provide direction and guidance on how to plan, design, build, operate and maintain a city where cycling is a meaningful form of transportation for social and economic activities.

POLICY STATEMENT:

The City of Calgary will use the following policies to support cycling as a year-round mode of transportation that is connected, convenient and obstruction-free, and accessible regardless of age, gender, income, culture or ability:

1. **Plan and build compact, mixed-used communities.**
2. **Give priority to the planning, design, implementation and operation of bicycle routes and facilities with all land use and transportation planning and design.**
3. **Improve existing bicycle routes and facilities and build missing links.**
4. **Design facilities, educate the public and enforce laws to increase acceptance and understanding and decrease conflicts among road and pathway users.**
5. **Give priority to the maintenance of bicycle routes and facilities.**
6. **Provide bicycle routes that are of engaging character, safe and feel secure.**
7. **Provide bicycle parking and other amenities at destinations.**
8. **Ensure that bicycle facilities are included in the design and operation of City facilities (i.e. Calgary Transit and City-owned buildings)**

The Bicycle Policy and Needs Report attached to this policy identifies the basic transportation needs of cyclists and is based on best practices from North America and Europe. The policies and needs will be used in several areas including the development process, capital projects, bicycle projects, maintenance and replacement activities. These policies and needs will inform the creation of a Bikeway Design Guide for Calgary. This 2008 Council approved Policy and Needs Report can be found at **www.calgary.ca.** Search for **"Bicycle Policy"**. The 2011 Council approved Cycling Strategy can be found by searching for **"Cycling Strategy"**.

4.2 BICYCLE STREET DESIGN

All streets should be designed with the expectation that cyclists will use them. This does not mean every street needs a dedicated bicycle facility, nor will every street accommodate all types of bicyclists. Minimizing the footprint dedicated to motor vehicle traffic and slowing down the speed of moving traffic benefits bicyclists. Ideally, all multi-lane streets should have bicyclist-specific accommodation (e.g. bike lanes). On multi-lane streets where bike lanes aren't feasible because of space constraints, other bicycle treatments should be applied (e.g. shared off-street multi-use pathway). The following are the Bicycle Facilities principles embedded in the Complete Streets Guide for the street palette:

BICYCLE DESIGN GUIDELINES

1. The type of bicycle facility should be determined based on:
   - Bicycle network connectivity (as specified in the City of Calgary Bikeway Implementation Plan)
   - Current and future demand for a route;
   - Cycling policies (e.g. Bicycle Policy TP011);
   - Design/Posted speed;
   - Surrounding land uses;
   - Driveway frequency;
   - Level of transit service (e.g. frequent BRT vs. infrequent bus); and
   - Daily traffic volume and composition
2. Minimum bike lane width is 1.5 metres free of obstructions and obstacles (1.3m permitted in retrofit projects where there are constraints).
3. Wider on-street facilities (e.g. 1.5m min bike lane + 0.5m min buffer) should be provided adjacent to a parking lane (i.e. buffer to protect from car doors) and on a grade (as cyclists may not travel in a straight line while travelling uphill).
4. A physically separated (e.g. min 0.5 min painted buffer), exclusive facility should be provided when any of the following criteria are met:
   a) truck volumes are > 10 per cent of total volume
   b) design speed is > 60 km/h
   c) when two-way traffic volumes exceed 20,000 vehicles per day.
5. Minimum width for regional pathways is 3.0m (uplands) and 4.0m (river and creek valleys).

The Bikeway Design Guide, currently under development for 2012 will provide more detailed design guidance.

CHAPTER 5

TRANSIT DESIGN

5.1 TRANSIT FRIENDLY DESIGN GUIDE

The Transit Friendly Design Guide describes the techniques for improved integration of transit into residential and non-residential areas to achieve the vision described in the Calgary Transportation Plan. It is designed to explain and provide examples of the physical requirements for good transit service and serves as a companion document to the Transit Oriented Development Policy Guidelines, which provide direction for development of areas within 600 metres walking distance of Light Rail Transit (LRT) and Bus Rapid Transit (BRT) stations.

The following principles summarize techniques that contribute to transit friendly development:

1. **Provide appropriate community densities.**
2. **Minimize walking distance.**
3. **Provide mixed land uses.**
4. **Organize density, land use and buildings to benefit from Transit.**
5. **Create a pedestrian friendly environment.**
6. **Route Transit into the community.**
7. **Reduce Transit travel time.**
8. **Build quality, user friendly Transit facilities.**

The Guide also includes a number of Transit Policies that can be grouped into these categories:

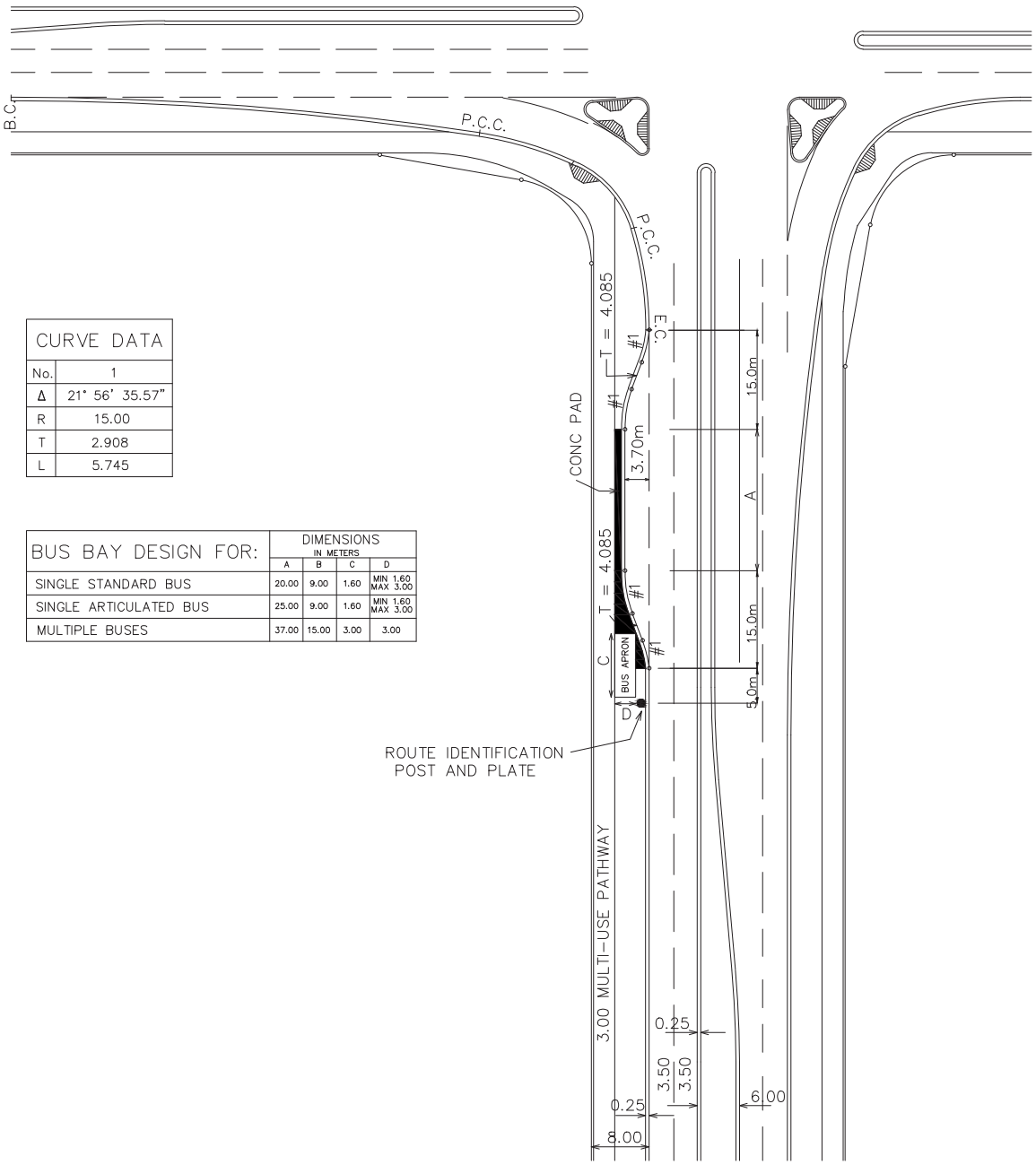
1. **Land Use and Community Design**
2. **Mobility**
3. **Integration with other travel modes**
4. **Cost/Affordability**
5. **Healthy Living**

The Transit Friendly Design Guide can be viewed or downloaded at:

www.calgarytransit.com/pdf/transit_friendly.pdf

5.2 BUS ZONE DESIGN

Building on principles within this Complete Streets Guide, bus zone detailed design sheets were developed (pages 36-38). Pages 39-40 show curb side bus zones contained in the Transit Friendly Design Guide.



CURVE DATA	
No.	1
Δ	21° 56' 35.57"
R	15.00
T	2.908
L	5.745

BUS BAY DESIGN FOR:	DIMENSIONS IN METERS			
	A	B	C	D
SINGLE STANDARD BUS	20.00	9.00	1.60	MIN 1.60 MAX 3.00
SINGLE ARTICULATED BUS	25.00	9.00	1.60	MIN 1.60 MAX 3.00
MULTIPLE BUSES	37.00	15.00	3.00	3.00

NOTES
1. REFER TO INTERSECTION DESIGN SHEET FOR INTERSECTION DESIGN DETAILS.
2. POST MUST BE A MINIMUM OF 0.50m FROM FACE OF CURB
3. CONCRETE PAVEMENT REQUIRED IN ALL BUS BAYS. THE THICKNESS SHALL BE 100mm AS PER DRAWINGS AND THE MATERIALS IS TO MEET CLASS 'A' CONCRETE SPECIFICATIONS AS LISTED IN SECTION 310.00.00 OF THE STANDARD SPECIFICATIONS ROAD CONSTRUCTION
4. EXTEND CROSS-FALL INTO THE BUS BAY
5. BUS BAYS ARE TO HAVE A MINIMUM PARALLEL WIDTH OF 3.70m TO THE EDGE OF THE LANE
6. TRANSIT APRONS MAY BE INCREASED TO 3.00 X 15.00m FOR ARTICULATED BUSES IF NEEDED
7. APPLICABLE FOR TIME POINTS OR ROADWAYS AT 70 km/h AND ABOVE
8. EASEMENTS MAY BE REQUIRED TO ACCOMMODATE TRANSIT BAY AND MULTI-USE PATHWAY

DIMENSIONS ARE METRES UNLESS OTHERWISE NOTED — METRIC

No.	Date	Revision	App'd

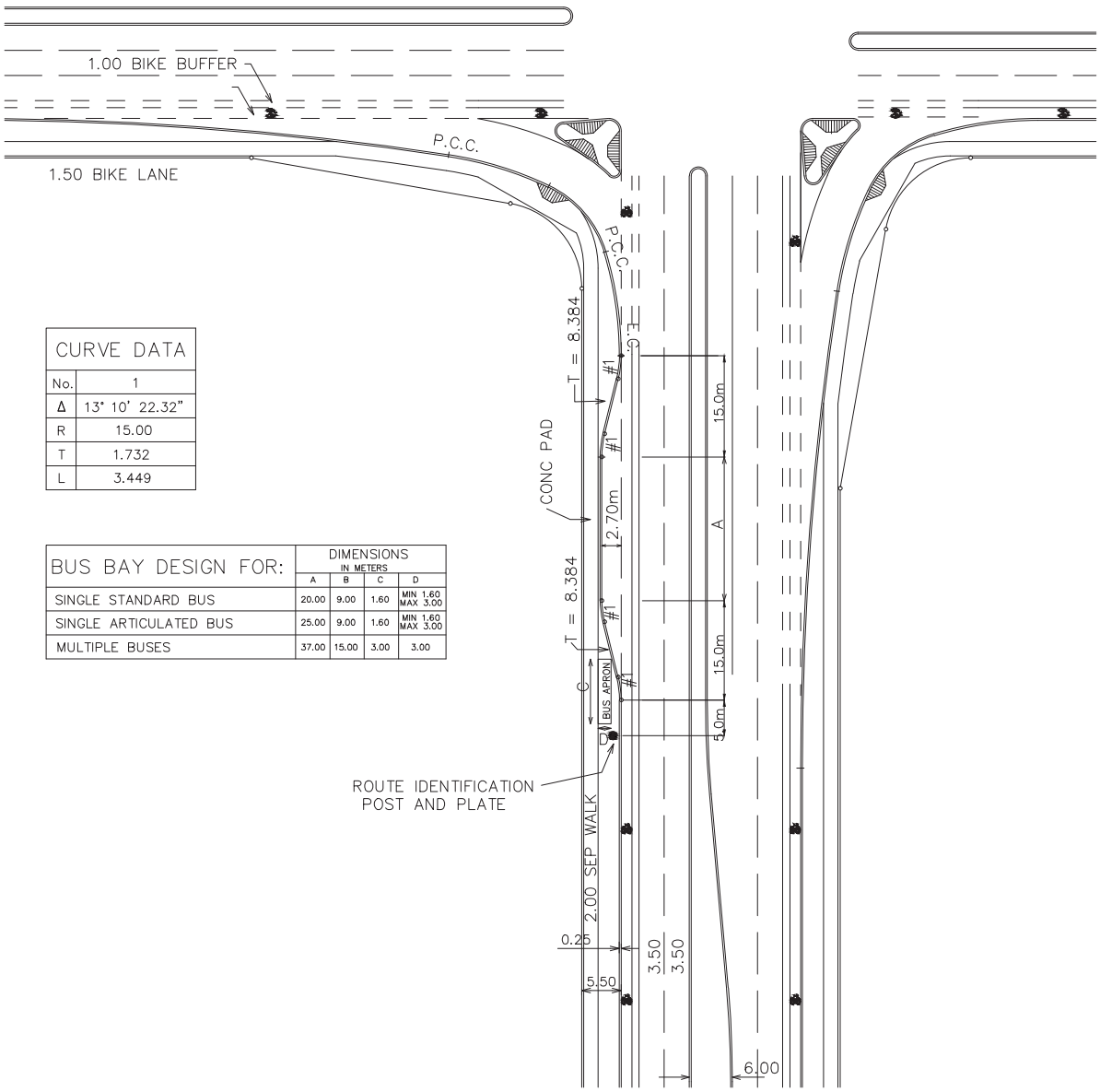
Drawn: CRH	Date: 2011-10
Scale: N.T.S.	
Approved for: City Engineer	

THE CITY OF CALGARY
ROADS

TYPICAL TRANSIT BAY DESIGN
MULTI-USE PATHWAY
ARTERIAL TO ARTERIAL STREET

Sheet: —

File.Number: —



CURVE DATA	
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T	1.732
L	3.449

BUS BAY DESIGN FOR:	DIMENSIONS IN METERS			
	A	B	C	D
SINGLE STANDARD BUS	20.00	9.00	1.60	MIN 1.60 MAX 3.00
SINGLE ARTICULATED BUS	25.00	9.00	1.60	MIN 1.60 MAX 3.00
MULTIPLE BUSES	37.00	15.00	3.00	3.00

NOTES
1. REFER TO INTERSECTION DESIGN SHEET FOR INTERSECTION DESIGN DETAILS.
2. POST MUST BE A MINIMUM OF 0.50m FROM FACE OF CURB.
3. CONCRETE PAVEMENT REQUIRED IN ALL BUS BAYS. THE THICKNESS SHALL BE 100mm AS PER DRAWINGS AND THE MATERIALS IS TO MEET CLASS 'A' CONCRETE SPECIFICATIONS AS LISTED IN SECTION 310.00.00 OF THE STANDARD SPECIFICATIONS ROAD CONSTRUCTION.
4. EXTEND CROSS–FALL INTO THE BUS BAY.
5. BUS BAYS ARE TO HAVE A MINIMUM PARALLEL WIDTH OF 3.70m TO THE EDGE OF THE LANE.
6. TRANSIT APRONS MAY BE INCREASED TO 3.00 X 15.00m FOR ARTICULATED BUSES IF NEEDED
7. APPLICABLE FOR TIME POINTS OR ROADWAYS AT 70 km/h AND ABOVE.
8. EASEMENTS MAY BE REQUIRED TO ACCOMMODATE TRANSIT BAY AND SEPARATE SIDEWALK.

DIMENSIONS ARE METRES UNLESS OTHERWISE NOTED — METRIC

No.	Date	Revision	App'd

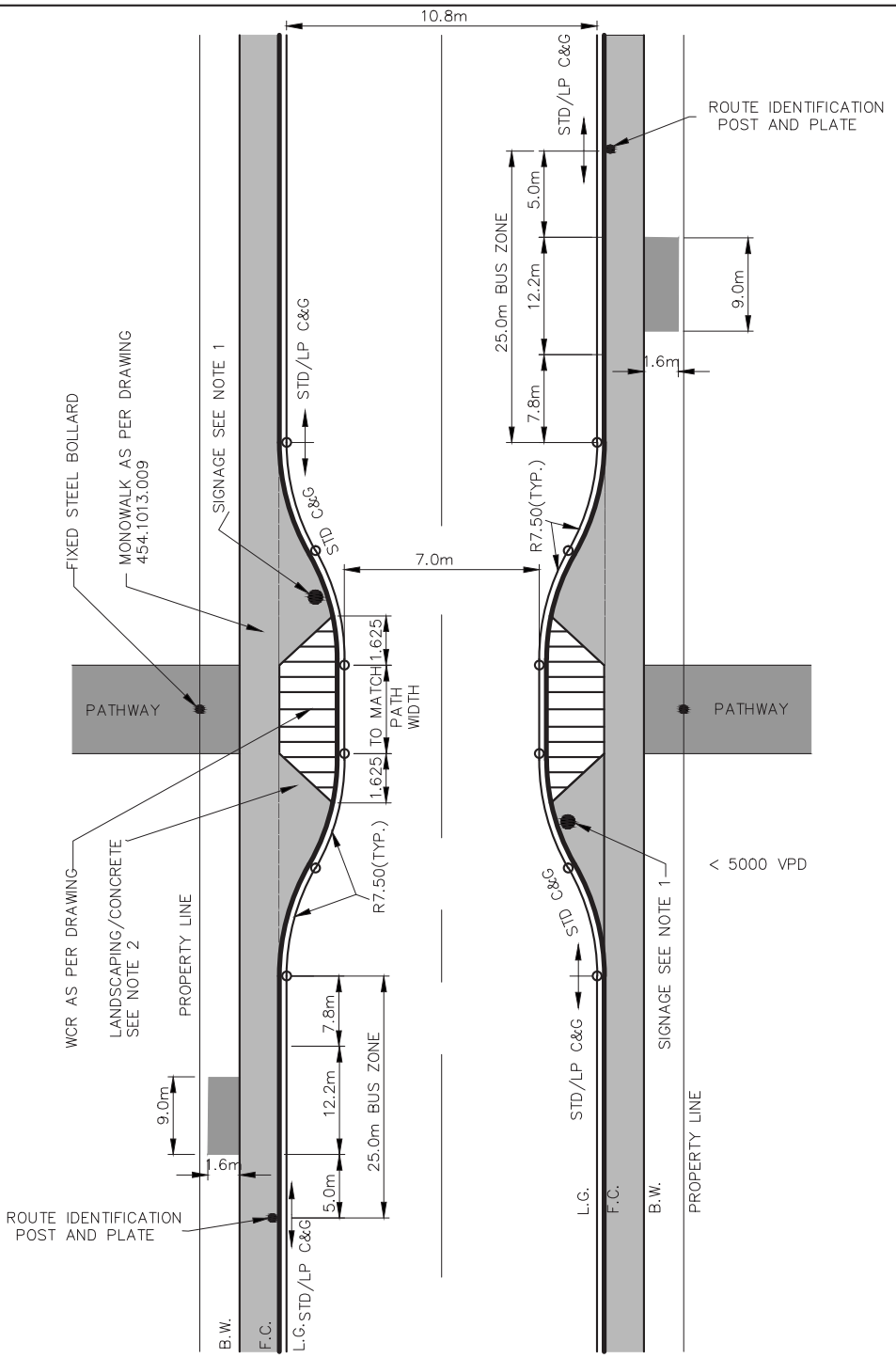
Drawn: KJM	Date: DEC. 2011
Scale: N.T.S.	
Approved for City Engineer	

THE CITY OF CALGARY
ROADS

ON STREET BIKE LANES
ARTERIAL TO ARTERIAL STREET
TYPICAL TRANSIT DESIGN

Sheet: —
File.Number: —

FILE: *FILE UEPES*
DATE: *DATETIME*
ISC : UNRESTRICTED



NOTES:

1. SIGNAGE LOCATION TO BE CONFIRMED WITH TRAFFIC ENGINEERING.
2. BULB OUT TO BE HARD SURFACED FOR MONOWALKS AND GRASSED FOR SEPARATE WALK DESIGNS.
3. CROSSING LOCATION SHALL BE CENTERED ON BULB OUT.
4. PAVEMENT WIDTH AND ROUTE IDENTIFICATION POST LOCATION VARIES FOR OTHER ROADWAY CLASSIFICATION.
5. POST MUST BE A MINIMUM OF 0.5m FROM FACE OF CURB.
6. WHEN BICYCLE LANES ARE PRESENT, MODIFICATIONS MAY BE REQUIRED TO CURB EXTENSIONS.

DIMENSIONS ARE METRES UNLESS OTHERWISE NOTED — METRIC

No.	Date	Revision	App'd
1	2011–10	–	

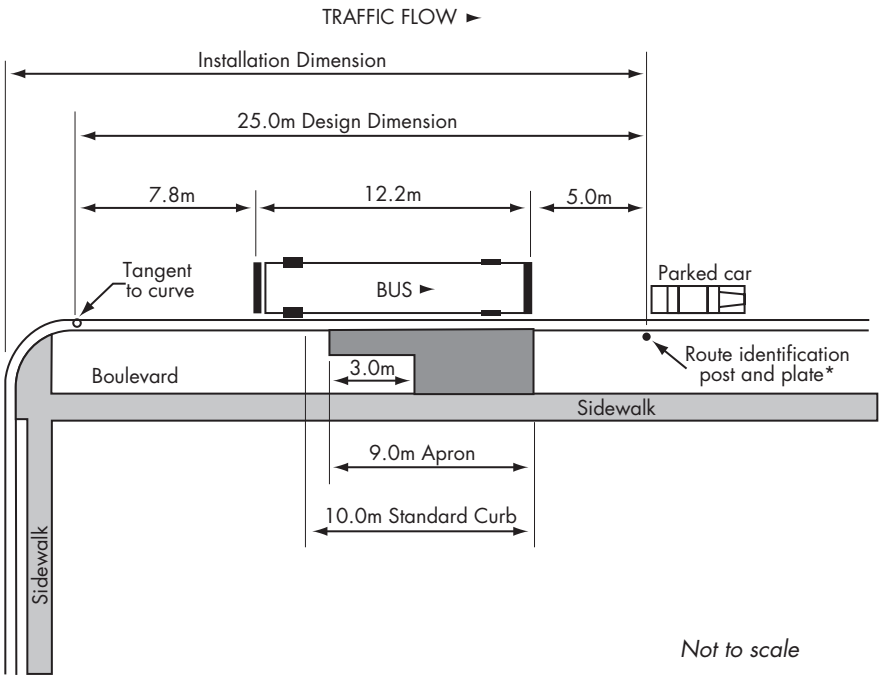
Drawn CRH | Date 2011–10
Scale N.T.S.
Approved for City Engineer

THE CITY OF CALGARY
ROADS

COLLECTOR STREET
MID BLOCK CROSSING
BUS ZONE DETAIL

Sheet –
File.Number –

FAR-SIZE ZONE (FROM PAGE 37, APPENDIX B, TRANSIT FRIENDLY DESIGN GUIDE)



**Post must be a minimum of 0.5m from face of curb.*

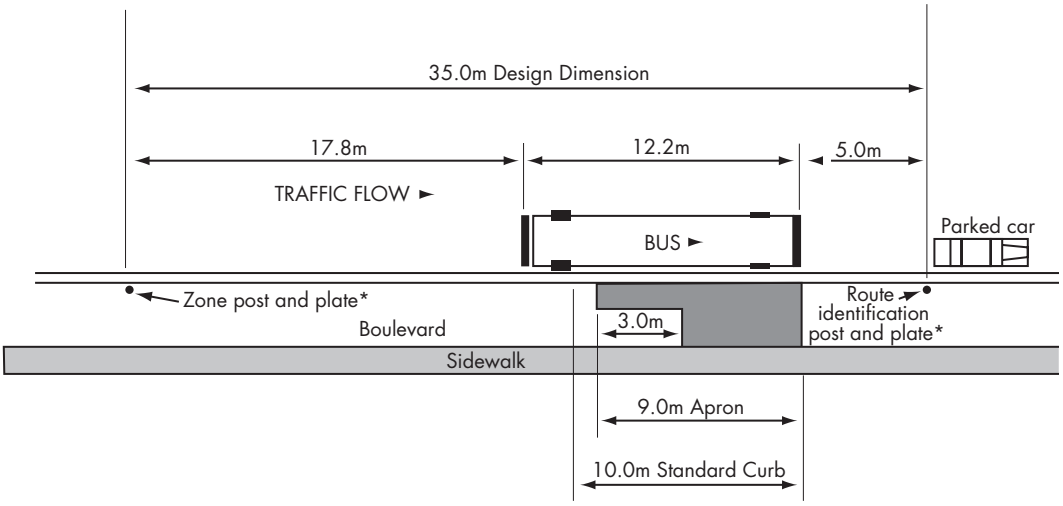
All zones are sized for wheelchair accessibility.

A person in a wheelchair occupies a space 760mm x 1220mm and can turn within a 1500mm diameter circle.

Note: For more information on bus zones, refer to Bus Zone Location and Design, City of Calgary Transportation Department, 1992.

MID-BLOCK ZONE (FROM PAGE 38, APPENDIX B, TRANSIT FRIENDLY DESIGN GUIDE)

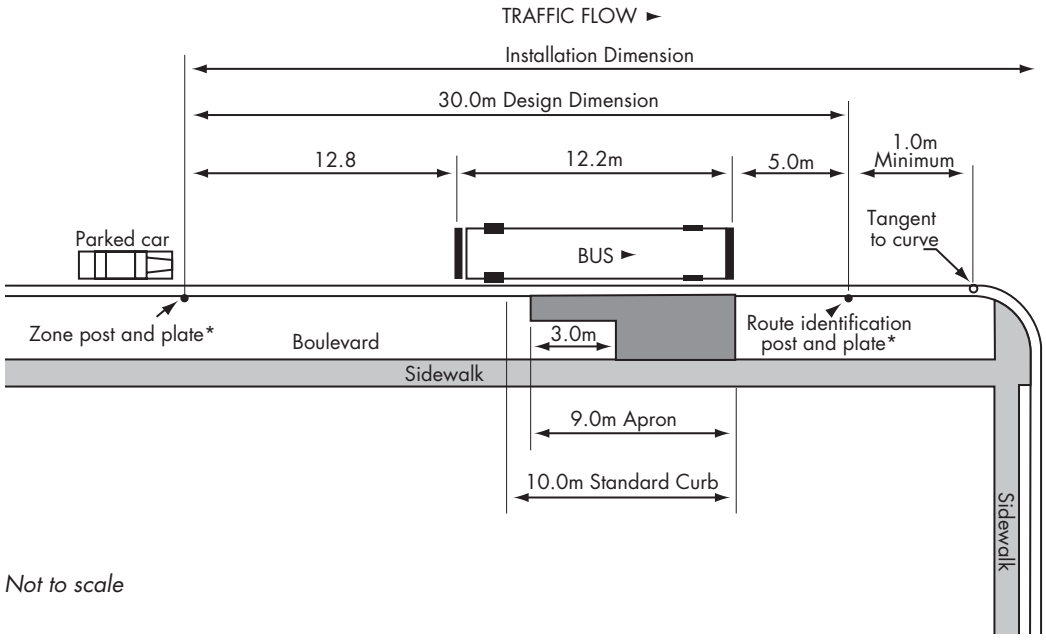
Mid-Block Zone



Not to scale

NEAR-SIDE ZONE (FROM PAGE 38, APPENDIX B, TRANSIT FRIENDLY DESIGN GUIDE)

Near-Side Zone



Not to scale

**Post must be a minimum of 0.5m from face of curb.*

All zones are sized for wheelchair accessibility.

A person in a wheelchair occupies a space 760mm x 1220mm and can turn within a 1500mm diameter circle.

Note: For more information on bus zones, refer to Bus Zone Location and Design, City of Calgary Transportation Department, 1992.

CHAPTER 6

TRAFFIC CALMING

6.0 TRAFFIC CALMING POLICY (TP002)

Traffic calming is an effective approach to address existing traffic issues on Local Streets (residential and collector streets). This Policy provides clear direction on the types of traffic calming measures to be considered in Calgary, and appropriate circumstances for their use.

The Institute of Transportation Engineers (ITE) defines Traffic Calming as:

> **"..the combination of mainly physical measures that reduce the negative effects of motor vehicle use, alter driver behaviour and improve conditions for non-motorized street users."**

OBJECTIVES:

- Reduce vehicle speeds
- Discourage through traffic on local streets
- Minimize conflicts between street users
- Enhance the neighbourhood environment

PRINCIPLES:

- Involve the community
- Identify the real problem
- Quantify the problem
- Consider improvements to the major street network first
- Use self-enforcing measures
- Minimize access restrictions
- Target automobiles and trucks only
- Monitor conditions

MEASURES:

- Vertical deflection
- Horizontal deflection
- Obstructions
- Signage

The policy supplements the Transportation Association of Canada (TAC) "Canadian Guide to Neighbourhood Traffic Calming"

The 2003 Council Traffic Calming policy can be found at **www.calgary.ca.** Search for **"Traffic Calming Policy"**.

CHAPTER 7

ACCESSIBLE DESIGN

7.0 ACCESS DESIGN GUIDELINES

The Calgary Corporate Accessibility Policy (CSPS003) approved by Council in 2005, directs Administration to follow the latest edition of the City of Calgary Access Design Standards in all City projects.

The purpose of the Guidelines is to create a more liveable and accessible city for people with disabilities, including the elderly. This is accomplished by increasing the awareness of the needs of these citizens and providing design solutions that increase and enhance the accessibilities to the outdoors throughout the year.

This document was created by the Advisory Committee on Accessibility, consisting of members with disabilities, representatives from the community and City of Calgary business units. Though these standards apply within the property boundaries of City owned/operated buildings and facilities, construction within road rights-of-way will require consultation with appropriate City departments in addition to these standards.

The document can be located at:

www.calgary.ca/PDA/DBA/Documents/development/access_design_standards.pdf

The Advisory Committee on Accessibility (ACA) strongly supports the Pedestrian Design guidelines in Chapter 4, specifically those related to wider sidewalk widths, sidewalks on both sides of the street, and two wheelchair ramps at each intersection corner.

CHAPTER 8

STREETSCAPE DESIGN

Street design from a low impact development, urban forestry, shallow utility, and street furniture perspective have been combined into this single chapter as no one element can be designed without consideration of the others. Section 8.1 discusses Green Infrastructure (natural green elements) and Low Impact Development (stormwater source control) strategies to incorporate into street design. The goal is to develop a sustainable city by protecting the natural environment within the road right of way.

Section 8.2 discusses the City of Calgary Urban Forestry Strategic Plan and its goal to protect the urban forest along with the environmental, economic, aesthetic, social, and historic benefits is provides.

Section 8.3 provides guidelines on Shallow Utility Design, most of which are directly from the CTP.

Section 8.4 provides an introduction to public realm design and the future content that will be provided by Planning's Urban Design group.

8.1 GREEN INFRASTRUCTURE & LOW IMPACT DEVELOPMENT DESIGN

8.1.1 INTRODUCTION

The goal of the Calgary Transportation Plan (CTP) and Municipal Development Plan (MDP) is to develop a sustainable city by protecting the natural environment, ensuring the economy remains strong and that communities are vibrant and accommodating. The CTP includes transportation policies that work in conjunction with the land use policies of the MDP. Complete Streets is one of the CTP policy areas identified, which includes the specific inclusion of Green Infrastructure (GI) policies. GI is defined in the MDP/CTP as:

> **. . . An interconnected network of natural green and engineered green elements applicable at multiple scales in the land use and mobility framework. Natural green elements include the conservation and integration of traditional green elements such as trees, wetlands, riparian areas and parks. Engineered green elements include systems and technologies designed to mimic ecological functions or to reduce impacts on ecological systems. Examples include green alleys, green buildings and green roadways and bridges.**

Another policy area identified in the CTP is Environment and Transportation. The objective of this policy is to protect air, land, water and biodiversity in the planning, design, operation and maintenance of all transportation infrastructure. GI supports achieving this objective, and can be integrated with another city initiative that is underway related to Low Impact Development (LID). LID is defined in the MDP/CTP as:

> **An approach to land development that uses various land planning and design practices and technologies to simultaneously conserve and protect natural resource systems and reduce infrastructure costs.**

LID includes sustainable stormwater source control practices and is being advanced by The City's Water Resources group. This Department is currently developing the Low Impact Development Design & Construction and Operations and Maintenance manual for the development industry and City staff. The manual will include design guidelines, design specifications and checklists for six modules suitable for sustainable stormwater practices in the Calgary region to support the GI strategies. The manual is expected to be completed by the end of 2012 (see Section 8.1.7).

8.1.2 STRATEGIC GOALS

Progress toward meeting the goals and objectives in the MDP/CTP will be monitored by measuring with Core Indicators for Land Use and Mobility. These high level indicators include:

- Watershed health as measured by per cent of impervious surface
- Urban forest as measured by per cent of tree canopy

To assist in driving these changes, GI Policies included in Section 3.7 of the CTP stipulate:

o.) All new and retrofit road and street designs should incorporate GI strategies to contribute to the environmental health and visual aesthetics of the urban fabric.

p.) In all designs, natural processes should be maintained and re-established by conserving, protecting, and restoring habitat quantity and quality. Watersheds should be protected by filtering roadway runoff.

q.) Native vegetation and a layered tree canopy should be incorporated within corridors to reduce the urban heat island effect and improve air quality.

The GI and LID applications summarized in the next section fully support the intent of these policies.

8.1.3 SOLUTION ANALYSIS

In the evaluation of possible GI or LID solutions to introduce in mobility corridors, consideration must be given to all functional elements that are either required or desired within the limits of the right-of-way (ROW). Figure 1-3, Section 1.4 identifies three specific zones in corridors which include the Roadway (space between the curb lines), Public realm (space between the curb line and the property line) and the Interface Zone (space between the property line and developed areas and buildings on private lands). Applications to introduce sustainability strategies and solutions will vary by zone.

8.1.4 GREEN INFRASTRUCTURE STRATEGIES

The strategies that follow provide a high-level framework and guidance for development and implementation of more detailed, sustainable solutions. Specific solutions will be supported by guidelines and standards that will come from various functional departments within the city.

PRINCIPLE RESOURCE: WATER – MIMIC NATURAL HYDROLOGY

Strategies:

- Maximize On Site Infiltration (vegetated swales, absorbent soils, infiltration planters and galleries)
- Reduce Effective Impervious Area (narrow paved areas, pervious pavements, curb openings)
- Slow and Detain Runoff (flow through planters, rain gardens, trees and the urban forest)
- Filter Street Runoff (filter strips, biofiltration swales, stormwater wetlands)
- Balance Water Demand (xeriscaping)

PRINCIPLE RESOURCE: AIR – MITIGATE GHG EMISSIONS

Strategies:

- Design networks and streets to prioritize Walking and Cycling
- Enhance the Urban Forest (maximize tree planting, optimum growth conditions for trees)
- Reduce Energy Demand (energy conservation and alternative energy systems)

PRINCIPLE RESOURCE: HABITAT – ENHANCE URBAN BIODIVERSITY

Strategies:

- Preserve and Enhance Biodiversity (diverse native vegetation, re-create wetland areas, create a layered canopy)
- Increase Habitat Connectivity (wildlife corridors, wildlife crossings and passages)
- Increase Urban Tree Canopy (mature trees)

GUIDELINES FOR IMPLEMENTING GI STRATEGIES INCLUDE:

- Designating space to enable the effective introduction of GI as feasible.
- Using techniques and technologies to reduce environmental impacts.
- In all designs, maintaining and re-establishing natural processes by conserving, protecting and restoring habitat quantity and quality.
- By considering the following elements when building GI into mobility corridors: site assessment, streetscape, pavement, utilities, stormwater management, landscape and construction practices.
- Applying GI whenever transportation corridors are planned, constructed, repaired or maintained. Not every strategy will be applicable in these corridors, but as many elements as possible, should be included.
- Integrating strategies and solutions that provide the greatest environmental benefits into the corridor.
- Special care must be taken in the implementation of GI adjacent to high volume streets to ensure that subgrade soil moisture content is not increased.

8.1.5 LOW IMPACT DEVELOPMENT SOLUTIONS

In support of resource conservation and pollution prevention mandates, The City of Calgary has adopted a toolbox of options to manage stormwater runoff. Reducing the amount of impervious cover, increasing natural lands set aside for conservation, and using impervious areas for more effective stormwater treatment should be considered at the planning level. At the site and community level, however, the City of Calgary is currently developing the Low Impact Development Design & Construction, Operations, and Maintenance Manual for the Development Industry and City Administration. See Section 8.1.7 for more. These Stormwater Source Control Practices (SCPs) include:

SCP - BETTER PLANNING PRACTICES

Strategies:

- Reduce the amount of impervious cover, increase natural lands set aside for conservation, and use pervious areas for more effective stormwater treatment.

SCP – GRASS SWALES OR BIOSWALES

Strategies:

- Treat and attenuate the runoff volume from minor storm events as well as convey excess runoff from major storm events downstream by way of dry swales and bioswales.

SCP – ABSORBENT LANDSCAPING

Strategies:

- Preserve and/or restore the moisture storage and infiltration capacities of soils to reduce stormwater runoff.

SCP – BIORETENTION AREAS

Strategies:

- Facilitate attenuation of runoff flow and treatment of stormwater through settling, fine filtration, extended detention and some biological uptake.

SCP – POROUS PAVEMENTS

Strategies:

- Installation of permeable pavement in low-speed and low-volume traffic areas to accommodate pedestrian or vehicular traffic while facilitating infiltration of precipitation falling directly on the porous surface or flowing from adjacent areas. Note: Calgary's sanding practices will require specialized equipment to clean and will require additional maintenance funding.

SCP – STORMWATER REUSE

Strategies:

- Direct storm runoff into storm ponds and use the water for irrigation of green and open spaces within the community, in order to reduce the volume of runoff discharged to receiving water bodies.

SCP – RAINWATER HARVESTING

Strategies:

- Apply rainwater harvesting to capture runoff from roof areas and other impermeable surfaces before it discharges onto the ground or drains into the storm sewer system, in order to reduce the volume of runoff discharged to receiving water bodies.

SCP – GREEN ROOFS

Strategies:

- Install veneers of living vegetation on top of buildings to help manage stormwater through a variety of hydrologic processes that otherwise take place at ground level.

8.1.6 SUMMARY

The integrated application of both GI and LID strategies, along with strategies from other City departments, in future projects will assist with creating more sustainable development in The City of Calgary and will help to achieve the goals and objectives that have been adopted by The City.

Figures 8-1 and 8-2 illustrate various Green Infrastructure and Low Impact Development Strategies.

FIGURE 8-1

GREEN INFRASTRUCTURE STRATEGIES

Mimic Natural Hydrology

Maximize Infiltration

Infiltration Galleries

University infiltGallery

Curb Cuts

Water Centre

Rain Gardens

Alex Ferguson School

Detain Stormwater

Structured Swales

Pennoyer Street, Portland

Flow-through Planters

12 Street, Portland

Dry Swales

UBC Finance Parking Lot

Curb Extensions

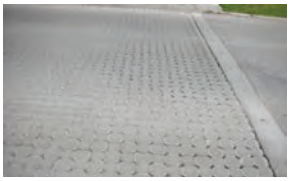
4 Street SW

4 Street SW

Minimize Impermeable Surfaces

Porous Pavement

Permeable Pavers



Currie Barracks Test Site

Grass Paving

Filter Runoff

Biofiltration Swales

Currie Barracks Test Site

Filter Strips

Mission Road

Stormwater Wetlands

UniverCity Ponds

FIGURE 8-1 (CONT.)

Enhance Urban Forestry

Create Habitable Patches

Native Vegetation

Roxboro Park

Layered Canopy

Landsdowne Avenue SW

Diverse Vegetation

Landsdowne Avenue SW

Vegetated Medians and Islands

1 Avenue NE, Bridgeland

Create Connectivity

Green Corridors

Bow Pathway, WestHillhurst

Wildlife Crossings

Elbow Pathway, Mission

Banff National Park

Expand Areas of Urban Forest

Planted Islands

Mission Road

Planter Boxes

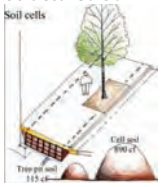
Memorial Drive

Create Optimum Growth Conditions

Tree Trenches

4 Street SW

Structured Soil



Mitigate Climate Change

Intercept Precipitation

Water Absorbing Vegetation

Currie Barracks Test Site

Trees in Paved Areas

Macleod Trail SE

Preserve Mature Trees

Garden Crescent SW

Reduce Urban Heat Island Effect

Increase Tree Canopy

8 Street NW

High Albedo Pavement

Reduce Irrigation

Xeriscaping

University of Calgary

Reduce Energy Use

Solar Powered Irrigation

75R Crowfoot Cir NW

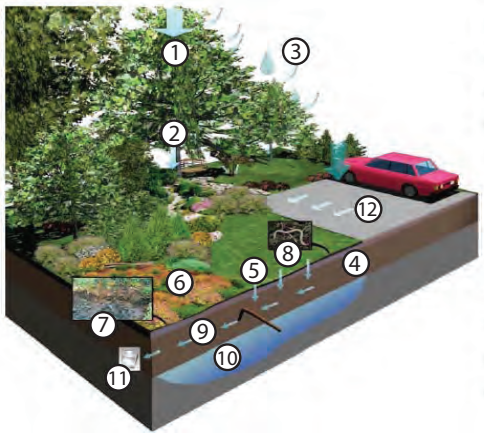
Energy Efficient Lighting

Mission Road

FIGURE 8-2

LOW IMPACT DEVELOPMENT SYSTEMS

ABSORBENT LANDSCAPE



1. CROWN INTERCEPTION
2. THROUGHFALL AND STEMFLOW
3. EVAPOTRANSPIRATION
4. SOIL WATER STORAGE
5. SOIL INFILTRATION
6. SURFACE VEGETATION
7. ORGANICS AND COMPOST
8. SOIL LIFE
9. INTERFLOW
10. DEEP GROUNDWATER
11. WATER QUALITY IMPROVEMENT
12. IMPERMEABLE SURFACES AND SURFACE RUNOFF

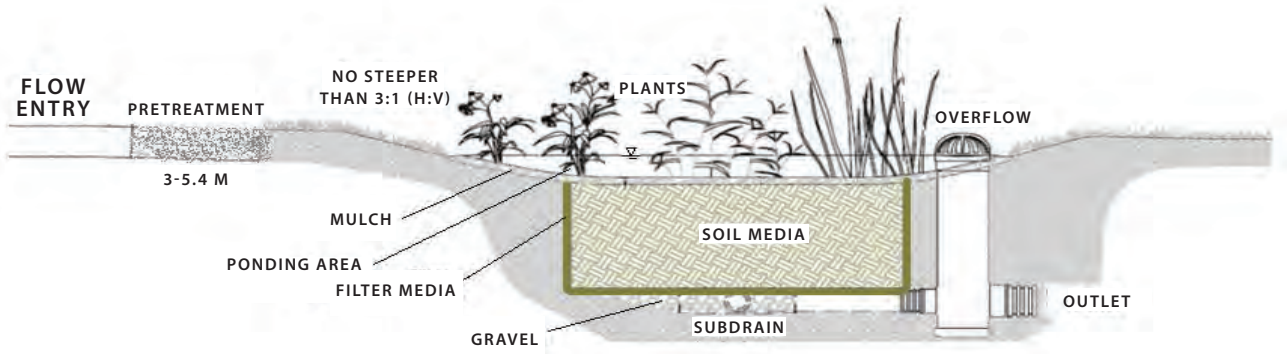
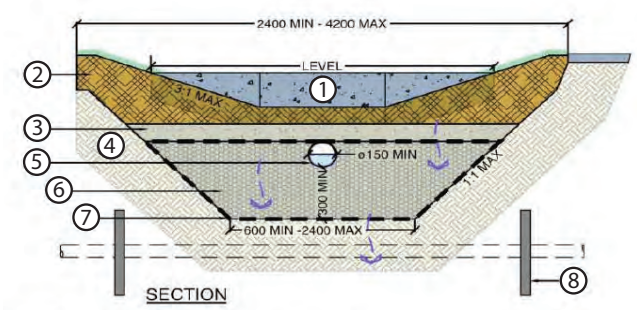


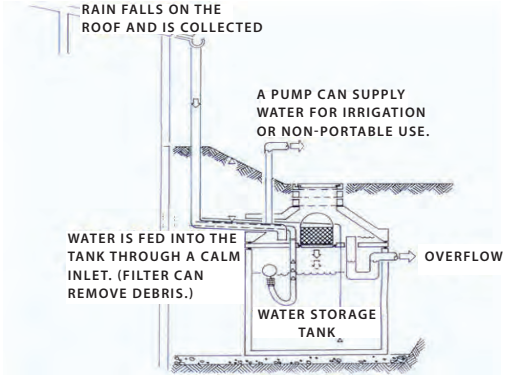
FIGURE 8-2 (CONT.)

BIOSWALE SYSTEM



1. CONCRETE WEIR KEYED 100 MM INTO SWALE SIDE SLOPE
2. GROWING MEDIUM
3. SAND
4. SUBGRADE
5. PERFORATED DRAIN PIPE (150 Ø MINIMUM)
6. DRAIN ROCK RESERVOIR
7. GEOTEXTILE ALONG ALL SIDES OF RESERVOIR
8. TRENCH DAMS AT ALL UTLITY CROSSINGS

BIORETENTION SYSTEM



PERMEABLE PAVEMENT SYSTEM

8.1.7 LOW IMPACT DEVELOPMENT DESIGN & OPERATIONS MANUAL

The City of Calgary is currently developing the Low Impact Development Design & Construction and Operations and Maintenance manual for the development industry and City staff. The LID manual will contain six modules describing stormwater source control practices (SCP) suitable for the Calgary region including guidelines and specifications for design and corresponding checklists. The manual is expected to be completed by the end of 2012.

The LID manual will include detailed information for the following:

MODULE 1: GEOTECHNICAL AND HYDRO-GEOLOGICAL AND CONSIDERATIONS;

MODULE 2: VEGETATIVE AND ABSORPTIVE PRACTICES:

a) Bioswales;

b) Absorbent landscaping; and

c) Bioretention areas

MODULE 3: GREEN ROOF SYSTEMS;

MODULE 4: STORMWATER CAPTURE AND RE-USE;

MODULE 5: RAINWATER HARVESTING; AND

MODULE 6: PERMEABLE PAVEMENT STRUCTURES.

The stormwater source control practices contained within modules 1, 2 and 6 can be installed within the street or utility right of way. It should be noted that the practices within modules 3, 4 and 5 are not appropriate within street and utility right of way. However, these practices also reduce the volume of stormwater runoff directed to our streets and benefits include improved water quality of stormwater before directing it to the storm ponds and receiving waters.

The following provides a brief description of the stormwater source practices contained in modules 1, 2 and 6:

MODULE 1 - GEOTECHNICAL CONSIDERATIONS

Several source control practices rely on infiltration to function properly. This module will provide details of the geotechnical and hydro-geological investigations and computations required for site assessment. It will also identify the requirements to ensure that established soil conductivities are maintained during construction and for the design life of the chosen SCP.

MODULE 2 – VEGETATIVE AND ABSORPTIVE PRACTICES

The module will describe in detail key design principles and design criteria that will assist designers to properly design these vegetative source control practices. A brief description of the purpose of each practice is listed below.

A. BIOSWALES;

Treat and attenuate the runoff volume from minor storm events as well as convey excess runoff from major storm events downstream by way of dry swales and bioswales.

B. ABSORBENT LANDSCAPING;

Preserve and/or restore the moisture storage and infiltration capacities of soils to reduce stormwater runoff.

C. BIORETENTION AREAS;

Facilitate attenuation of runoff flow and treatment of stormwater through settling, fine filtration, extended detention and biological uptake.

MODULE 6 - PERMEABLE PAVEMENT*

This module will describe in detail key design features for a variety of pavement types and develop design criteria that will enable designers to properly design permeable pavement structures. Permeable pavement can be installed in low-speed and low-volume traffic areas to accommodate pedestrian or vehicular traffic while facilitating infiltration of precipitation falling directly on the porous surface or flowing from adjacent areas.

* Use discretion in your design as permeable pavements could negatively impact universal access.

Photo credit: "Tree Space Design", CaseyTrees, Washington D.C.

8.2 URBAN FORESTRY

8.2.1 INTRODUCTION

Trees are a valuable part of our communities. Not only are they beautiful, but they add color to a vista, provide privacy and security, and add a sense of serenity and character to our surroundings. Trees clean the air, reduce storm water runoff and erosion, save energy, create wildlife habitat, and generally contribute to the quality of life of residents.

Urban trees require our help to reach a size where they can provide benefits to society. These benefits far outweigh the costs associated with caring for these trees, as our urban forest provides valuable environmental, economic, aesthetic, social, and historic benefits to our community.

8.2.2 URBAN FORESTRY STRATEGIC PLAN (UFSP)

In 2007, City of Calgary Council approved the Parks Urban Forestry Strategic Plan. It is a non-statutory plan, approved by City Council and is aligned with Council's 2006 Priorities, the 2002 Calgary Open Space Plan and the Parks Water Management Strategic Plan.

The purpose of the Urban Forest Strategic Plan (UFSP) and policies is to provide a framework for City staff and the community partners to make key decisions about the management of the urban forest for sustainability today that will have a positive impact for future generations.

To achieve and maintain a healthy sustainable urban forest, it is critical The City of Calgary, businesses, and homeowners plant the right trees - in the right place - in the right way - and then apply active, consistent and continuing management. The Parks Urban Forest Strategic Plan (UFSP) sets the framework for City staff and community partners to make smart decisions by providing the vision, values, outcomes, policies, and strategies needed to be successful.

In this plan are 15 guiding principles that provide the philosophical context for the outcome-based policies, strategies, and key action steps. The approach to addressing these principles and achieving our outcomes is organized into three focus areas:

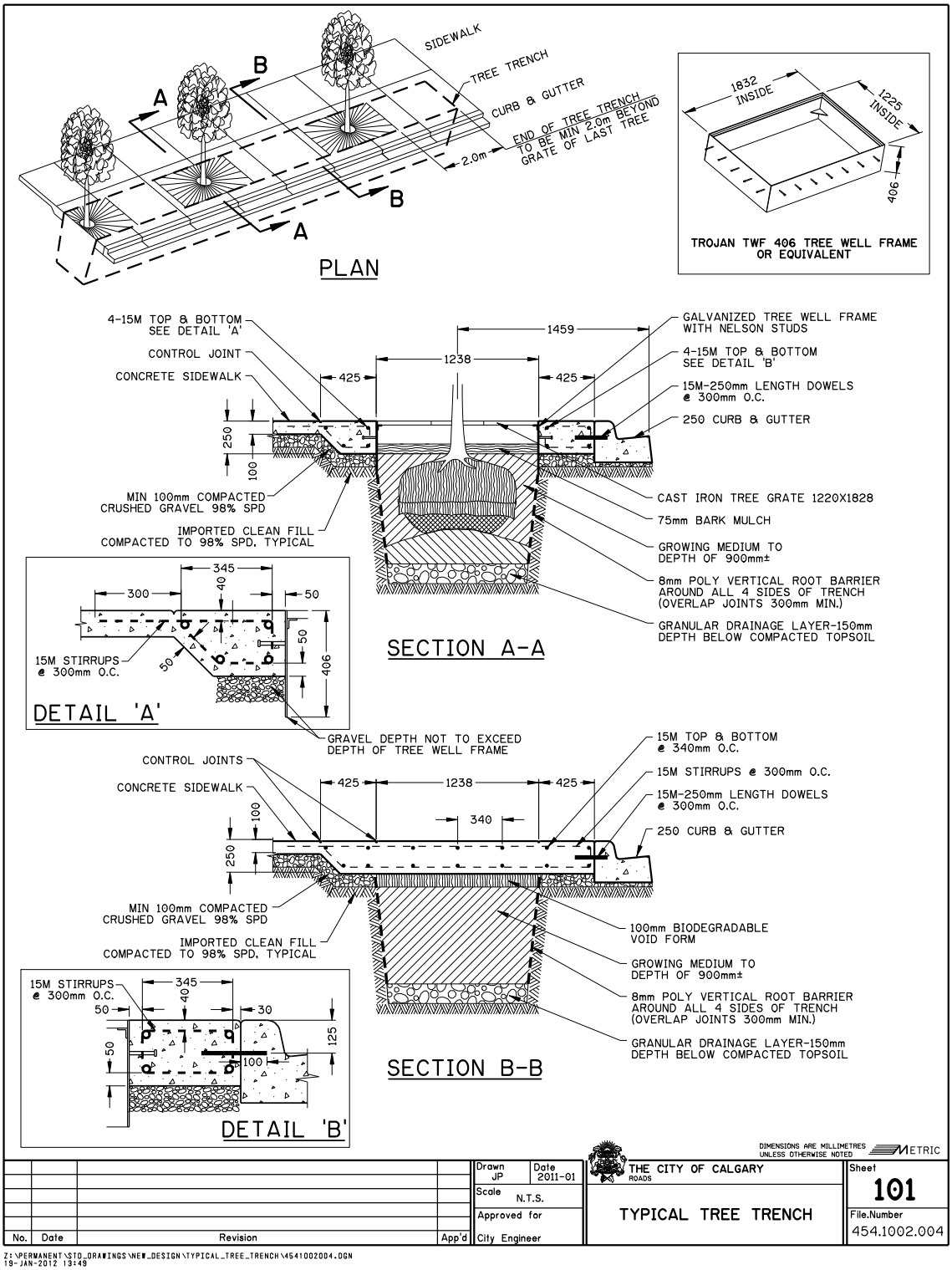
1. Achieve and Maintain Healthy Trees
2. Collaborate with the Community
3. Resource to Manage and Measure the Asset

To download or view the entire Plan, visit **www.calgary.ca** and search **"Urban Forestry Strategic Plan".**

8.2.3 TREE TRENCH SPECIFICATION

Tree trenching is one strategy the City of Calgary has utilized to incorporate trees into an urban street environment that allows trees to reach a higher level of maturity than individual tree boxes. The City of Calgary specification for a tree trench is shown below.

FIGURE 8-3



8.2.4 TREE PLANTING GUIDELINES

Some general guidelines for the planting of public street trees in Calgary:

TREE PLANTING GUIDELINES

1. Locate further away from curbs to protect from salt spray (2.0m minimum preferred)
2. Use raised planter beds (particularly in narrow medians). Ensure that safety standards (e.g. clearances) are met
3. Where wider boulevard or median space is available, consider off-set double row planting
4. For higher traffic volume locations, consider application of wood mulch cover to better protect trees from salt spray (e.g. Canyon Meadows Drive SE)
5. For redevelopment projects where new roads are being planned or relocated in established areas, alignments should consider the protection of mature public trees
6. Particularly in constrained boulevard spaces, use Silva-cell installation which allows structural support and uncompacted soil to co-exist. Uncompacted soil benefits trees (see Figure 8-3)

8.3 SHALLOW UTILITY DESIGN

The Aerial and Buried utility elements of the Roadway cross-section (See Figure 1-3 and 1-4 of the Guide) are an intricate and complex part of the roadway element picture. The required location of these elements, and the required clearances associated with them, in many cases drives what is feasible elsewhere within the cross-section. Reserved space within the public realm (or boulevard) is required for installation, access for maintenance, and clearance from other buried elements. The following guidelines (and policies) for shallow utility placement should be adhered to

SHALLOW UTILITY DESIGN GUIDELINES

1. All utilities should be located so that manholes and appurtenances are away from wheel paths, and the travel surface of pedestrians and cyclists, and curb end gutter.
2. **CTP POLICY 3.7S**: The priority and placement for shallow utilities infrastructure (trenches and above-ground equipment) is as follows:
    i. In back alleys and lanes;
    ii. In shallow utility easements on private property;
    iii. Within right-of-way, placed in the public realm zone; and
    iv. Within right-of-way under the roadway (i.e., parking, shared or bike lanes or paved shoulders).
3. **CTP POLICY 3.7T**: Deep utilities should be located so that manholes and appurtenances do not interfere with the movement of pedestrians, cyclists, and vehicles.
4. Cross-sections showing placement of shallow utilities and easements must be provided at the Outline Plan and Land Use stages for all street classifications.
5. In higher density areas and Liveable Street corridors, shallow utilities should be placed underground in joint trenches wherever possible. Easement may not be required if minimum 5.3m unsurfaced space (e.g., landscaping) is available within public realm zone.
6. Common trenching and utility ducts for shallow utilities lines should continue to be utilized to minimize line assignments as much as possible. In the event that common trenching is not

SHALLOW UTILITY DESIGN GUIDELINES

possible, separate alignments for electric, telephone and cable, streetlight cables, and for gas lines should be identified. The required separation from the sidewalks, trees, streetlight poles, hydrants and service valves must be respected as described in Section 9.2.

7. The placement of shallow utility above-ground equipment, transformers and pedestals, and their required separation from the sidewalks, trees, streetlight poles, hydrants and service valves must be respected as described in the Design Guidelines for Subdivision Servicing. Above ground equipment cannot be placed in sidewalks or multi-use pathways. Where above ground equipment cannot be accommodated within the public realm zone, pocket easements or other space outside right-of-way is required.
8. Where shallow utility lines remain within the ROW roadway zone, without adequate unsurfaced space, then site specific planning and design work must be completed to accommodate the installed shallow utility infrastructure.
9. Where shallow utilities are installed overhead, separate alignments should be shown for the electric power poles. Utility poles should be utilized for street lighting.
10. In situations where public street trees, low impact development features, and/or other public realm features are desired but space is not available, consider Silva-cell installation that will allow these elements to co-exist with shallow utilities.

8.4 PUBLIC REALM DESIGN

The Public Realm Design section of this Guide, once completed, will provide a detailed description of the Municipal Development Plan (MDP) and Calgary Transportation Plan (CTP) goals and objectives and guiding policies with regards to public realm design and how to create public places for our streets.

This section will reference the street typology of the MDP/CTP and define our streets as places for people to meet their daily activities and uses. Streets are not just conduits to move cars; they are the identity of each community. Streets should be a place for people to connect, interact and be filled with the joy of living.

Once completed, this section will include the vision, activities, functions and components of complete streets as public places. It will also introduce design techniques, streetscape furniture, and an implementation process. This section will be complete for 2012 Interim Complete Streets Guide and be arranged in the following manner:

Elizabeth Street in Okotoks

Downtown Quebec City

1. Preface
2. Goals and Objectives
3. Streets Character and Typology
4. Complete streets as public places (Vision, activities, functions)
5. Design Techniques
6. Streetscape furniture
7. Implementation process

CHAPTER 9

STREET DESIGN

9.1 GENERAL GUIDELINES

9.1.1 INTRODUCTION

Streets and their geometric design have traditionally focused on the movement of motor vehicles, resulting in street environments that overlook other users. This emphasis can be seen in wide travel lanes, large corner radii, and turn lanes. These detract from the safety of pedestrians and overall connectivity for non-automobile users. The geometric design of the travelled way and intersections has usually reflected the desire to move auto traffic as quickly as possible. Consistent with the Calgary Transportation Plan, this guide outlines a shift in approach which reorders the public right-of-way to more directly and effectively serve the needs of pedestrians and bicyclists, and to create Complete Streets.

Roadway design in this chapter is defined as the part of the street right-of-way between the lips of gutters, and can include parking lanes, bicycle lanes, transit lanes, general use travel lanes, and medians. The design of the roadway is critical to the design of the entire street right-of-way because it affects not just the users in the roadway, but those using the entire right-of-way, including the areas adjacent to the street.

9.1.2 ESSENTIAL PRINCIPLES OF STREET DESIGN

The following key principles should be kept in mind for a well-designed street:

1. **DESIGN TO ACCOMMODATE ALL USERS.** Street design should accommodate all users of the street, including pedestrians, cyclists, transit users, automobiles, and commercial vehicles. A well-designed street provides appropriate space for all street users to coexist.
2. **DESIGN USING THE APPROPRIATE SPEED FOR THE SURROUNDING CONTEXT.** The right design speed should respect the desired role and responsibility of the street, including the type and intensity of land use, urban form, the desired activities on the sidewalk, such as outdoor dining, and the overall safety and comfort of pedestrians and bicyclists. The speed of vehicles impacts all users of the street and the liveability of the surrounding area. Lower speeds reduce the frequency and severity of collisions, injuries, and property damage and encourage cycling, walking, business.
3. **DESIGN FOR SAFETY**. The safety of all street users, especially the most vulnerable users (children, the elderly, and disabled) and modes (pedestrians and bicyclists) should be paramount in any design of the street. The safety of streets can be dramatically improved through appropriate geometric design and operations.

Building on the momentum of Complete Streets that have been successfully implemented in different parts of the North America and around the world, there is a clear need for the City of Calgary to retrofit existing streets and to create new types of street environments that reflect the key principles, values and desires of all users. This chapter discusses different factors affecting street design. Individual geometric design elements such as lane width and sight distance are examined in greater detail. The benefits and constraints of each element are examined and the appropriate location and correct use of each element is defined, in order to maximize the creation of Complete Streets.

Within the context of the transition that is occurring in Calgary to the Complete Streets design approach, there is a need to update the City's Design Guidelines for Subdivision Servicing (DGSS) document. Although the 2012 update of the 2004 DGSS contains elements of pedestrian, bicycle and transit-oriented design information, a more comprehensive revision of the DGSS document is being undertaken as part of this Complete Streets Program.

9.1.3 FACTORS AFFECTING STREET DESIGN

9.1.3.1 USERS

PEDESTRIANS

Refer to Section 3.2: Pedestrian Street Design.

CYCLISTS

Refer to Section 4.2: Bicycle Street Design.

TRANSIT ACCOMMODATION

Designing for transit vehicles on streets takes into consideration many factors. Buses usually operate in mixed traffic, often stop and start for passengers, and must be accessible to people boarding the bus. The implications for street design include lane width, intersection design, signal timing, pedestrian access, pedestrian waiting areas, sidewalk design, and bus stop, sign, shelter, and bench placement and design. The Transit Friendly Design Guide (see Chapter 5: Transit Design) describes in greater detail these and other design and operational considerations. Exclusive bus lanes should be considered where express bus, Bus Rapid Transit or enhanced transit service of regular bus routes will be provided and right of way is available.

9.1.3.2 DESIGN VEHICLES

The 'design vehicle' influences several geometric design features including lane width, corner radii, median nose design, and other intersection design details. In the Complete Streets context, designing for a larger vehicle than necessary is undesirable, due to the potential negative impacts larger dimensions may have on pedestrian crossing distances and the speed of turning vehicles. On the other hand, designing for a vehicle that is too small can result in operational problems if larger vehicles frequently use the facility.

A range of design vehicles is presently used given the context of the adjacent development:

- SU-9 for downtown
- WB-19 for local commercial
- WB-21 for big box (regional commercial)
- Turnpike doubles for heavy industrial areas

The design vehicle should be accommodated without encroachment into opposing traffic lanes. It is generally acceptable to have encroachment onto multiple same-direction traffic lanes on the receiving street.

9.1.3.3 DESIGN SPEED

The application of design speed for Complete Streets is philosophically different than for conventional transportation practices. Traditionally, design speed has been set according to speed-flow density curves and align with street function for vehicles. This has many negative effects. Speed puts all road users at risk, and prioritizes efficiency over access. Local economies thrive on attracting people. Because high design speeds reduce pedestrian and bicycle access to places, they degrade the social and retail life of a street and devalue the adjacent land.

In contrast to this approach, the goal for Complete Streets is to establish a design speed that creates a safer and more comfortable environment for motorists, pedestrians, and bicyclists. This approach also increases access to adjacent land, thereby increasing its value, and therefore is appropriate for the surrounding context. For the Liveable Street types, design speeds of 30 to 50 km/h are desirable. Alleys and narrow streets intended to function as shared spaces may have design speeds as low as 20 km/h. A key principle is that street and travel lane width must be set to **COMPLEMENT THE DESIRED SPEED FOR THE STREET ENVIRONMENT**.

Design speed neither determines nor predicts exactly at what speed motorists will travel on a street segment; rather, design speed determines the elements and dimensions for the various elements permitted. Features associated with high-speed designs, such as large curve radius, straight and wide travel lanes, ample clear zones (no on-street parking or street trees), guardrails, and so on, degrade the walking and cycling experience and make it difficult to design Complete Streets. In the end, the design of the street encourages high speeds and creates a vicious cycle. A slower design speed allows the use of features that enhance the walking environment, such as small curb radii, narrower sections, trees, on-street parking, curb extensions, and street furniture, which in turn slow traffic: a positive cycle.

As a general statement, existing design has led to speeding issues and an undesirable environment for all users.

9.1.3.4 ACCESS MANAGEMENT

A major challenge in street design is balancing the number of access points to a street. As discussed in Chapter 1, Sustainable Street and Network Design, there are many benefits of well-connected street networks. At the same time, most conflicts between users occur at intersections and driveways. The presence of many driveways (in addition to the necessary intersections) creates many conflicts between vehicles entering or leaving a street, bicyclists and pedestrians riding or walking along the street, and bus zones situated along the street. When possible, new driveways should be minimized and old driveways should be eliminated or consolidated, and raised medians should be placed to limit left turns into and out of driveways. Care should be taken in this rationalization process to consult with and consider the use, circulation, and economic needs of the businesses/developments affected.

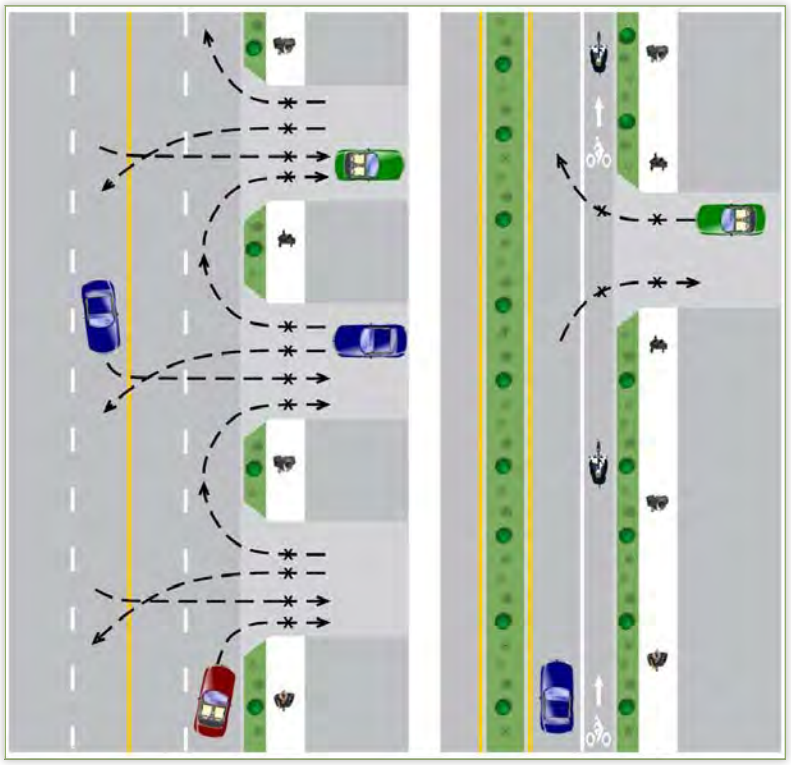
Access management, through limiting driveways and providing raised medians, has many benefits:

- The number of conflict points is reduced, especially by replacing centre-turn lanes with raised medians, as left turns by motorists account for a high number of crashes with cyclists and pedestrians.
- Pedestrian crossing opportunities are enhanced with a raised median.
- Universal access for pedestrians is easier, since the sidewalk is less frequently interrupted by driveway slopes.
- Improved traffic flow may reduce the need for street widening, allowing part of the protected right-of-way to be recaptured for other users.

The following possible negative effects of access management should be considered and addressed:

- Streamlining a street may increase motor vehicle speeds and volumes, which can be detrimental to other users (pedestrians, cyclists).
- Reduced access to businesses may require circuitous travel for all users, including pedestrians and bicyclists.
- Adjacent land-uses can experience decreased access. This can impact businesses as well as residents. Again, careful planning of access management should consider these points.

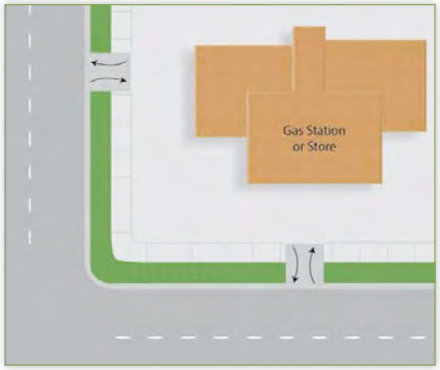
BEFORE **AFTER**



Adding medians and consolidating driveways to manage access (Credit: Michele Weisbart)

X = conflict point

Corner with many wide driveways (Credit: Michele Weisbart)



Reconstructed corner with fewer, narrower driveways (Credit: Michele Weisbart)

9.1.4 CROSS SECTION ELEMENTS

Complete Street design treats streets as part of the public realm. The public realm is shaped by the features and cross-section elements used in creating the overall street. Careful attention to what features are included, where they are placed, and how the cross-section elements are assembled and interact is essential to the design process. Refer to Section 8.4.

Appropriate proportion of accessible stalls need to be provided in areas with street parking. Details for the design of the accessible stalls and their relationship/access to sidewalk is yet to be developed.

9.1.4.1 ON-STREET PARKING

On-street parking can be important in the urban environment for the success of the retail businesses that line the street and to provide a buffer for pedestrians and help calm traffic speeds. On-street parking occupies about half the surface area per car compared to off-street spaces, which require driveways and aisles for access and manoeuvering.

In those occasional cases where angle parking is proposed for on-street parking, designers should consider the use of reverse-in angle (or front out) parking in lieu of front-in angled parking. Motorists pulling out of reverse-in angled parking can better see the active street they are entering. This is especially important to bicyclists.

Revision to the Traffic Bylaw and Calgary Parking Authority enforcement practices for reverse-in angle parking will be required for this practice to be widely accepted within the City of Calgary.

Refer to section 122 of the City of Calgary Land Use Bylaw (1P2007) for rules on parking stall dimensions.

Reverse-in angled parking: Boise, ID, USA (Credit: Dan Burden)

9.1.5 TRAVEL LANES

Travel lane widths should be provided based on the **CONTEXT AND DESIRED SPEED** for the area that the street is located in. Lane width selection should be based on:

- Design/desired speed
- Context/Location (e.g. 3.7m lanes should be provided on Primary Goods Movement network, 3.5m lanes on Transit network, 3.3m lanes on non-transit liveable streets)
- Bicycle facility requirements

For drivers to understand how fast they should drive, lane widths have to create some level of driver discomfort when driving too fast. The presence of on-street parking can reduce speeds. When designated high occupancy vehicle lanes or transit lanes are used, there may be wider lane widths for large vehicles to operate, but car drivers may feel more comfortable driving faster than the posted speed.

Alleys can be designed as one-way or two-way. Right-of-way width should be a minimum of 7 metres with no permanent structures located within the right-of-way that would interfere with vehicle access to garages or parking spaces, access for waste and recycling collection, and other operational needs.

The vehicular lane widths used in the cross-sections in this Chapter are based on a survey of municipal practice in North American 'winter cities' and have been approved by this Program's Steering Committee (led by the General Manager of Transportation) in May 2011.

Wide two-lane street (Credit: Ryan Snyder)

Narrow two-lane street (Credit: Michael Ronkin)

9.1.6 TURN LANES

The need for turn lanes for vehicle mobility should be balanced with the need to manage vehicle speeds and the potential impact on the border width such as sidewalk width. Pedestrian and cyclist comfort and safety is also a major consideration. Turn lanes tend to allow higher speeds to occur through intersections, since turning vehicles can move over to the turn lane, allowing the through vehicles to maintain their speed.

Left-turn lanes are acceptable in Calgary's urban environment since there are negative impacts to roadway capacity when left turns block the through movement of vehicles. Sometimes just a left-turn pocket is

sufficient, just long enough for one or two cars to wait out of traffic. The installation of a left-turn lane can be beneficial when used to perform a road diet such as reducing a four lane section to three lanes with the center lane providing for turning movements in both directions.

The applicability of right turn lanes is different than left turn lanes. While right turns from through lanes may delay through movements, they also create a reduction in speed due to the slowing of turning vehicles. The installation of right-turn lanes increases the crossing distance for pedestrians and the speed of vehicles; therefore, exclusive right turn lanes should rarely be used except at "T" intersections. When used, they should be mitigated with raised channelization islands. See Chapter 10, "Intersection Design," for more details.

9.1.7 MEDIANS

Medians used on urban streets provide access management by limiting left turn movements into and out of abutting development to locations where a separate left turn lane or pocket can be provided. The reduced frequency of conflicts and number of conflict points decreases the likelihood of vehicle collisions, provides pedestrians with a refuge as they cross the street, and provides space for landscaping, lighting, and utilities. Medians are usually raised and curbed. Landscaped medians enhance the street or help to create a gateway entrance into a community.

Median width varies and should be based on:

- Design/posted speed
- Pedestrian accessibility and waiting requirements
- Requirement for turning lanes
- Green infrastructure requirements
- Available right-of-way, and
- The street classification/function

Because medians require a wider right-of-way, the designer must weigh the benefits of a median with the issues of pedestrian crossings, namely crossing distance, speed, lane-use context, and available boulevard width. It is a desirable design practice, in conjunction with reduced travel lane width, to incorporate raised medians (preferably with low-maintenance landscaping) into the design of streets, as they **visually narrow the roadway and provide a refuge for midblock pedestrian crossings where permitted**. (Note: this is not applicable to Skeletal Roads).

Well-designed street medians bring multiple benefits (Credit: Dan Burden)

9.1.8 RIGHT-OF-WAY

The selection of right-of-way width is a critical decision, because not only must the competing requirements of the cross-section elements be considered, but also the key fact that street right-of-way in new development areas takes up a major portion of the developer's raw land. The economic needs of the development are therefore a key part of the right-of-way equation. In considering right-of-way in Calgary 'greenfield' and redevelopment areas, this Guide shall have consideration for the following:

RIGHT-OF-WAY GUIDELINES

1. Right-of-way (ROW) width should be set to complement multi-modal facility function. Horizontal and vertical zones should be designated for placement and development of zone elements within the corridor.
2. When minimum ROW is utilized, additional building setback (e.g. 1.5-4.5m) and easements should be provided if possible, based on the Land Use Bylaw.
3. Where sufficient spacing within a ROW does not exist for both sidewalks, bicycles and parking, priority should be given to sidewalk, then bicycles to meet the minimum widths set out in the Design Elements tables for each street classification.
4. Where sufficient space within a ROW does not exist for both sidewalks and green infrastructure, priority should be given to sidewalk to meet the minimum widths set out in the Design Elements tables for each street classification.
5. Until the City of Calgary's agreements on oversize and cost sharing arrangements with the development industry have been re-negotiated, ROW options should be selected to fit into already existing dimensions, as defined in the current Design Guide for Subdivision Servicing.

9.1.9 PUBLIC REALM ELEMENTS

Public realm elements contribute not only to the 'Liveable' setting inherent in 'Complete Streets,' but also to other key considerations such as user safety, road operation and maintenance activities, and construction. The following public realm element principles are inherent to this Guide:

PUBLIC REALM ELEMENTS (ALSO REFER TO SECTION 1.4)

PUBLIC REALM DESIGN GUIDELINES

1. Public realm safety features (i.e., clear zones, side slopes, setbacks, and so on) must be considered for all roads and streets, in accordance with the design speed.
2. Public realm elements must be designed to minimize visual and physical clutter. Placement of traffic and transit signs, traffic signals and controllers, utility structures, benches and trees must not physically obstruct the path of travel or obscure sight lines for pedestrians, cyclists and motorists and must provide sufficient width for pedestrian movement. At the same time, signs/signals must be within the driver's primary cone of vision. Placement of signs, signals must be confirmed with the Roads Traffic Division.
3. Consider driveway spacing, street light spacing, and tree spacing when locating bus zones along roadways with transit service.
4. Public realm zones must maximize the buffer between pedestrians and vehicular travel lanes on both Liveable and higher classification streets.

5. In addition to sidewalk width, a minimum 0.3 metres is required from back of walk to property line for construction (Note: Not applicable to Skeletal Roads).
6. The Public realm width must consider snow storage requirements.

OTHER GEOMETRIC DESIGN ELEMENTS

VERTICAL ALIGNMENT

The Transportation Association of Canada (TAC) Geometric Design Guide provides acceptable values for designing vertical curves for Complete Streets. The values used in vertical curve design should be selected based on the design speed appropriate for the context of the street. Using higher values can contribute to increased vehicle speeds and may require increased modification to the natural terrain, increasing negative impacts to the natural environment.

HORIZONTAL ALIGNMENT

The TAC Geometric Design Guide provides appropriate values for designing horizontal curves for Complete Streets. The values used in horizontal curve design should be selected based on the design speed appropriate for the context of the street. Using higher values can contribute to increased vehicle speeds and also impacts the character of the street. Larger horizontal curves also create a more "suburban" or "rural" highway feel.

SIGHT DISTANCE

STOPPING SIGHT DISTANCE

The TAC Geometric Design Guide provides appropriate values for designing stopping sight distance for living streets. In addition, the 2004 AASHTO *Guide for Achieving Flexibility in Highway Design* is based on the latest research concerning the establishment of stopping sight distance. The document states that the established values for stopping sight distance are very conservative and provide adequate flexibility without creating increased crash risk. Consequently, appropriate design speed selection is critical to avoid overly negative impacts such as unnecessarily limiting on-street parking and tree planting.

INTERSECTION SIGHT DISTANCE

Intersection sight distance should be calculated in accordance with the TAC Geometric Design Guide using the design speed appropriate for the street being evaluated. When executing a crossing or turning manoeuvre onto a street after stopping at a stop sign, stop bar, or crosswalk, drivers will move slowly forward to obtain sight distance (without intruding into the crossing travel lane) stopping a second time as necessary. Therefore, when curb extensions are used or on-street parking is in place, the vehicle can be assumed to move forward on the second step movement, stopping just shy of the travel lane, increasing the driver's potential to see further than when stopped at the stop bar. As a result, the increased sight distance provided by the two step movement allows parking to be located closer to the intersection.

HORIZONTAL CLEARANCE/CLEAR ZONE

Horizontal clearance is the lateral distance from a specified point on the roadway, such as the edge of the travel lane or face of the curb, to a public realm feature or object. The clear zone is the relatively flat unobstructed area that is to be provided for safe operations and use by errant vehicles.

In urban areas (i.e. non-arterial), horizontal clearance based on clear zone requirements for rural and suburban highways is not practical, nor necessary because urban areas are characterized by more bicyclists and pedestrians, lower speeds, more dense abutting development, closer spaced intersections and accesses to property, higher traffic volumes, and restricted right-of-way. Therefore, streets with curbs and gutters in urban areas do not have sufficiently wide public realm zones to provide broad clear zones. Consequently, while there are specific horizontal clearance requirements for these streets they are based on clearances for normal operation and on maintaining some boulevard space for errant vehicles. The minimum horizontal clearance is 0.5 metres measured from the face of the curb. This is primarily intended for sign posts and poles, so they aren't hit by large vehicles with overhangs maneuvering close to the curb.

TRAVELLED WAY LIGHTING

Pedestrians and cyclists are disproportionately hit when visibility is poor: at dusk, night, and dawn. Many crossings are not well lit. Providing illumination or improving existing lighting increases nighttime safety at intersections and midblock crossings, as motorists can better see pedestrians and cyclists. Pedestrian scale lighting along sidewalks provides greater security, especially for people walking and cycling alone at night.

Transit stops require both kinds of lighting: strong illumination of the travelled way for safer street crossing, and pedestrian scale illumination at the stop or shelter for security.

If bus stops are present between roadway sections, it is necessary to illuminate the roadway and the bus stop. The lighting at the bus stop is essential to provide safety for transit users. Bus stops have high pedestrian and cycling activity; therefore, it is necessary to provide adequate lighting at these facilities.

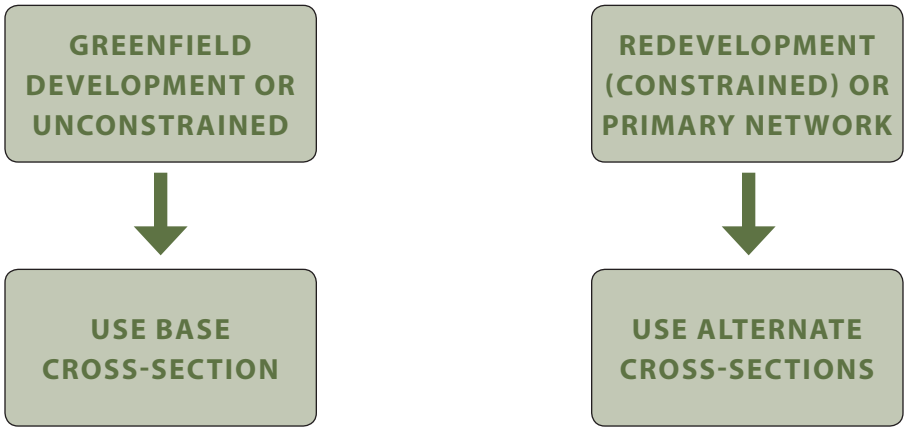
9.2 CITY OF CALGARY STREET DESIGN SHEETS

INTRODUCTION

The following sections of the guide provide information on standard designs for the various street types within the four basic categories outlined in Chapter 2 (Skeletal, Arterial, Liveable, and Local). For each category of street, this guide provides the following four design components:

1. **DEFINITION SHEETS**: For each classification of street within the category, the definition sheet includes a conceptual cross section and an explanation of the basic function of the street, the standard right-of-way requirement, and information on access conditions, intersection spacing, and operational notes relevant to that street type.
2. **DESIGN ELEMENTS TABLE**: This table summarizes a variety of design parameters such as minimum lane widths, design speeds, and grade requirements for the all street classifications within that category.
3. **DETAILED CROSS SECTIONS FOR BASE STANDARDS**: For each classification of street within the category, the detailed cross section shows the common design for that street, including lane widths, sidewalk and pathway locations, utility line assignments, and public realm widths. Some detailed cross section sheets include an inset showing a second common design. For the purposes of this guide, each of these options is considered part of the base cross section. The detailed cross sections presented have been reviewed and approved for use by all affected City departments.
4. **CONCEPTUAL CROSS SECTION AND CRITERIA OF USE FOR ALTERNATE STANDARDS**: For each classification of street, alternate cross sections have been prepared to take into account some of the more common contextual situations or constrained retrofit situations which may lead to designs that deviate from the base cross section. Some of these alternates would be required in specific contexts (for example, a Divided Arterial – High Speed alternate shows required changes if the street is designed to speeds above 60 km/h) while others are optional but appropriate in certain circumstances (such as the Collector – Parking One Side which may be used – but would not be required – if the street flanks a park or green space). These alternates have been developed at a conceptual level only, and detailed cross sections would be developed on a project-by-project basis. This guide provides widths and arrangements for key elements of the alternate cross section and the contextual criteria that govern their use.

As outlined in Chapter 1 of this guide, taking the context of a street into account in its design is critical to achieving the objectives of Complete Streets. For any street design project, the designer should review the base standard and the recommended alternates, as well as the specific land uses and context for the street in question to determine the optimum design for that location. The detailed cross sections presented for the base standards are the most commonly used designs for these street types. In preparing detailed designs for alternate or custom cross sections, the base cross sections provide a guide to spacing requirements between the street elements including trees, LID components, shallow utilities, and hard surfaces.



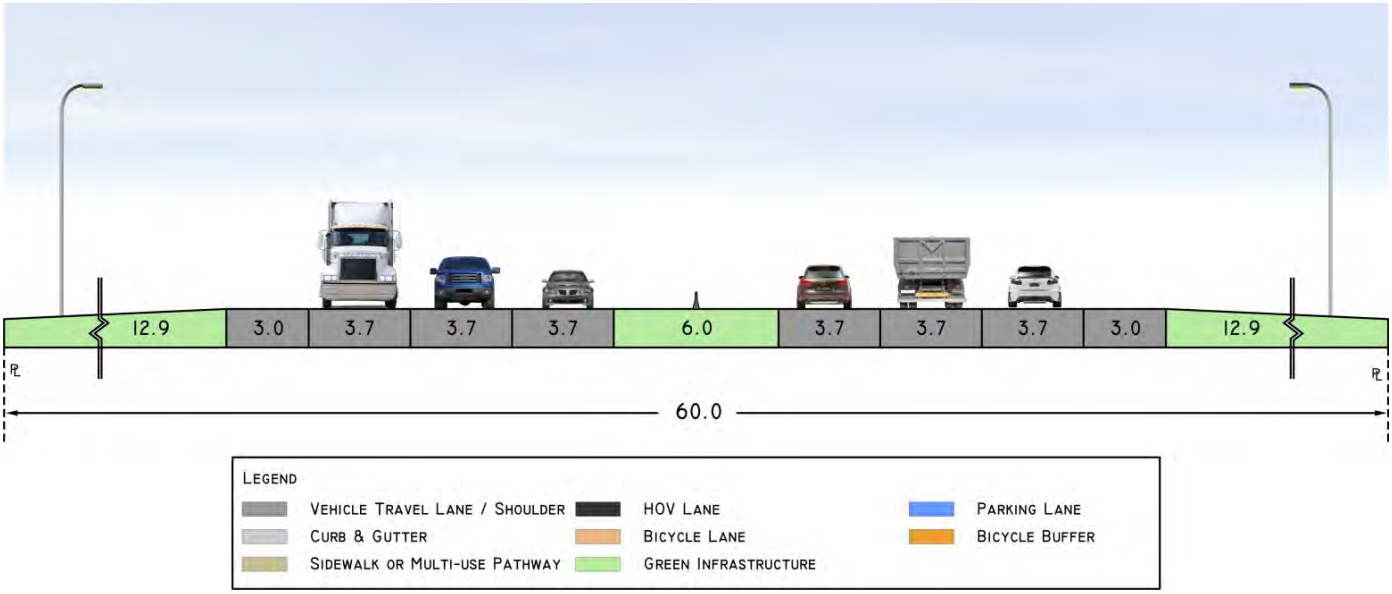
9.3 SKELETAL ROAD DESIGN SHEETS

INTRODUCTION

As outlined in Chapter 2, there is one classification of road in this category. Although Skeletal Roads are typically developed via a functional planning exercise, this guide provides general information on typical design which may be of use for general planning purposes, and to assist designers working on projects adjacent to future Skeletal Road alignments.

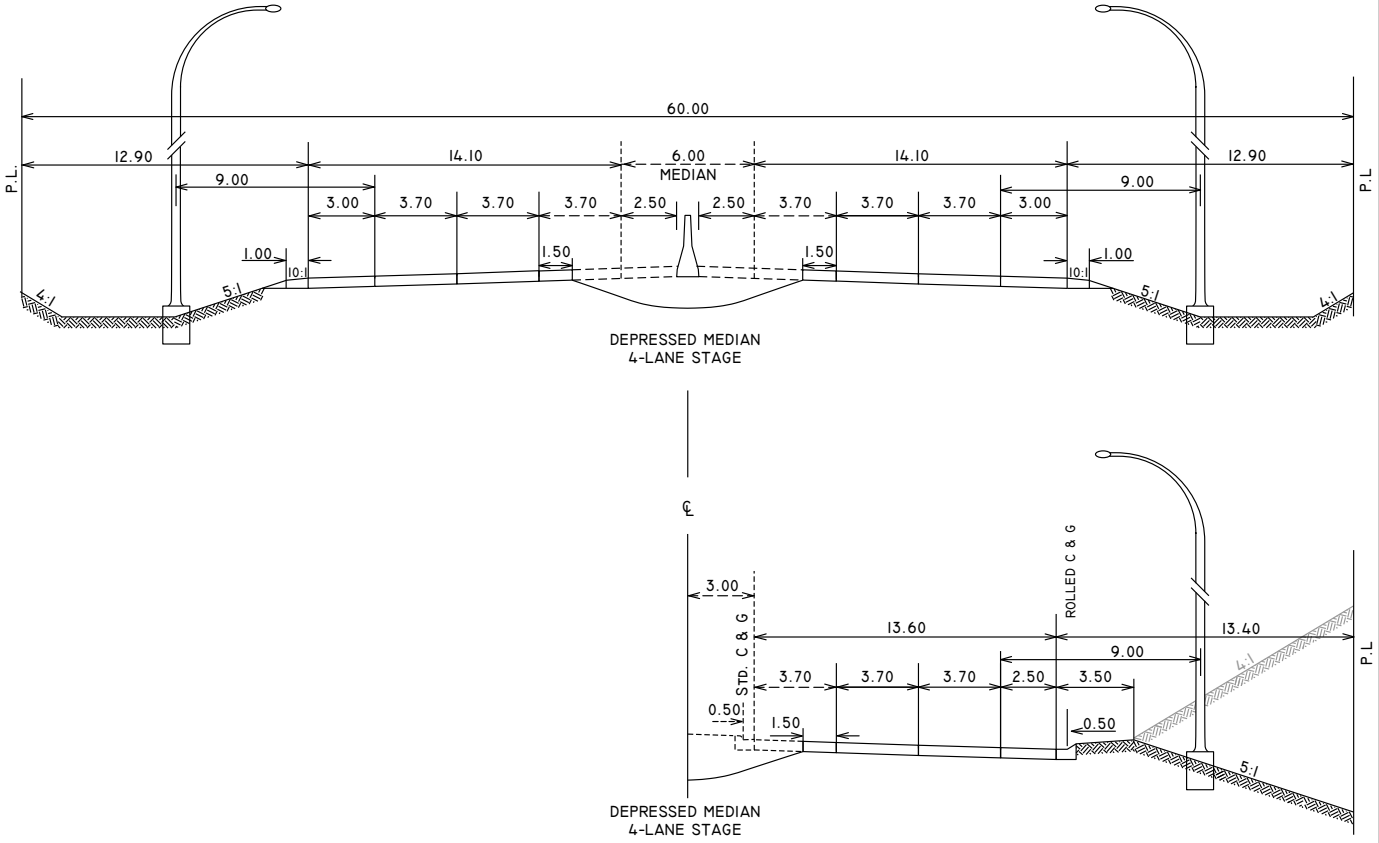
This section contains the following elements

1. **DEFINITION SHEETS**: Page 75 provides the definition sheet for the Skeletal Road classification.
2. **DESIGN ELEMENTS TABLE**: Page 76 provides the standard design elements for Skeletal Roads within Calgary. Note that Skeletal Road design is closely related to, and frequently relies on the standards of, Highway design, and as such relevant provincial and national standards should be consulted in the development of roads of this type.
3. **DETAILED CROSS SECTIONS FOR BASE STANDARDS**: A detailed design for a typical cross section of a Skeletal road is included on Page 77. The main cross section displays a roadway with open shoulder / ditch drainage design typically used in open areas of the City (e.g. Anderson Road west of Deerfoot Trail). The inset displays a typical curb and gutter design for more urban contexts (e.g. Glenmore Trail west of MacLeod Trail).
4. **CONCEPTUAL CROSS SECTION AND CRITERIA OF USE FOR ALTERNATE STANDARDS**: There are no alternate standards presented for the Skeletal Road classification.



Skeletal Road		
Daily Traffic Volume (vehicles)	**Number of Lanes**	**Right-of-way Requirement**
30,000 - 90,000	**4, 6 or 8**	**60.0 m (min)**
Function	• Connect and permit relatively unimpeded higher speed flow for through traffic between major elements of the City of Calgary transportation network. • Operate as a segment of the Primary Goods Movement and HOV Network. • Provides priority for autos and goods movement.	
Access Conditions	• Intersections are grade separated when warranted. • Divided roadways with full control of access. • Direct access to abutting property is prohibited. • May have intersections with other Skeletal Roads and Arterial street types only. • Intersections (for interim conditions) should be a minimum 800 m apart. • In special circumstances 450 m intersection spacing could be considered. • At-grade intersections should be signalized.	
Notes	• Interchange spacing will generally be 2.0 to 2.4 km; however closer spacing may be considered under special circumstances. • Skeletal Roads are designed in accordance with TAC standards and for capacity conditions reflecting Level of Service “D” or higher. • At grade pedestrian crosswalks are permitted at intersections in the interim stage only; however grade separated walkways should be used where warranted. • The right-of-way width is minimum 60 m but may vary depending on number of lanes, sloping requirements, road grades, and noise attenuation requirements. • Noise attenuation study is required at the Outline Plan application stage for residential lots adjacent to Skeletal Roads and interchange areas, including Transportation Utility Corridors (TUC), to determine noise attenuation and right-of-way requirements.	

Design Elements		
Skeletal Roads Base Cross-Sections, Sheet # 1 of 1		
Base Cross-Section	**Skeletal**	**Comments**
Right-of-way required	60.0 m (min.)	
Number of travel lanes	4, 6 or 8	
Travel lane width	3.7 m	
Basic width	4 x 3.7 m	
Paved shoulder	Outside: -3.00 m open shoulder (rural cross-section) -2.5 m with curb and gutter	Inside painted shoulder width 1.5 m
Curb and gutter (gutter)	0.75 m rolled (0.5 m)	
Median width	6 m (min.)	median barrier requirement without curb and gutter including 2.5 m paved shoulders
Sidewalk width	Not required	pedestrian/bicycle movement may be accommodated if safe horizontal clearance requirements can be met
mono		
separate		
Multi-use pathway	Not required	
Bicycle lane width	n.a.	
Alignment		
Design speed	70 – 100 km/h	
Minimum centreline radius	340 m	
Maximum super-elevation	6%	
Maximum grade	4%	
Minimum grade	0.8%	
Minimum stopping sight distance	140 m	
Other		
Daily traffic volume	30,000 - 90,000 vpd	
Minimum interchange spacing	800 m	Interim conditions only
Traffic signals	none	could be considered for interim conditions only
Pedestrian crossing	grade separated	at grade crossings could be considered for interim conditions only
Bus route	limited	
Truck route	yes	
Sound attenuation	yes	



Notes:

- Typical 2% grade for road cross-slope and boulevards
- Cross-slope to be modified with superelevated sections
- Maximum 3:1 slopes may be permitted to limit right-of-way requirements
- When applicable, water main will be installed on the opposite side of the road from storm and sanitary lines
- Additional separation may be required between storm and sanitary sewers if excessive vertical difference occurs
- Manholes in roadway will be installed outside of wheel paths.
- Multi-Use Pathways are permitted when width of right-of-way >80 m
- Utility line assignments must be identified during planning stage
- Setback to street light pole may vary with design speed
- This standard is intended as a guideline for new development, where not applicable make adjustments as required
- Offsetting roadway centreline within the right-of-way is not recommended due to future utility conflicts
- Road, boulevard and right-of-way may vary to accommodate bicycle facilities

NOTE: details for bicycle and L.I.D. facilities are still under development

			Drawn / Date	THE CITY OF CALGARY ROADS	Sheet
			Scale: NTS	SKELETAL ROAD	
			Approved for City Engineer		File Number:

Dimensions are Metres Unless Otherwise Noted — METRIC

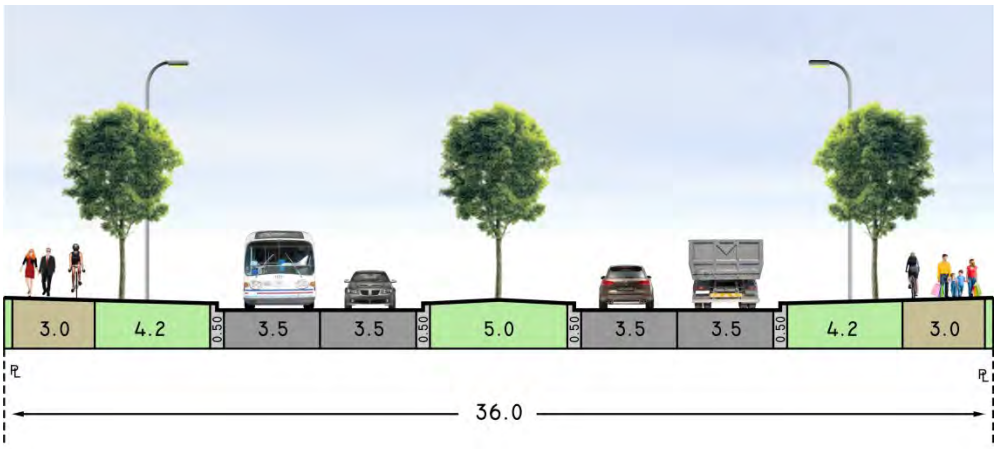
9.4 ARTERIAL STREET DESIGN SHEETS

INTRODUCTION

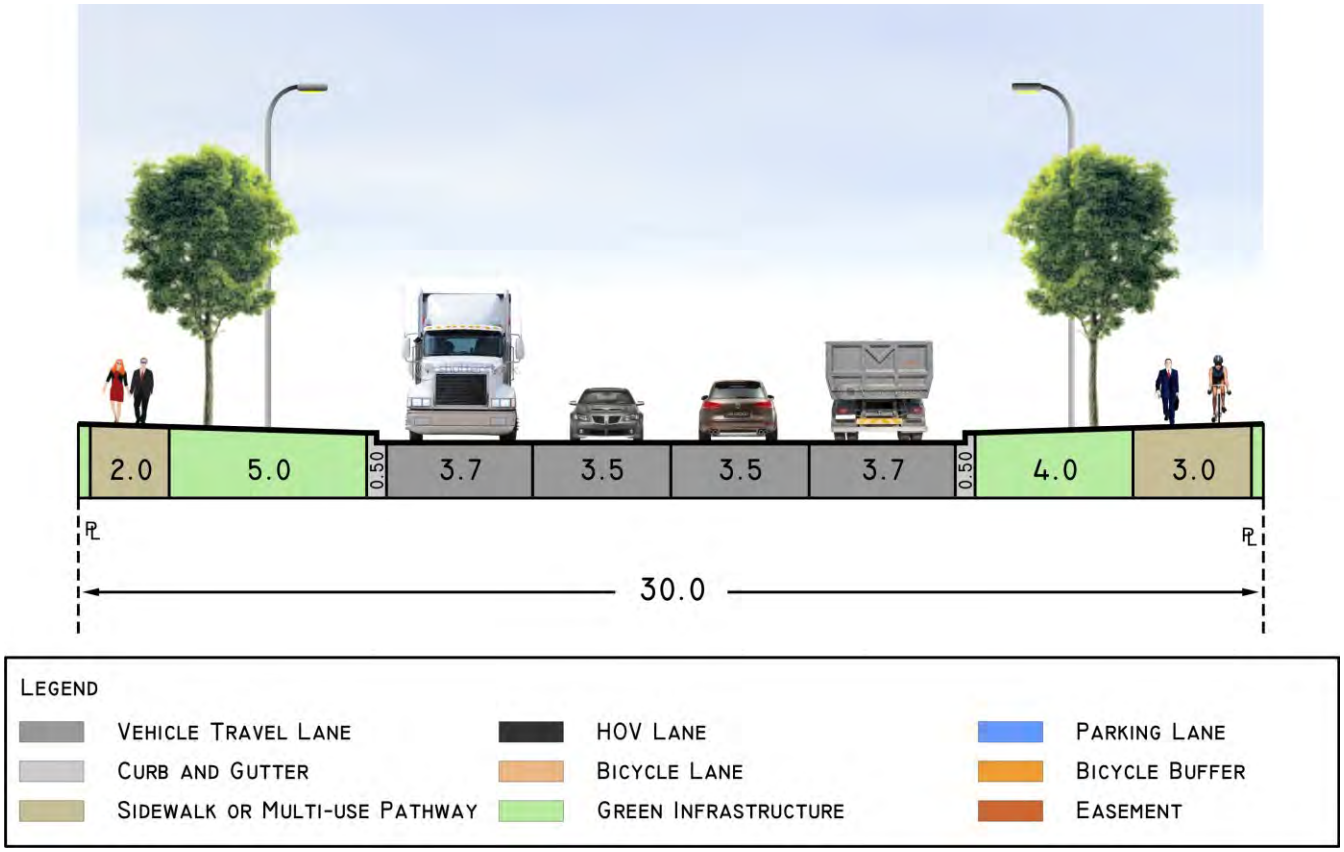
As outlined in Chapter 2, there are three classifications of road in this category (Divided Arterial, Industrial Arterial, Local Arterial).

This section contains the following elements

1. **DEFINITION SHEETS**: The definition sheets for the Divided Arterial, the Industrial Arterial, and the Local Arterial are provided on Pages 79-81.
2. **DESIGN ELEMENTS TABLE**: The standard design elements for the three classifications of Arterial Streets is provided on Page 82.
3. **DETAILED CROSS SECTIONS FOR BASE STANDARDS**: Detailed designs for the Arterial Streets are included on pages 83-85. The Divided Arterial Street shows a main cross section with a multi-use pathway, an inset shows an option with an on-street bike lane, which is restricted to lower volume arterials.
4. **CONCEPTUAL CROSS SECTION AND CRITERIA OF USE FOR ALTERNATE STANDARDS**: There are a number of alternate concepts for the Divided Arterial based on a variety of contextual factors. A flow chart is provided on page 86 to clarify the relationships between the various alternate standards, which are shown in pages 87-91. There is one alternate cross section of the Industrial Arterial (for higher speed contexts) and one for the Local Arterial (which provides more trees than the base cross section). These are shown on page 91.

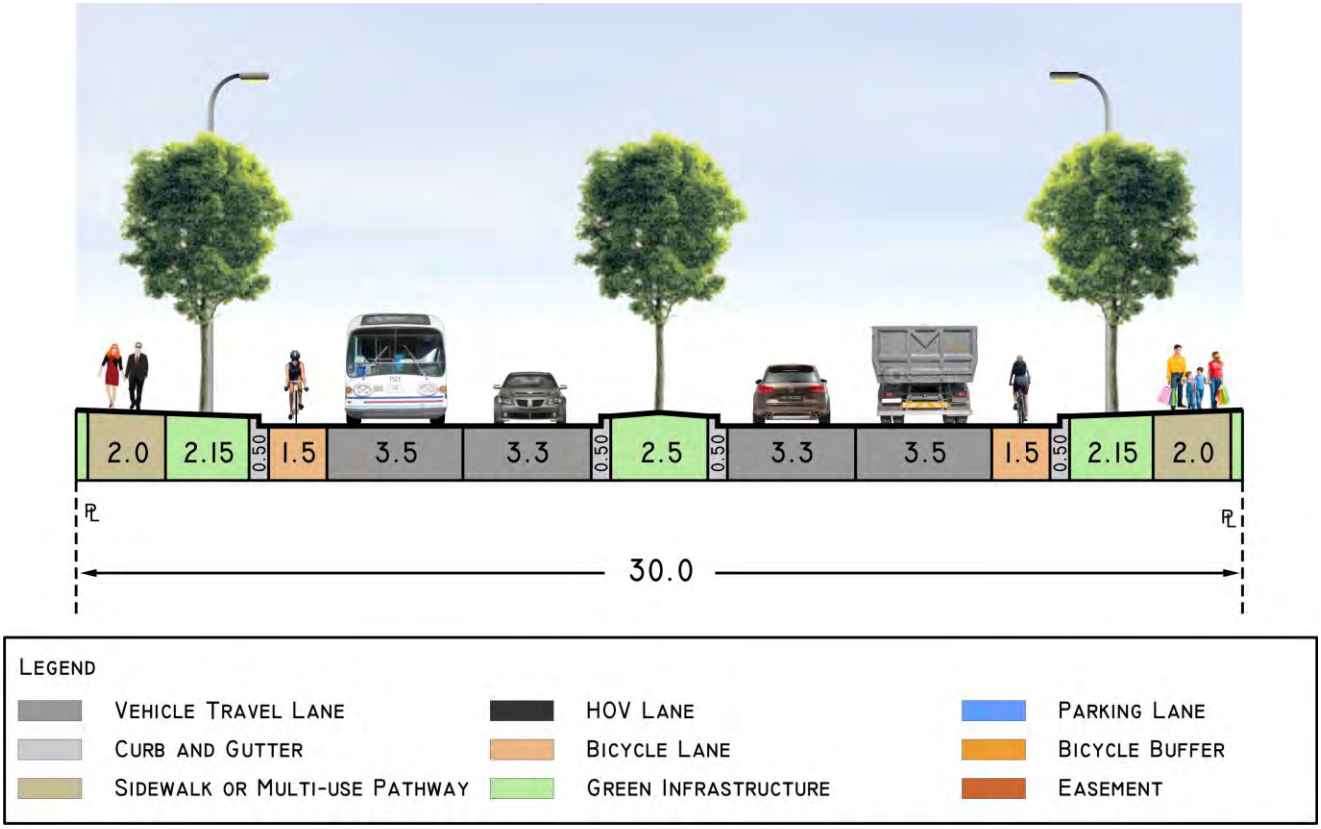


Arterial Street **Divided Arterial**		
Daily Traffic Volume (vehicles)	**Number of Lanes**	**Right-of-way Requirement**
10,000 - 30,000	**4**	**36.0 m (min)**
Function	• To expedite the movement of vehicles between multiple communities and major destinations. • To serve adjacent commercial lands and to collect and distribute traffic from Skeletal Roads to other street types or directly to traffic destinations. • Operate as a segment of Primary Transit, Goods Movement and Cycling Network. • High priority for autos, goods movement, transit and cycling modes.	
Access Conditions	• Direct access is only available to abutting commercial and industrial properties subject to traffic and design conditions and is generally restricted to right turns in and out. • No direct vehicular access is allowed to abutting residential properties. • Intersections may be grade separated when warranted. • Intersection spacing less than minimum 300 m is considered an exception and has to be located and designed to the satisfaction of the General Manager, Transportation. • The minimum acceptable spacing between the terminal of an interchange ramp and the centreline of the first Intersection on a Divided Arterial is 400 m. • At grade intersections should be channelized to provide proper control of the turning movements. • At-grade intersections should generally be signalized. • Left turn bays not permitted on curves with less than 400m centreline radius.	
Notes	• Bus bays are desirable when design/posted speed >60 km/h and at all transit timing stop locations. • No residential frontage is permitted along arterial streets. • Arterial Streets are designed to capacity level “D” or better. • The right-of-way width may need to be increased depending on number of lanes, sloping requirements, road grades, and noise attenuation requirements and special conditions such as accommodation of LRT, LID, pedestrian pathways. • Noise attenuation study is required for residential lots adjacent to Arterial streets to determine noise attenuation requirements. • Boulevard pathway is not desirable where there are more than 7 driveways or street crossings in a 1km stretch. • Low impact Development (LID) and bicycle accommodations are required within the right-of-way.	



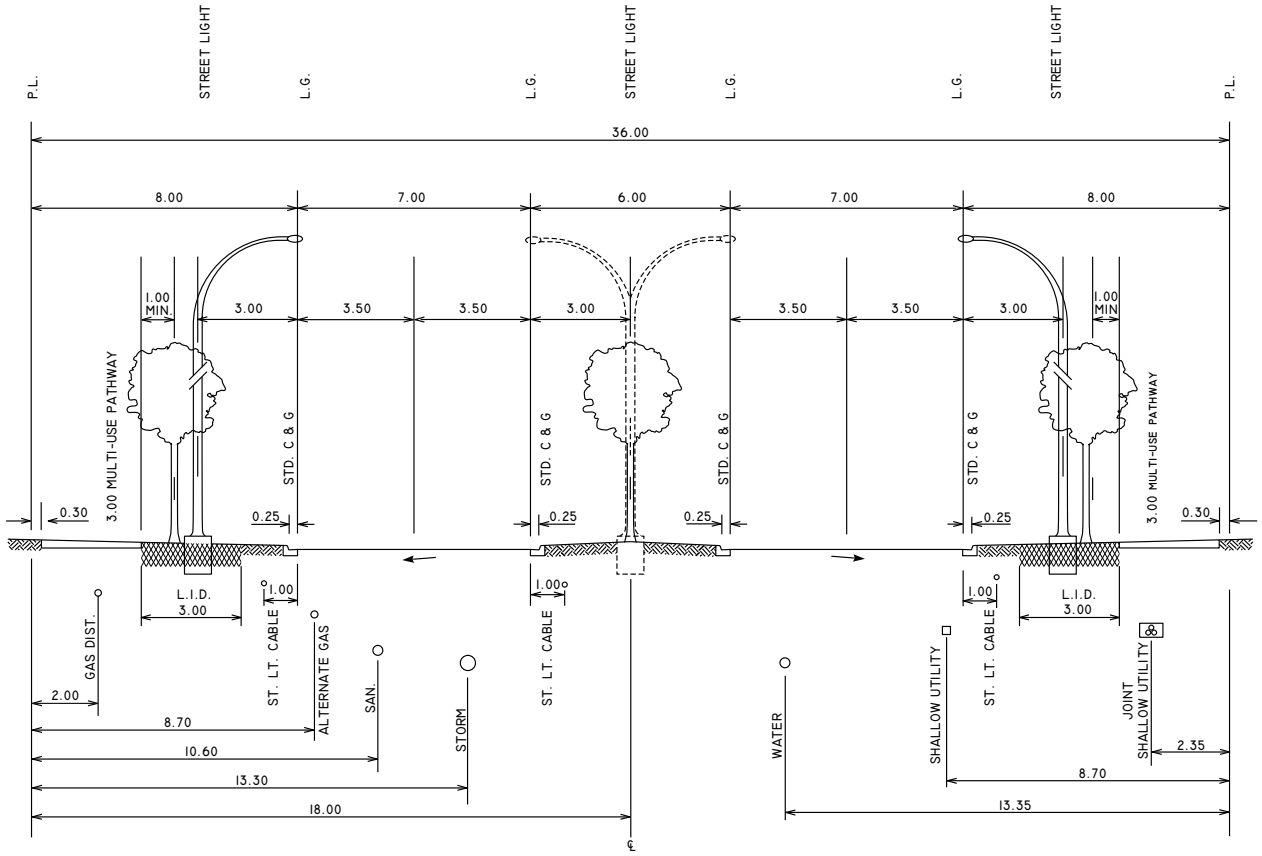
Arterial Street **Industrial Arterial**		
Daily Traffic Volume (vehicles)	**Number of Lanes**	**Right-of-way Requirement**
10,000 - 30,000	**4**	**30.0 m (min)**

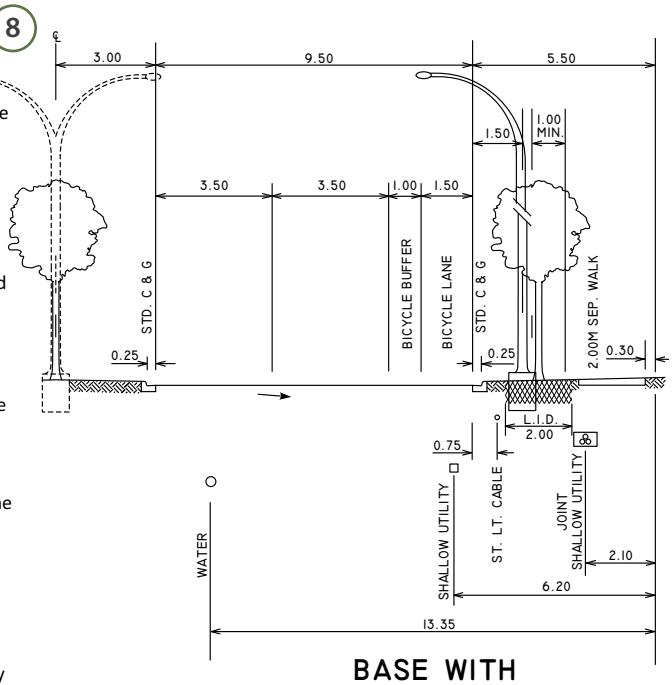
Function	• To expedite the movement of vehicles between major traffic generators and between industrial subdivisions. • To serve adjacent commercial and industrial lands and to collect and distribute traffic from other Arterial and Industrial streets to lesser category streets or directly to traffic destinations. • May operate as a part of Primary Transit and Primary Goods Movement Network • High priority for Goods movement.
Access Conditions	• Direct access is only available to abutting commercial and industrial properties subject to traffic and design conditions and is generally restricted to right turns in and out. • Intersections may be grade separated when warranted. • Intersection spacing less than minimum 300 m is considered an exception and has to be located and designed to the satisfaction of the General Manager, Transportation. • At grade intersections should be channelized to provide for proper control of the turning movements. • At-grade intersections should generally be signalized. • No residential frontage is permitted.
Notes	• Bus bays are desirable when design/posted speed ≥70 km/h and at all transit timing stop locations. • Industrial Arterial Streets are designed to capacity level “D” or better. • The right-of-way width may need to be increased depending on number of lanes, sloping requirements, road grades, and noise attenuation requirements and special conditions such as accommodation of LRT. • Low Impact Development (LID) and bicycle facilities are required within the right-of-way.



Arterial Streets **Local Arterial**		
Daily Traffic Volume (vehicles)	**Number of Lanes**	**Right-of-way Requirement**
10,000 - 15,000	**4**	**30.0 m (min)**
Function	• To provide significant connections between residential communities and destinations where traffic volumes are at the low end for Arterial Streets. • To provide Arterial connections while allowing more opportunities for access than a Divided Arterial. • Operate as a segment of Primary Transit, Goods Movement and Cycling Network. • High priority for autos, goods movement transit and cycling modes.	
Access Conditions	• No residential frontage is permitted • No direct vehicular access to abutting residential properties, including driveways and lanes, is permitted. • Minimum intersection spacing is 150 m. However greater spacing should be used wherever possible. • A direct access to abutting commercial properties and multi-family sites (M-1 and MC-1) is permitted subject to traffic conditions and/or design conditions at the discretion of the approval authority of the Transportation Department, and is generally restricted to right turns in and out. • No lane connection to Local Arterial streets is permitted • Local Arterial streets may intersect with Collector streets, Primary Collector Streets, Local Arterial and Arterial Streets.	
Notes	• Left turn bays and channelized intersections are generally not necessary but may be required to accommodate traffic conditions. • Noise attenuation study is required for residential lots adjacent to Local Arterial streets to determine noise attenuation requirements. • Low Impact Development (LID) and bicycle facilities are required within the right-of-way.	

Design Elements **Arterial Streets** Base Cross-Sections, Sheet # 1 of 1			
Base Cross-section	**Divided Arterial**	**Industrial Arterial**	**Local Arterial**
Right-of-way required	36.0 m (min.)	30.0 m (min.)	30.0 m (min.)
Number of travel lanes	4	4	4
Travel lane width	3.5 m	3.5/3.7 m	3.3/3.5 m
Basic width	2 x 7 m 2 x 9.5 m	14.4 m	2 x 8.3 m
Parking lane width	none	none	none
Curb and gutter (gutter)	0.75 m (0.5 m)	0.5 m (0.25 m)	0.5 m (0.25 m)
Median width	6 m	none	3.5 m
Sidewalk width			
mono	n.a.	n.a.	n.a.
separate	2.0 m separate walk on both sides OR	2.0 m separate walk on one side	2.0 m separate walk on both sides
Multi-use pathway	3.0 m multi-use pathway on both sides (for 2 x 7 m width) OR	3.0 m multi-use pathway on one side.	none
Bicycle lane width	1.5 m + 1.0 m buffer (for 2 x 9.5 width)	none	1.5 m
Alignment			
Posted speed	50 / 60 km/h	50 / 60 km/h	50 km/h
Minimum centreline radius (speed dependent)	90 / 120 m	90 / 120 m	90 m
Maximum super-elevation	6% / 8%	6% / 8%	4%
Maximum grade	7% / 6%	7% / 6%	8%
Minimum grade	0.6%	0.6%	0.6%
Minimum stopping sight distance (speed dependent)	65 / 85 m	65 / 85 m	65 m
Other			
Daily traffic volume	10,000 – 30,000 vpd	10,000 - 30,000 vpd	10,000 – 15,000 vpd
Minimum intersection spacing	300 m	300 m	150 m
Traffic signals	as warranted	as warranted	as warranted
Pedestrian crossing	at grade	at grade	at grade
Alternate on-street bike route	yes	no	no
Bus route	yes	yes	yes
Truck route	yes	yes	no
Sound attenuation	yes	No	yes





Notes:

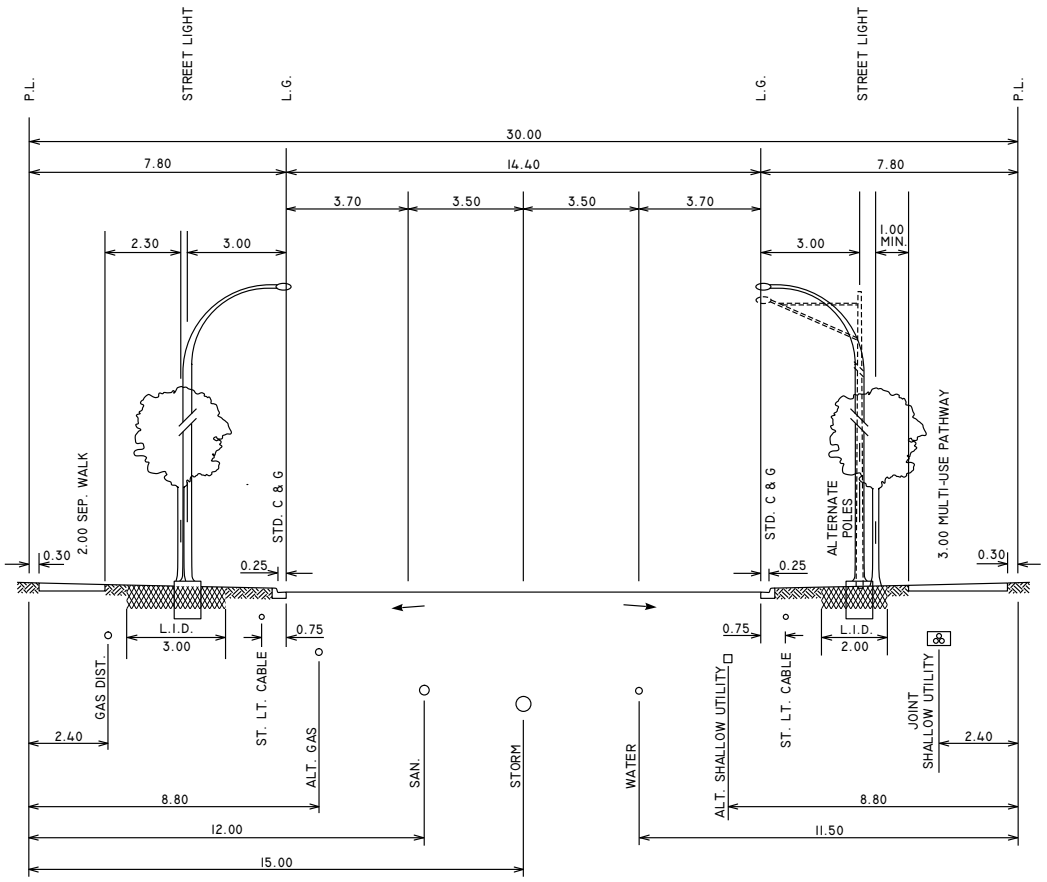
- Utility line assignments must be confirmed during the planning stage
- Hydrants on 3.00 line (Industrial Arterial 4.50 line)
- Hydrant valves 1.0m from water line
- Service valves on 3.00 line (Industrial Arterial 4.50 line)
- Hydrants and service valves shall maintain a minimum 3.0m separation to centre line of power poles, streetlights, trees, and the edge of transformers, pull boxes, junction terminals and other surface structures
- Trees offset minimum 1.0m from sidewalk and pathway, and on centre line in median
- Trees shall be of a species as approved by Parks
- All trees to be shallow root species
- Tree planting not permitted under overhead power lines unless non-canopy trees are specified
- Bus loading zones must be considered when locating trees and underground/surface utilities
- Gas feeder mains in roadway, distribution line in boulevard, opposite side from overhead
- Typical 2% grade for road cross-slope and boulevards
- Water main will be installed on the opposite side of the road from storm and sanitary lines
- Additional separation may be required between storm and sanitary sewers if excessive vertical difference occurs
- Manholes in roadway will be installed outside of wheel paths
- Pre-installed service connections to be installed 3.50 inside P.L. or 5.00 m inside P.L. when crossing gas and one other shallow utility
- This standard is intended as a guideline for new development, where not applicable make adjustments as required
- Offsetting roadway centreline within the right-of-way is not recommended due to future utility conflicts
- Road, boulevard and right-of-way may vary to accommodate bicycle facilities

NOTE: details for bicycle and L.I.D. facilities are still under development

BASE WITH ON-STREET BIKE LANE (<20,000 VPD)

DIMENSIONS ARE METRES UNLESS OTHERWISE NOTED — METRIC

			DRAWN	DATE	THE CITY OF CALGARY ROADS
			SCALE: NTS		DIVIDED ARTERIAL STREET DESIGN SPEED/POSTED SPEED ≤ 60KPH
			APPROVED FOR		SHEET
			CITY ENGINEER		FILE NUMBER:



Notes:

- Utility line assignments must be confirmed during the planning stage
- Hydrants on 3.00 line (Industrial Arterial 4.50 line)
- Hydrant valves 1.0m from water line
- Service valves on 3.00 line (Industrial Arterial 4.50 line)
- Hydrants and service valves shall maintain a minimum 3.0m separation to centre line of power poles, streetlights, trees, and the edge of transformers, pull boxes, junction terminals and other surface structures
- Trees offset minimum 1.0m from sidewalk and pathway, and on centre line in median
- Trees shall be of a species as approved by Parks
- All trees to be shallow root species
- Tree planting not permitted under overhead power lines unless non-canopy trees are specified
- Bus loading zones must be considered when locating trees and underground/surface utilities
- Gas feeder mains in roadway, distribution line in boulevard, opposite side from overhead
- Typical 2% grade for road cross-slope and boulevards
- Water main will be installed on the opposite side of the road from storm and sanitary lines
- Additional separation may be required between storm and sanitary sewers if excessive vertical difference occurs
- Manholes in roadway will be installed outside of wheel paths
- Pre-installed service connections to be installed 3.50 inside P.L. or 5.00 m inside P.L. when crossing gas and one other shallow utility
- This standard is intended as a guideline for new development, where not applicable make adjustments as required
- Offsetting roadway centreline within the right-of-way is not recommended due to future utility conflicts
- Road, boulevard and right-of-way may vary to accommodate bicycle facilities

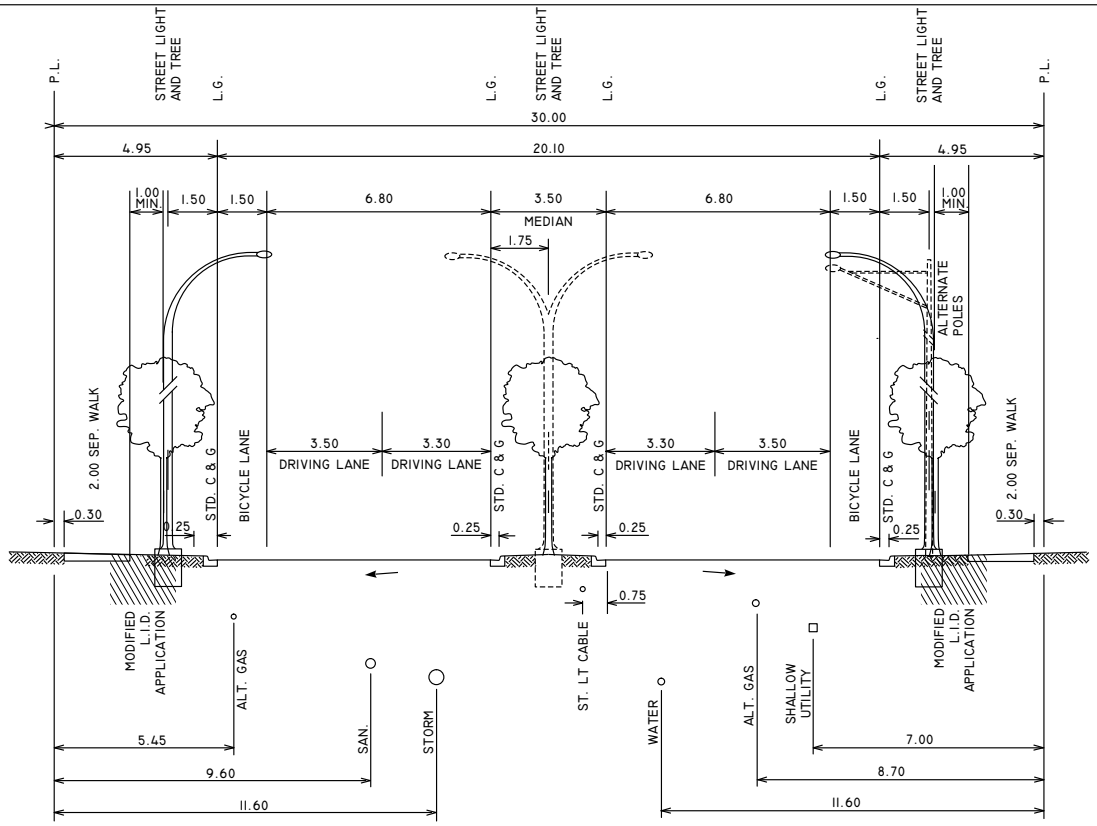
NOTE: details for bicycle and L.I.D. facilities are still under development

			Drawn	Date	THE CITY OF CALGARY ROADS
			Scale: NTS		INDUSTRIAL ARTERIAL
			Approved for		DESIGN SPEED/POSTED SPEED ≤ 60KPH
			City Engineer		

Dimensions are Metres Unless Otherwise Noted — METRIC

Sheet

File Number:



Notes:

- Utility line assignments must be confirmed during the planning stage
- Hydrants on 3.00 line (Industrial Arterial 4.50 line)
- Hydrant valves 1.0m from water line
- Service valves on 3.00 line (Industrial Arterial 4.50 line)
- Hydrants and service valves shall maintain a minimum 3.0m separation to centre line of power poles, streetlights, trees, and the edge of transformers, pull boxes, junction terminals and other surface structures
- Trees offset minimum 1.0m from sidewalk and pathway, and on centre line in median
- Trees shall be of a species as approved by Parks
- All trees to be shallow root species
- Tree planting not permitted under overhead power lines unless non-canopy trees are specified
- Bus loading zones must be considered when locating trees and underground/surface utilities
- Gas feeder mains in roadway, distribution line in boulevard, opposite side from overhead
- Typical 2% grade for road cross-slope and boulevards
- Water main will be installed on the opposite side of the road from storm and sanitary lines
- Additional separation may be required between storm and sanitary sewers if excessive vertical difference occurs
- Manholes in roadway will be installed outside of wheel paths
- Pre-installed service connections to be installed 3.50 inside P.L. or 5.00 m inside P.L. when crossing gas and one other shallow utility
- This standard is intended as a guideline for new development, where not applicable make adjustments as required
- Offsetting roadway centreline within the right-of-way is not recommended due to future utility conflicts
- Road, boulevard and right-of-way may vary to accommodate bicycle facilities

NOTE: details for bicycle and L.I.D. facilities are still under development

				Drawn	Date	THE CITY OF CALGARY ROADS
				Scale: NTS		LOCAL ARTERIAL STREET
				Approved for City Engineer		DESIGN SPEED/POSTED SPEED ≤ 50KPH

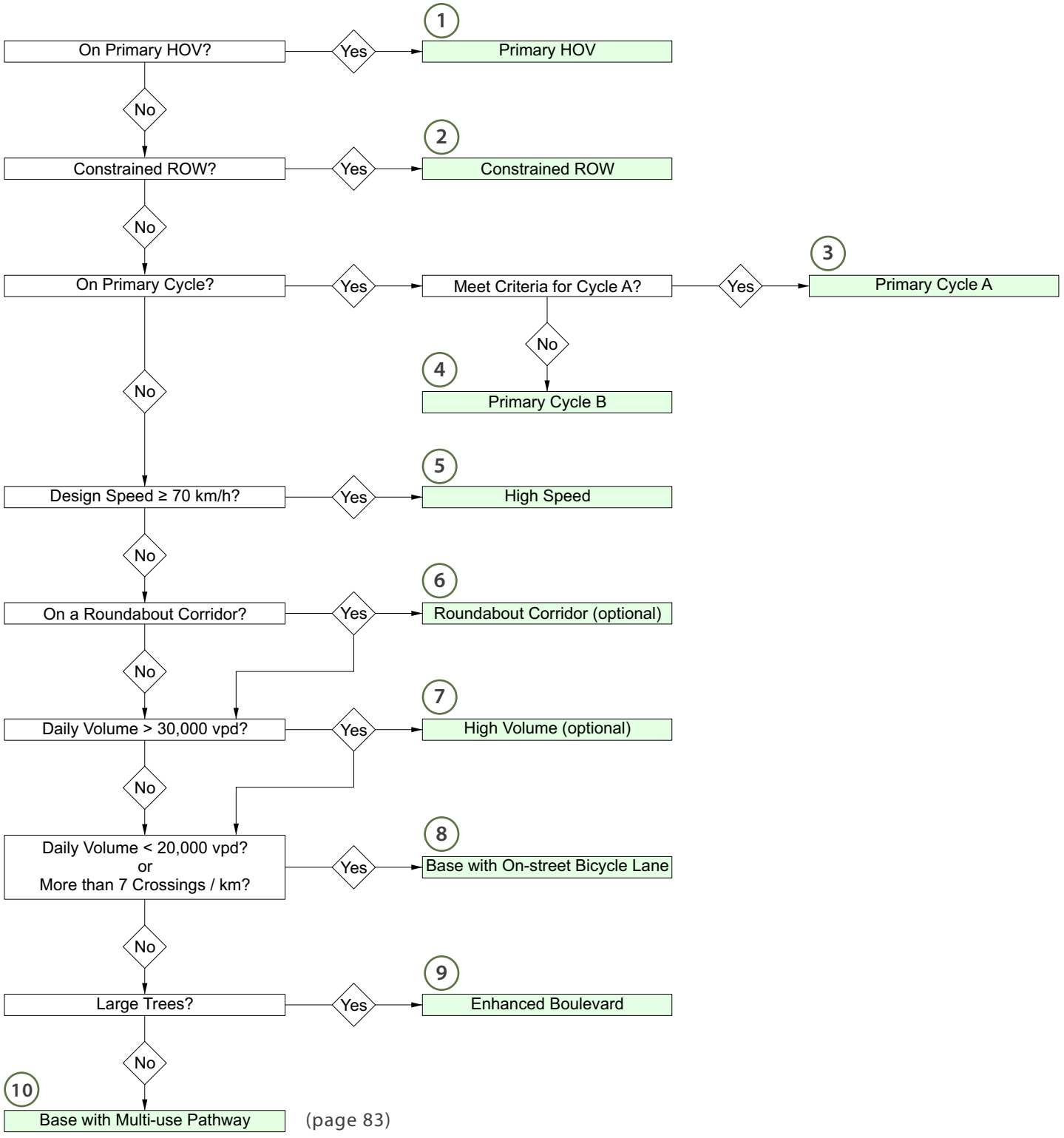
Dimensions are Metres Unless Otherwise Noted — METRIC

Sheet

File Number:

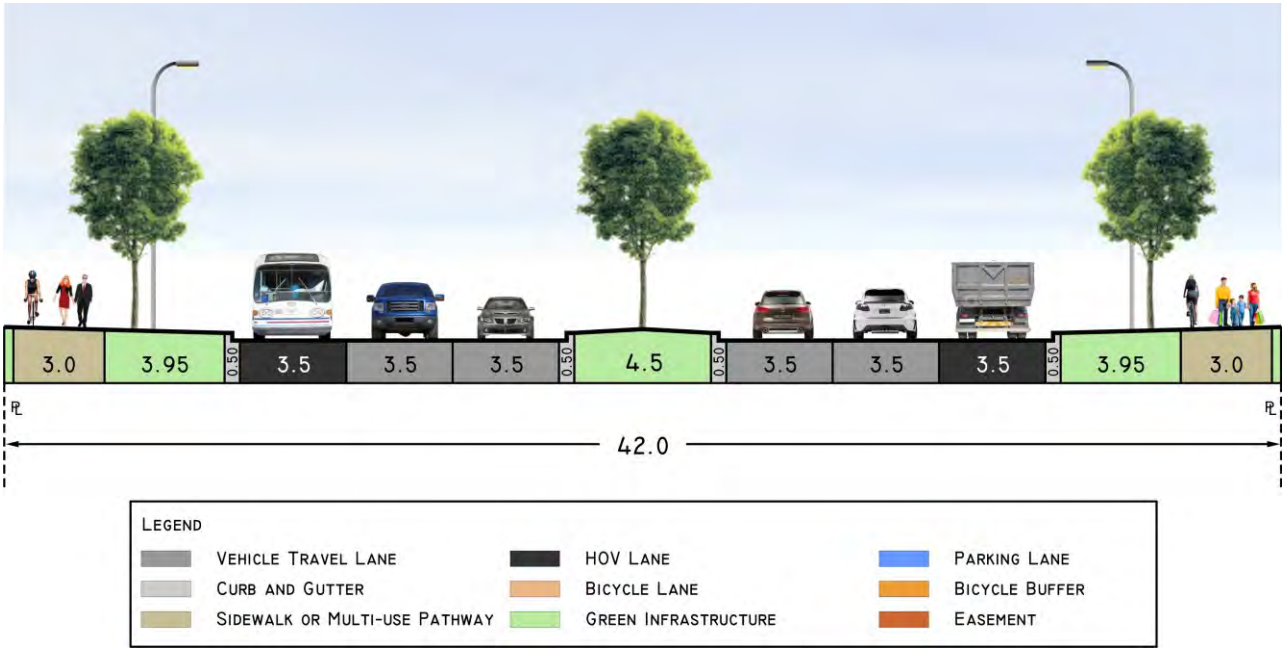
ARTERIAL STREET ALTERNATE STANDARDS SELECTION FLOW CHART

The following flow chart is intended to clarify the relationships between the various alternate standards for the Divided Arterial Street. An alternate higher up the chart takes precedence over one further down, except where optional alternates are noted. For example, an arterial street on the Primary HOV network (per CTP map 6) would use the Primary HOV alternate cross section even if the design were intended to be built to a 70km/h design speed.



(page 83)

1 DIVIDED ARTERIAL - PRIMARY HOV

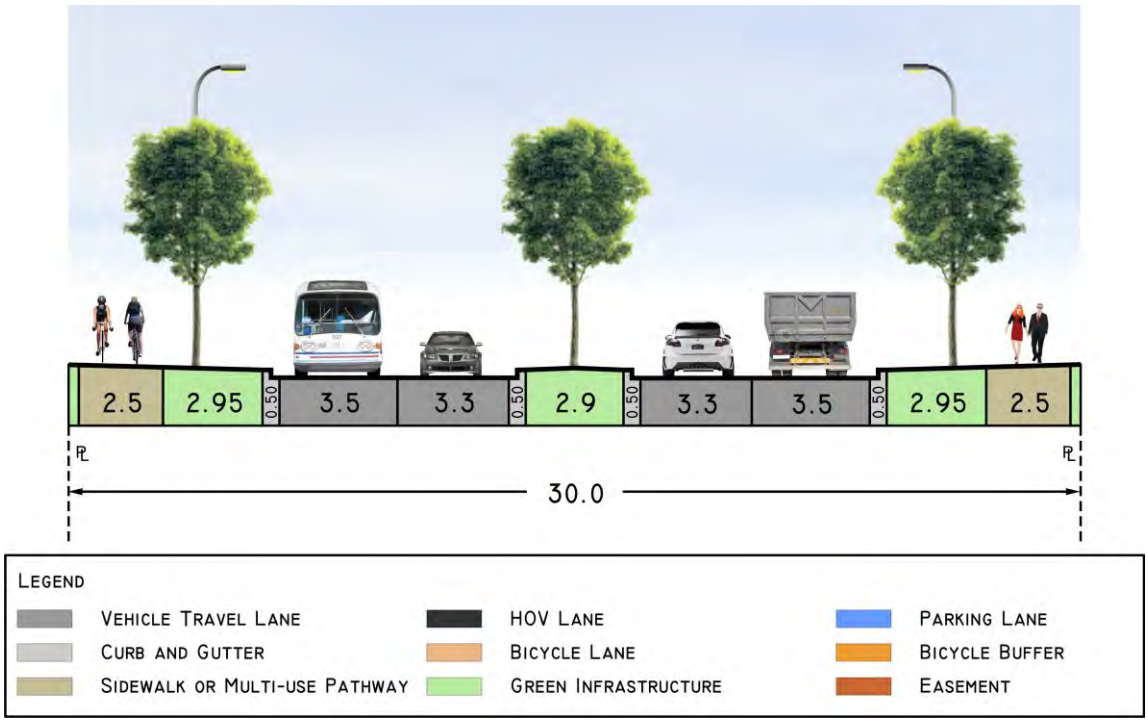


MUST USE IF

- On Primary HOV Network

Note: HOV is often accommodated on a 4-lane cross-section with the outside lanes for exclusive HOV use.

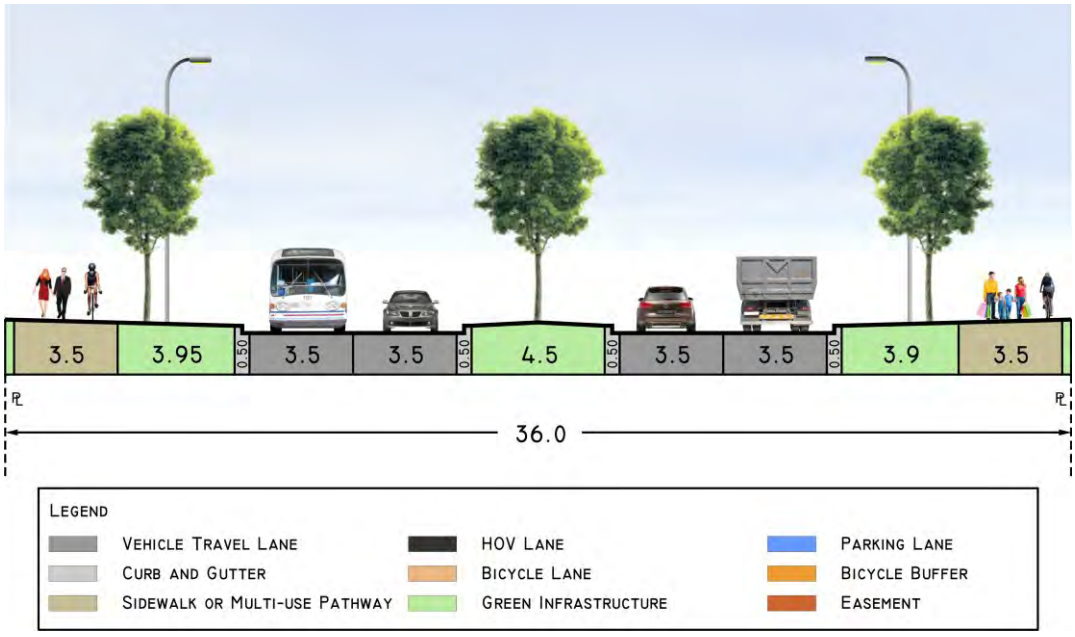
2 DIVIDED ARTERIAL - CONSTRAINED ROW



MAY USE IF

- ROW is limited to 30 m due to existing long-term development AND
- No other combination of street types and road network can reasonably provide appropriate capacity

3 DIVIDED ARTERIAL - PRIMARY CYCLE A



MUST USE IF

- On Primary Cycle Network AND
- Not on HOV Network AND
- Long-term daily volumes ≥ 20,000 vpd

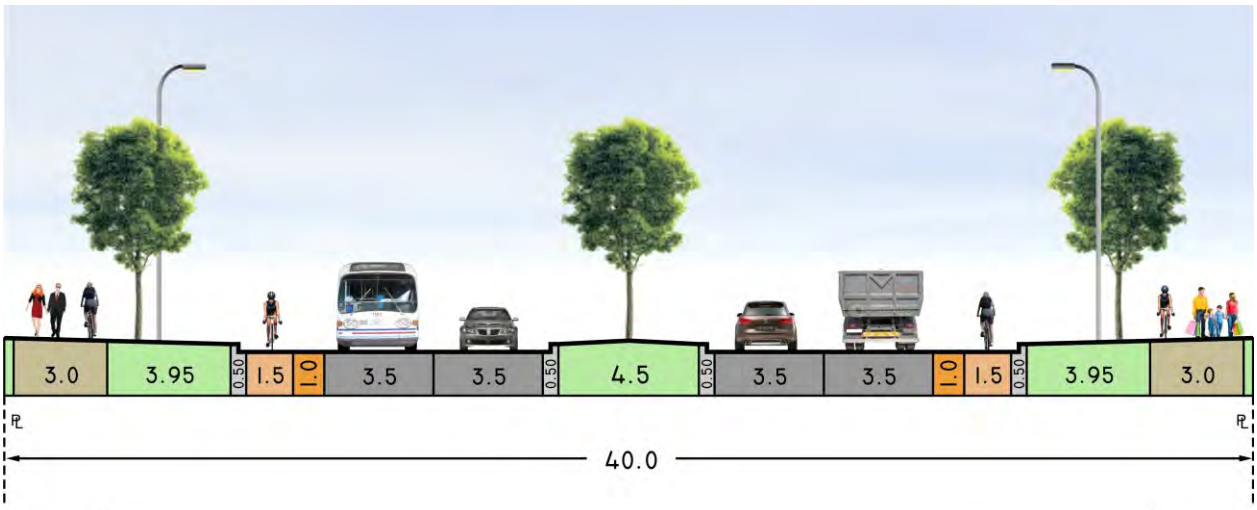
MAY USE IF

- On Primary Cycle Network AND
- Not on HOV Network AND
- Long-term daily volumes < 20,000 vpd AND
- ROW limited to 36.0 m by long-term existing development

NOTE:

Multi-use Pathway interruptions by driveways and / or cross streets must not exceed 7 per 1000 m.

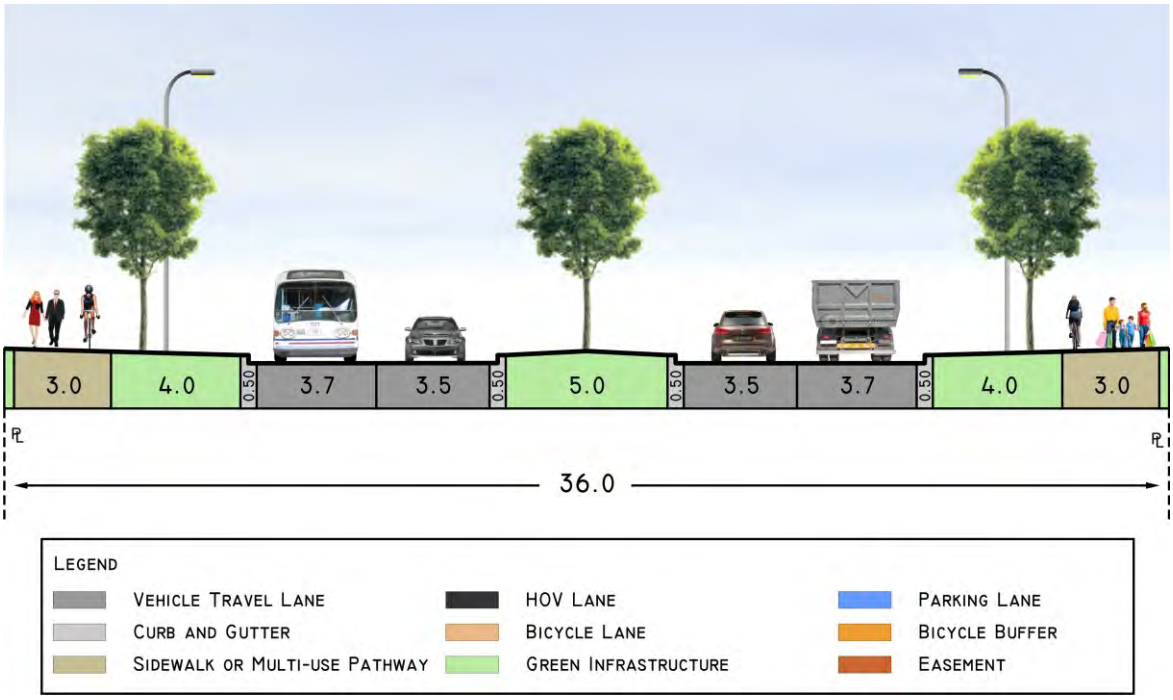
4 DIVIDED ARTERIAL - PRIMARY CYCLE B



MUST USE IF

- On Primary Cycle Network AND
- Not on HOV Network AND
- Does not meet criteria for Cycle A

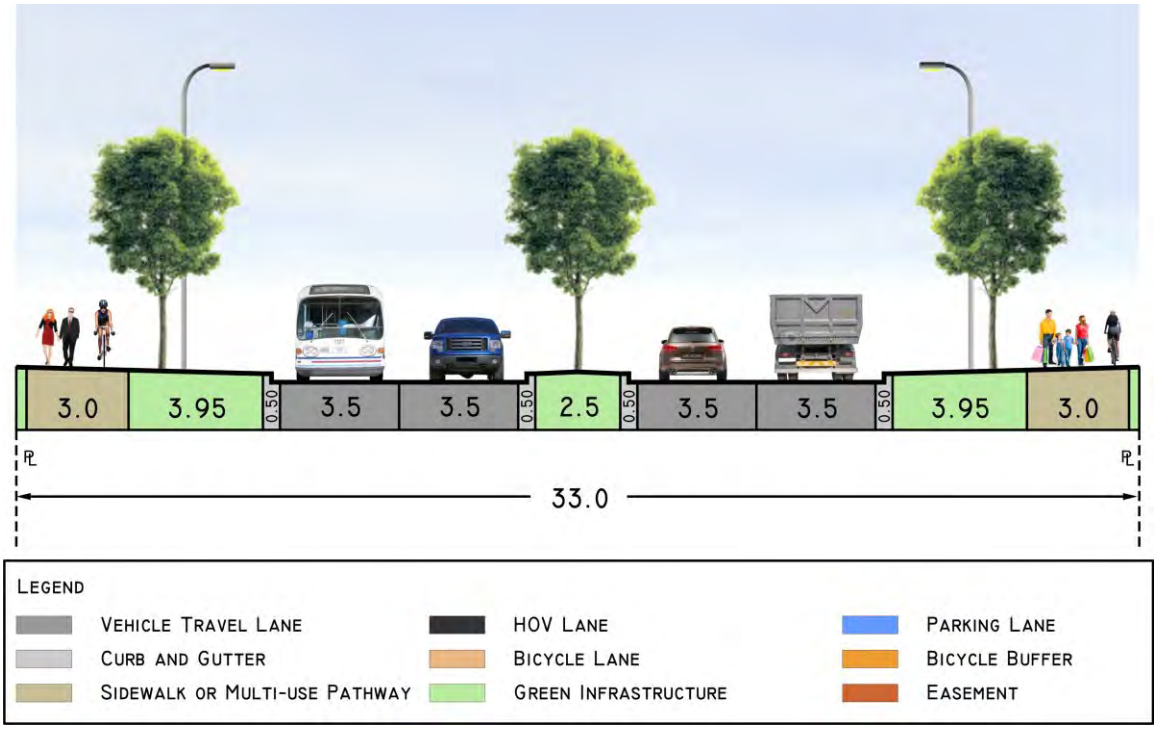
5 DIVIDED ARTERIAL - HIGH SPEED



MUST USE IF

- Design speed and / or posted speed ≥70 km/h AND
- Not on primary HOV network

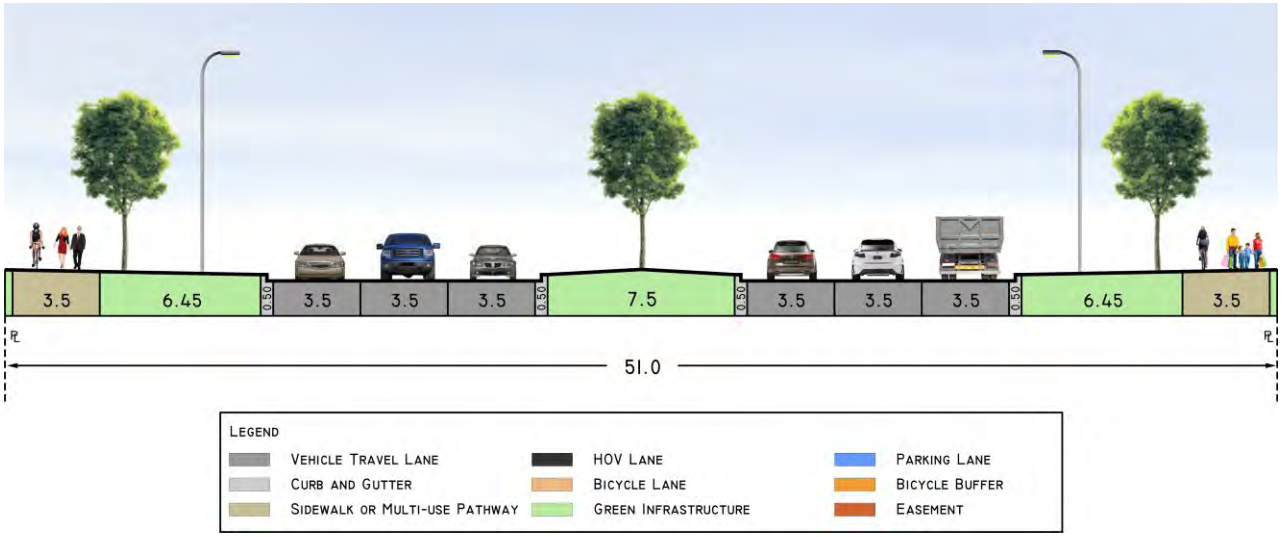
6 DIVIDED ARTERIAL - ROUNDABOUT CORRIDOR



MAY USE IF

- Section of arterial road is bounded by roundabouts with no intervening all-turns intersections / accesses

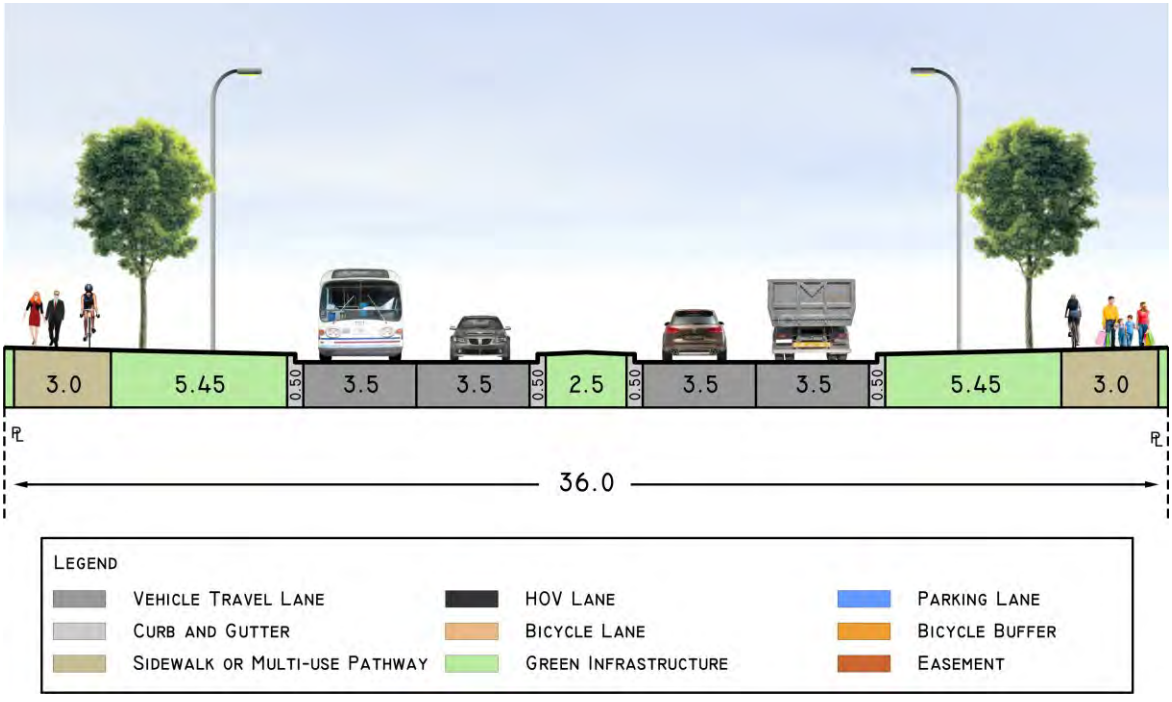
7 DIVIDED ARTERIAL - HIGH VOLUME



MAY USE IF

- Long range daily volumes ≥ 30,000 vpd (upper range) AND
- Design / posted speed ≤ 60 km/h AND
- Context (adjacent land uses, access requirements) is not appropriate to a Skeletal Road

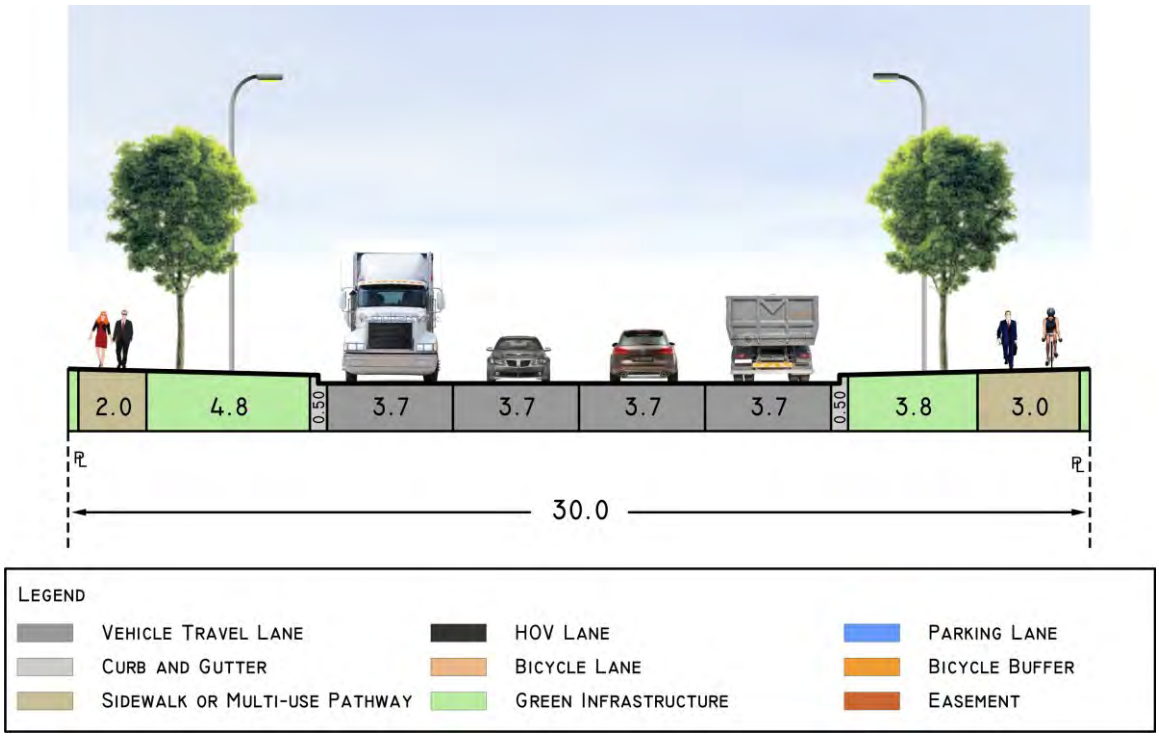
9 DIVIDED ARTERIAL - ENHANCED BOULEVARD



MAY USE IF

- Larger trees or more landscaping or street furniture will be provided than allowed in standard boulevard AND
- Adjacent land us is appropriate for visual concealment from roadway (e.g. not urban, not commercial)

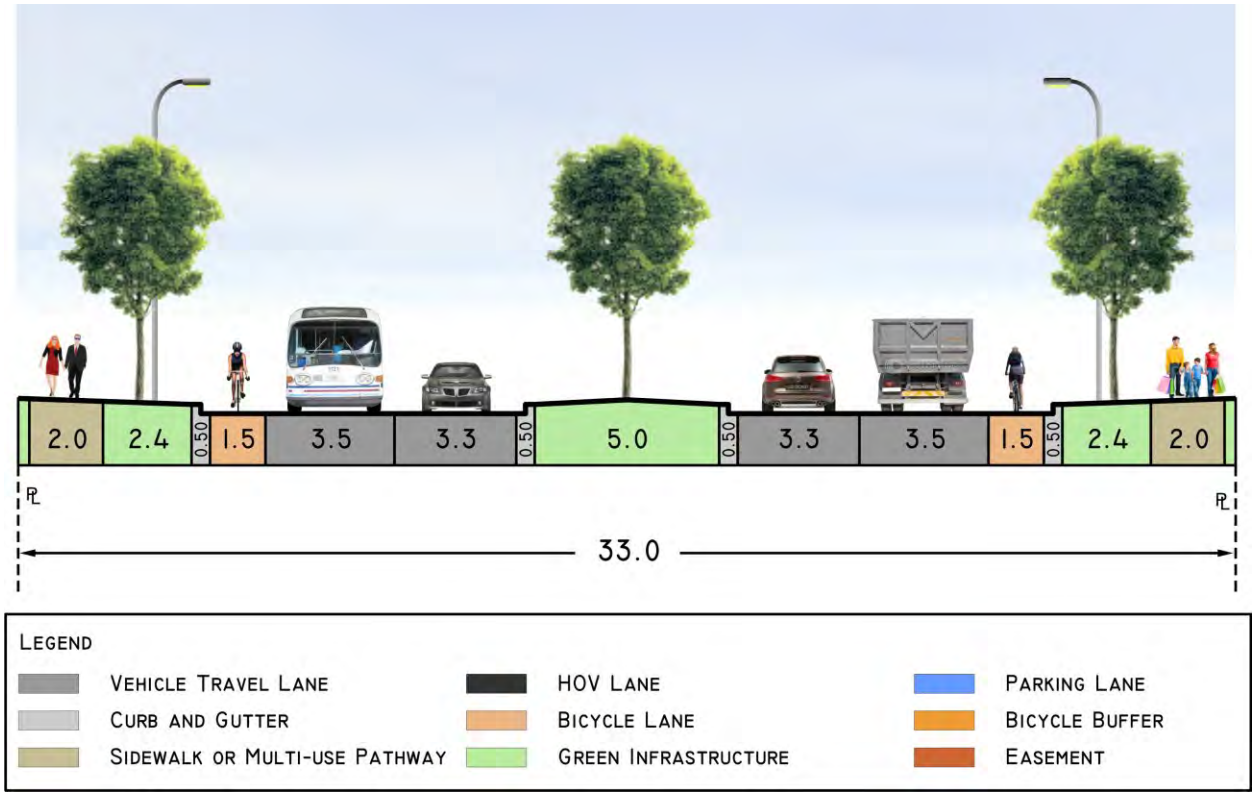
INDUSTRIAL ARTERIAL - HIGH SPEED



MUST USE IF

- Design and posted speed ≥ 70 km/h

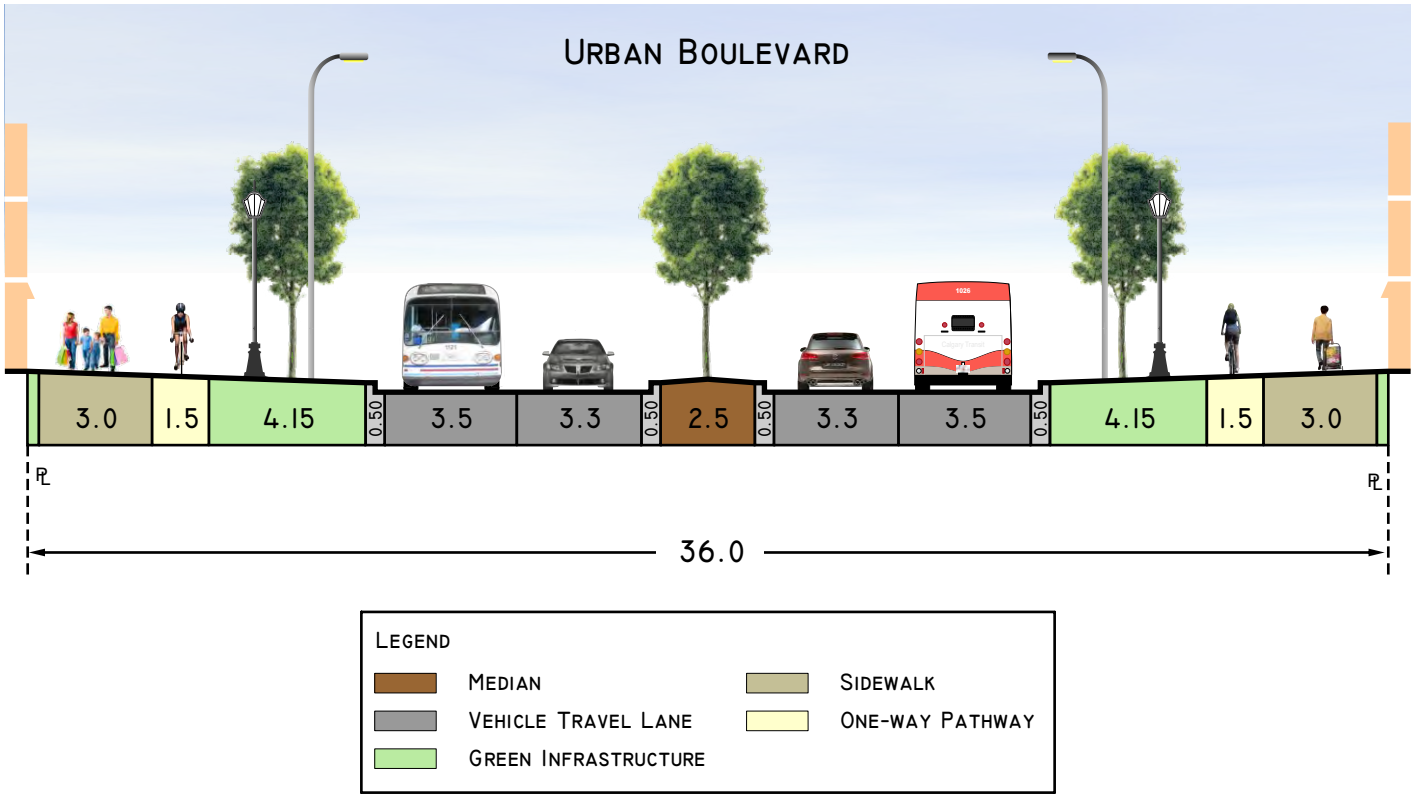
LOCAL ARTERIAL - WIDE MEDIAN

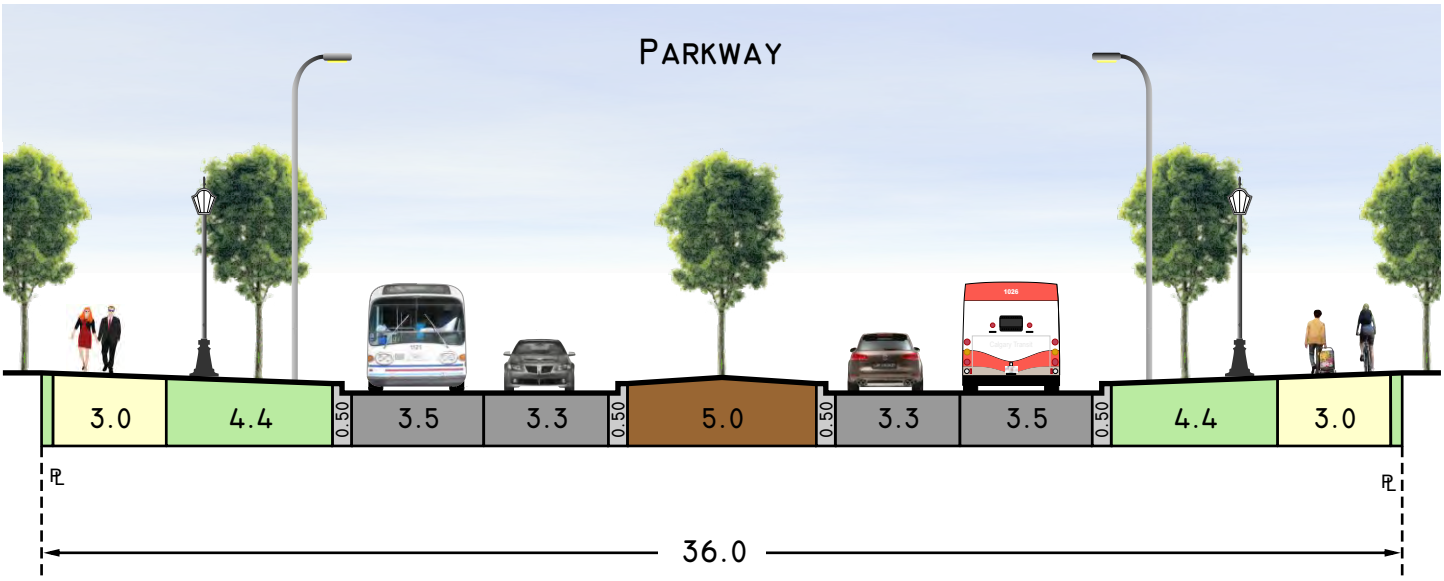


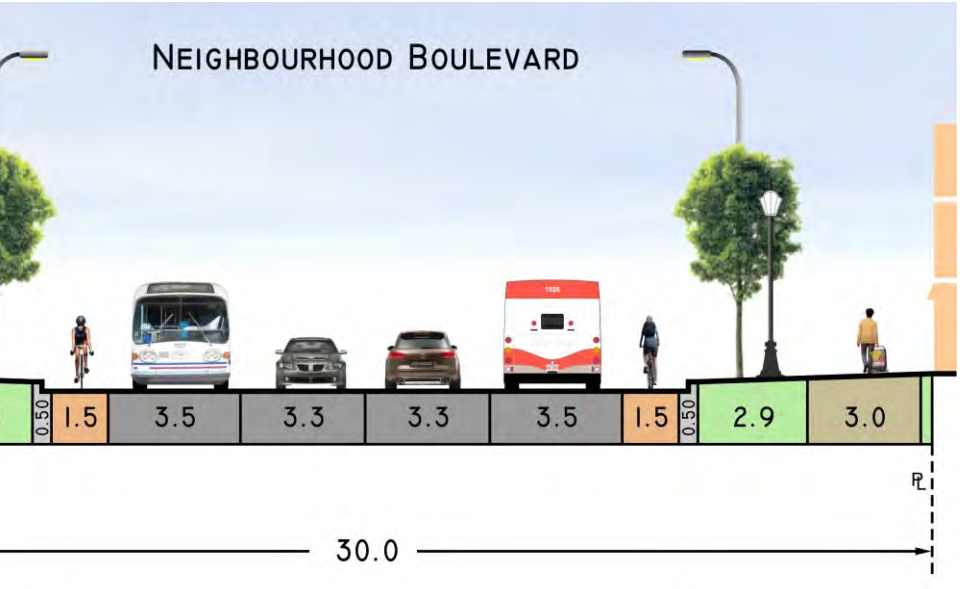
NO RESTRICTIONS ON USE

9.5 LIVEABLE STREETS CONCEPTS

As outlined in Chapter 2, there are three classifications of road in this category (Urban Boulevard, Parkway, Neighbourhood Boulevard). Only the conceptual cross-sections have been developed for the 2011 Interim Complete Streets Guide. Other elements for this category will be developed in 2012.




PARKWAY
3.0
4.4
0.50
3.5
3.3
0.50
5.0
0.50
3.3
3.5
0.50
4.4
3.0
PL
PL
36.0


NEIGHBOURHOOD BOULEVARD
3.0
2.9
0.50
1.5
3.5
3.3
3.3
3.5
1.5
0.50
2.9
3.0
PL
PL
30.0

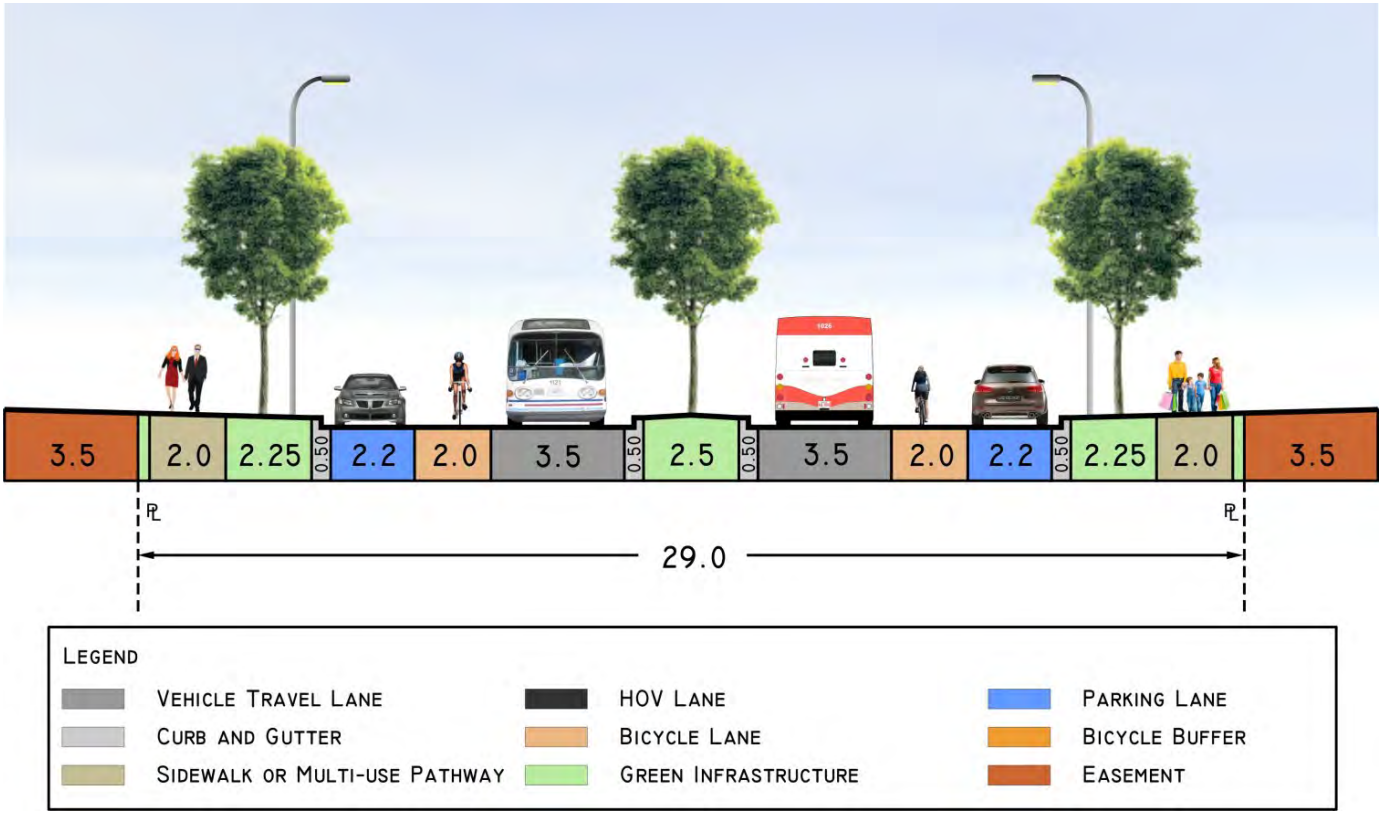
9.6 LOCAL STREET DESIGN SHEETS

As outlined in Chapter 2, there are six classifications of road in this category (Primary Collector, Collector, Activity Centre Street, Industrial Street, Residential Street, and Lane (Alley).

This section contains the following elements

1. **DEFINITION SHEETS**: Pages 95-100 provide the definition sheets for the Primary Divided Collector, Collector, Industrial Street. Definition sheets for Activity Centre Street, Residential Street, and Lane (Alley) will be included in the 2012 guide.
2. **DESIGN ELEMENTS TABLE**: Pages 101-102 provides the standard design elements for the six classifications of Local Streets.
3. **DETAILED CROSS SECTIONS FOR BASE STANDARDS**: Detailed designs for the Local Streets are included on pages 103-108. The base standard for the Primary Collector includes a standard version with one driving lane per direction and an inset option with two driving lanes per direction. The Collector includes a standard with monowalk and surface LID treatment, and an inset option with separate walk and a modified LID treatment. The Industrial Street cross section allows for either buried or overhead utilities. Activity Centre Street and Residential Street detailed designs will be completed in 2012. One alternate cross section for the Residential Street (called the Residential Entrance Street) is common enough that a detailed design has been prepared for use when this alternative is contextually appropriate.
4. **CONCEPTUAL CROSS SECTION AND CRITERIA OF USE FOR ALTERNATE STANDARDS**: The five alternate cross sections for Primary Collectors and their criteria for use are shown on pages 109-111. The three alternate cross sections for Collectors are shown on pages 112-113. Two alternates for the Industrial Street cross section are shown on page 114. Two alternates for the Lane (Alley) cross section are shown on page 115-116.

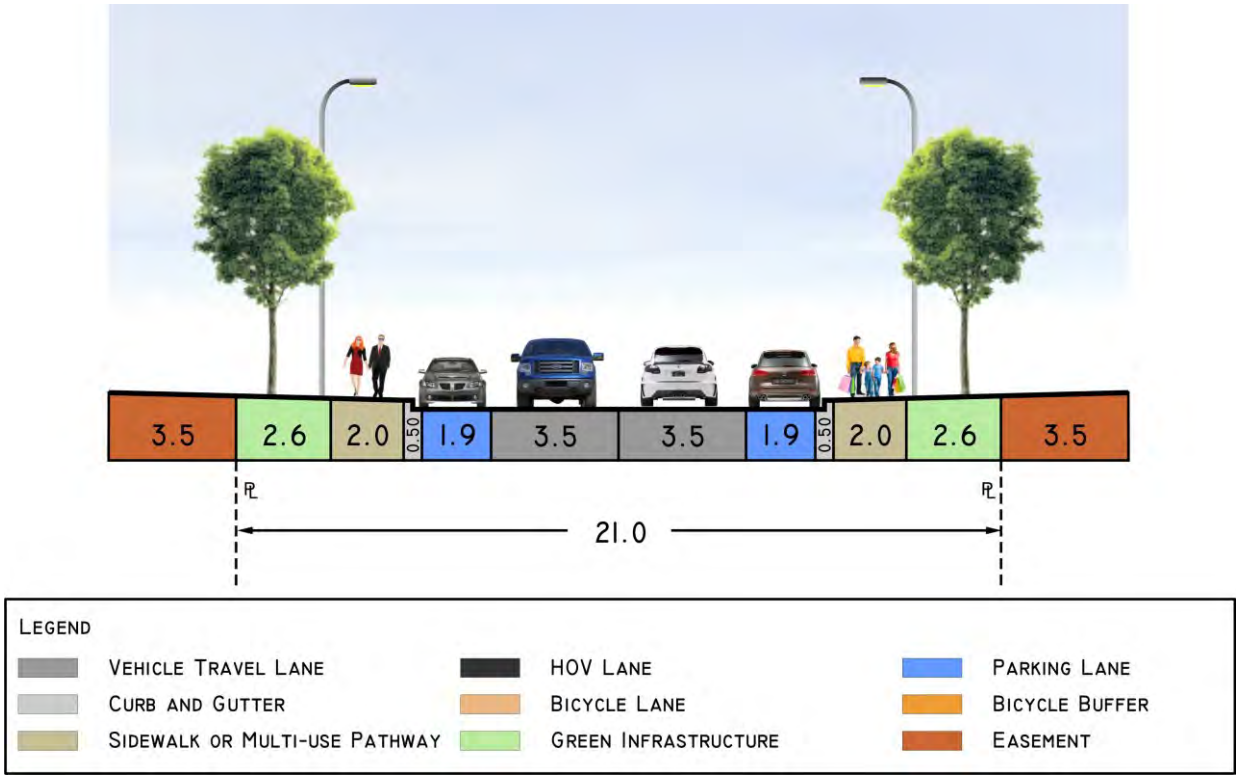
PRIMARY COLLECTOR



Local Street **Primary Collector**		
Daily Traffic Volume (Environmental Capacity) (vehicles)	**Number of Lanes**	**Right-of-way Requirement**
12,500*	**2 or 4**	**29.0 m, 30.0 m**
Function	• To connect local streets in residential areas to local destinations and Arterial streets. • To serve secondary traffic generators such as neighbourhood commercial centres, parks and golf courses, and neighbourhood-to-neighbourhood traffic with the community. • May operate as a segment of Primary Transit and/or Primary Cycling Network. • High priority for transit, cycling and walking modes.	
Access Conditions	• A minimum intersection spacing of 120 m shall be provided between an Arterial street and the first intersection on a Primary Collector street. • Intersection spacing for other intersections shall be minimum 60 m. • Access to adjacent properties is permitted but is generally restricted to right turns in and out. • Lane connections to Primary Collector streets are permitted. • Primary Collector streets may intersect with Residential streets, Collector Streets, other Primary Collector streets, Liveable Streets and Arterial streets.	
Notes	• There are following types of Primary Collector streets; ○ 29.0 m R.O.W. – 1 driving lane with bicycle lane and parking in each direction, separated by 3.5 m median. ○ 30.0 m R.O.W. – 2 driving lanes with bicycle lane (no parking) in each direction, separated by 3.5 m median.	

*Per "Environmental Capacity Guidelines for Roadways Policy" (TP009)

COLLECTOR



Local Street **Collector Street**		
Daily Traffic Volume (Environmental Capacity) (vehicles)	**Number of Lanes**	**Right-of-way Requirement**
5,500*	**2**	**21.0 m**
Function	• To connect local streets within a community, and to connect those streets to the transportation network beyond the community. • To serve secondary traffic generators such as neighbourhood commercial centres, parks and golf courses and neighbourhood-to-neighbourhood traffic within the community. • May operate as a segment of Primary Cycling Network and/or bus route. • High priority for transit, cycling and walking modes.	
Access Conditions	• Direct access is permitted to abutting properties. • Minimum intersection spacing is 60 m. Wherever possible, a desirable intersection spacing of 80 m should be used. • Collector streets may intersect with Residential streets and other Collector streets, Primary Collectors, Liveable Streets and Arterials.	
Notes	• Collector streets are undivided roadways. • This standard may also be used where residential and/or commercial frontage occurs on one side of the road and where no bus route is planned. • Low Impact Development (LID) facilities are required within the right-of-way.	

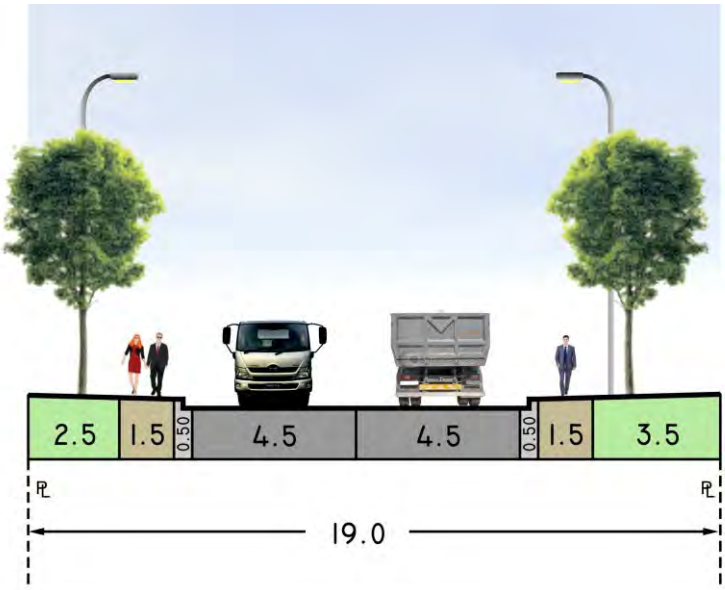
*Per "Environmental Capacity Guidelines for Roadways Policy" (TP009)

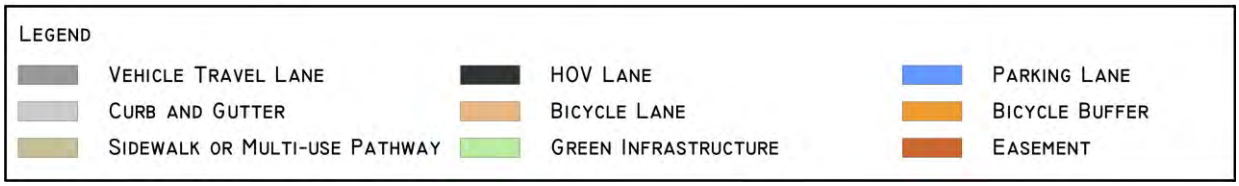
ACTIVITY CENTRE STREET

TO BE DETERMINED

Local Street **Activity Centre Street**		
Daily Traffic Volume (Environmental Capacity) (vehicles)	**Number of Lanes**	**Right-of-way Requirement**
TBD	**TBD**	**TBD**
Function	• To provide a local street appropriate for activity nodes and corridors within a community.	
Access Conditions	• TBD	
Notes	• TBD	

INDUSTRIAL STREET





Local Street **Industrial Street**		
Daily Traffic Volume (vehicles)	**Number of Lanes**	**Right-of-way Requirement**
<10,000	**2**	**19 m**
Function	• To provide direct access to adjacent industrial and commercial properties. • To collect and distribute traffic from industrial and commercial properties to Arterial streets. • May operate as a segment of bus route. • High priority for goods movement made.	
Access Conditions	• Direct access is permitted to industrial and commercial properties. • Industrial Streets may intersect with other Industrial Streets, Industrial Arterials and Divided Arterial streets.	
Notes	• Undivided roadway with intersections controlled by signage or signals where warranted.	

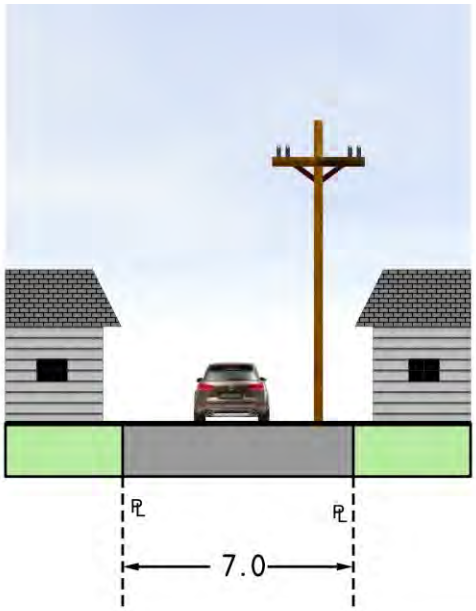
RESIDENTIAL STREET

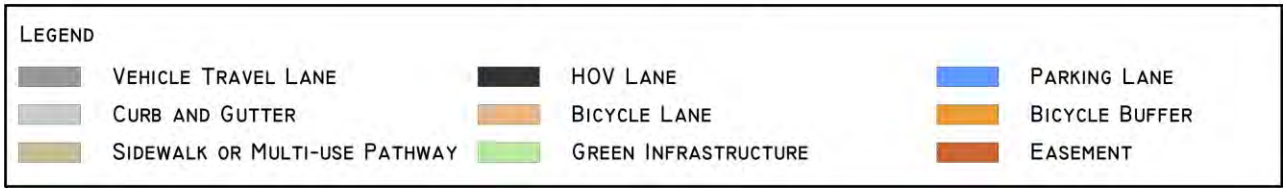
TO BE DETERMINED THROUGH RESIDENTIAL STREETS POLICY WORK (2012)

Local Streets **Residential Street**		
Daily Traffic Volume (Environmental Capacity) (vehicles)	**Number of Lanes**	**Right-of-way Requirement**
1,500*	**2**	**TBD**
Function	• To provide direct access to adjacent residential properties • To collect and distribute traffic from residential properties to Collector and Residential streets. • High priority for cycling and walking modes.	
Access Conditions	• Direct access is permitted to abutting residential properties. • Access is not permitted to commercial properties. • Residential streets may intersect with Residential streets, Collector streets and Primary Collector streets.	
Notes	• Undivided roadway with intersections controlled by signage. • Parking permitted on both sides but may be restricted under special circumstances.	

*Per "Environmental Capacity Guidelines for Roadways Policy" (TP009)

LANE

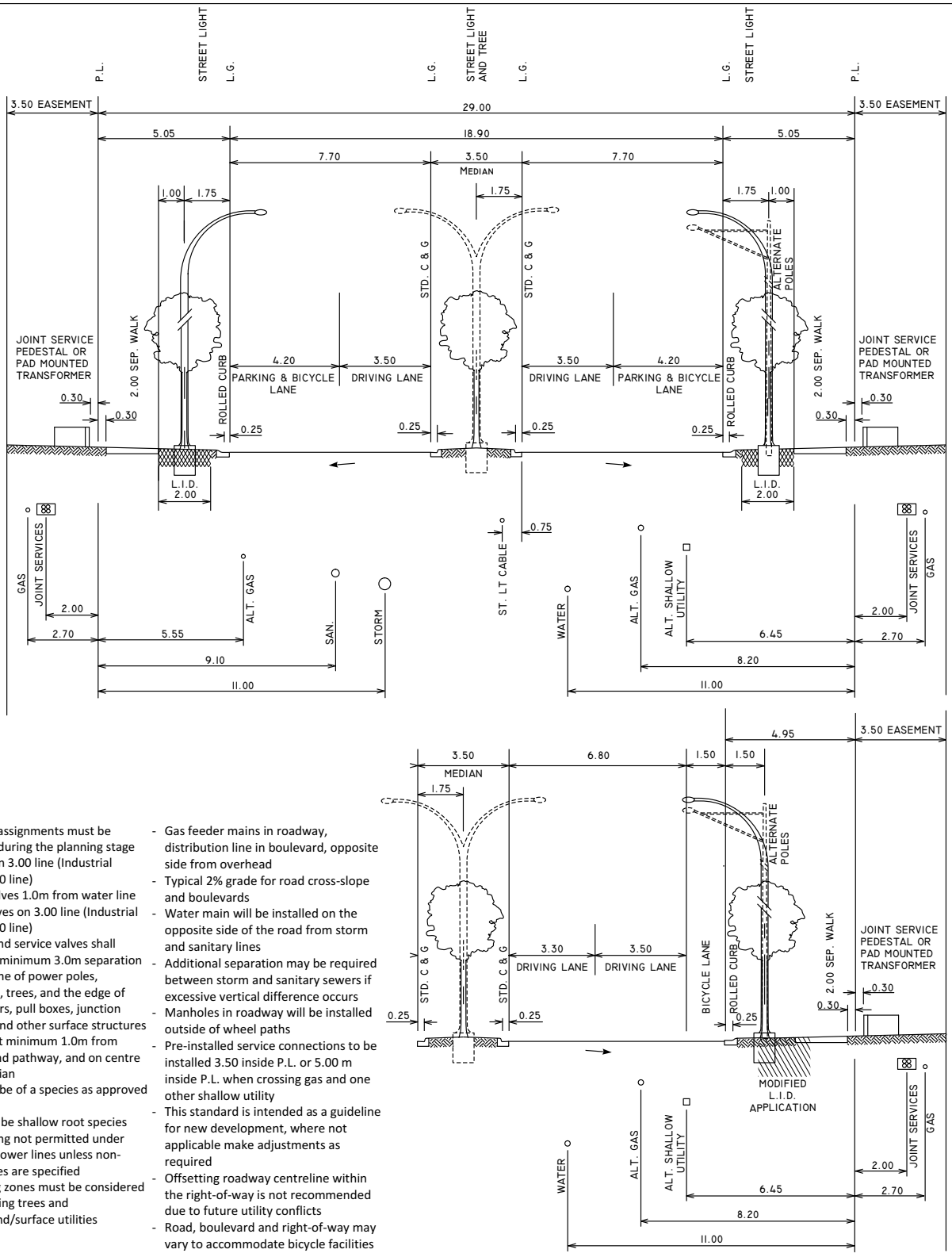




Local Streets **Lane (Alley)**		
Daily Traffic Volume (Environmental Capacity) (vehicles)	**Number of Lanes**	**Right-of-way Requirement**
TBD	**TBD**	**7.0 m**
Function	• TBD	
Access Conditions	• TBD	
Notes	• TBD	

Design Elements **Local Streets** Base Cross-Sections, Sheet # 1 of 2			
Base Cross-section	**Primary Collector**	**Collector**	**Activity Centre**
Right-of-way required	29.0 m, 30.0 m	21.0 m	TBD
Number of travel lanes	2 or 4	2	TBD
Travel lane width	3.3 / 3.5 m	3.5 m	TBD
Basic width	2 x 7.7 m (2-lane) 2 x 8.3 m (4-lane)	10.8 m	TBD
Parking lane width	2.2 m	1.9 m (must be rolled curb)	TBD
Curb and gutter (gutter)	0.5 m (0.25 m)	0.5 m (0.25 m)	TBD
Median width	3.5 m	none	TBD
Sidewalk width			
mono	2.0 m	2.0 m	TBD
separate	2.0 m	none	TBD
Multi-use pathway	none	none	TBD
Bicycle lane and buffer	2.0 m (for 2 x 7.7 m pavement) and 1.5 m (for 2 x 8.3 m) (including door buffer zone)	none	
Alignment			
Posted speed	50 km/h	50 km/h	TBD
Minimum centerline radius	90 m	90 m	TBD
Maximum super-elevation	4%	4%	TBD
Maximum grade	8%	8%	TBD
Minimum grade	0.6%	0.6%	TBD
Minimum stopping sight distance	65 m	65 m	TBD
Other			
Daily traffic volume	5,000 - 12,500 vpd	1,000 - 5,500 vpd	TBD
Minimum intersection spacing	60 m	60 m	TBD
Traffic signals	as warranted	as warranted	TBD
Pedestrian crossing	at grade	at grade	TBD
On street bike route	signed bicycle route	signed bicycle route	TBD
Bus route	yes	yes	TBD
Truck route	no	no	TBD
Sound attenuation	no	no	TBD

Design Elements **Local Streets** Base Cross-Sections, Sheet # 2 of 2			
Base Cross-section	**Industrial Street**	**Residential**	**Lane (Alley)**
Right-of-way required	19.0 m	TBD	TBD
Number of travel lanes	2	TBD	TBD
Travel lane width	4.5 m	TBD	TBD
Basic width	9.0 m	TBD	TBD
Parking lane width	none	TBD	TBD
Curb and gutter (gutter)	0.5 m (0.25 m)	TBD	TBD
Median width	none	TBD	TBD
Sidewalk width			
mono	1.5 m on both sides	TBD	TBD
separate	none	TBD	TBD
Multi-use pathway	none	TBD	TBD
Alignment			
Posted speed	50 km/h	TBD	TBD
Minimum centreline radius	80 m	TBD	TBD
Maximum super-elevation	8%	TBD	TBD
Maximum grade	10%	TBD	TBD
Minimum grade	0.6%	TBD	TBD
Minimum stopping sight distance	65 m	TBD	TBD
Other			
Daily traffic volume	10,000 vpd	TBD	TBD
Minimum intersection spacing	60 m	TBD	TBD
Traffic signals	as warranted	TBD	TBD
Pedestrian crossing	at grade	TBD	TBD
On street bike route	none	TBD	TBD
Bus route	no	TBD	TBD
Truck route	no	TBD	TBD
Sound attenuation	no	TBD	TBD



Notes:

- Utility line assignments must be confirmed during the planning stage
- Hydrants on 3.00 line (Industrial Arterial 4.50 line)
- Hydrant valves 1.0m from water line
- Service valves on 3.00 line (Industrial Arterial 4.50 line)
- Hydrants and service valves shall maintain a minimum 3.0m separation to centre line of power poles, streetlights, trees, and the edge of transformers, pull boxes, junction terminals and other surface structures
- Trees offset minimum 1.0m from sidewalk and pathway, and on centre line in median
- Trees shall be of a species as approved by Parks
- All trees to be shallow root species
- Tree planting not permitted under overhead power lines unless non-canopy trees are specified
- Bus loading zones must be considered when locating trees and underground/surface utilities
- Gas feeder mains in roadway, distribution line in boulevard, opposite side from overhead
- Typical 2% grade for road cross-slope and boulevards
- Water main will be installed on the opposite side of the road from storm and sanitary lines
- Additional separation may be required between storm and sanitary sewers if excessive vertical difference occurs
- Manholes in roadway will be installed outside of wheel paths
- Pre-installed service connections to be installed 3.50 inside P.L. or 5.00 m inside P.L. when crossing gas and one other shallow utility
- This standard is intended as a guideline for new development, where not applicable make adjustments as required
- Offsetting roadway centreline within the right-of-way is not recommended due to future utility conflicts
- Road, boulevard and right-of-way may vary to accommodate bicycle facilities

NOTE: details for bicycle and L.I.D. facilities are still under development

BASE WITH FOUR LANES

Dimensions are Metres Unless Otherwise Noted — METRIC

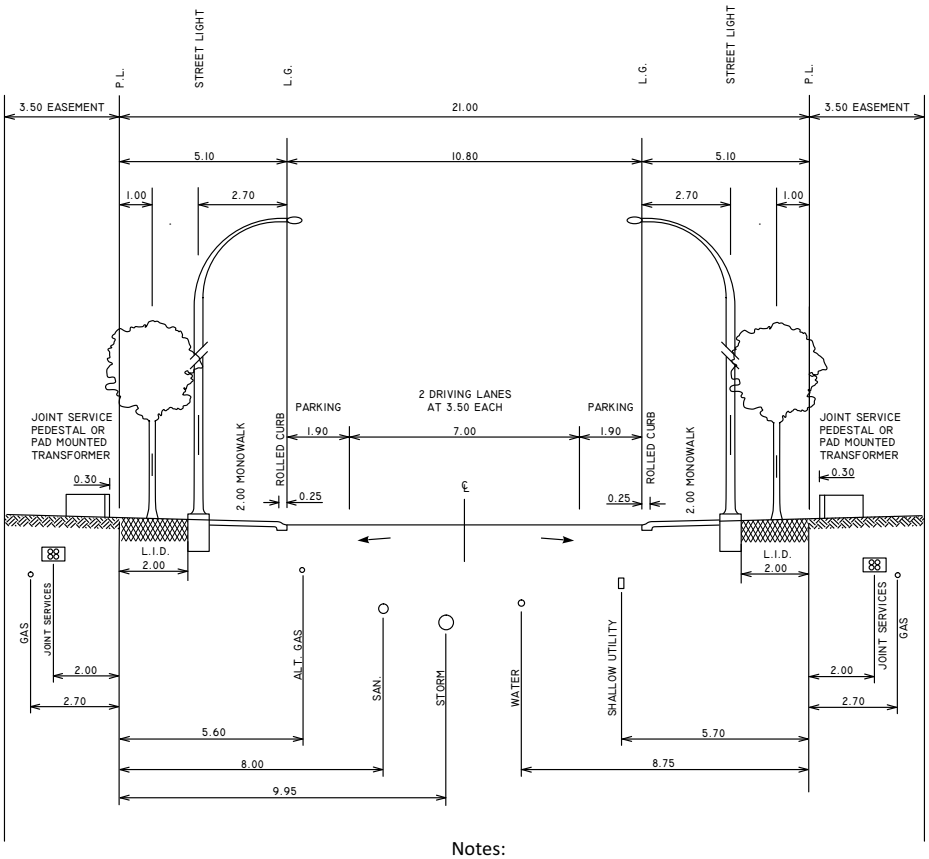
				Drawn	Date
				Scale: NTS	
				Approved for	
				City Engineer	

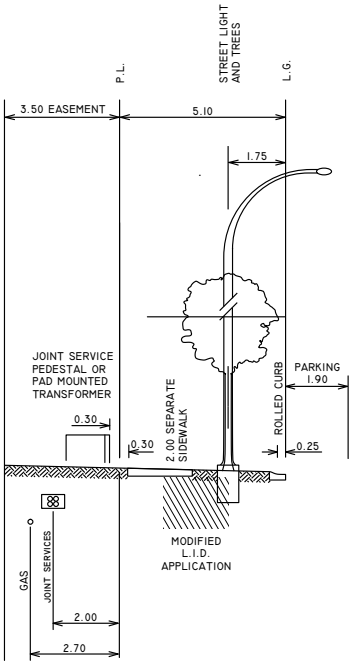
THE CITY OF CALGARY
ROADS

PRIMARY
COLLECTOR STREET

Sheet

File Number:





BASE WITH SEPARATE SIDEWALK

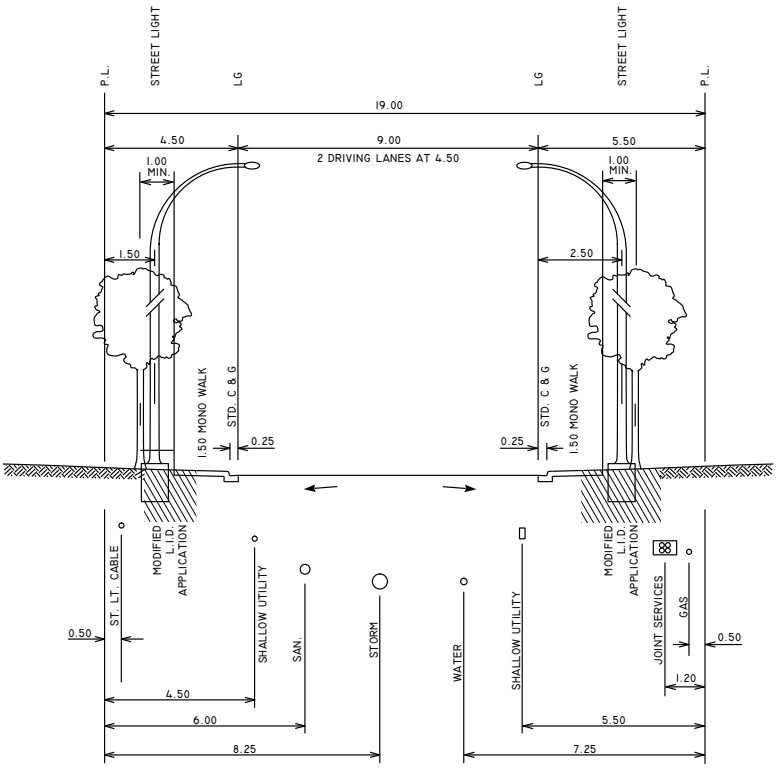
Notes:

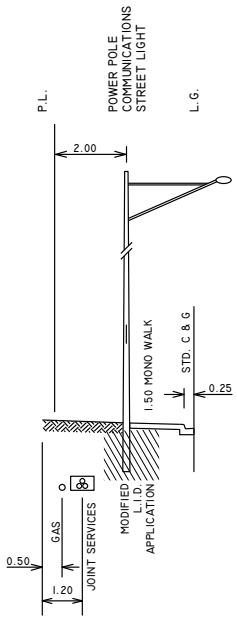
- Utility line assignments must be confirmed during the planning stage
- Hydrants on 3.00 line (Industrial Arterial 4.50 line)
- Hydrant valves 1.0m from water line
- Service valves on 3.00 line (Industrial Arterial 4.50 line)
- Hydrants and service valves shall maintain a minimum 3.0m separation to centre line of power poles, streetlights, trees, and the edge of transformers, pull boxes, junction terminals and other surface structures
- Trees offset minimum 1.0m from sidewalk and pathway, and on centre line in median
- Trees shall be of a species as approved by Parks
- All trees to be shallow root species
- Tree planting not permitted under overhead power lines unless non-canopy trees are specified
- Bus loading zones must be considered when locating trees and underground/surface utilities
- Gas feeder mains in roadway, distribution line in boulevard, opposite side from overhead
- Typical 2% grade for road cross-slope and boulevards
- Water main will be installed on the opposite side of the road from storm and sanitary lines
- Additional separation may be required between storm and sanitary sewers if excessive vertical difference occurs
- Manholes in roadway will be installed outside of wheel paths
- Pre-installed service connections to be installed 3.50 inside P.L. or 5.00 m inside P.L. when crossing gas and one other shallow utility
- This standard is intended as a guideline for new development, where not applicable make adjustments as required
- Offsetting roadway centreline within the right-of-way is not recommended due to future utility conflicts
- Road, boulevard and right-of-way may vary to accommodate bicycle facilities

NOTE: details for bicycle and L.I.D. facilities are still under development

Dimensions are Metres Unless Otherwise Noted — METRIC

			Drawn	Date	THE CITY OF CALGARY ROADS
			Scale: NTS		COLLECTOR (PARKING BOTH SIDES)
			Approved for City Engineer		
					Sheet
					File Number:





Notes:

- Utility line assignments must be confirmed during the planning stage
- Hydrants on 3.00 line (Industrial Arterial 4.50 line)
- Hydrant valves 1.0m from water line
- Service valves on 3.00 line (Industrial Arterial 4.50 line)
- Hydrants and service valves shall maintain a minimum 3.0m separation to centre line of power poles, streetlights, trees, and the edge of transformers, pull boxes, junction terminals and other surface structures
- Trees offset minimum 1.0m from sidewalk and pathway, and on centre line in median
- Trees shall be of a species as approved by Parks
- All trees to be shallow root species
- Tree planting not permitted under overhead power lines unless non-canopy trees are specified
- Bus loading zones must be considered when locating trees and underground/surface utilities
- Gas feeder mains in roadway, distribution line in boulevard, opposite side from overhead
- Typical 2% grade for road cross-slope and boulevards
- Water main will be installed on the opposite side of the road from storm and sanitary lines
- Additional separation may be required between storm and sanitary sewers if excessive vertical difference occurs
- Manholes in roadway will be installed outside of wheel paths
- Pre-installed service connections to be installed 3.50 inside P.L. or 5.00 m inside P.L. when crossing gas and one other shallow utility
- This standard is intended as a guideline for new development, where not applicable make adjustments as required
- Offsetting roadway centreline within the right-of-way is not recommended due to future utility conflicts
- Road, boulevard and right-of-way may vary to accommodate bicycle facilities

NOTE: details for bicycle and L.I.D. facilities are still under development

BASE WITH OVERHEAD POWER POLE (POWER + COMMUNICATIONS)

			Drawn	Date	THE CITY OF CALGARY ROADS
			Scale: NTS		INDUSTRIAL STREET (NO PARKING)
			Approved for City Engineer		

Dimensions are Metres Unless Otherwise Noted — METRIC

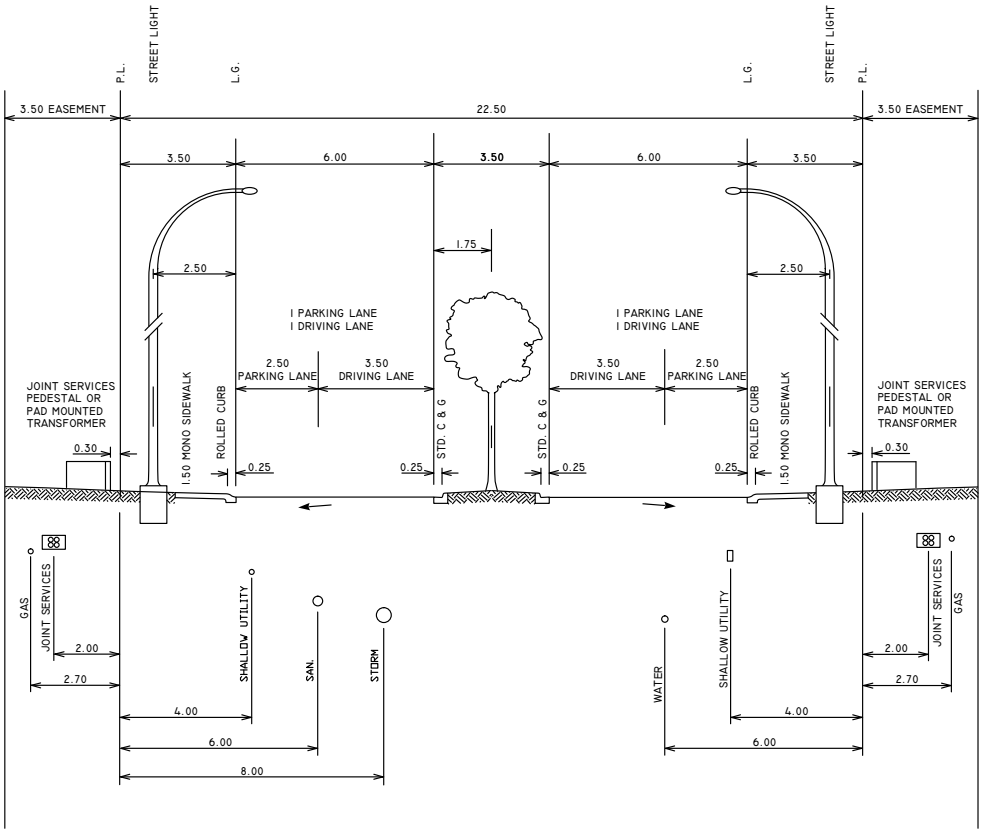
Sheet

File Number:

TO BE DETERMINED THROUGH RESIDENTIAL STREETS POLICY WORK (2012)

				Drawn	Date	THE CITY OF CALGARY Roads	Sheet
				Scale: NTS		RESIDENTIAL STREET	File Number:
				Approved for City Engineer			

Dimensions are Metres
Unless Otherwise Noted
METRIC



FOR FLANKAGE LOTS

Notes:

- Utility line assignments must be confirmed during the planning stage
- Hydrants on 3.00 line (Industrial Arterial 4.50 line)
- Hydrant valves 1.0m from water line
- Service valves on 3.00 line (Industrial Arterial 4.50 line)
- Hydrants and service valves shall maintain a minimum 3.0m separation to centre line of power poles, streetlights, trees, and the edge of transformers, pull boxes, junction terminals and other surface structures
- Trees offset minimum 1.0m from sidewalk and pathway, and on centre line in median
- Trees shall be of a species as approved by Parks
- All trees to be shallow root species
- Tree planting not permitted under overhead power lines unless non-canopy trees are specified
- Bus loading zones must be considered when locating trees and underground/surface utilities
- Gas feeder mains in roadway, distribution line in boulevard, opposite side from overhead
- Typical 2% grade for road cross-slope and boulevards
- Water main will be installed on the opposite side of the road from storm and sanitary lines
- Additional separation may be required between storm and sanitary sewers if excessive vertical difference occurs
- Manholes in roadway will be installed outside of wheel paths
- Pre-installed service connections to be installed 3.50 inside P.L. or 5.00 m inside P.L. when crossing gas and one other shallow utility
- This standard is intended as a guideline for new development, where not applicable make adjustments as required
- Offsetting roadway centreline within the right-of-way is not recommended due to future utility conflicts
- Road, boulevard and right-of-way may vary to accommodate bicycle facilities

FOR FRONTAGE LOTS

L.G. TO L.G. DIMENSION 6.50m

R.O.W. DIMENSION 23.50m

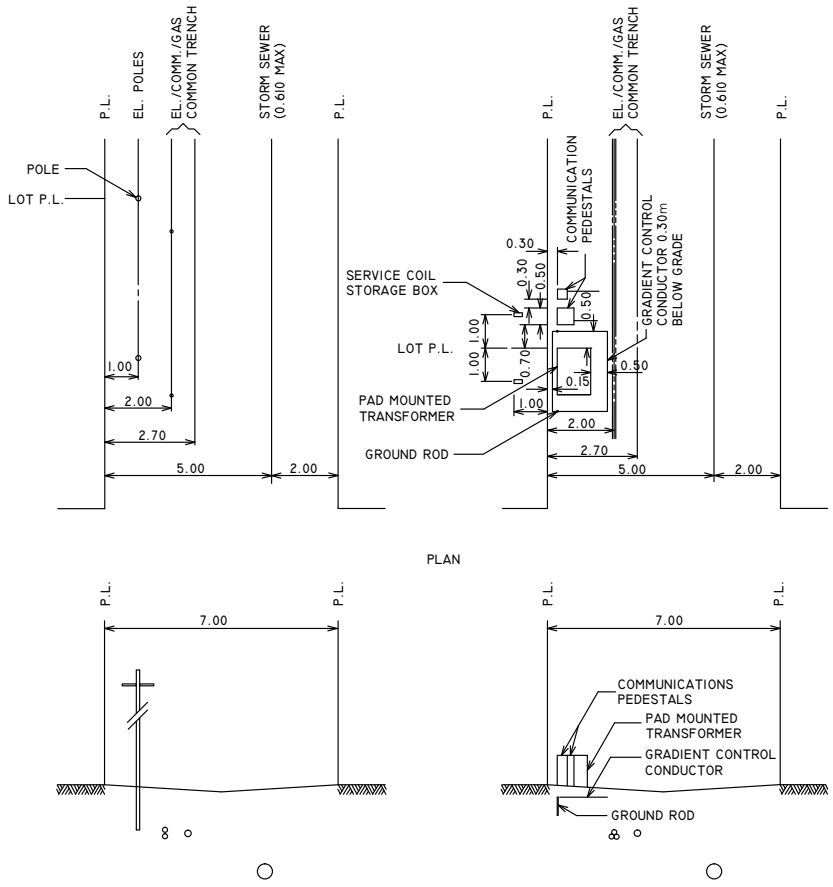
NOTE: details for bicycle and L.I.D. facilities are still under development

				Drawn	Date	THE CITY OF CALGARY ROADS
				Scale: NTS		RESIDENTIAL STREET-ENTRANCE
				Approved for City Engineer		

Dimensions are Metres Unless Otherwise Noted — METRIC

Sheet

File Number:



ELECTRICAL DISTRIBUTION (OVERHEAD)

NOTE: 1. THE MAXIMUM SIZE OF STORM IS 610MM (24") DIAMETER & MAXIMUM DEPTH OF 3.50M

ELECTRICAL DISTRIBUTION (UNDERGROUND)

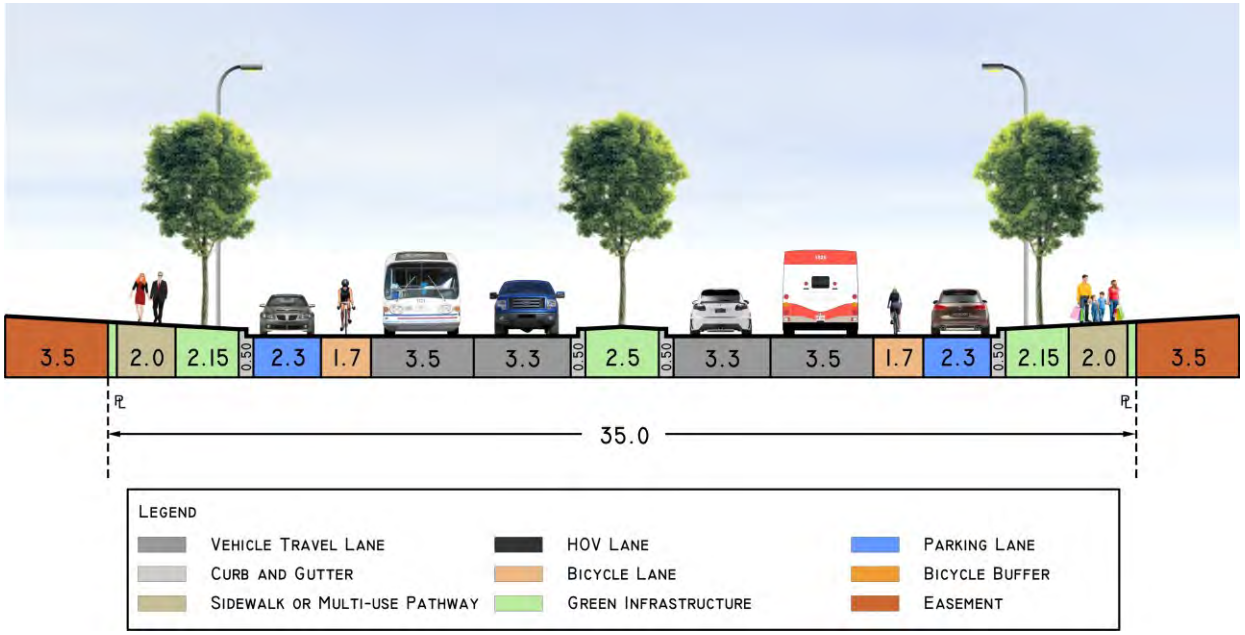
EL/COMM/GAS COMMON TRENCH

COMMUNICATION PEDESTAL PLACEMENTS TO BE DETERMINED IN FIELD

		Drawn / Date	THE CITY OF CALGARY ROADS	Sheet
		Scale: NTS	LANE (ALLEY) 7.00m WIDTH	File Number:
		Approved for City Engineer		

Dimensions are Metres Unless Otherwise Noted — METRIC

PRIMARY COLLECTOR - HIGH CAPACITY / COMMERCIAL FRONTAGE



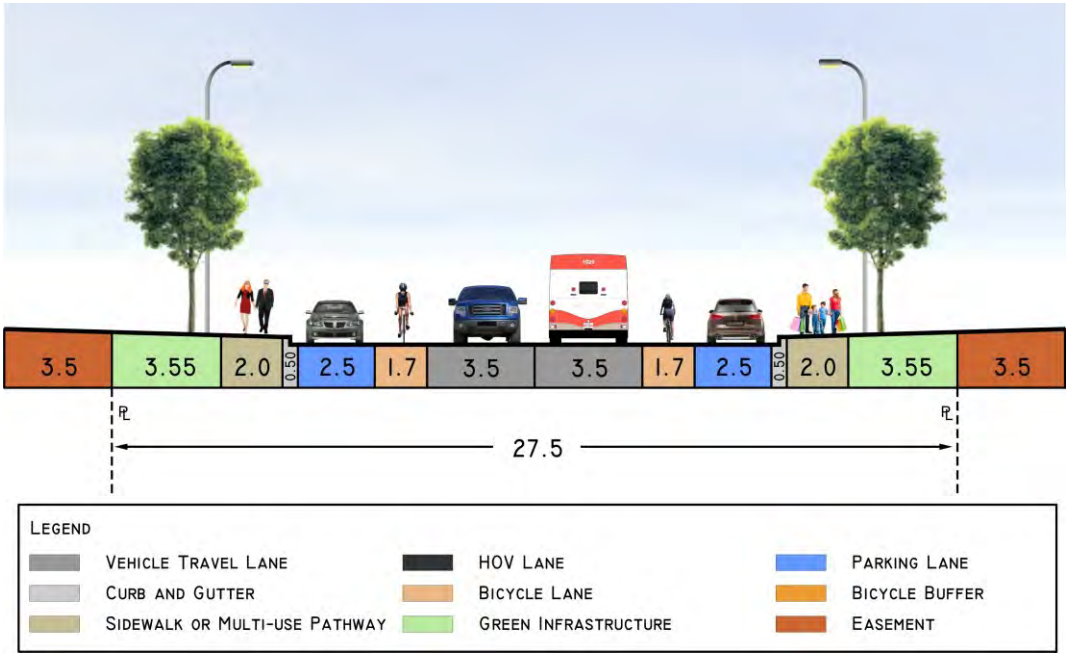
MUST USE IF

- Commercial frontage covering > 50 m of at least one side of roadway between adjacent all-turns intersection

MAY USE IF

- Long range daily volumes ≥ 9,000 vpd

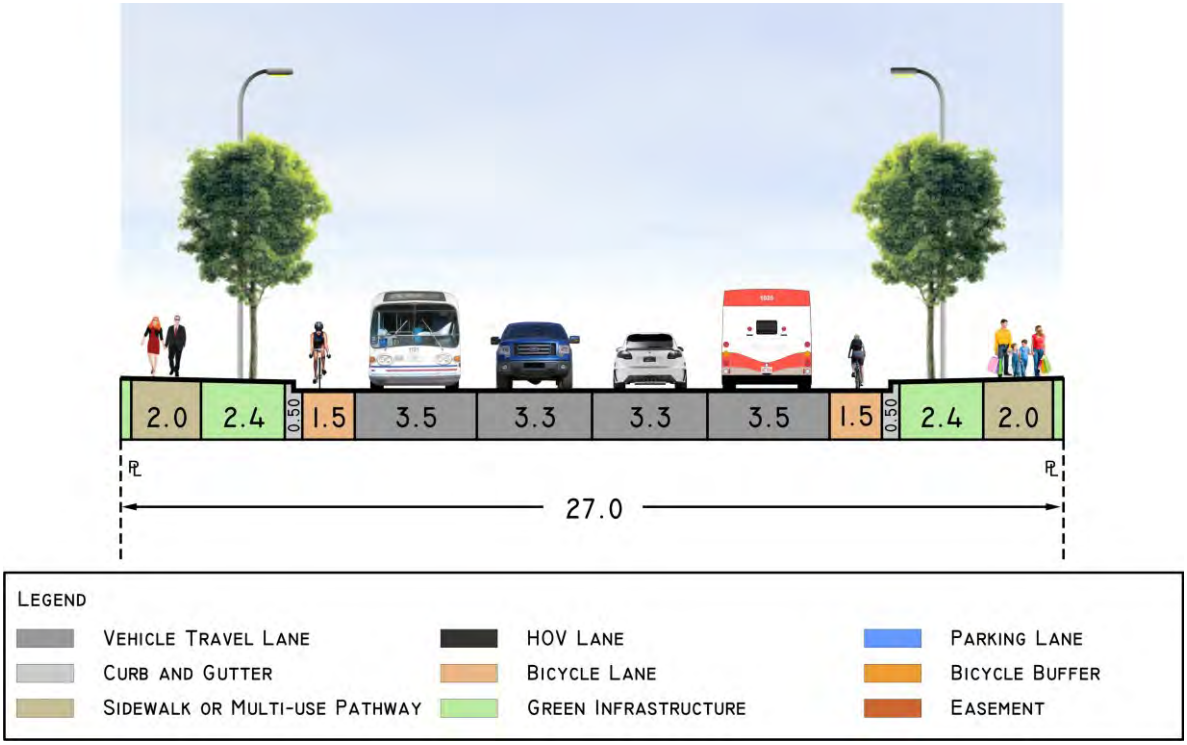
PRIMARY COLLECTOR - ENHANCED BOULEVARD



MAY USE IF

- Additional boulevard space will be used to accommodate LID infrastructure or larger trees than can be accommodated in standard cross-section AND
- Long range daily volume < 9,000 vpd

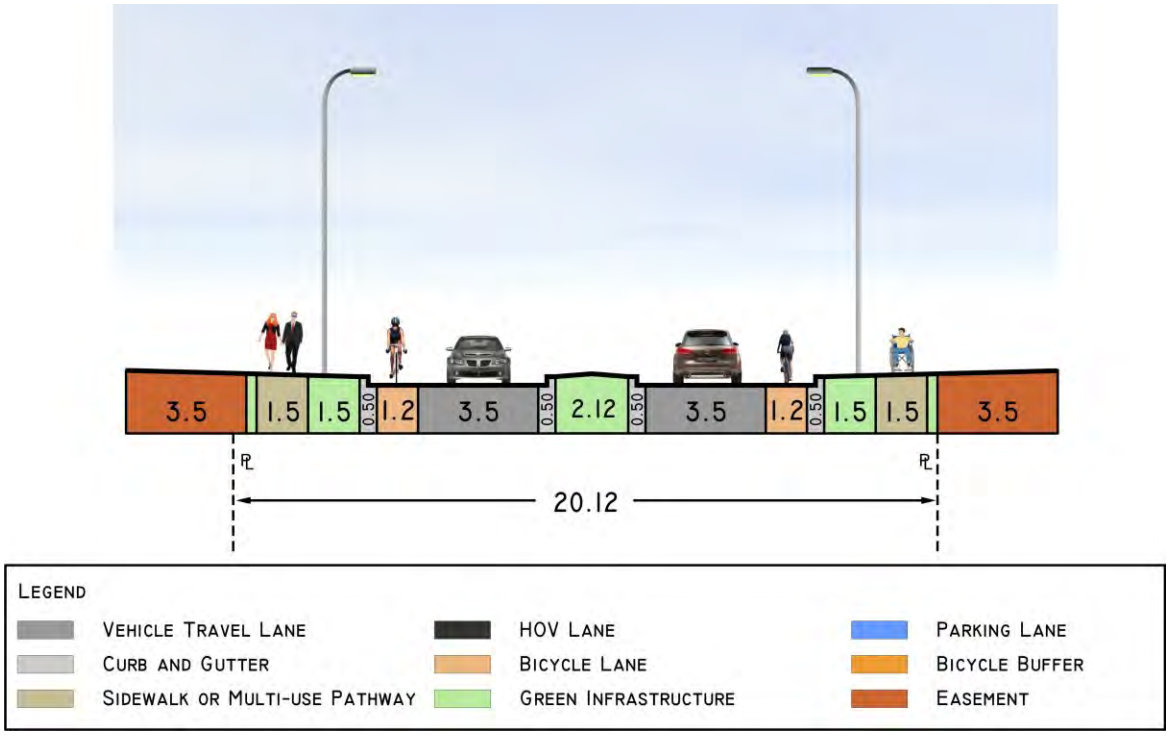
PRIMARY COLLECTOR - UNDIVIDED



MAY USE IF

- Roadway is adjacent to residential flankage only

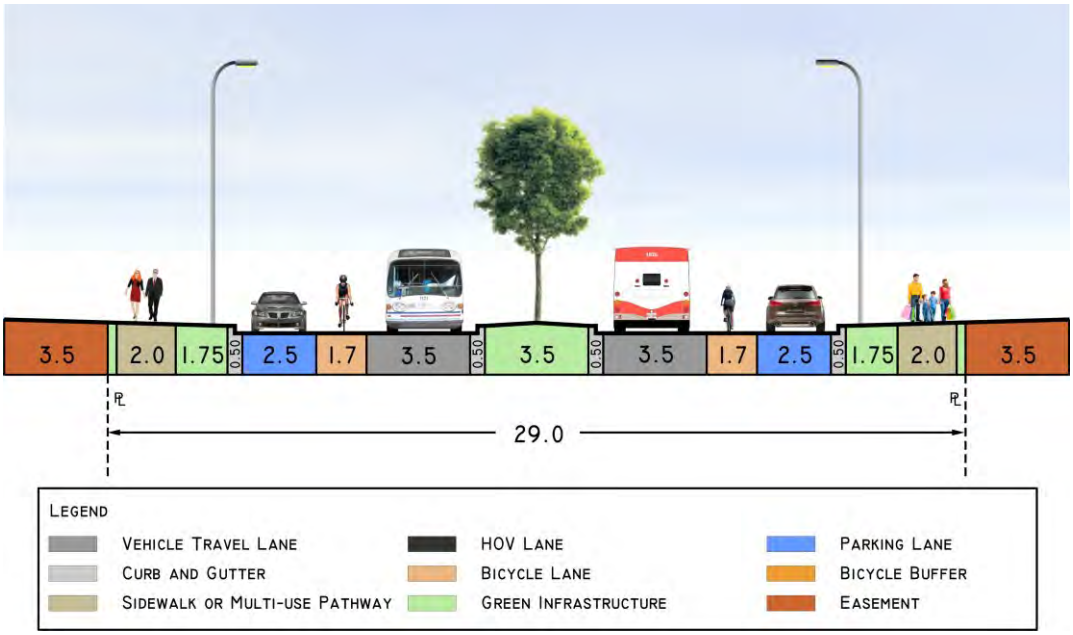
PRIMARY COLLECTOR - CONSTRAINED ROW



MAY USE IF

- ROW is limited below 23 m due to existing long-term development AND
- No bus routes are planned along the roadway

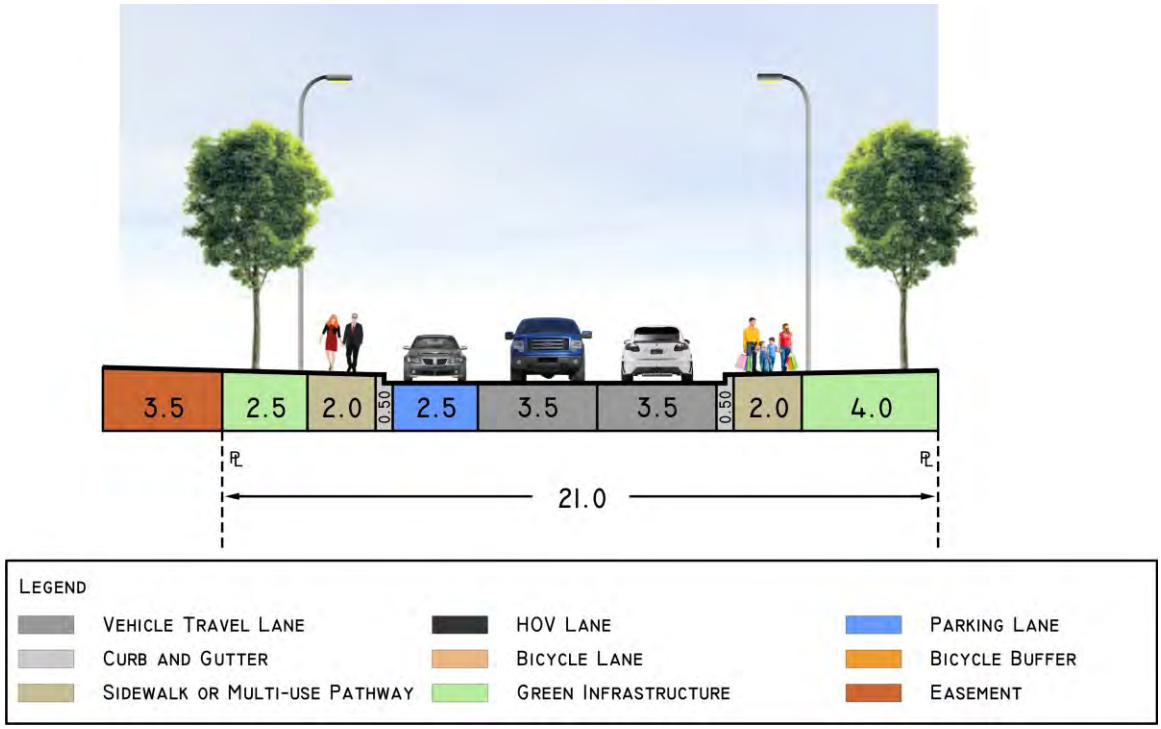
PRIMARY COLLECTOR - ENHANCED MEDIAN



MAY USE IF

- Larger trees will be provided in median than can be accommodated in standard cross-section

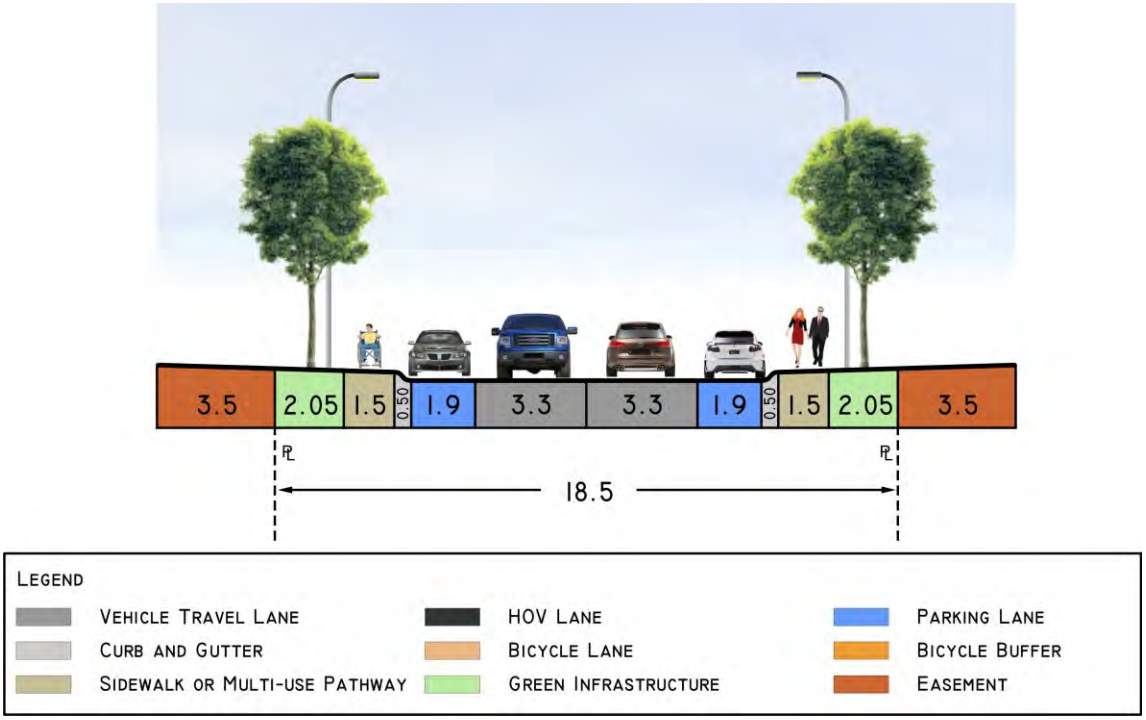
COLLECTOR - ENHANCED GREENSCAPE



MAY USE IF

- Development on side without parking is limited to park / green space
- Park / green space is not active recreational

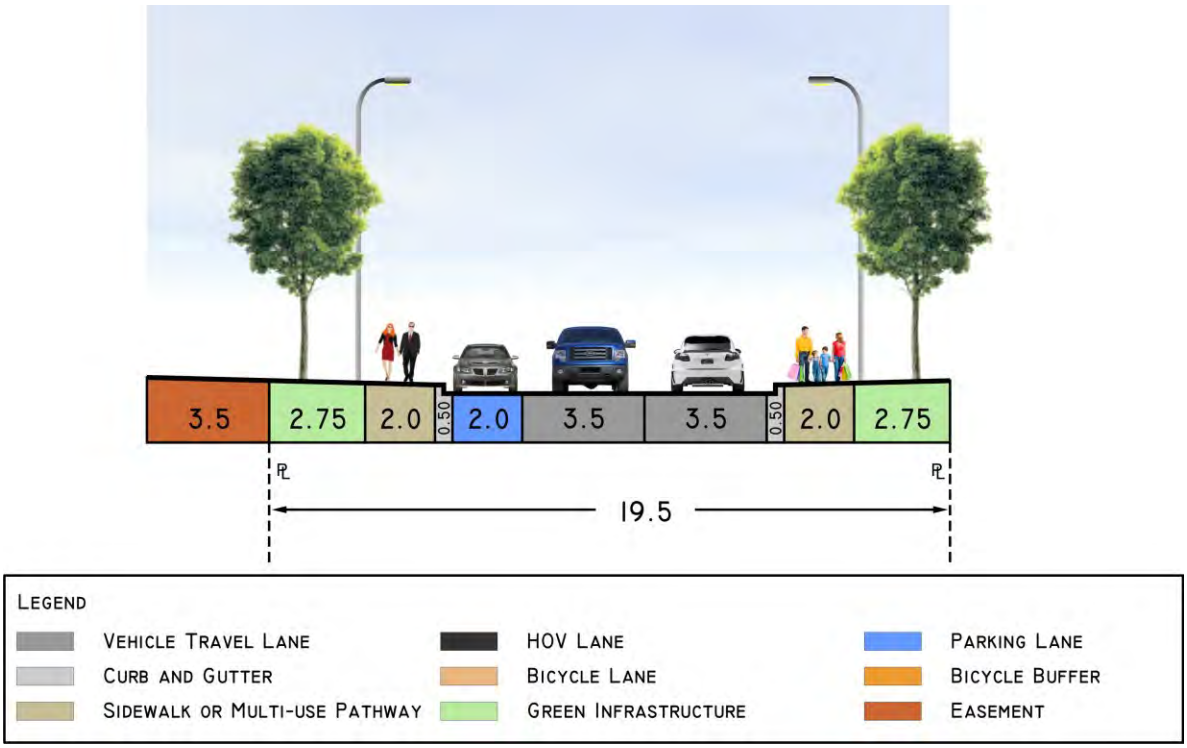
COLLECTOR - CONSTRAINED ROW



MAY USE IF

- ROW is restricted below 21.0 m by long-term existing development
- No bus routes are planned along roadway
- Rolled curb used adjacent to 1.9m parking lane

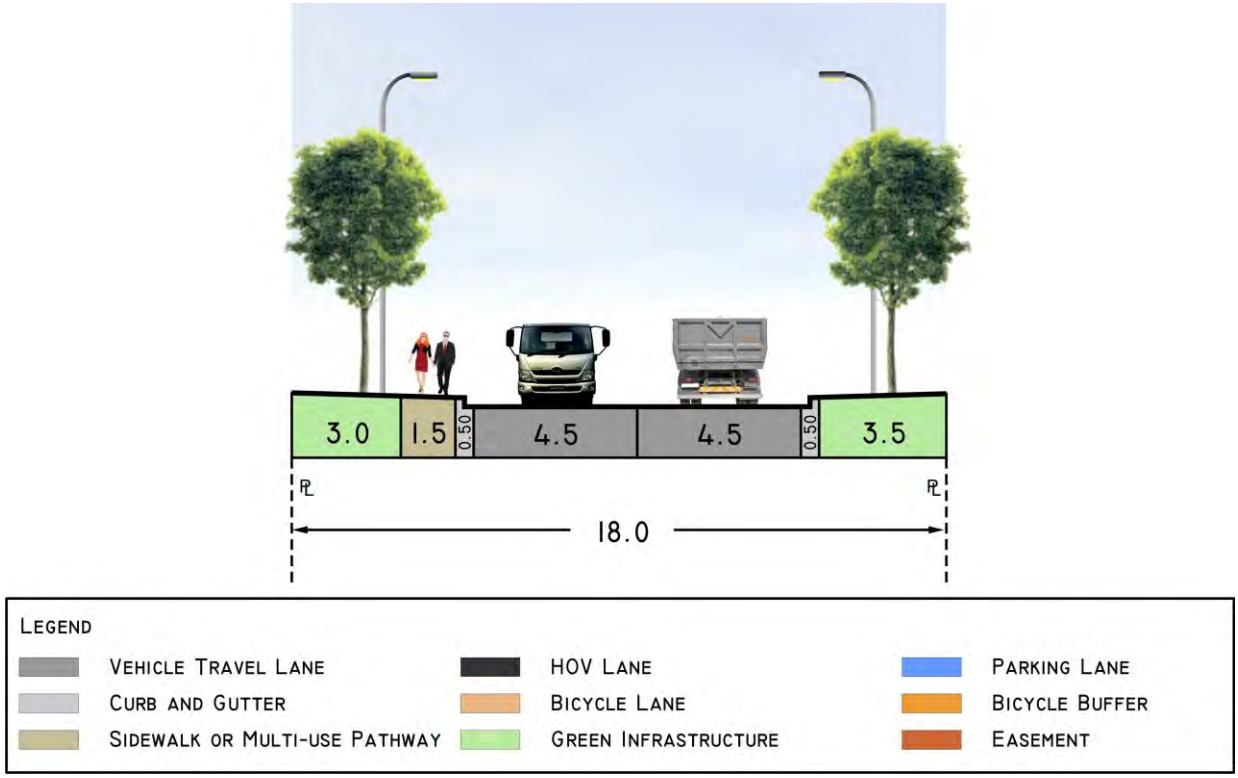
COLLECTOR - RESIDENTIAL FLANKAGE



MAY USE IF

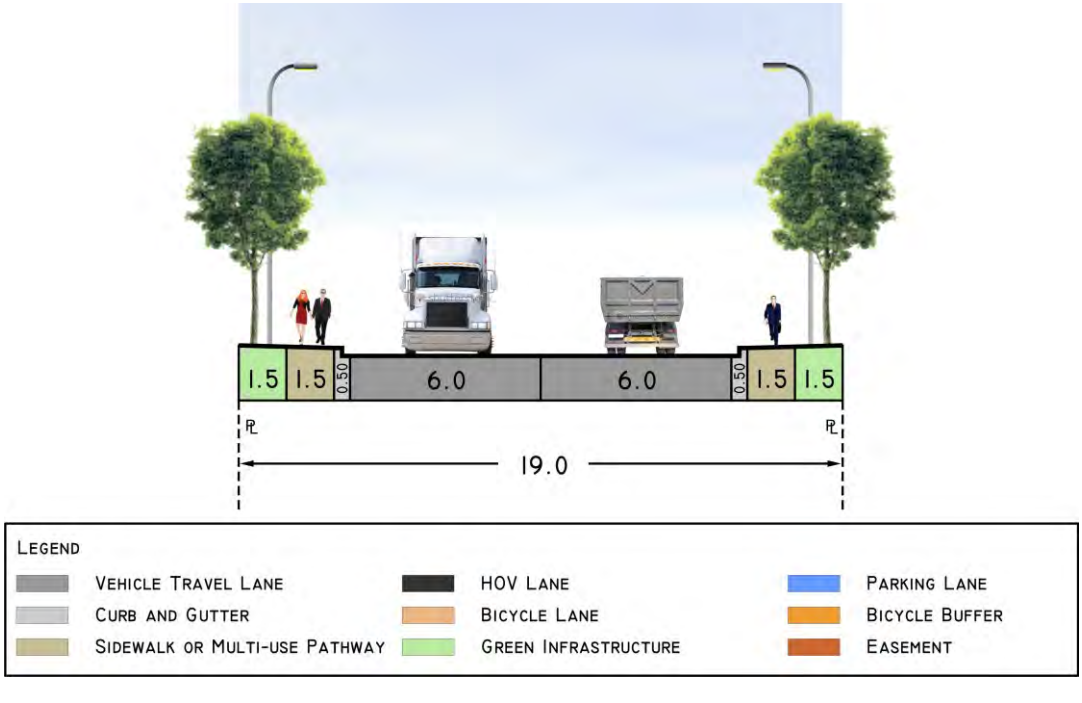
- Development on side without parking is limited to flankage residential

INDUSTRIAL STREET - LOW DENSITY



- Only in low-density industrial development areas
- Parking is not permitted

INDUSTRIAL STREET - 12.0 M ROADWAY



MUST BE USED IF

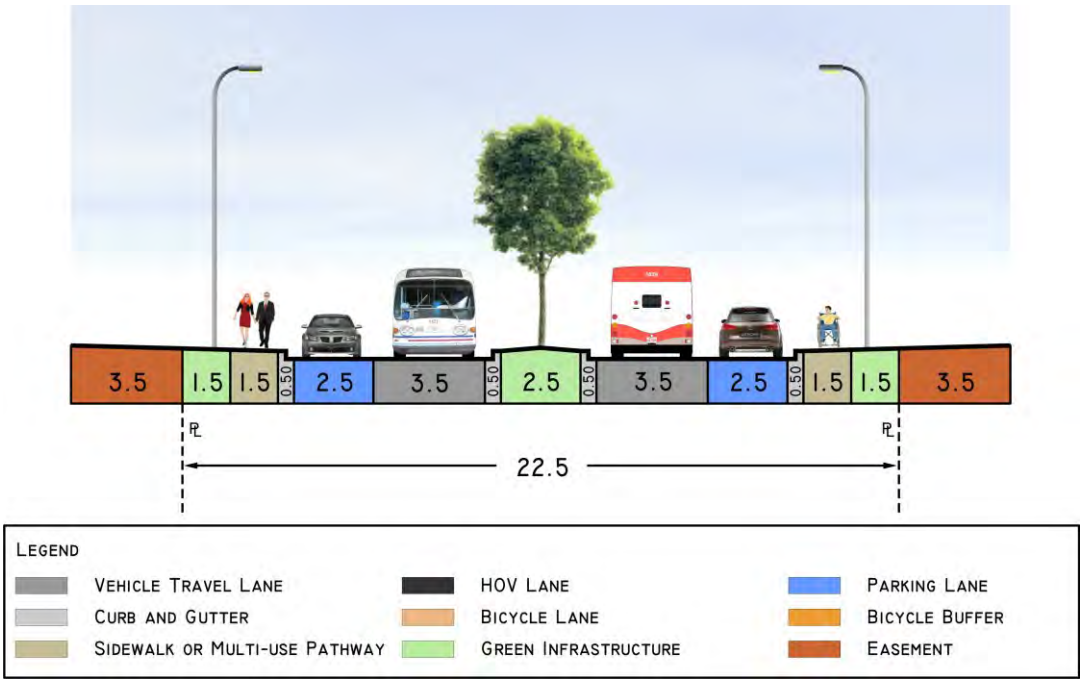
- Daily volumes > 5,000 vpd

MAY BE USED IF

- Required to accommodate large vehicle traffic for adjacent industrial parks

Note: Parking permitted

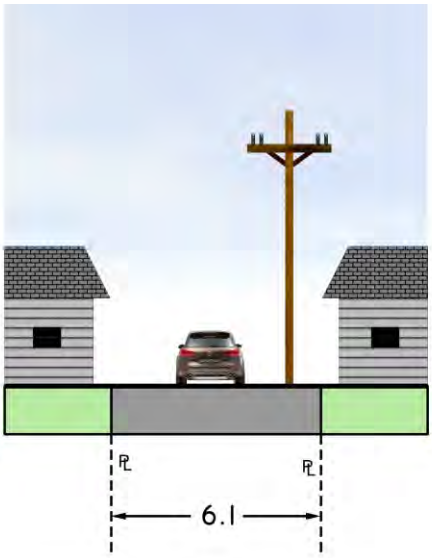
RESIDENTIAL - ENTRANCE STREET



MAY BE USED IF

- No restriction on use

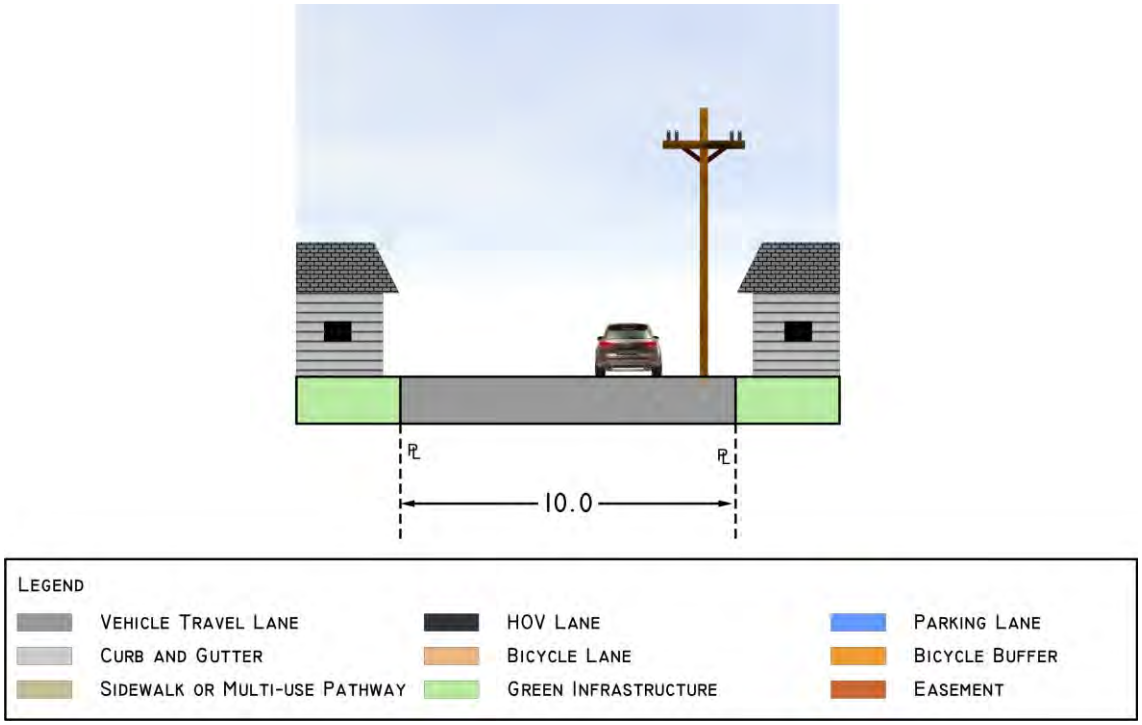
LANE - CONSTRAINED ROW



MAY BE USED IF

- ROW constrained below 7.0 m by existing long-term development

LANE - DEEP UTILITY ASSIGNMENT



MAY BE USED IF

- Deep utilities provided to adjacent development via lane

CHAPTER 10

INTERSECTION DESIGN

10.1 GENERAL GUIDELINES

10.1.1 INTRODUCTION

Most conflicts between street users occur at intersections, where travelers cross each other's path. Good intersection design indicates to those users approaching the intersection what they must do and who has to yield. Exceptions to this include places where speeds are low (typically less than 30 km/h) or where a shared space design ("naked streets") causes users to approach intersections with caution. Conflicts for pedestrians and bicyclists are exacerbated due to their greater vulnerability, lesser size, and reduced visibility to other users.

This chapter describes design considerations in intersection geometry and intersection signalization, as well as roundabouts and other features to improve safety, accessibility, and mobility for all users. The benefits and constraints of each feature are examined, and the appropriate use and design of each feature are described.

10.1.2 ESSENTIAL PRINCIPLES OF INTERSECTION DESIGN

The following principles apply to the design of all intersections:

- Intersections must be designed to accommodate all applicable modes of transportation safely.
- Good intersection designs are compact.
- Unusual conflicts should be avoided.
- Simple right-angle intersections are best for all users since many intersection problems are worsened at skewed and multi-legged intersections.
- Free-flowing movements should be avoided at intersections.
- Access management practices should be used to remove additional vehicular conflict points near the intersection.
- Traffic signal timing should consider the safety and convenience of all users and should not hinder bicycle or foot traffic with overly long waits or crossing times that are too short.

Intersection geometry is a critical element of intersection design, regardless of the type of traffic control used. Geometry sets the basis for how all users traverse intersections and interact with each other. The principles of intersection geometry apply to both street intersections and freeway on- and off-ramps.

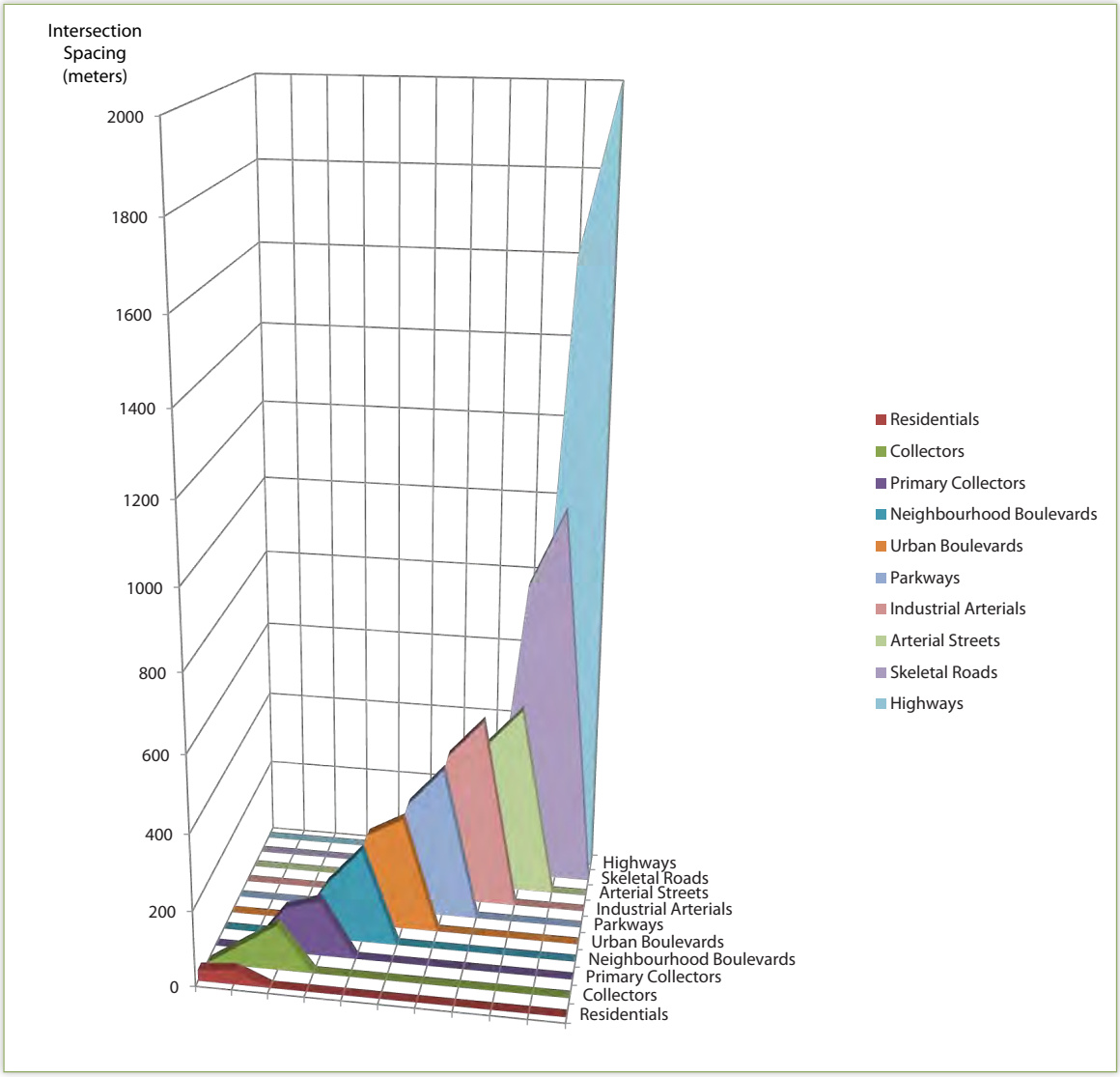
10.1.3 INTERSECTION AND ACCESS CONTROL

Intersection (or access) spacing is dictated by the function of a street and the land use it serves. In general terms, the higher the design speed and the higher the intended vehicle capacity of a street, the larger the required intersection spacing. Figure 10-1 illustrates the approximate intersection spacing (in metres) for each classification within the 2011 road and street palette.

Intersection spacing on Arterial Streets is most dependent on adjacent land use intensity and posted traffic speed. Higher intersection spacing is appropriate when passing through areas of lower densities

(40 or less persons per hectare and 40 or less jobs per hectare) and with higher posted speeds (70 km/h). Shorter intersection spacing is appropriate in areas of greater density (greater than 40 persons per hectare and greater than 40 jobs per hectare) and with lower posted speeds (50 km/h).

FIGURE 10-1



10.1.4 INTERSECTION SKEW

Skewed intersections are generally undesirable, because they introduce the following complications for all users:

- The travel distance across the intersection is greater, which increases exposure to conflicts and lengthens signal phases for pedestrians and vehicles.
- Skewed intersections can provide poor sight lines, which can be improved by reducing the skew angle.
- Obtuse angles encourage speeding.

THE MAXIMUM ALLOWABLE INTERSECTION ANGLE IN CALGARY IS 75°.

To alleviate the problems with existing angled intersections, several options are available:

- Every reasonable effort should be made to design or redesign the intersection closer to a right angle. Additional right-of-way may need to be provided, but this can be offset by the larger area no longer needed for the intersection, which can be sold back to adjoining property owners or reallocated for a pocket park, rain garden, greenery, or other such use where practical.
- Pedestrian refuges should be provided if the crossing distance exceeds approximately 12 metres.
- General use travel lanes and bike lanes may be striped with dashes to guide cyclists and motorists through a long undefined area.

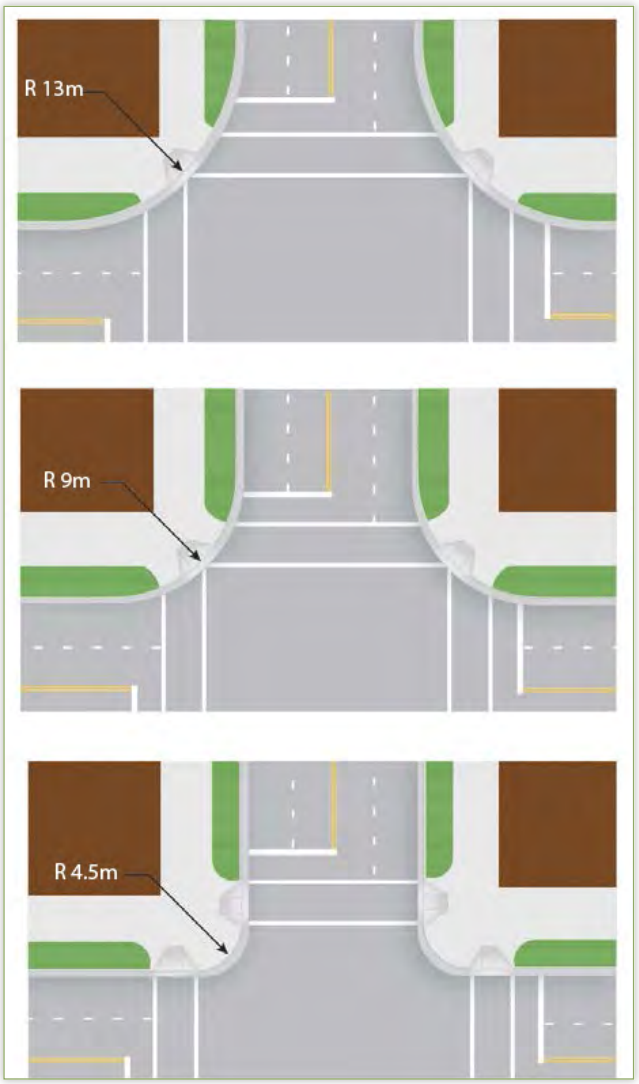
MULTI-LEG INTERSECTIONS (more than two approaching streets) are generally undesirable and introduce the following complications for all users:

- Multiple conflict points are added as users arrive from several directions.
- Users may have difficulty assessing all the approaches to identify all possible conflicts.
- At least one leg will be skewed.
- Users must cross more lanes of traffic and the total travel distance across the intersection is increased.

To alleviate the problems with multi-leg intersections, several options are available:

- Every reasonable effort should be made to design the intersection so there are no more than four legs. This is accomplished by removing one or more legs from the major intersection and creating a minor intersection further upstream or downstream.
- As an alternative, one or more of the approach streets can be closed to motor vehicle traffic, while still allowing access for pedestrians and cyclists.
- A roundabout should be considered if the other options are not practicable or if the setting is appropriate within a corridor.
- Pedestrian refuges should be created if the crossing distance exceeds approximately 14 metres.
- General use travel lanes and bike lanes may be striped with dashes to guide bicyclists and motorists through a long undefined area.

10.1.5 CORNER RADII



Tighter corner radii reduce crossing distance and slow turning traffic. (Credit: Michele Weisbart)

This intersection geometry feature has a significant impact on the comfort and safety of non-motorized users. Smaller corner radii should be used whenever feasible, as they provide the following benefits:

- Smaller, more pedestrian-scale intersections
- Reduced pedestrian crossing distance and crossing time
- Slower vehicular turning speeds
- Better geometry for installing perpendicular ramps for both crosswalks at each corner
- Simpler, more appropriate crosswalk placement, in line with the approaching sidewalks

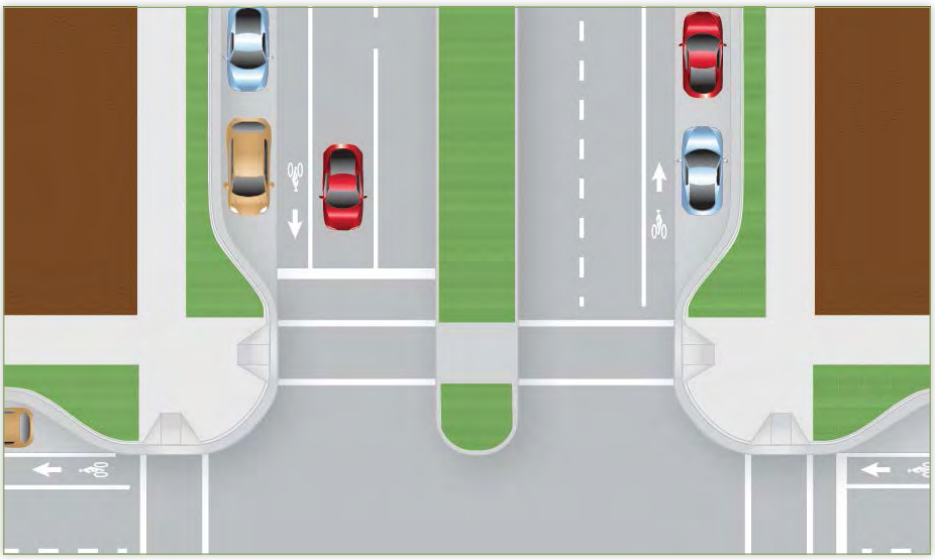
The application of corner radii needs to consider both the street classification and the land-use/vehicle setting. Smaller curb radii are not applicable on Skeletal Road or Industrial Arterial/Street intersections.

Larger design vehicles such as the transit bus or single-unit truck should be used only where they are known to regularly make turns at the intersection, and corner radii should be designed based on the larger design vehicle traveling at slow speed. In addition, designers should consider the effect that bicycle lanes and on-street parking have on the effective radius, increasing the ease with which large vehicles can turn. For example, all intersections must be capable of accommodating EMS vehicles, but such vehicles make use of the entire available pavement at the intersections.

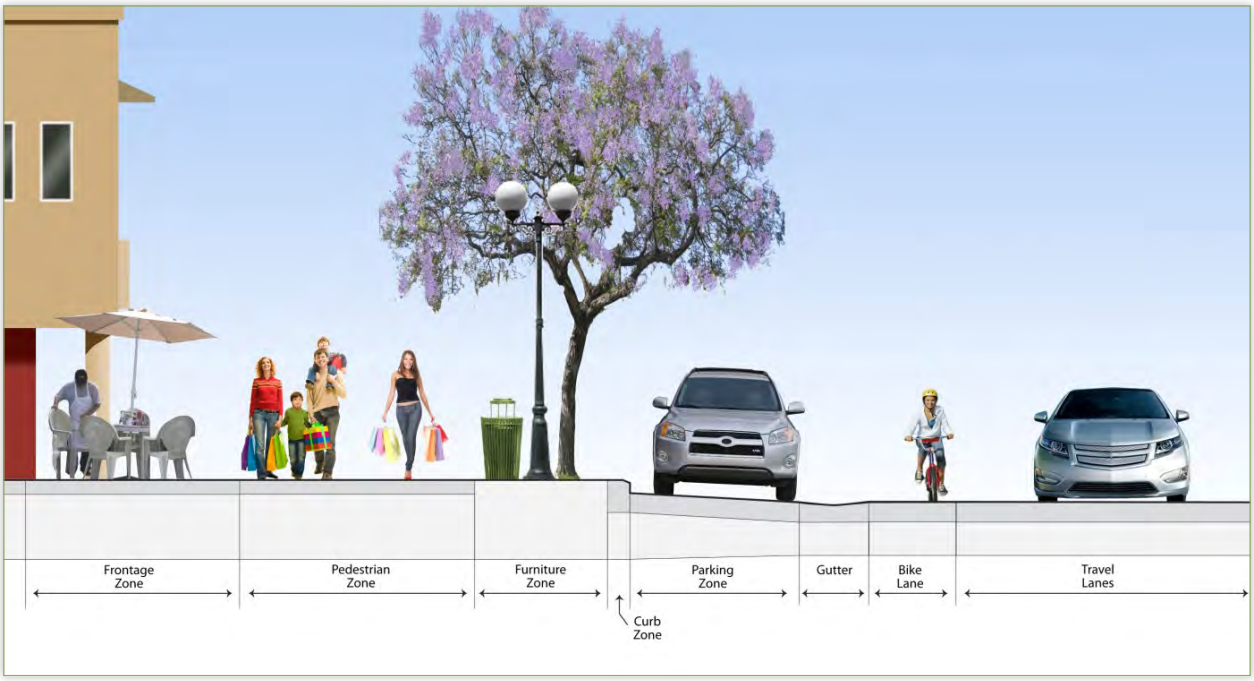
Encroachment by large vehicles onto multiple receiving lanes is acceptable. When a design vehicle larger than the passenger vehicle is used, the truck or bus should be allowed to turn into all available receiving lanes. As described in Chapter 9, "Street Design", larger, infrequent vehicles (the 'control vehicle') can be allowed to encroach on multiple departure lanes and partway into opposing traffic lanes.

10.1.6 CURB EXTENSIONS

Where on-street parking is allowed, curb extensions should be considered to replace the parking lane at crosswalks on Liveable Streets (and on some Local Streets). Curb extensions should be the same width as the parking lane. The appropriate corner radius should be applied based on the guidance in the previous section (10.1.5). Due to reduced street width, the corner radius on a curb extension may need to be larger than if curb extensions were not installed.



Integrating curb extensions and on-street parking into the sidewalk corridor enhances pedestrian safety and the walking experience. (Credit: Michele Weisbart)



An example of integrating curb extensions and parking into the sidewalk corridor by placing a reverse gutter between the parking and the traveled way. (Credit: Michele Weisbart)

Curb extensions are not applicable on Skeletal Roads and all classes of Arterial Streets in Calgary, but are applicable on the other street types noted above.

They offer many benefits related to liveability:

- Reduced pedestrian crossing distance resulting in less exposure to vehicles and shorter pedestrian clearance intervals at signals

- Improved intersection safety - prevents 'passing on the right' where pedestrian visibility is severely limited
- Improved visibility between pedestrians and motorists
- Control of parking near intersections
- A narrowed roadway, which has a potential traffic calming effect
- Additional room for street furniture, landscaping, and curb ramps
- Slower turning vehicles
- Management of streetwater runoff

10.1.7 ACCOMMODATION OF TRANSIT VEHICLES

All transit trips begin and end with a pedestrian or bicycle trip, and connections between one route and another also involve a walk movement, so all the points related to comfortable, safe and convenient accommodation of pedestrians in Complete/Liveable Streets apply equally to transit users. In addition, intersection designs need to make the following specific provisions for safe and convenient operation of buses:

- Transit stops should be located past a curb extension wherever possible. (Note: Not applicable to Skeletal Roads and Industrial Arterials or where Design/Posted speeds are greater than 60 km/h, or transit timepoint locations).
- Bus bays are not desired on all street classifications, as they impede buses ability to merge back into traffic. Bus bays are desirable in the following locations:
  - » LRT stations
  - » Transfer locations
  - » Timepoints
  - » Schools
  - » Streets with Design/Posted speeds greater than 60 km/h
  - » Streets with dedicated carpool or HOV lanes

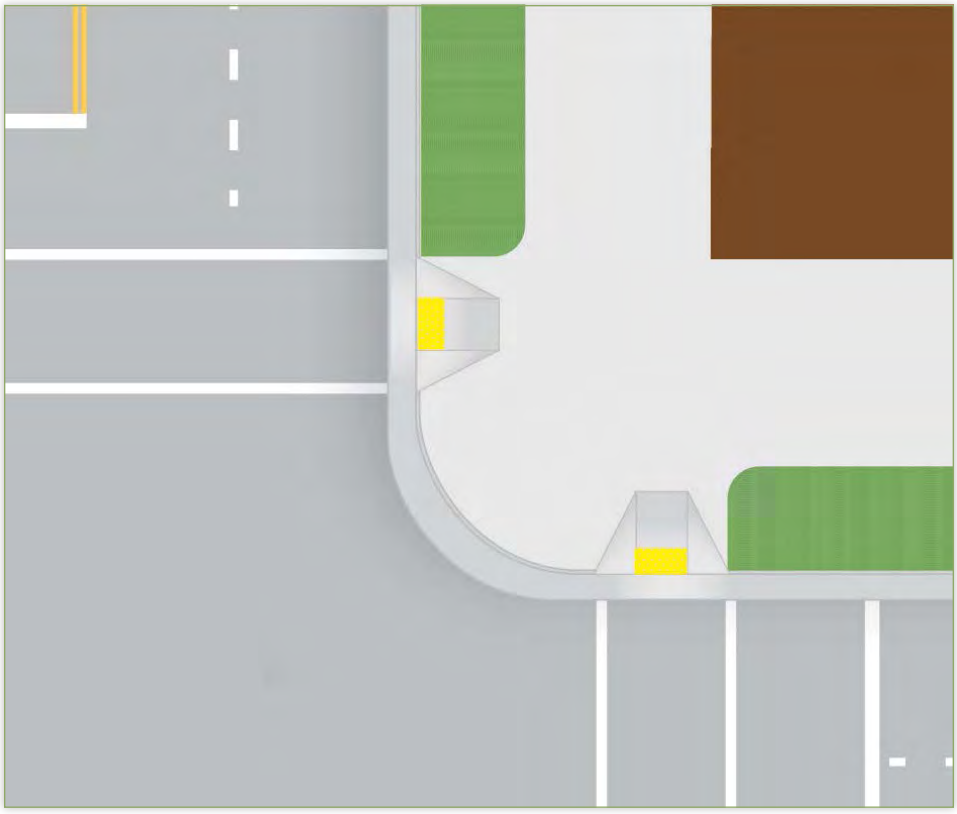
Typical bus bay treatments at Arterial intersections, together with transit zone arrangements at mid-block bulb-out locations are provided in Chapter 5 of the Guide.

10.1.8 CROSSWALK AND RAMP PLACEMENT

Crosswalks and ramps at intersections should be placed so they provide convenience and safety for pedestrians. The following recommended practices will help achieve these goals:

- Allow crossings on all legs of an intersection, unless there are no pedestrian-accessible destinations on one or more of the corners.
- Provide marked crosswalks at signalized intersections.
- Place crosswalks as close as possible to the desire line of pedestrians, which is generally in line with the approaching sidewalks.

- Provide as short as possible a crossing distance to reduce the time that pedestrians are exposed to motor vehicles; this is usually as close as possible to right angles across the roadway, except for at skewed intersections.
- Provide one ramp per crosswalk (two per corner for standard intersections with no closed crosswalks). Ramps must be entirely contained within a crosswalk (the crosswalk can be flared to capture a ramp that cannot be easily relocated). Align the ramp run with the crosswalk when possible, as ramps that are angled away from the crosswalk may lead some users into the intersection. At intersections where streets are skewed or where larger radii are necessary for trucks, it can be difficult to determine the best location for crosswalks and sidewalk ramps. In these situations, it is important to balance the recommended practices above. Tighter curb radii make implementing these recommendations easier.



One curb ramp per crosswalk should be provided at corners. Ramps should align with sidewalks and crosswalks. (Credit: Michele Weisbart)

10.1.9 RIGHT-TURN CHANNELIZATION ISLANDS

Right-turn lanes should generally be avoided on Complete Streets, as they increase the size of the intersection, the pedestrian crossing distance, and the likelihood of right-turns-on-red by inattentive motorists who do not notice pedestrians on their right. In particular, right-turn channelization should be avoided in intersections having pedestrian, cycling and transit priority.

However, in the case where an intersection approach has a high (at least 200 vehicles per hour) right-turn volume, a right-turn lane may be the best solution to provide additional vehicle capacity without adding additional lanes elsewhere in the intersection. Where a channelized right-turn island is required, pedestrian safety and accessibility need to be incorporated into their design.

For turns onto streets with only one through lane and where truck turning movements are rare, providing a small corner radius for the right-turn lane often provides the best solution for pedestrians' safety and comfort. However, at intersections of multi-lane streets where trucks make frequent right turns, a raised channelization island between the through lanes and the right-turn lane is a good alternative to an overly large corner radius, and also enhances pedestrian safety and access. If designed correctly, a raised island can achieve the following objectives:

- Allow pedestrians to cross fewer lanes at a time
- Allow motorists and pedestrians to judge the right-turn/pedestrian conflict separately
- Reduce pedestrian crossing distance, which can improve signal timing for all users
- Balance vehicle capacity and truck turning needs with pedestrian safety
- Provide an opportunity for landscape and hardscape enhancement (on the island)

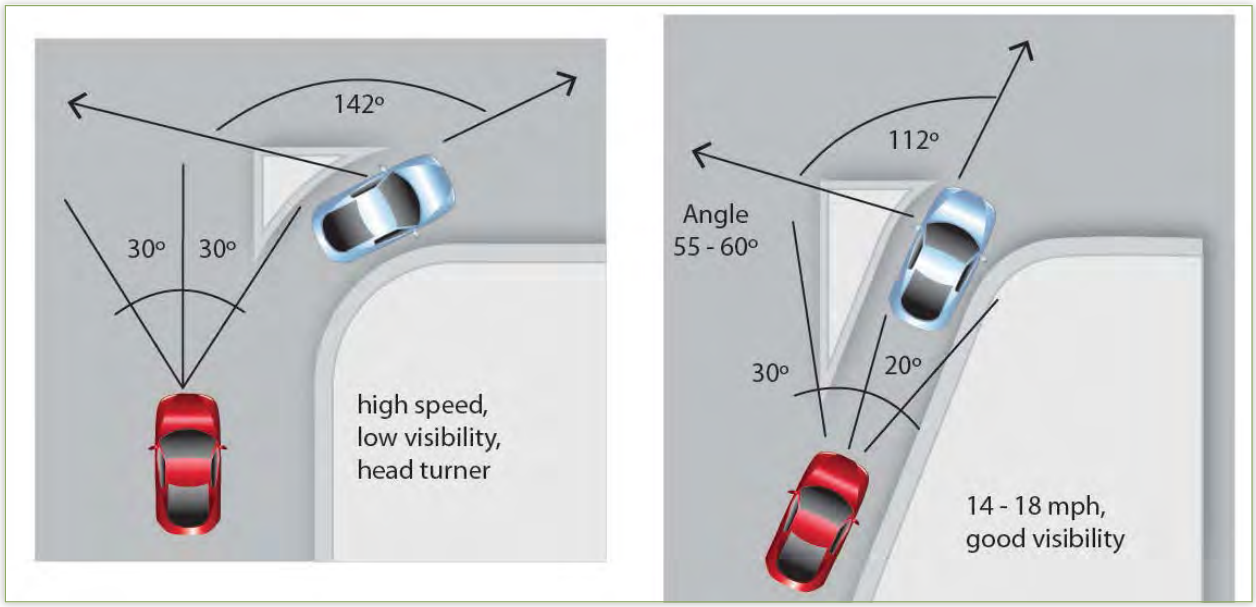
The following design practices for right-turn lane channelization islands should be used to provide safety and convenience for pedestrians, bicyclists, and motorists:

- Provide a yield sign for the turning lane
- Provide at least a 60-degree angle between vehicle flows, which reduces turning speeds and improves the yielding driver's visibility of pedestrians and vehicles on the cross-street
- Place the crosswalk across the right-turn lane about one car length back from where drivers yield to traffic on the other street, allowing the yielding driver to respond to a potential pedestrian conflict first, independently of the vehicle conflict, and then move forward, with no more pedestrian conflict

These goals are best accomplished by creating an island that is roughly twice as long as it is wide. The corner radius will typically have a long radius (45 to 90 metres) followed by a short radius (6 to 15 metres). When creating this design, it is necessary to allow large trucks to turn into multiple receiving lanes. This design may not be practical for right-turn lanes.

An entirely different channelization design is that used in the case that provides free-flow movements (through a slip lane) where right-turning motorists turn into an exclusive receiving lane ('Lane Away') at high speed. In this situation, right turns should be signal-controlled to provide for a signalized pedestrian walk phase.

Traffic channelization is an effective mitigation strategy when intersection radii reduction is not an option. (Credit: Michele Weisbart)



Sharper angles of slip lanes are important to slow cars and increase visibility (Credit: Michele Weisbart)

10.1.10 YIELD AND STOP CONTROLLED INTERSECTIONS

Intersection control options include the following:

- **YIELD** control, which is under-utilized and should be considered to reduce unnecessary stops caused by the overuse of STOP signs. Uncontrolled intersections are yield-controlled by default.
- **TWO-WAY STOP** control, the most common form of intersection control. This method tends to be overused. At many intersections a traffic circle is a preferable and more effective option.
- **ALL-WAY STOP** control. This is often overused, incorrectly, to slow traffic. The use of all-way stops should be consistent with the Manual of Uniform Traffic Control Devices (MUTCD). At many intersections a traffic circle is a preferable and a more effective option.

10.1.11 ROUNDABOUTS

Refer to Section B.2.

10.2 CITY OF CALGARY INTERSECTION DESIGN SHEETS

As outlined in Section 10.1, intersection design can vary significantly depending on the context – topography, adjacent land use, design vehicles, and relative demand for various movements can all influence the design. The following section of the guide includes standard designs for a number of common intersection types. These standard designs show the key features of intersections of these types – corner curve dimension, sidewalk ramp locations, etc. – which serve as a guide for intersection design in non-standard circumstances. The designs also demonstrate how various bicycle facilities (on-street lanes, pathways) can be incorporated into the intersection design to ensure the safety and comfort of these more vulnerable users.

One important feature shown in the standard intersection designs is the amount of right-of-way required to accommodate corner features. Some updated cross sections presented in Chapter 9 of this report require additional right-of-way at adjacent intersections to accommodate the movements of all users through the intersection.

The intersection design sheets are sorted in terms of the involved street classifications as outlined below. Designs shown in *italics* are to be developed in 2012:

SKELETAL ROADS:

- Skeletal Roads are typically connected to the road network via grade separated interchanges. No standard designs are displayed.

ARTERIAL STREETS:

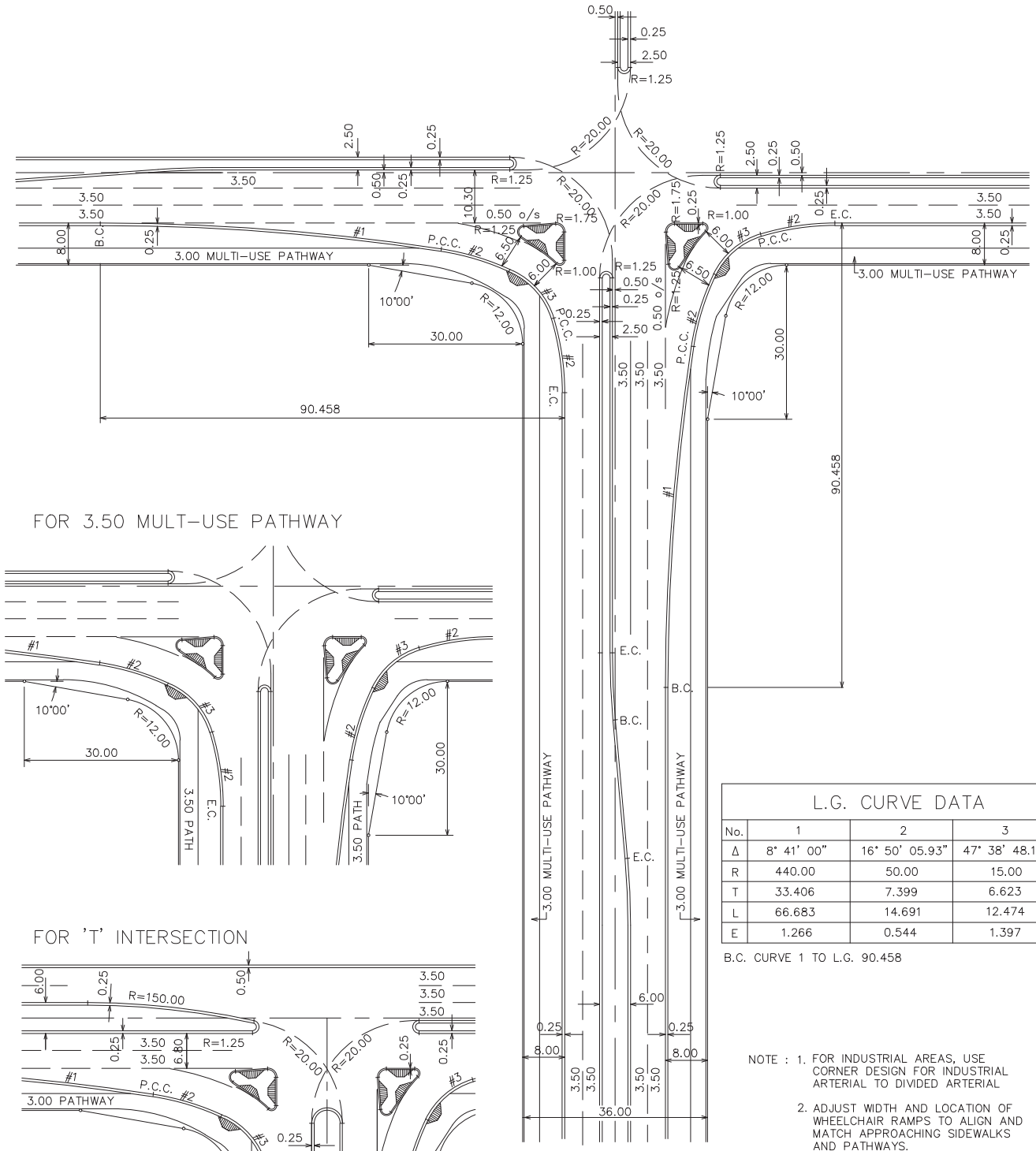
- Divided Arterial (with multi-use pathway) to Divided Arterial (with multi-use pathway)
- Divided Arterial (with bike lanes) to Divided Arterial (with bike lanes)
- Divided Arterial (with multi-use pathway) to Divided Arterial (with bike lanes)
- Industrial Arterial to Divided Arterial (with multi-use pathway)
- Industrial Arterial to Divided Arterial (with bike lanes)
- Local Arterial to Divided Arterial (with multi-use pathway)
- Local Arterial to Divided Arterial (with bike lanes)

LIVEABLE STREETS:

- *To be developed in 2012*

LOCAL STREETS:

- *Primary Collector Street to Divided Arterial*
- *Collector Street to Divided Arterial*
- Industrial Street to Divided Arterial (with multi-use pathway)
- Industrial Street to Divided Arterial (with bike lanes)
- Industrial Street to Industrial Arterial
- Industrial Street to Industrial Street



L.G. CURVE DATA			
No.	1	2	3
Δ	8° 41' 00"	16° 50' 05.93"	47° 38' 48.14"
R	440.00	50.00	15.00
T	33.406	7.399	6.623
L	66.683	14.691	12.474
E	1.266	0.544	1.397

B.C. CURVE 1 TO L.G. 90.458

NOTE : 1. FOR INDUSTRIAL AREAS, USE CORNER DESIGN FOR INDUSTRIAL ARTERIAL TO DIVIDED ARTERIAL

2. ADJUST WIDTH AND LOCATION OF WHEELCHAIR RAMPS TO ALIGN AND MATCH APPROACHING SIDEWALKS AND PATHWAYS.

3. BICYCLE AND OTHER LANE MARKINGS TO BE CONFIRMED IN DETAIL DESIGN STAGE.

DIMENSIONS ARE METRES UNLESS OTHERWISE NOTED — METRIC

No.	Date	Revision	App'd
7	2011-08	ADDED MULTI-USE PATHWAY – CHANGED LANE WIDTHS	
6	2008-11	ADDED SIDEWALKS AND CORRECTED CENTER LINE ON "T" INTERSECTION	
5	06-11	CORRECTED MEDIAN WIDTH ON "T" INTERSECTION	
4	03-11	REVISED TURNING RADII AND WIDE CURB LANE	
3	99-05	ADDED DIAGRAM "FOR T INTERSECTION"	

Drawn R.B.T. Date OCT. '94
Scale: N.T.S.
Approved for City Engineer

THE CITY OF CALGARY
ROADS

INTERSECTION DESIGN (REVISED)
FOR 36.00m R.O.W.
DIVIDED ARTERIAL TO DIVIDED
ARTERIAL STREET (60kph OR LESS)

Sheet 7

File.Number 454.1014.005

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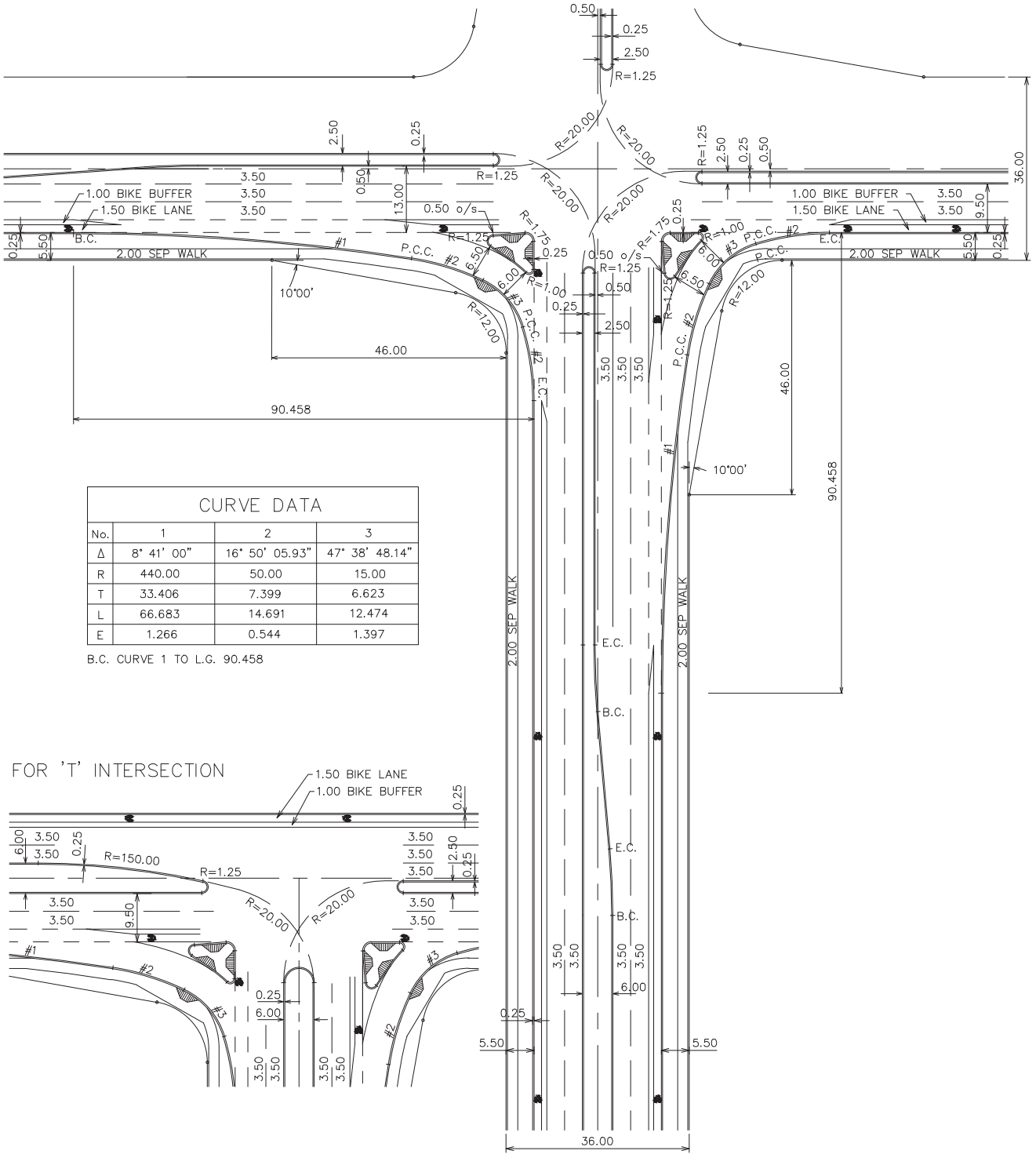


CURVE DATA			
No.	1	2	3
Δ	8° 41' 00"	16° 50' 05.93"	47° 38' 48.14"
R	440.00	50.00	15.00
T	33.406	7.399	6.623
L	66.683	14.691	12.474
E	1.266	0.544	1.397

B.C. CURVE 1 TO L.G. 90.458

FOR 'T' INTERSECTION

NOTES:

1. FOR INDUSTRIAL AREAS, USE CORNER DESIGN FOR INDUSTRIAL MAJOR TO MAJOR STREET.
2. ADJUST WIDTH AND LOCATION OF WHEELCHAIR RAMPS TO ALIGN AND MATCH APPROACHING SIDEWALKS AND PATHWAYS.
3. BICYCLE AND OTHER LANE MARKINGS TO BE CONFIRMED IN DETAIL DESIGN STAGE.

DIMENSIONS ARE METRES UNLESS OTHERWISE NOTED — METRIC

No.	Date	Revision	App'd

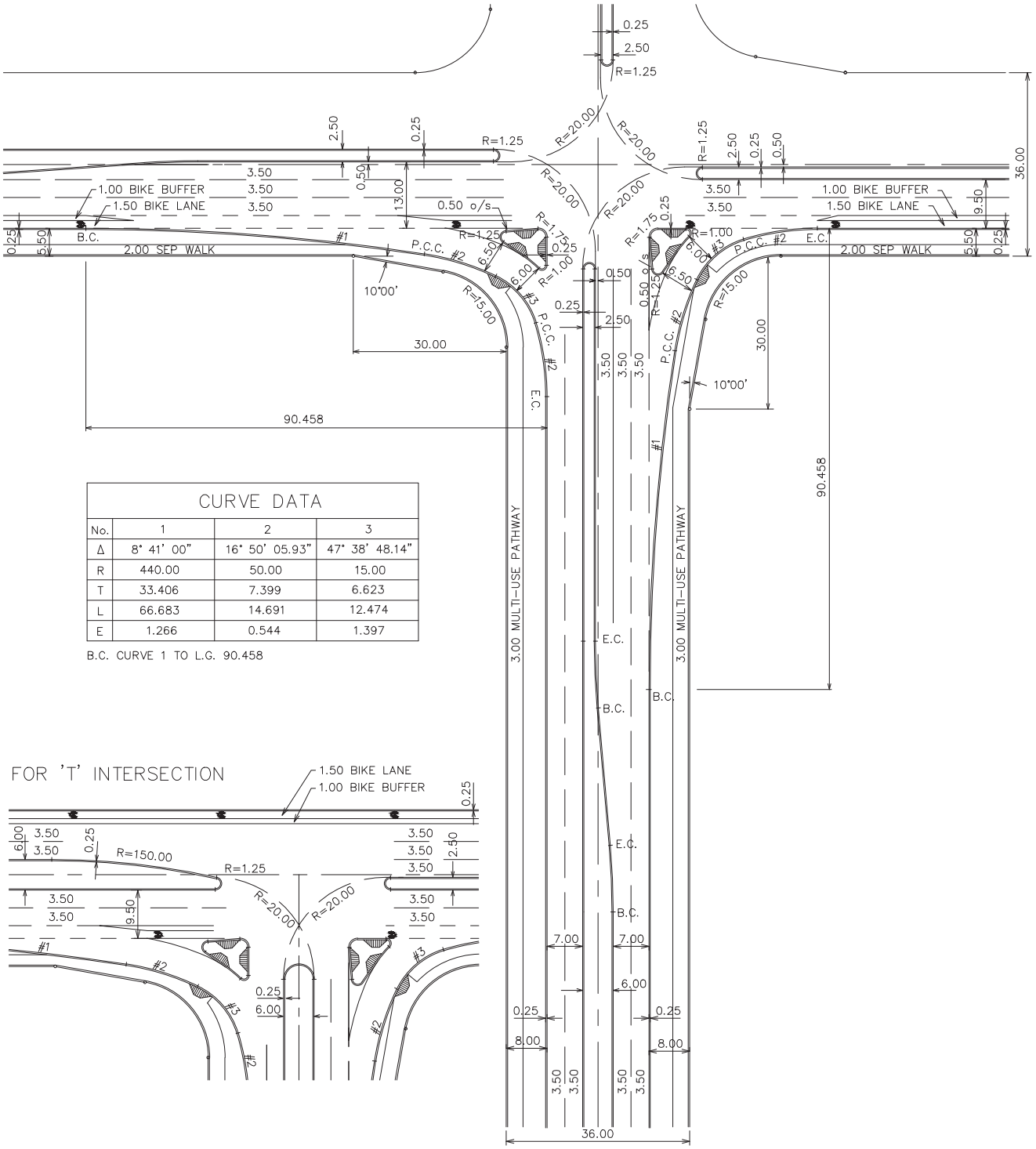
Drawn R.B.T. | Date OCT. '94
Scale: N.T.S.
Approved for City Engineer

THE CITY OF CALGARY
ROADS

INTERSECTION DESIGN
ARTERIAL TO ARTERIAL STREET
FOR 36.00m R.O.W.
ON STREET BIKE LANES

Sheet 7B
File.Number 454.1014.005B

FILE: *FILE UEPES*
DATE: *DATETIME*
ISC : UNRESTRICTED



CURVE DATA			
No.	1	2	3
Δ	8° 41' 00"	16° 50' 05.93"	47° 38' 48.14"
R	440.00	50.00	15.00
T	33.406	7.399	6.623
L	66.683	14.691	12.474
E	1.266	0.544	1.397

B.C. CURVE 1 TO L.C. 90.458

NOTES:

1. FOR INDUSTRIAL AREAS, USE CORNER DESIGN FOR INDUSTRIAL MAJOR TO MAJOR STREET.
2. ADJUST WIDTH AND LOCATION OF WHEELCHAIR RAMPS TO ALIGN AND MATCH APPROACHING SIDEWALKS AND PATHWAYS.
3. BICYCLE AND OTHER LANE MARKINGS TO BE CONFIRMED IN DETAIL DESIGN STAGE.

DIMENSIONS ARE METRES UNLESS OTHERWISE NOTED — METRIC

No.	Date	Revision	App'd

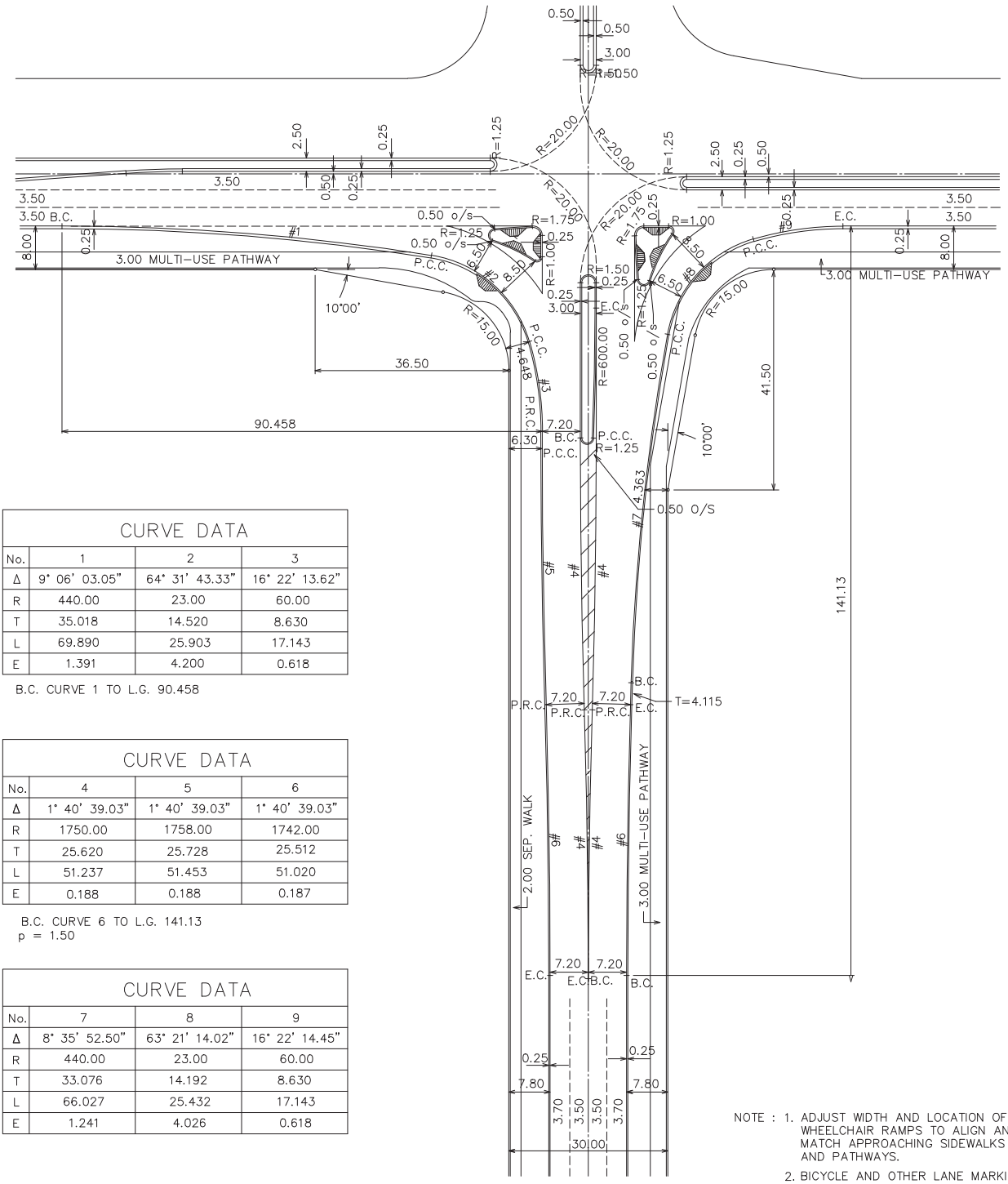
Drawn: JP — Date: 2011-09
Scale: N.T.S.
Approved for City Engineer

THE CITY OF CALGARY
ROADS

INTERSECTION DESIGN
ARTERIAL TO ARTERIAL STREET
FOR 36.00m R.O.W.
ON STREET BIKE LANE/MULTI-USE PATHWAY

Sheet: 7A-A
File.Number: 454.1014.005A

FILE: *FILE_UEPES*
DATE: *DATETIME*
ISC : UNRESTRICTED



CURVE DATA			
No.	1	2	3
Δ	9° 06' 03.05"	64° 31' 43.33"	16° 22' 13.62"
R	440.00	23.00	60.00
T	35.018	14.520	8.630
L	69.890	25.903	17.143
E	1.391	4.200	0.618

B.C. CURVE 1 TO L.G. 90.458

CURVE DATA			
No.	4	5	6
Δ	1° 40' 39.03"	1° 40' 39.03"	1° 40' 39.03"
R	1750.00	1758.00	1742.00
T	25.620	25.728	25.512
L	51.237	51.453	51.020
E	0.188	0.188	0.187

B.C. CURVE 6 TO L.G. 141.13
p = 1.50

CURVE DATA			
No.	7	8	9
Δ	8° 35' 52.50"	63° 21' 14.02"	16° 22' 14.45"
R	440.00	23.00	60.00
T	33.076	14.192	8.630
L	66.027	25.432	17.143
E	1.241	4.026	0.618

NOTE : 1. ADJUST WIDTH AND LOCATION OF WHEELCHAIR RAMPS TO ALIGN AND MATCH APPROACHING SIDEWALKS AND PATHWAYS.

2. BICYCLE AND OTHER LANE MARKINGS TO BE CONFIRMED IN DETAIL DESIGN STAGE.

DIMENSIONS ARE METRES UNLESS OTHERWISE NOTED — METRIC

No.	Date	Revision	App'd
8	2011–08	REVISED LANE WIDTHS AND SIDEWALKS	
7	2008–11	ADDED SIDEWALKS AND REVISED ISLAND THROAT WIDTH	
6	07–03	REVISED RADII ON CURVE #5 AND #6	
5	03–11	WIDE CURB LANE AND AN ADDITIONAL NOTE	
4	00–04	REVISE TURNING RADII TO 20.00m	

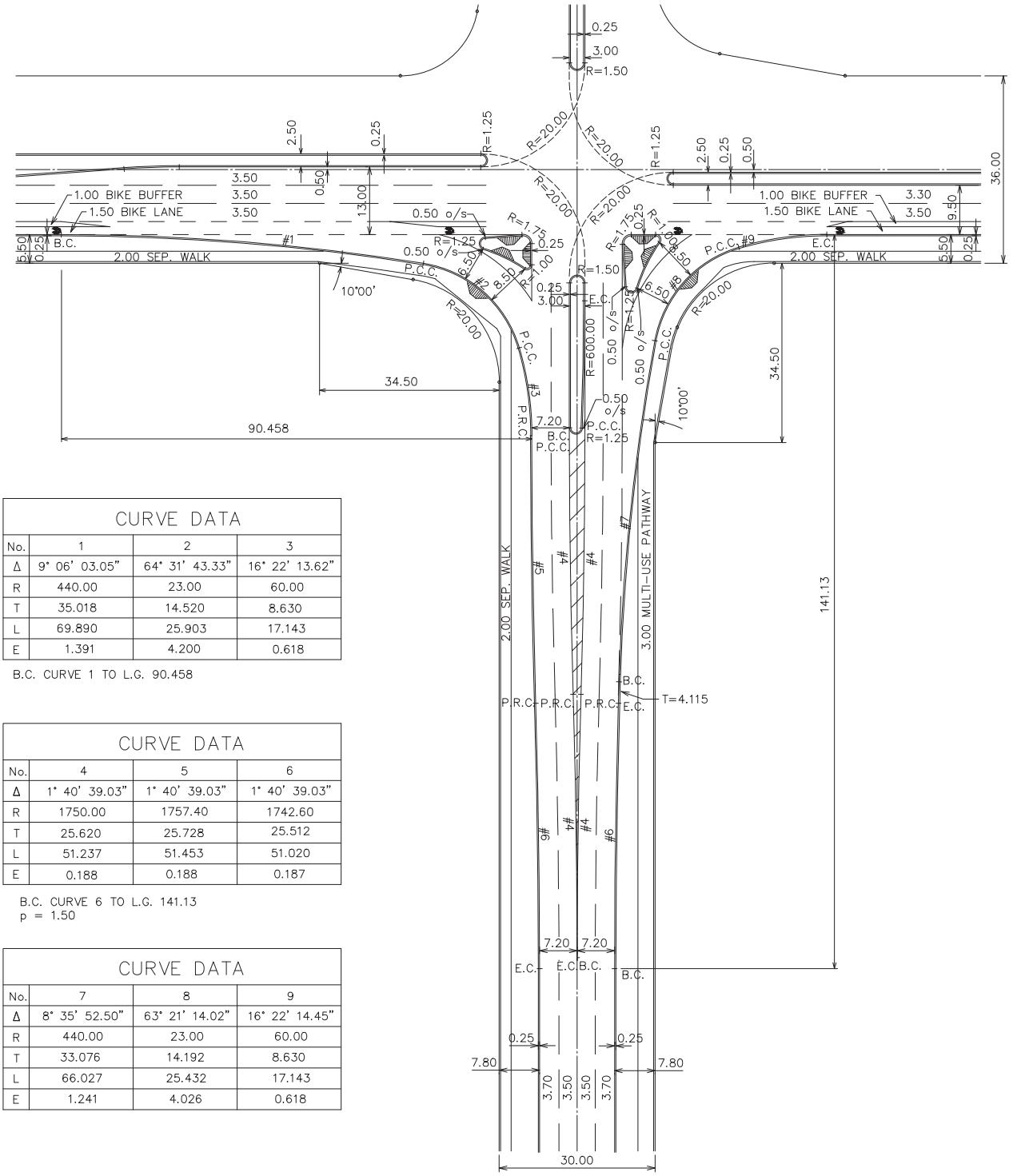
Drawn J.T.R. | Date SEPT. '96
Scale: N.T.S.
Approved for City Engineer

THE CITY OF CALGARY
ROADS

TYPICAL TEARDROP DESIGN FOR 30.00m R.O.W. INDUSTRIAL ARTERIAL TO DIVIDED ARTERIAL

Sheet 8
File.Number 454.1014.006

FILE C668700: Z:\permanent\Std_drawings\Microstation_files\4541014\4541014006.dgn
DATE: 13–Nov–08 14:16



CURVE DATA			
No.	1	2	3
Δ	9° 06' 03.05"	64° 31' 43.33"	16° 22' 13.62"
R	440.00	23.00	60.00
T	35.018	14.520	8.630
L	69.890	25.903	17.143
E	1.391	4.200	0.618

B.C. CURVE 1 TO L.G. 90.458

CURVE DATA			
No.	4	5	6
Δ	1° 40' 39.03"	1° 40' 39.03"	1° 40' 39.03"
R	1750.00	1757.40	1742.60
T	25.620	25.728	25.512
L	51.237	51.453	51.020
E	0.188	0.188	0.187

B.C. CURVE 6 TO L.G. 141.13
p = 1.50

CURVE DATA			
No.	7	8	9
Δ	8° 35' 52.50"	63° 21' 14.02"	16° 22' 14.45"
R	440.00	23.00	60.00
T	33.076	14.192	8.630
L	66.027	25.432	17.143
E	1.241	4.026	0.618

NOTES:

1. ADJUST WIDTH AND LOCATION OF WHEELCHAIR RAMPS TO ALIGN AND MATCH APPROACHING SIDEWALKS AND PATHWAYS.
2. BICYCLE AND OTHER LANE MARKINGS TO BE CONFIRMED IN DETAIL DESIGN STAGE.

DIMENSIONS ARE METRES UNLESS OTHERWISE NOTED — METRIC

No.	Date	Revision	App'd

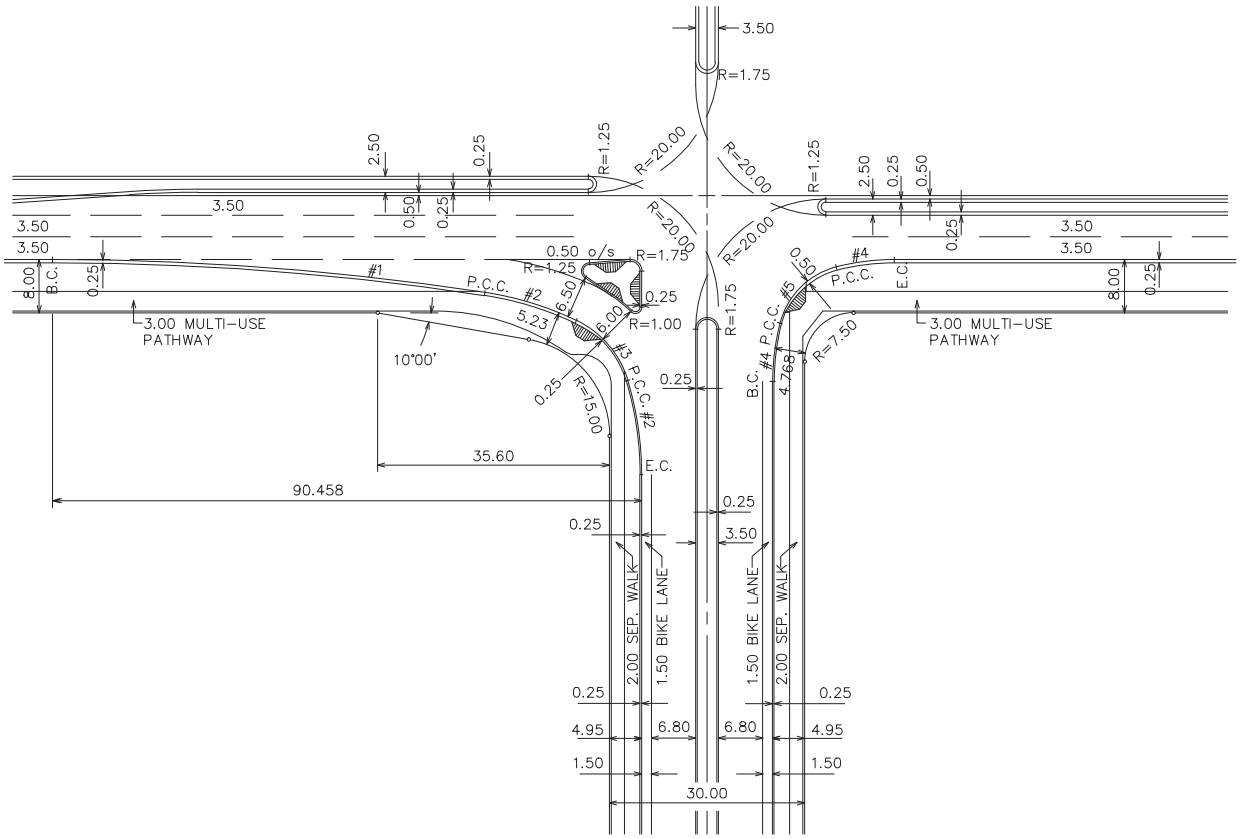
Drawn: JP — Date: 2011-09
Scale: N.T.S.
Approved for: City Engineer

THE CITY OF CALGARY
ROADS

TYP. TEARDROP DESIGN FOR 30.00m R.O.W. INDUSTRIAL ARTERIAL TO ARTERIAL STREET
ON STREET BIKE LANE/MULTI-USE PATHWAY

Sheet: 8A–A
File.Number: 454.1014.006A

FILE: *FILE_UEPES*
DATE: *DATETIME*
ISC : UNRESTRICTED



L.G. CURVE DATA					
No.	1	2	3	4	5
Δ	8° 41' 00"	16° 50' 05.93"	47° 38' 48.14"	14° 21' 41.44"	61° 16' 37.12"
R	440.00	50.00	15.00	36.00	12.00
T	33.406	7.399	6.623	4.536	7.108
L	66.683	14.691	12.474	9.024	12.834
E	1.266	0.544	1.397	0.285	1.947

B.C. CURVE 1 TO L.G. 90.458

NOTE : 1. ADJUST WIDTH AND LOCATION OF WHEELCHAIR RAMPS TO ALIGN AND MATCH APPROACHING SIDEWALKS AND PATHWAYS.

2. BICYCLE AND OTHER LANE MARKINGS TO BE CONFIRMED IN DETAIL DESIGN STAGE.

DIMENSIONS ARE METRES UNLESS OTHERWISE NOTED — METRIC

No.	Date	Revision	App'd
3	2011–08	REVISED LANES WIDTHS, SIDEWALKS,	
2	2008–11	ADDED SIDEWALKS	
1	03–11	REVISED TURNING RADII AND WIDE CURB LANE	

Drawn S.P.G. | Date DEC. '98
Scale: N.T.S.
Approved for City Engineer

THE CITY OF CALGARY
ROADS

INTERSECTION DESIGN
FOR 30.00m R.O.W. LOCAL
ARTERIAL TO DIVIDED ARTERIAL

Sheet 6
File.Number 454.1014.017

FILE: Z:\permanent\Std_drawings\Microstation_files\4541014\4541014017.dgn
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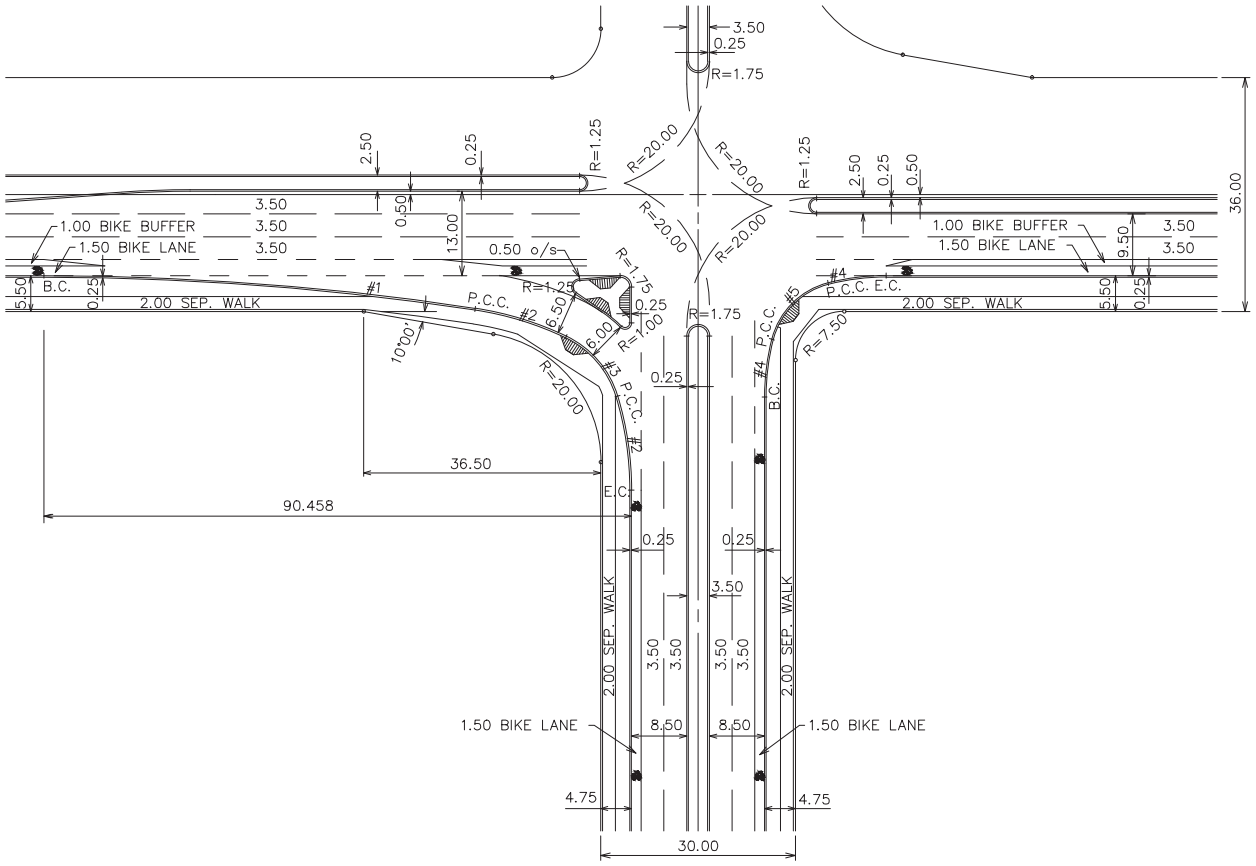

CURVE DATA					
No.	1	2	3	4	5
Δ	8° 41' 00"	16° 50' 05.93"	47° 38' 48.14"	14° 21' 41.44"	61° 16' 37.12"
R	440.00	50.00	15.00	36.00	12.00
T	33.406	7.399	6.623	4.536	7.108
L	66.683	14.691	12.474	9.024	12.834
E	1.266	0.544	1.397	0.285	1.947

B.C. CURVE 1 TO L.G. 90.458

NOTES:

1. ADJUST WIDTH AND LOCATION OF WHEELCHAIR RAMPS TO ALIGN AND MATCH APPROACHING SIDEWALKS AND PATHWAYS.
2. BICYCLE AND OTHER LANE MARKINGS BE CONFIRMED IN DETAIL DESIGN STAGE.

DIMENSIONS ARE METRES UNLESS OTHERWISE NOTED — METRIC

No.	Date	Revision	App'd

Drawn JP | Date 2011-09
Scale: N.T.S.
Approved for City Engineer

THE CITY OF CALGARY
ROADS

INTERSECTION DESIGN
FOR 30.00m R.O.W LOCAL ARTERIAL
TO ARTERIAL STREET
ON STREET BIKE LANES

Sheet 6A-A
File.Number 454.1014.017A

FILE: *FILE UEPES*
DATE: *DATETIME*
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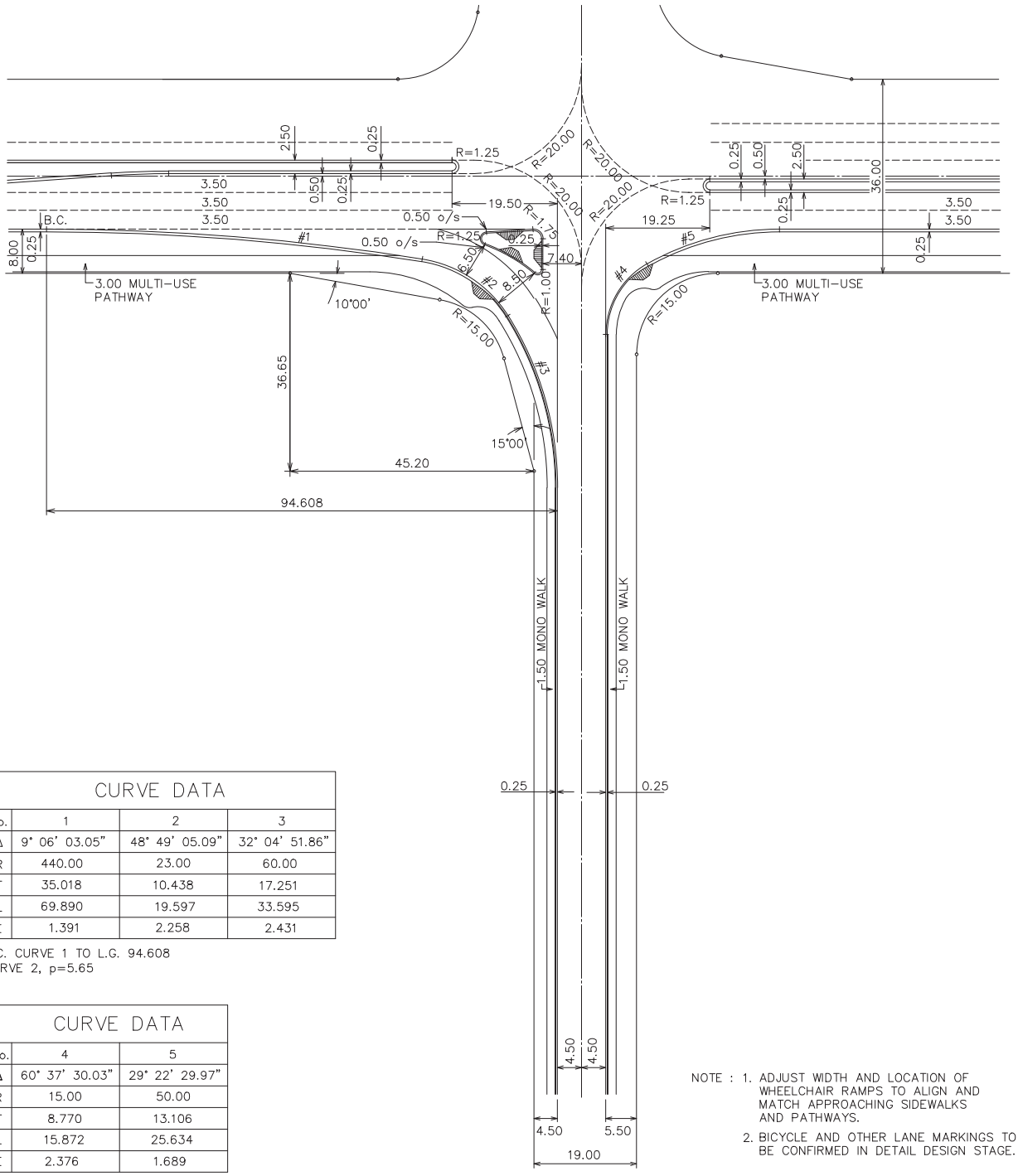


CURVE DATA			
No.	1	2	3
Δ	9° 06' 03.05"	48° 49' 05.09"	32° 04' 51.86"
R	440.00	23.00	60.00
T	35.018	10.438	17.251
L	69.890	19.597	33.595
E	1.391	2.258	2.431

B.C. CURVE 1 TO L.G. 94.608
CURVE 2, p=5.65

CURVE DATA		
No.	4	5
Δ	60° 37' 30.03"	29° 22' 29.97"
R	15.00	50.00
T	8.770	13.106
L	15.872	25.634
E	2.376	1.689

p = 4.50

NOTE : 1. ADJUST WIDTH AND LOCATION OF WHEELCHAIR RAMPS TO ALIGN AND MATCH APPROACHING SIDEWALKS AND PATHWAYS.

2. BICYCLE AND OTHER LANE MARKINGS TO BE CONFIRMED IN DETAIL DESIGN STAGE.

No.	Date	Revision	App'd
5	2011–08	REVISED DRIVING LANES, SIDEWALK AND PL	
4	2008–11	ADDED SIDEWALKS	
3	06–01	REVISED CURVES 1, 2 AND 3	
2	03–11	ADDITION OF WIDE CURB LANE	
1	01–01	REVISED INDUSTRIAL R.O.W. TO 18.00m OR 19.00m	

Drawn S.P.G. | Date 00–04
N.T.S.
Approved for
City Engineer

DIMENSIONS ARE METRES UNLESS OTHERWISE NOTED — METRIC

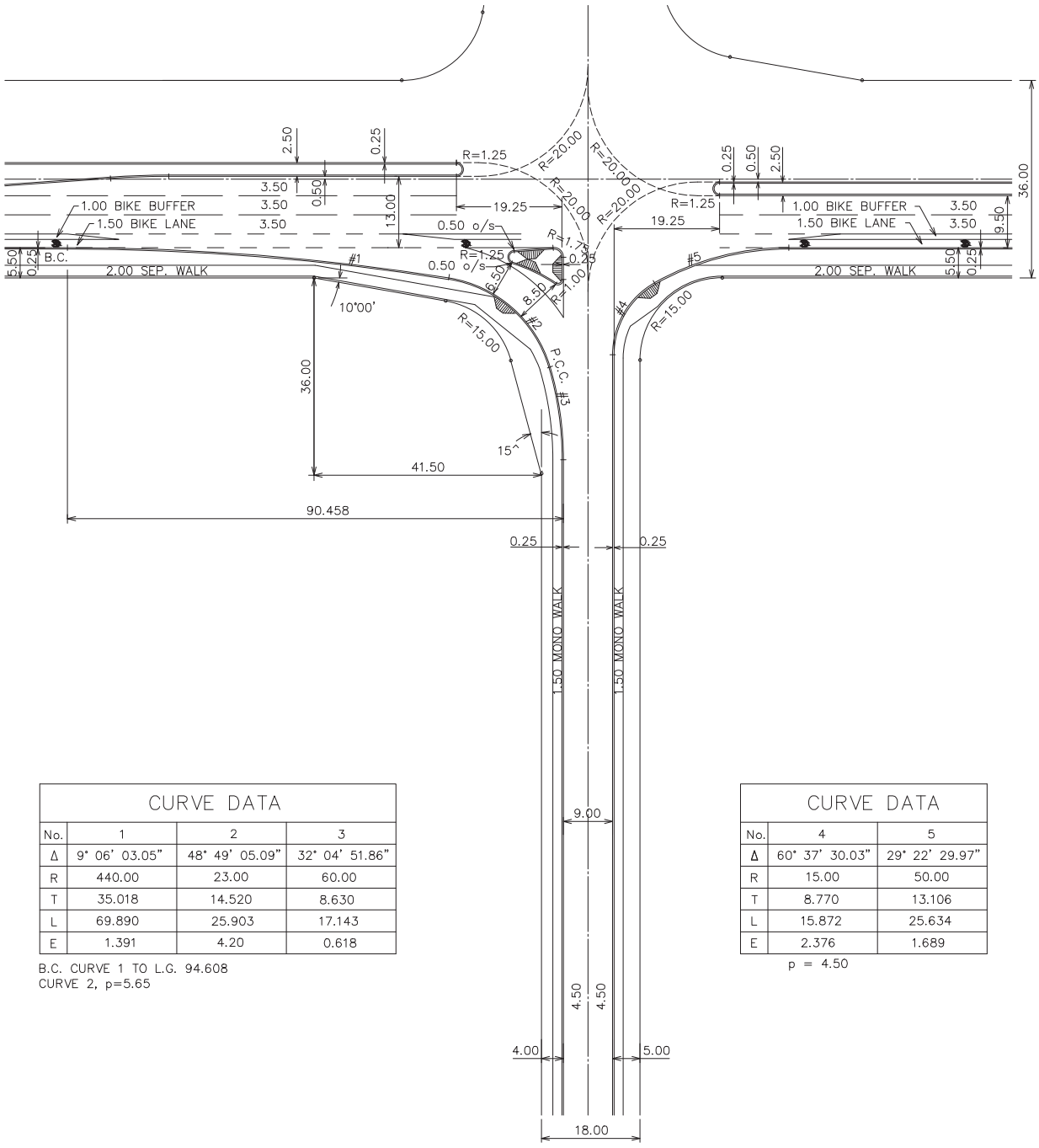
THE CITY OF CALGARY
ROADS

INTERSECTION DESIGN
INDUSTRIAL STREET TO
DIVIDED ARTERIAL

Sheet 9

File.Number 454.1014.022

FILE UEPES655280: Z:\permanent\Std_drawings\Microstation_files\4541014\4541014022.dgn
DATE: 13–Nov–08 14:26



CURVE DATA			
No.	1	2	3
Δ	9° 06' 03.05"	48° 49' 05.09"	32° 04' 51.86"
R	440.00	23.00	60.00
T	35.018	14.520	8.630
L	69.890	25.903	17.143
E	1.391	4.20	0.618

B.C. CURVE 1 TO L.G. 94.608
CURVE 2, p=5.65

CURVE DATA		
No.	4	5
Δ	60° 37' 30.03"	29° 22' 29.97"
R	15.00	50.00
T	8.770	13.106
L	15.872	25.634
E	2.376	1.689

p = 4.50

NOTES:

1. ADJUST WIDTH AND LOCATION OF WHEELCHAIR RAMPS TO ALIGN AND MATCH APPROACHING SIDEWALKS AND PATHWAYS.
2. BICYCLE AND OTHER LANE MARKINGS TO BE CONFIRMED IN DETAIL DESIGN STAGE.

DIMENSIONS ARE METRES UNLESS OTHERWISE NOTED — METRIC

No.	Date	Revision	App'd

Drawn JP	Date 2011-09
N.T.S.	
Approved for	
City Engineer	

THE CITY OF CALGARY
ROADS

INTERSECTION DESIGN
FOR 18.00m R.O.W. INDUSTRIAL
TO ARTERIAL STREET
ON STREET BIKE LANE

Sheet 9A–A

File.Number 454.1014.022A

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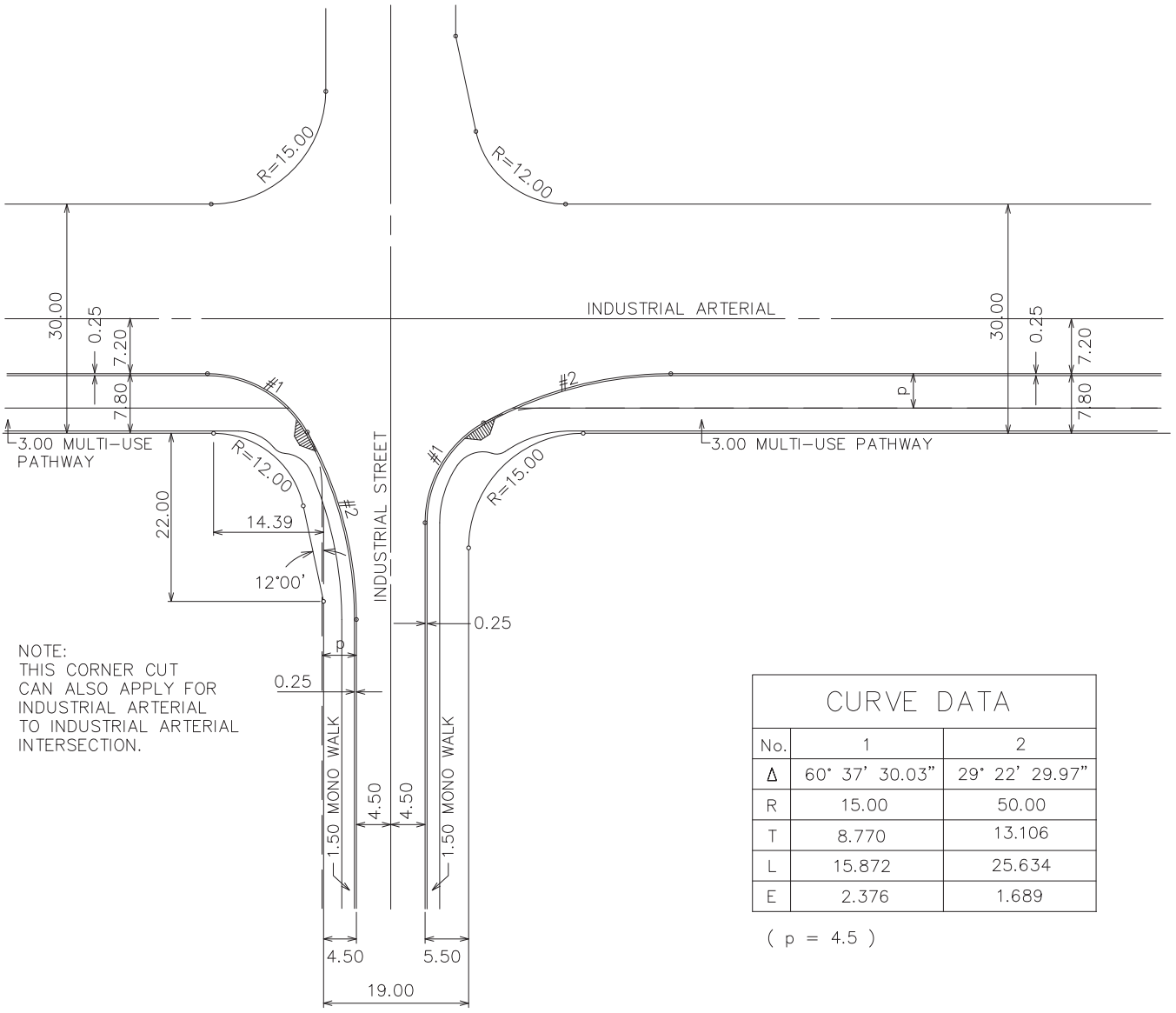
DATE: *DATETIME*
ISC : UNRESTRICTED



NOTE:
THIS CORNER CUT CAN ALSO APPLY FOR INDUSTRIAL ARTERIAL TO INDUSTRIAL ARTERIAL INTERSECTION.

CURVE DATA		
No.	1	2
Δ	60° 37' 30.03"	29° 22' 29.97"
R	15.00	50.00
T	8.770	13.106
L	15.872	25.634
E	2.376	1.689

(p = 4.5)

NOTES:
1. ADJUST WIDTH AND LOCATION OF WHEELCHAIR RAMPS TO ALIGN AND MATCH APPROACHING SIDEWALKS AND PATHWAYS.
2. BICYCLE AND OTHER LANE MARKINGS BE CONFIRMED IN DETAIL DESIGN STAGE.

No.	Date	Revision	App'd
6	2011-08	REVISED LANE WIDTHS, DIM TO PL, REVISED SIDEWALKS	
5	2008-11	ADDED SIDEWALKS	
4	2004-04	REVISED MAJOR CURB GUTTER FROM 0.50 TO 0.25	
3	03-11	ADDITIONAL NOTE AND DIMENSIONS	
2	01-01	CHANGE R.O.W WIDTH TO 18.00m OR 19.00m	

Drawn J.T.R. Date SEPT. '96
Scale: NTS
Approved for City Engineer

DIMENSIONS ARE METRES UNLESS OTHERWISE NOTED METRIC

THE CITY OF CALGARY ROADS

INTERSECTION DESIGN INDUSTRIAL STREET TO INDUSTRIAL ARTERIAL

Sheet 11

File.Number 454.1008.001

FILE: Z:\permanent\Std_drawings\Microstation_files\4541008\4541008001.dgn
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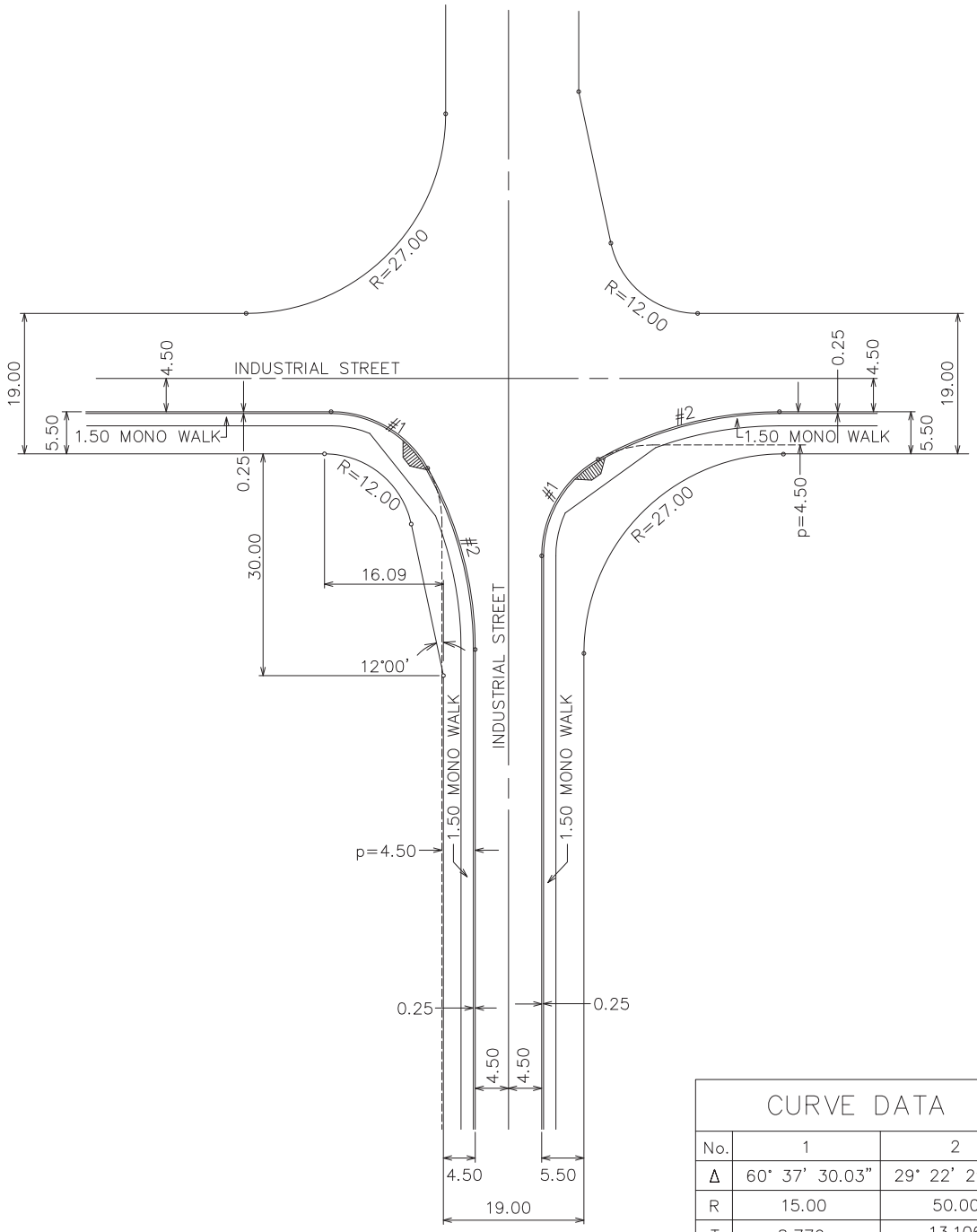


CURVE DATA		
No.	1	2
Δ	60° 37' 30.03"	29° 22' 29.97"
R	15.00	50.00
T	8.770	13.106
L	15.872	25.634
E	2.376	1.689

(p = 4.5)

NOTE : 1. FOR SKEWED INTERSECTIONS, SLIGHTLY LARGER RADII MAY BE REQUIRED TO ACCOMODATE LARGE TRUCKS.

2. ADJUST WIDTH AND LOCATION OF WHEELCHAIR RAMPS TO ALIGN AND MATCH APPROACHING SIDEWALKS AND PATHWAYS.

3. BICYCLE AND OTHER LANE MARKINGS BE CONFIRMED IN DETAIL DESIGN STAGE.

DIMENSIONS ARE METRES UNLESS OTHERWISE NOTED — METRIC

No.	Date	Revision	App'd
4	2011–08	REVISED LANES TO 4.50m – REVISED SIDEWALKS TO 1.50m	
3	2008–11	ADDED SIDEWALKS	
2	01–01	REVISE R.O.W. DIM TO 18.00m OR 19.00m	
1	99–12	REVISE CORNER TO BE A TWO CENTER CURVE	

Drawn J.T.R. | Date SEPT. '96
Scale: NTS
Approved for City Engineer

THE CITY OF CALGARY
ROADS

INTERSECTION DESIGN FOR INDUSTRIAL STREET TO INDUSTRIAL STREET

Sheet 10
File.Number 454.1008.002

FILE: Z:\permanent\Std_drawings\Microstation_files\4541008\4541008002.dgn
DATE: 13-Nov-08 14:34

CHAPTER 11

IMPLEMENTATION STRATEGY

11.1 INTRODUCTION

This part of the Guide begins to discuss how to take the content from Chapters 1-10 of this Guide and put them into practice. Complete Streets can only be successful if there is a strong implementation strategy.

The objectives for this chapter include:

- Understanding the new "Context Sensitive" approach to street planning & design (similar to "Charrette")
- Provide some North American implementation best practices
- Identification of (and some suggested preliminary revisions to) processes within The City to align with this new methodology
- Short and long-term action items that need to be undertaken by The City of Calgary

11.2 CONTEXT SENSITIVE DESIGN

DEFINITION:

Context sensitive solutions (CSS) is a collaborative, interdisciplinary approach that involves all stakeholders in providing a transportation facility that fits its setting. It is an approach that leads to preserving and enhancing scenic, aesthetic, historic, community, and environmental resources, while improving or maintaining safety, mobility, and infrastructure conditions.

Source: ContextSensitiveSolutions.org

–Results of Joint AASHTO/FHWA Context Sensitive Solutions Strategic Planning Process Summary Report, March 2007

CORE PRINCIPLES OF CSS:

The following core principles apply to transportation processes, outcomes, and decision-making:

1. Strive towards a shared stakeholder vision to provide a basis for decisions;
2. Demonstrate a comprehensive understanding of contexts;
3. Foster continuing communication and collaboration to achieve consensus;
4. Exercise flexibility and creativity to shape effective transportation solutions, while preserving and enhancing community and natural environments.

Source: ContextSensitiveSolutions.org

CHARLOTTE, NORTH CAROLINA URBAN STREET DESIGN GUIDE & THE SIX-STEP PROCESS

Charlotte, NC developed an Urban Street Design Guideline (USDG), a Complete Streets document that presents a comprehensive approach to designing new and modified streets within Charlotte to respond to two basic issues, common to Calgary and many North American cities:

1. The need to better plan for continued growth and development
2. People want better streets.

To appropriately apply the Urban Street Design Guide (USDG), the plan/design team must assess the expectations of a variety of stakeholders in order to best reflect their contexts and intended functions. This assessment is also intended to ensure that the resulting streets are "complete" streets – streets that provide for the safety and comfort of all users to the best extent possible. The perspectives of all interested stakeholders interested in or affected by existing or future streets will be incorporated into a new process for planning and designing streets. This new process consolidates traditional city planning, urban design, and transportation planning activities into a six step process:

1. Define existing and future land use context.
2. Define existing and future transportation context.
3. Identify deficiencies.
4. Describe future objectives
5. Define street type and initial cross-section.
6. Describe Trade-offs and Select Cross-section.

Source: USDG

11.3 IMPLEMENTATION BEST PRACTICES

From the review of implementation practices and procedures throughout North America, there are some consistent elements that will influence the success of introducing Complete Streets in Calgary. These elements are summarized below:

- Policies and directives must cascade throughout the organization and be linked and assigned at all levels and departments.
- There must be **buy-in and commitment at all levels of the organization**, which includes senior level involvement through steering committees, and a **clear expectation that the status quo is not an option**. This message must be delivered to both internal and external stakeholders.
- Core policies specific to Complete Streets must be reinforced in all supporting policies. Any inconsistencies must be identified and changed.
- There must be clear and assigned **accountability** for specific implementation steps and results ("who does what by when") in every affected business unit and department.
- A **decision-making framework** (process, procedures and involvement) must be clearly set out and followed to arrive at effective solutions.
- **Collaboration** must occur between all stakeholders, including internal and external groups.
- To ensure continuous improvement and learning, the **implementation must be routinely measured, monitored, reported** and acted upon.
- All new or amended procedures for planning, design, construction, operations and maintenance must be fully integrated with existing organization systems and processes to **embed multimodal facilities into general project designs.**
- **Practices and procedures for multi-modal facilities must be introduced at the initial planning stages** and continued throughout the development process including the operation and maintenance stages.

- While structure and consistency is important, there also needs to be a **high degree of flexibility** to develop solutions that meet the unique circumstances of each street.

Section 11.4 identifies the current City processes that require revision to align with this context sensitive approach.

11.4 CITY OF CALGARY PROCESS IDENTIFICATION

The City of Calgary has processes spanning a number of departments to plan, design, and implement public streets. A successful Complete Streets Program must identify these existing processes and revise them. This will be a complex and time consuming task. For this Interim Guide, some preliminary recommendations are presented.

11.4.1 POLICY DOCUMENTS

City of Calgary policy documents include:

- Regional Context Studies (e.g. South Shaganappi RCS)
- Area Structure Plans (e.g. West Macleod ASP)
- Area Redevelopment Plans (e.g. Sunalta ARP)
- Station Area Plans (e.g. Chinook SAP)
- Special Policy Areas

The Land Use Planning & Policy business unit lead these policy exercises in collaboration with several other business units, including Transportation Planning. Transportation Planning needs to **ensure that streets that fall under the "Liveable" classification are identified on transportation network figures, and that Complete Street language and policy are incorporated** into these documents.

11.4.2 DEVELOPMENT APPLICATION REVIEW

The Corporate Planning & Applications Group (CPAG) of the Development and Building Approvals Business Unit receives, reviews, conditions, and approves up to two (2) thousand development submissions each year. Submissions include:

- Outline Plan & Land Use applications
- Stand-alone Land Use Amendment applications
- Road Closure applications
- Subdivision (Tentative Plan) applications
- Development Permits

CTP policy and Complete Streets guidelines have an impact on all of these submissions because they involve establishing street alignment, street right-of-way width, and intersection or access locations.

OUTLINE PLAN & LAND USE APPLICATIONS

Outline plans articulate the vision for a community. They show the street, intersections, access points, development parcels (and associated land use), and open space for a new community. If policy guidance doesn't exist in the Area Structure Plan (ASP) governing the area, then the Outline Plan/Land Use application is the first opportunity to identify streets that need to be given special attention (i.e. those within activity nodes and corridors). While the objective is to ensure that all streets within an Outline Plan are "Complete", it is the higher classification of streets within an Outline Plan that require more focus. The CTP Maps (Section 3.1) and the Revised Road and Street Palette (Figure 2-1) will assist in determining the function and land use context of a street. This determination should occur as early in the application review process as possible. Typically, this would be the (non-mandatory) pre-application meeting with the applicant team. All proposed streets should align with the cross-sections in Chapter 9. **Street design details (full street right-of-way, pavement width, sidewalk width, utility locations) will need to be determined at this Outline Plan stage. This will require a collaborative effort between the applicant team and the assigned CPAG team.** If agreement cannot be reached by all parties in a timely manner, the current Design Guidelines for Subdivision Servicing shall govern (see Part B of this Guide).

STAND-ALONE LAND USE AMENDMENT APPLICATIONS

Stand-alone Land Use amendment applications are made when there is a desire to change the land use designation of a single parcel of land to accommodate a particular development type. During the review of this type of application, there is opportunity to **ensure that right-of-way setback is preserved for the future design of the adjacent street.** If known, this is also an appropriate time to examine access considerations that can be conditions at the Development Permit stage.

ROAD CLOSURE APPLICATIONS

Road closure applications are typically submitted when there is a desire to consolidate unused public road right-of-way with an adjacent parcel of land. This is an opportunity for the CPAG review team to **ensure that publicly owned land for potential pedestrian connections, bicycle connections, and/or linear park space remains in the City's inventory.**

SUBDIVISION/TENTATIVE PLANS

Subdivision plans provide the technical and legal details necessary to construct streets, utilities, buildings, and parks. All proposed streets should be designed to match the cross-sections presented in Section Chapter 9. **The design of new street types will require a collaborative effort between the applicant team and the assigned CPAG team at the Outline Plan stage.**

DEVELOPMENT PERMITS

Development Permits provide the concept of how a building or group of buildings on a site are to be developed. By this application stage, the details of the adjacent street are generally established, though **inner city redevelopment may present an opportunity to revise the details of adjacent streets.** In either case, details such as **building set-back, street access, and site design for pedestrians may require review.**

Minimizing driveway accesses that cross pedestrian corridors is one of many examples of ensuring a development permit is aligned with CTP policies and Complete Streets guidelines.

11.4.3 MAJOR TRANSPORTATION INFRASTRUCTURE PROJECTS

Major transportation infrastructure projects are typically planned by Transportation Planning, and designed and constructed by Transportation Infrastructure. Projects can include street and intersection improvements, corridor revitalization, interchange construction, pedestrian overpass construction, or LRT track and station construction. Traditionally, the planning, design and construction of these projects has revolved around the automobile with facilities for pedestrians and cyclists as a secondary consideration. This Complete Streets Guide aims to **include these other users (or stakeholders) at the front end of these projects during the planning stage.** Several projects at the City follow this context-sensitive approach to planning, design, and construction, including the 17th Avenue SE Corridor, and 13th Avenue Greenway. These two projects are presented in Appendix A.

11.4.4 OTHER CITY TRANSPORTATION PROJECTS

Several Divisions within the Roads Business Unit undertake many small scale transportation projects annually. Transportation Planning prioritizes and plans these projects, and engages the affected stakeholders. These projects include:

- Various Street Improvements (sidewalks, curbs)
- Wheelchair ramp installations
- Industrial sidewalks
- Local Improvements (e.g. sidewalk replacement, lane paving)
- Development access
- Community traffic improvements including traffic calming measures
- Pedestrian / bike improvements (e.g. Brentwood/University of Calgary area)
- Streetscape improvements
- Optimization projects to improve operation of all modes
- Safety countermeasures for all modes

There has been steady progress to **include facilities for all users in the planning, design, and construction of these projects.** During the development of the Final Complete Streets Guide, the processes behind these projects will be examined and, where possible, design, build, operation and maintenance improvements made to better align with the Guide.

11.4.5 MAINTENANCE PROGRAM

The Maintenance and Traffic Division of Roads has several maintenance programs, including:

- Maintenance Division:
  - » Street resurfacing/reconstruction
  - » Street sweeping
  - » Bridge rehabilitation
  - » Snow & Ice control
- Traffic Division:
  - » Detours
  - » Signals
  - » Street signs
  - » Pavement markings

There are opportunities to improve on these existing maintenance programs to better align with Complete Streets guidelines. For example, **a street resurfacing (or overlay) project presents an opportunity to implement a road diet or introduce bicycle lanes** by redesigning the road marking plans. Revising the snow and ice control program (including the securing of additional funding) to ensure bike lanes and sidewalks in activity centers are cleared of snow and ice during the winter months is another example. During the development of the Final Complete Streets Guide, these programs will be examined and, where possible, improvements made to better align with Complete Streets guidelines.

11.4.6 PARKS PROJECTS

The Parks Business Unit currently maintains over 700 kilometres of pathway (500 km within parks and river valleys, 200 km along roadways) and 3,400 parks within the City. Parks also constructs new pathway and reconstructs existing pathway every year. The planning for new pathways and parks is an **opportunity to identify, plan, construct and maintain missing links in the pedestrian and cycling network.** Transportation Planning and Parks currently work together in this regard. The Final Guide should ensure that this collaborative process is clearly defined and documented.

11.5 COST SAVINGS STRATEGIES

Chapter 6 of "Complete Streets: Best Policy and Implementation Practices" by the American Planning Association sums it up best...

> **"Successful implementation of complete streets policies is achieved by integrating multimodal facilities into general project design. This folds the costs for these facilities into the costs of the overall project."**

Retrofitting a street with a wider sidewalk or a multi-use pathway as a stand-alone project is much more expensive than having incorporated those upgrades into the original project design. While this is a general best practice, this document offers other best practices project examples:

- Consider paint, signs, rocks, and planters in the median or public realm to achieve results for very little cost.
- Consider the installation of bike-only traffic lights, bus priority signals, and bike detectors when installing traffic signals.
- Improve facilities for transit patrons (e.g. upgrade bus shelter, lay-by) when installing sidewalks
- Consider restriping a street for a road diet or bike lanes when repaving a road
- Coordinate sidewalk improvements with road diets (reducing the number of lanes on a roadway cross-section to provide space for other users).

11.6 PERFORMANCE MEASURES

Performance measures are used to evaluate a particular activity, project, or program in which an organization is engaged. In the context of Complete Streets, qualitative performance measures can include health, safety, economics and user satisfaction. Quantitative performance measures can include kilometres of new sidewalks, number of new curb ramps, or number of new street trees.

Performance measures (and desired targets) for Complete Streets are currently under development. An evaluation or scoring tool that incorporates both quantitative and qualitative aspects of a street will need to be developed to measure performance. Though this scoring tool will be used primarily to determine if targets are met, it can serve a number of other important functions:

- Quantify an improvement (before vs. after) for a specific street project
- Prioritize future candidate projects
- Adjust future capital work programs
- Adjust future operational funding requirements

Performance measures and the associated scoring tool for Complete Streets are currently under development and will be included incorporated into the 2012 Interim Guide.

11.7 ACTION ITEMS

A number of short-term and medium-term actions need to be undertaken to successfully implement the Complete Streets Guide. Actions are identified as either being within the current scope or fall outside the Complete Streets Program.

SHORT TERM (2012-13) ACTIONS

1. Residential Streets Policy (included and to be completed Q1 2012)
2. Environmental Capacity Guideline Policy (included and to be completed Q4 2012)
3. Revisions to Land Use Bylaw Right-of-Way Setback Table (not included)
4. Revisions to the Design Guide for Subdivision Servicing (included and to be completed 2012)
5. Revisions to the Oversize Levy Agreement (included and to be completed 2012)
6. Complete Scoring Tool and establish monitoring program (included and to be completed 2012)

MEDIUM TERM ACTIONS (2013-15)

1. Revisions to the Streets Bylaw and Traffic Bylaw (not included)
2. Revisions to City Processes identified in Section 11.4 (not included)
3. Establishing new capital and operational funding strategies for 'enhanced streets' (not included)
4. Complete Streets education/marketing plan (not included)

APPENDIX A

CASE STUDIES

CASE STUDIES

A.1 LA JOLLA BOULEVARD CONVERSION, SAN DIEGO, CA, USA

La Jolla Boulevard in the Bird Rock neighbourhood of San Diego is an example of the conversion of a five-lane road to a Complete Street. Due to parents' complaints that they had to drive their children across the road, a community charrette was organized in 2002. As a result, a new concept was developed that included a median, one 3.3 metre travel lane in each direction, 'park assist' lanes next to the parallel parking lane on the east side, and a wider 'park assist' lane next to the angled parking on the west side of the street. The five intersections that were controlled by two or four-way stop control and signals were converted to single-lane roundabouts.

The project was opened in stages and completed in August 2008. Although the traffic volumes have decreased because of the U.S. recession from 22,000 vehicles per day to 17,000 vehicles per day, the pedestrian and bicycle volumes have increased enormously (City of San Diego traffic counts and traffic webcam, 2010)

La Jolla Boulevard intersection before and after roundabout: San Diego, CA, USA (Credit: Michael Wallwork)

A.2 17TH AVENUE SE CORRIDOR REVITALIZATION, CALGARY, AB

PROJECT OBJECTIVE:

To identify a transportation corridor that:

- Complements the land use concept plan;
- Promotes walking, cycling, transit and a public realm; and
- Provides a transit corridor connecting to the downtown.

PROCESS

- Transportation Planning (TP) met with Land Use Planning & Policy (LUPP) to coordinate activities
- Brainstorming sessions with LUPP, consultants and City staff from various business units were held with TP
- Prepared a master schedule (LUPP and TP) and coordinated activities for seamless flow
- Formed a community advisory groups for consultations

- Joint stakeholder meetings hosted
- Joint open houses hosted
- Information shared with internal and external stakeholders periodically

STAKEHOLDERS

- Community Advisory Group
- Business Revitalization Zones
- Area Aldermen
- Staff from various City Business Units
- Town of Chestermere
- Alberta Transportation

ALTERNATIVE CROSS-SECTIONS

Initially, the following two concepts were selected for further examination:

- Median transit lanes with four auto lanes, on-street bike lanes, boulevard and sidewalks
- Curbside transit lanes with four auto lanes, on-street bike lanes, boulevard and sidewalks

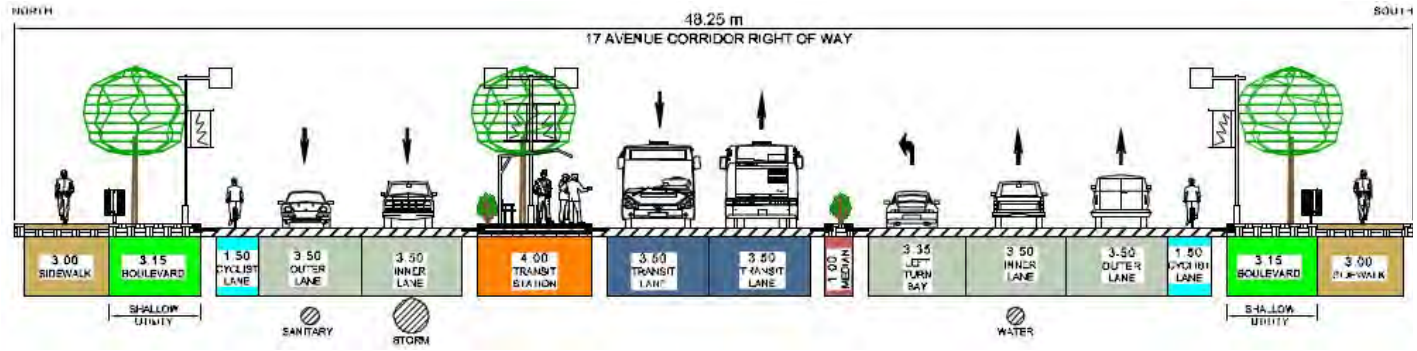
Later, at the direction of the stakeholders, a reduced capacity roadway (two auto lanes with transit lanes) was developed and evaluated.

The cross-sections were prepared and models developed to confirm the impact on the traffic operations. The model confirmed that the two lane option would cause undesirable levels of congestion along the corridor. This would divert traffic to the surrounding street and potentially create short-cutting in the adjacent neighbourhoods.

PREFERRED CROSS-SECTION

The three cross-sections were evaluated against set criteria (safety, operations, sustainable modes, cost, and social and environmental impacts). Based on the evaluation matrix, the cross-section with median transit lanes and four auto lanes was the preferred option.

TYPICAL CROSS-SECTION AT INTERSECTION



FUNDING SOURCES

City Council approved the study recommendations and directed Administration to identify a funding source for the project. Council identified the Alberta Government Green Transit Incentives Program (GREEN TRIP), as a potential funding source for the project. The proposed corridor promotes transit service and is expected to double ridership by 2035.

SUCCESSES

- Obtained buy-in from the aldermen, communities and their representatives
- Alignment of Planning and Transportation objectives
- Collaboration with Roads to establish preferred cross-sections
- First median transit busway for Calgary

LESSONS LEARNED

- Initial collaboration between Planning and Transportation challenging – Community Planning and Transportation Planning required understanding of each others' issues and constraints.
- Informing Planning of limitations created by Transportation design standards
- Ensuring communities felt like they were being heard. Their concerns and suggestions were examined and the results shared with them.
- Consultants need guidance on challenging projects.
- Good budget control is essential.
- Sufficient funds should be allocated for public consultation on challenging projects
- Communication is the key to success

A.3 13TH AVENUE SW GREENWAY, CALGARY, AB

PROJECT OBJECTIVE

To create a green loop around the Centre City, linking the pathways of the Bow and Elbow Rivers to create an "Emerald Necklace" through the Centre City, or a recreational loop for users. Focus is pedestrians first, and on the recreational aspects of the street. The redevelopment of 13th Avenue from the Elbow River to 19th Street West will complete this recreational loop.

13TH AVENUE HERITAGE GREENWAY PLAN (PHASES 1-3)

PROCESS

- Visioning completed by Land Use Planning & Policy. Several stakeholder meetings were held, and there were several issues which created delay. These included the legalities of cycle tracks, utility conflicts, street width, etc.
- Transportation took over the project in late 2008 when the vision and several unrefined options had been well established. The task was to take the project forward with a design plan that could be implemented
- Meetings were held with all internal stakeholders to ensure the plan worked from all perspectives.
- A preferred cross section was approved. Roads began the detailed design of the cross-section with the assistance of a landscape architect and a heritage planner.
- The plan was presented and approved by the Ward Alderman in Q2 2009.
- The plan was presented and endorsed by community stakeholders (Victoria Crossing Business Revitalization Zone, Beltline & Sunalta Community Associations)
- A public Information Session was held in November 2009. Residents adjacent to the project were informed by mail out, advertising signs, and the City website.
- Challenges with tree trench design and surface material details took most of 2010 to address
- The project is currently under construction (2012).

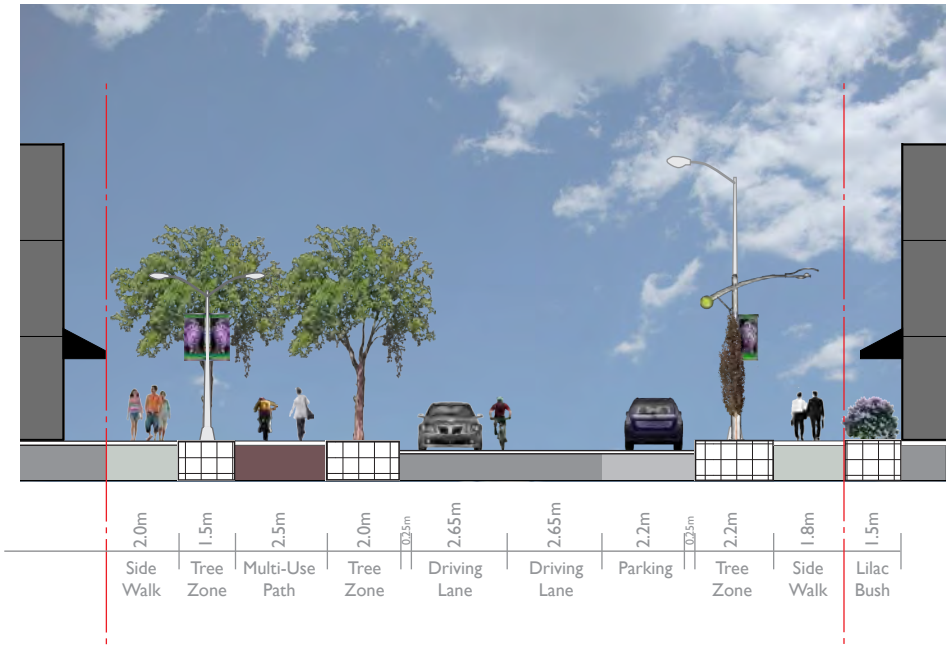
STAKEHOLDERS

- Land Use Planning & Policy (urban design),
- Parks (urban forestry and landscape architects),
- Roads Development and Projects
- Roads Traffic,
- All Utilities,
- Fire Department,
- Pedestrian & Bicycle associations
- Community Associations
- Area Business Revitalization Zone (BRZ)
- Adjacent residents
- Transportation Planning

ALTERNATIVE CROSS-SECTIONS

Over 12 variations were examined including one-way operation, retaining parking, and meandering pathways. Most were not workable because of the constraints such as limited ROW width, utility locations, the need for a separation between the pathway and parking and the need to retain the vision of 'canopy-carriageway-column' from the north to the south boundary of the project.

PREFERRED CROSS-SECTION (2 STREET SW – 1 STREET SE)



FUNDING SOURCES

- $5,000,000 capital funding for project
- $140,000 from Beltline Development Levy
- Water Services – replacement of water line and curb work if disturbed as part of their project
- Enmax – removal of existing overhead poles
- New developments – potential for contribution to project in place of new sidewalk construction & landscaping

MAINTENANCE ISSUES

- Non-standard streetlights
- Unique street furniture
- Pathway snow clearing

SUCCESSES

Approval of a final cross section given all the stakeholders and demands for this facility.

CHALLENGES

Extensive number of stakeholders and demands. There had to be trade-offs, the biggest one being parking.

APPENDIX B

RELATED GUIDELINES / POLICIES

PART B: RELATED GUIDELINES & POLICIES

This purpose of this part of the Guide is to provide the user with the Transportation-related City of Calgary guidelines and policies that exist or are in current development. These related guidelines and policies provide more in-depth information that is beyond the scope of this Guide.

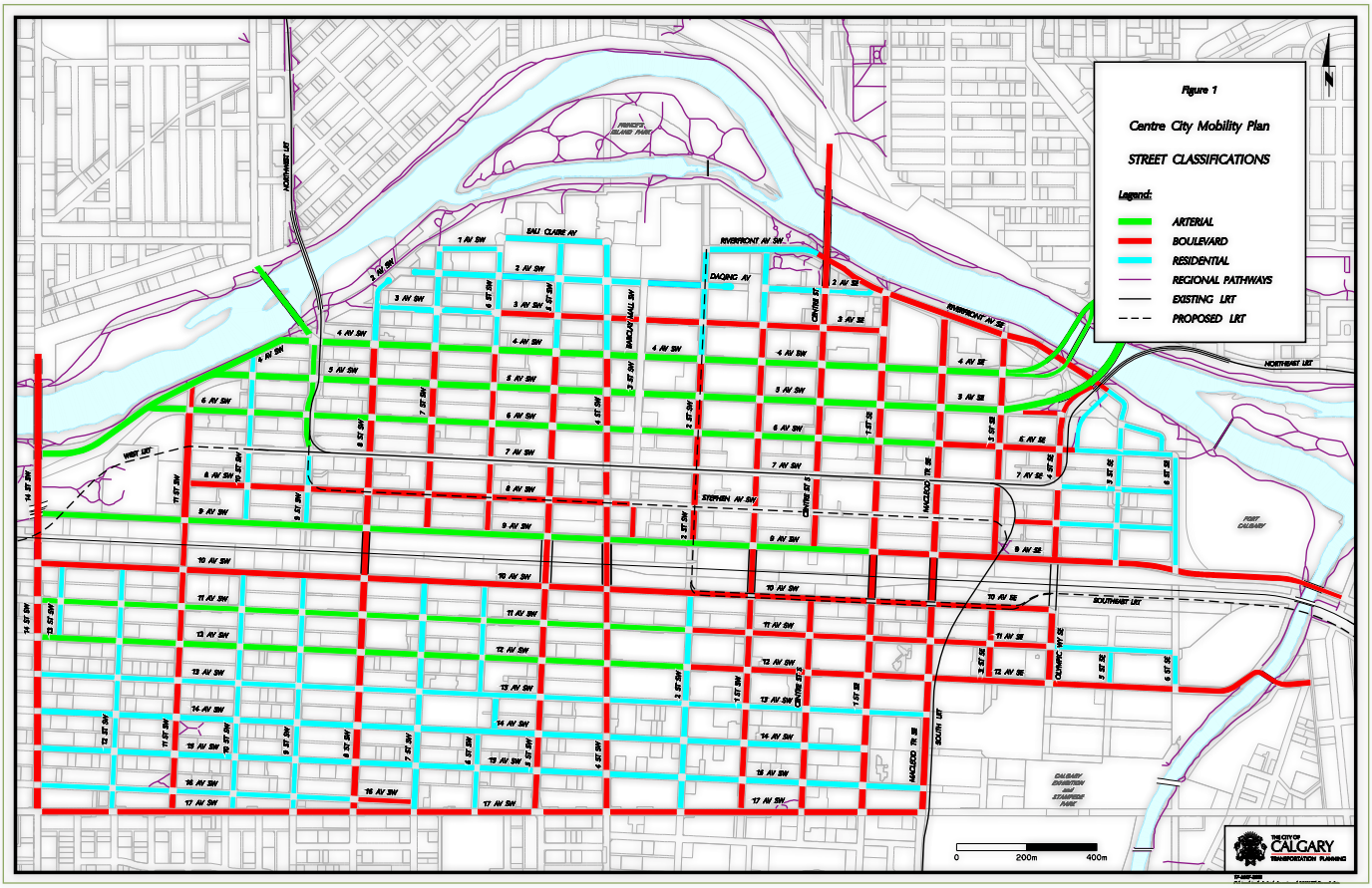
B.1 CENTRE CITY MOBILITY PLAN

The objective of this plan is to provide a balanced and coordinated long-term plan that provides for pedestrians, cyclists, transit customers, goods movement, and vehicles in the Centre City. It supports the Centre City Plan and includes a review of the role and function of the rights-of-way within the Centre City. This plan will provide guidance for land use/development applications and transportation corridor re-development in the Centre City.

Three street classifications are identified for the Centre City: Arterials, Urban Boulevards, and Residential Streets as shown in this figure:

FIGURE B-1: STREET CLASSIFICATIONS (FROM FIGURE 1, CENTRE CITY MOBILITY PLAN)

The Plan includes similar figures for the pedestrian network, bicycle network, transit network, and the streetscape character.



B.2 ROUNDABOUT POLICY & GUIDELINES

City of Calgary Council approved a Roundabout Policy in April 2011. Highlights from this policy are summarized below.

The modern roundabout is a form of circular intersection where traffic flows counter-clockwise around a raised central island, thereby preventing vehicles from passing through the intersection on a linear path. Roundabouts offer the opportunity to improve intersection safety while increasing intersection capacity and reducing delay. Roundabouts also offer advantages verses traffic signals with respect to ongoing operating costs.

POLICY:

The City of Calgary will use roundabouts as the preferred option of traffic control on arterials and collectors in Greenfield areas where a new intersection is planned that warrants or may warrant a future traffic signal or all-way stop.

In existing developed areas, a roundabout should be examined where a traffic control up-grade is warranted, capital improvements are being considered, or safety or capacity issues have been identified. The use of roundabouts in these circumstances will be at the discretion of the General Manager, Transportation.

Intersection control evaluations will be conducted to ensure roundabout suitability. If a roundabout is found to be inappropriate, an alternate method of intersection control may be used as justified by the evaluation. The General Manager, Transportation shall be the approving authority for roundabouts.

The above policy will be used in several areas including:

- The development process;
- Capital projects; and
- Replacement activities

Outline plans approved prior to the adoption of the Roundabout Policy should be examined for roundabout usage in conjunction with the developer on an opportunity basis.

GUIDELINES:

Transportation Planning has developed Roundabout Guidelines including design, right-of-way requirements, and landscaping.

The document is available for viewing or download at **www.calgary.ca.** Search for **"Roundabout Guidelines".**

B.3 TRANSPORTATION IMPACT ASSESSMENT (TIA) GUIDELINES

A Transportation Impact Assessment (TIA) is typically required to support the transportation aspects of a proposed development that has the potential of generating significant amounts of new transit users, pedestrians, bicycle and vehicular traffic or that could potentially change the mobility patterns (transit, pedestrian, bicycle and/or vehicular) in the area where it is proposed.

In Calgary, as a rule of thumb, if a development has the potential for generating more than 100 person trips per hour (considering all modes) at any given peak period or for any given mode, a TIA will be required. On occasions, despite the development not reaching the threshold value above-mentioned, a TIA will still be requested due to particular circumstances in the area surrounding the project or due to concerns of the surrounding/adjacent communities, or other circumstances that TDS deems appropriate to review.

The purpose of the Transportation Impact Assessment (TIA) Guidelines is to provide applicants, development and transportation consultants with the framework to prepare studies for The City of Calgary. It provides guidance regarding the process for preparing and submitting TIAs, including basic information that should be contained in the study.

The Guide can be downloaded or viewed online at: **www.calgary.ca.** Search for **"TIA Guidelines".**

B.4 NEIGHBOURHOOD DESIGN AND PLANNING PROCESS INITIATIVE

Administration is currently developing a series of integrated policy updates to reflect new priorities set out in the MDP/CTP and in response to ongoing challenges facing the planning process. These initiatives include:

- New policies to direct high-quality neighbourhood design in greenfield areas,
- Innovative Regulatory Techniques such as form-based controls, for developments in which a high quality public realm is of particular importance, such as Activity Centres and Corridors,
- An Incentive-Based Evaluation System that will encourage high quality, sustainable development projects,
- A Priority Application Review Process to convey priority review status to applications that promote sustainability through innovative design.

This work is being led by Land Use Planning & Policy (LUPP).

B.5 ENVIRONMENTAL CAPACITY GUIDELINES FOR ROADWAYS (POLICY TP009)

This Transportation Policy provides guidelines for the number of vehicles allowed on residential, collector, primary collector, and major roadways in Calgary. In 2003, this Policy was revised to increase these thresholds in response to increased traffic volumes throughout the City. Business Units within Transportation, the development industry, and communities rely on these thresholds for everything from planning future road sizes to evaluating the impacts of new developments on existing roads.

The policy will be reviewed in 2012. It will require significant changes to align with the objectives of the CTP/MDP. For example, current thresholds are subjective and auto-centric, based exclusively on vehicle trips, not person trips. Furthermore, areas such as the Downtown, TODs, and other activity centers will likely have traffic volumes in excess of these existing thresholds. As part of the Final Complete Streets Guide, the Environmental Capacity Guidelines for Roadways Policy will be revisited and rewritten to address these issues.

APPENDIX C

GLOSSARY

ACCESSIBILITY

Ease of access/egress to any location by walking, cycling, transit, and private vehicles, or for commercial vehicles.

ACTIVE MODES

Non motorized travel, primarily walking and cycling but also includes roller-blading and movements with mobility devices.

ACTIVITY CENTRE

All areas defined as Major Activity Centres, Community Activity Centres or Neighbourhood Activity Centres in the MDP, and as shown on the MDP Urban Structure Map.

COMPLETE COMMUNITY

A community that is fully developed and meets the needs of local residents through an entire lifetime.

Complete communities include a full range of housing, commerce, recreational, institutional and public spaces. A complete community provides a physical and social environment where residents and visitors can live, learn, work and play.

COMPLETE STREET

A street that moves people, by foot, bike, bus and car; provides places where people can live, work, shop and play; supports the natural environment; facilitates movement of trucks and service vehicles, and supports our economy.

GREEN ALLEY

Is an alley designed to reduce environmental impacts and discharges to the storm sewer system. The design will allow rain water to percolate through vegetation or porous pavement to the ground, providing natural drainage. Increased vegetation will filter storm water and may improve air quality.

GREEN BUILDING

Green building practices aim to reduce the environmental impact of buildings. (E.g. vegetated roof to reduce storm run-off)

GREEN INFRASTRUCTURE

An interconnected network of natural green and engineered green elements applicable at multiple scales in the land use and mobility framework. Natural green elements include the conservation and integration of traditional green elements such as trees, wetlands, riparian areas and parks. Engineered green elements include systems and technologies designed to mimic ecological functions or to reduce impacts on ecological systems.

Examples include green alleys, green buildings and green roadways.

GREEN ROADWAYS

Are roadways that utilize stormwater management strategies street designs with features such as street trees, landscaped swales and special paving materials that allow infiltration and limit runoff.

IMPERVIOUS SURFACES

Mainly artificial structures, such as building roofs, roadway pavements, sidewalks and parking lots, that cannot be easily penetrated by water, thereby resulting in runoff.

LOW IMPACT DEVELOPMENT (LID)

An approach to land development that uses various land planning and design practices and technologies to simultaneously conserve and protect natural resource systems and reduce infrastructure costs.

MODE SPLIT OR MODAL SPLIT

The proportion of total person trips using each of the various modes of transportation. The proportion using any one mode is its modal share.

MONOLITHIC SIDEWALK

A sidewalk structure that includes the curb and gutter. (i.e. no boulevard separates the curb from the sidewalk).

PEDESTRIAN-ORIENTED

An environment designed to make travel on foot convenient, attractive and comfortable for various ages and abilities. Considerations include directness of the route, interest along the route, safety, amount of street activity, separation of pedestrians and traffic, street furniture, surface material, sidewalk width, prevailing wind direction, intersection treatment, curb cuts, ramps and landscaping.

RIGHT-OF-WAY (ROW)

Publicly owned land containing roads and streets and/or utilities.

ROAD DIET

A technique to reduce the number of lanes on a roadway cross-section. One of the most common applications of a road diet is to improve safety or provide space for other users (e.g. pedestrians, cyclists) in the context of two-way streets with 2 lanes in each direction.

STREET

Roadways that are designed to accommodate all modes of transportation (to varying degrees depending on the specific type of street). They also contribute to sense of place, and typically provide more streetscape elements than roads.

STREETSCAPE

All the elements that make up the physical environment of a street and define its character. This includes paving, trees, lighting, building type, style setback, pedestrian, cycle and transit amenities, street furniture, etc.

TRANSIT ORIENTED DEVELOPMENT (TOD)

Transit oriented development is a walkable, cyclable, mixed-use form of development typically focused within 600m radius of a transit station (LRT or BRT). Its intent is to create mobility options for transit riders and the local community.

TYPOLOGY

Typology defines the key geographic areas within the urban boundary that share common characteristics.

Typologies establish the strategic framework within which more detailed land use designations and policies can be established. Integral to each typology and the city as a whole are the "Road and Street Palette" and transit services which are integrated with the land use pattern or typologies.

UNIVERSAL DESIGN

Universal design is the design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design.

URBAN FOREST

All the trees and associated vegetative understory in the city, including trees and shrubs intentionally planted, naturally occurring or accidentally seeded within the city limits.

APPENDIX D

KEY ISSUES SUMMARY

APPENDIX D: KEY ISSUES SUMMARY

The purpose of the tables in this Appendix is to track key issues raised by project stakeholders. The responses include answers of clarification, answers to issues that can be addressed now, and answers to issues that will be addressed over the course of the Program.

Page	Issue	Stakeholder Comment	Response
General	Bike Accommodation (New Jan. 2012)	Insufficient design considerations have been made to effectively integrate cycling as a legitimate mode of transportation	Most of the efforts in 2011 have gone into revising existing road design standards and incorporating space for bikes where there was none before. The arterial street cross section has replaced undesirable wide curb lanes with safer, wider off-street pathways either side. Local arterial streets and primary collectors now have bike lanes (none existed previously). Local collectors and residential streets have no special bike facilities as low volumes and speeds allow bikes to share the street. A parallel project, the development of a Bikeway Design Guide, will provide more in-depth design considerations that integrate cycling facilities into street and intersection design.
General	Public Realm Design (New Jan. 2012)	Document does not cover design of the public realm or interface near building fronts	Content on public realm design (Section 8.4) is being provided by Urban Design Group in Planning for the 2012 Final Guide.
General	Confusing document structure (New Jan. 2012)	Document jumps between strategic content to detailed policy to detailed design and back	This is the challenge of trying to combine principles, specific guidelines and detailed design drawings. In the 2012 Final Guide, the detailed design drawings will reside outside the Guide. The strategic content is intended to be an introduction to the philosophy of the Calgary Transportation Plan and Complete Street Design.

Page	Issue	Stakeholder Comment	Response
General	Funding/Timing	Overall funding is a major issue and the proposed schedule doesn't address this issue until Q4 2012. Since Interim Complete Streets Guidelines will be in place between now and Q4 2012, what happens in the meantime? Will the City start to require items identified in the interim guidelines before the funding has been addressed? Funding and alignment will take some time to reach consensus on, so what happens in the next 2 -3 years?	We acknowledge that resolving funding issues (e.g. who pays for what on a new street cross-section) will take time. We are beginning to examine this now, but it likely will not be resolved before Q4 2012. In the meantime, if new standards are requested, the funding will have to be negotiated on a case by case basis.
General	Long Term vs. Short Term Goals	A number of new corridors are being planned within the City that are intended to redevelop over time to reach the ultimate densities envisioned. Please comment on how the City envisions the Complete Streets Guide addressing the issue of planning streets that serve both the short term and long term densities envisioned.	Whenever possible, Complete Streets need to be constructed for the long-term goals. It would not be economical to construct interim enhanced boulevards requiring expensive relocation in the future.
General	Traffic Analysis	Prioritizing walking and cycling over autos means that degraded vehicular operations will need to be accepted. However, UDI has noted a continued push by TDS staff to still design for typical operational performance and in particular accommodate for anticipated queuing within turn bays. UDI is of the opinion that with these competing interests it will be difficult to satisfy all of the requirements to achieve approvals and projects will get stuck in a seemingly endless "churn". Please comment on how industry can avoid this anticipated "churn". Additionally, with respect to issues that get stuck in this "churn" which of these competing interests will "win out" and is there an escalation model for addressing these issues when they arise?	Transportation Impact Assessment Guidelines are now available which highlights to its users the need to look beyond solely vehicular operational performance. Issues regarding TIA review and approval are outside the scope of the Complete Streets Program and should be dealt with through Development Services. (Updated Nov. 2011)

Page	Issue	Stakeholder Comment	Response
Page 3 Section I.3	Road ROW Variance Transit	How much of the additional ROW is needed for regional and primary transit? Is there a limit to the amount of additional ROW that can be requested?	LRT ROW is dependent on a number of factors including track alignment and topography. Chapter 13, LRT Design Guidelines Rev 2 should be referenced. Generally speaking, tracks require up to 18m and stations up to 23m. BRT may require up to 12m additional ROW.
Page 125 Section 10.1.9		The absence of right turn channelization could create issues for Fire and Transit. Has this been vetted by them as of yet?	This has been vetted through Transit. This is being discussed with Fire/EMS. Intersection plans involving collector streets will be developed in 2012. (Updated Nov. 2011)
		Does the presence of a 4-lane road vs. a 6-lane road impact the need for channelization? Does design speed impact the need for channelization?	No. Where pedestrians, cyclists, Transit are priority, there should be no channelization.
Page 71 Section 9.1.8	Item #2	Is Fire OK with the additional building setback?	This is being discussed with Fire/EMS.
Page 30 Section 3.2	Sidewalks	While we recognize the need for wider sidewalks at transit hubs, we don't understand why it is necessary to provide wider sidewalks along transit routes. There may be places where this is necessary and a good idea, but are wider sidewalks really necessary for all sections of all transit routes...Especially those in industrial areas where ped volume are light? Wider (≥2.0m) sidewalks - While we recognize that each situation is different, we are concerned that there is not upper limit set on the width of the sidewalks. Please comment. This comment also applies to the references on Page 33.	Pedestrian volumes are not be the only criteria in determining the presence or width of sidewalks. (Updated Nov. 2011) City preference is for sidewalks both sides with some exceptions as stipulated in the Residential Streets Policy currently being written (Updated Jan. 2012) An upper limit is challenging to establish as it is dependent on the adjacent land use context and related pedestrian volumes. Downtown areas, for example, may have sidewalks in excess of 4.0m. (Updated Nov. 2011)

Page	Issue	Stakeholder Comment	Response
Page 70 Section 9.1.7	Medians (Snow Storage)	Snow storage is new and hasn't been referenced previously. What establishes snow storage requirements? Wouldn't snow storage causes trees, plants and grass to die on the streets that are sanded or salted?	Minimum median width is to a degree based on salting, sanding practices. Their base cross-sections respect this minimum (Updated Jan. 2012)
Page 59 Section 8.3	Utilities & Line Assignment	Typically shallow utility designs don't happen for an outline plan. Has this been discussed with the utilities? This occurs at the Tentative Plan and we don't feel it should be required at the Outline Plan stage. Please comment.	Agreed. This has been removed (Updated Jan. 2012)
Page 31 Figure A5	General Table	UDI feels that it is important to list the preliminary Design Elements of Local Streets even if they are still under review. While we recognize that the notes indicate they will be included in either the 2011 or 2012 update we are concerned with how these items will be address in the interim. Please comment.	Figures has been replaced by design elements in the 2011 Guide (section 9.2) (Updated Jan. 2012)
	Arterial Streets	As previously noted, we question the upper limit of intersection spacing at 500m. Please comment.	Upper limit of 500m removed (Updated Jan. 2012)
		As previously noted, we question the lower limit of the intersection spacing at 300m with the elimination of the local major standard. Please comment.	Local major not eliminated (Updated Jan. 2012)
	Urban Boulevard / Neighbourhood Boulevard	The 4.5 metre sidewalks seem huge, especially keeping in mind the potential building setbacks that would increase the "effective sidewalk width". Please comment on whether or not sidewalk within the private realm can be included in these dimensions.	We will review this within the Department in 2012.
Page 39 Part A.7 (2010 Guide)	Figure A10	Please comment on the potential liability issues associated with public access easements for additional sidewalk width.	Removed. See pages 94 and 95 of 2011 Guide (Updated Jan. 2012)

Page	Issue	Stakeholder Comment	Response
Appendix B	Green Infrastructure/ Low Impact Development Brief	The Interim Guide does not state what must be included in green infrastructure or how the objects within the green infrastructure are achieved.	The 2012 Final Guide will provide direction on the application / implementation appropriate for Calgary. (Updated Jan. 2012)
	Street Design between Intersections	General concerns over illustrating the complete street details between intersections that cross-sections can't convey. Bus zones and mid-block crossings, for example.	Included in 2011 and upcoming 2012 Guide (Updated Jan. 2012)