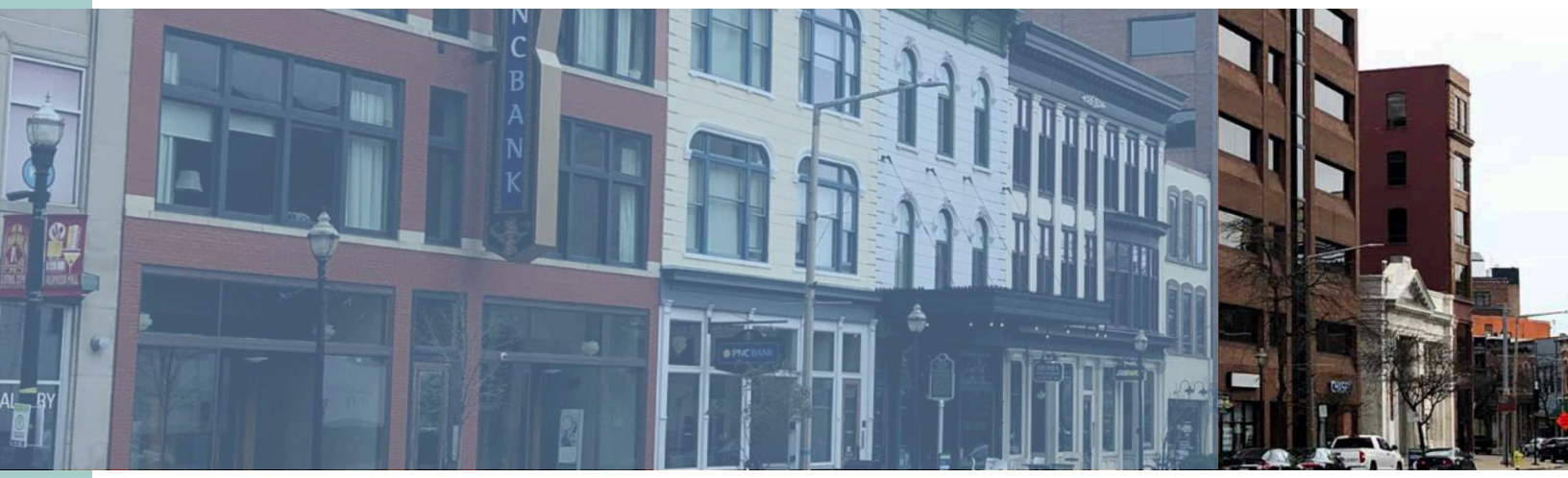
CITY OF KALAMAZOO

# STREET DESIGN MANUAL






NOVEMBER 2021

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# ACKNOWLEDGMENTS

The project team thanks the Advisory Committee Members for their involvement, insights, and engagement in developing the City of Kalamazoo Street Design Manual

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# 1.0 INTRODUCTION

# 1.1 STREET DESIGN MANUAL OVERVIEW

## PURPOSE OF THE STREET DESIGN MANUAL

The Imagine Kalamazoo 2025 Master Plan provides a comprehensive vision for the City, based on extensive community engagement and input. One of the central strategic themes in the city's vision was for a **Connected City - A city that is networked for walking, biking, riding, and driving.**

Critical to achieving the Connected City vision is the need to plan, design, and build **complete streets** that serve all members of the community equitably and enhance the resilience and sustainability of the city.

This manual gives both the public and private sector design standards and best practices for building and managing complete streets. It addresses the key roles of the street and the public right-of-way in supporting multiple modes of transportation, economic vitality, environmental health, and community character.

### What are "Streets?"

Streets, for purposes of this manual, are defined as the entire public right-of-way between buildings (not just the vehicle roadway). Streets includes the roadway and travel lanes, parking lanes, the amenity zone (between the curb and sidewalk) sidewalks, and public alleys.

## WHY HAVE A STREET DESIGN MANUAL?

Every street in Kalamazoo has its own personality and needs based on the residents, businesses, travelers, and activities occurring along the street corridor. Each street is also part of the public realm and must protect the health, safety, and comfort of all street users to the extent possible. When streets are identified for maintenance or other infrastructure projects, there is an opportunity to strengthen the performance of public streets and better support the health of the community.

A street design manual provides best practices and consistency in how streets are designed, built, and maintained. Clear standards and guidance supports a more robust and transparent decision-making process, and ensures that public infrastructure investments are well-aligned with community values and needs.

The following principles underpin this design manual:

- **Values: Ensure that street designs are aligned with community values and adjacent land uses**
- **Process: Establish a defensible and transparent process for street design and decision-making**
- **Consistency: Utilize consistent street design practices and methods**

## WHO SHOULD USE THE STREET DESIGN MANUAL?

While the street design manual is primarily a technical resource, it is anticipated to be accessible and usable by a broader audience. This includes the following:

- City staff, consultants, and partner agencies as they work to plan, design, engineer, construct, and maintain streets and public infrastructure.
- Private developers or utility providers with projects that impact the public right-of-way.
- Residents, business owners, and other members of the public that want to understand and/or advocate for improvements to public streets.

## ORGANIZATION OF THE STREET DESIGN MANUAL

The street design manual consists of the following chapters:

**CHAPTER 1: Introduction**

Provides an overview of the design manual purpose, as well as key terms and concepts governing the usage of the manual.

**CHAPTER 2: Street Typology Framework**

Describes the typology framework, which is a guiding plan depicting the organization of the streets across the City of Kalamazoo into distinct typologies that govern the character, function, and design of the street.

**CHAPTER 3: Street Design Process**

Provides design and decision-making tools governing street design projects in order to provide consistency and transparency in the process.

**CHAPTER 4: Street Design Elements**

Contains detailed guidance for individual physical design elements within the roadway.

# KEY TERMS

## Zones of the Street

The Kalamazoo Street Design Manual uses a number of terms throughout the document for describing the street environment and its qualities and functions.

A street is comprised of a number of zones that affect the uses and functions of the street, and relate to what "design elements" (see box on next page) may be applicable to areas of the street. Street zones include the following:

- **Right-Of-Way:** Publicly owned property where streets are located and is defined by adjacent property lines. (A)
- **Roadway:** The central portion of the street typically dedicated to travel lanes for vehicle, transit, and bicycle movement. (B)
- **Curbside Zone:** Area adjacent to the curb and commonly used for on-street parking and loading. (C)

**D** **Pedestrian Area:** This is the area between the curb and the outside edge of the public right-of-way and private property line. The Pedestrian Area encompasses the Amenity Zone, Sidewalk, and Frontage Zone.

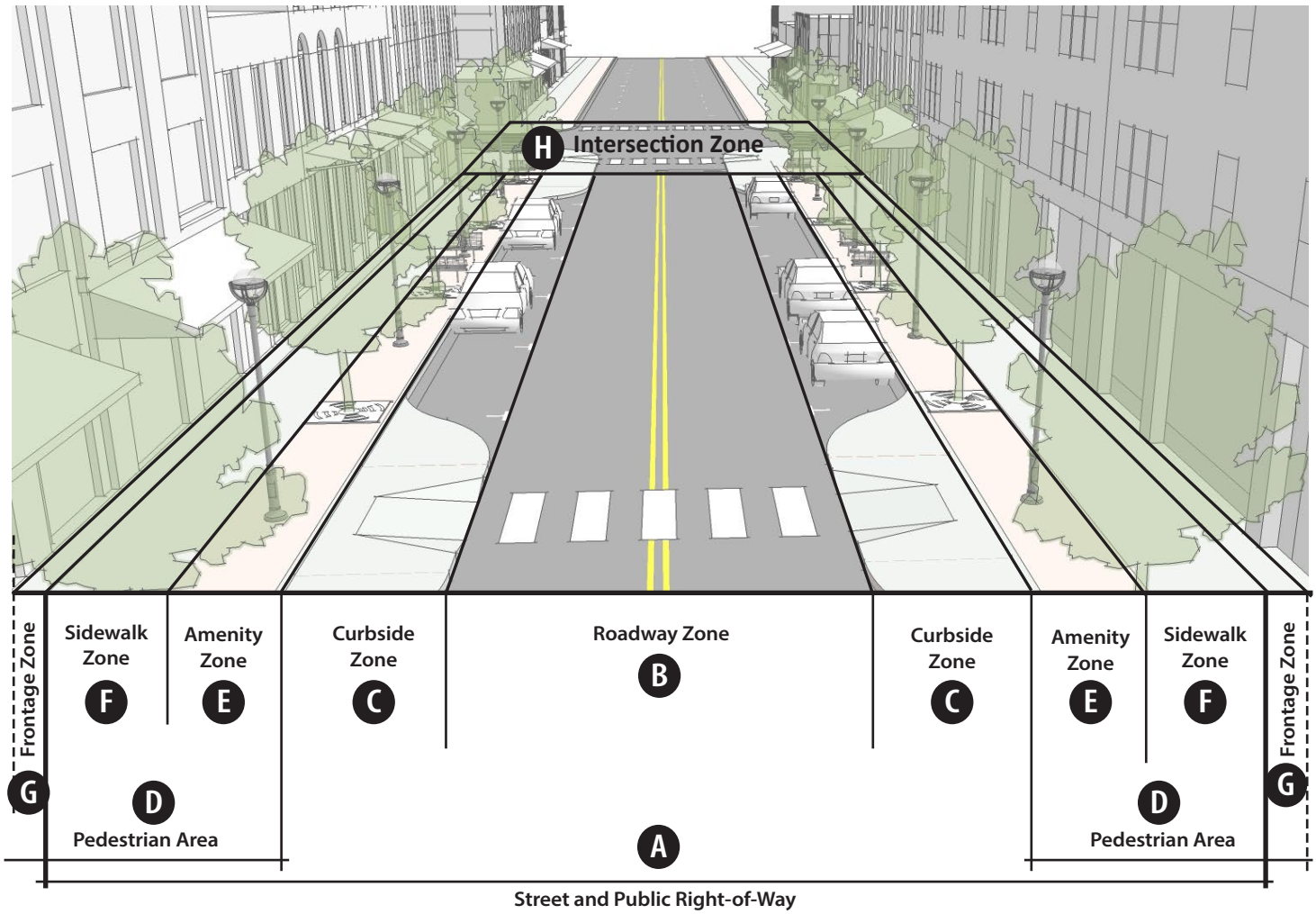
**E** **Amenity Zone:** Area between the sidewalk and the curb. Commonly the location for street trees, light poles, road signs, and other street furnishings.

**F** **Sidewalk Zone:** A clear, consistent, paved area dedicated to pedestrian movement. Outer edge of the sidewalk typically at the public right-of-way line. Sometimes referred to as simply the "sidewalk."

**G** **Frontage Zone:** Area between the public right-of-way (property line) and building faces. In some cases this zone may be used as additional public pedestrian space.

**H** **Intersection Zone:** The intersection zone occurs where two streets meet.

**Figure 1.1.1 - Street Zones**



## What are "Design Elements?"

A design element is a specific built feature or other physical amenity that is located in the street. The applicability of design elements to streets relate to the street's typology (refer to Chapter 2) and street zone.

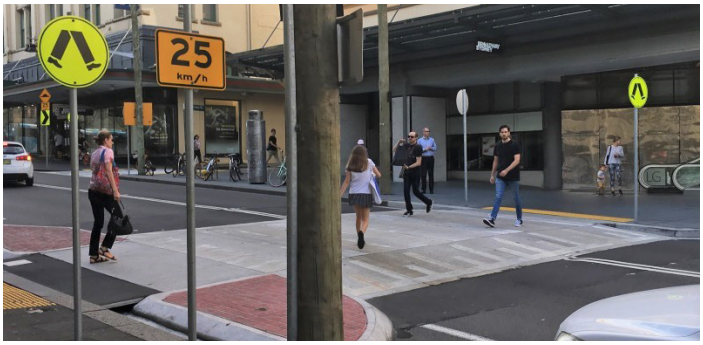
Design elements broadly include, but are not limited, to the following types of features:

- Travel surfaces and use zones, such as sidewalks, bicycle facilities, and vehicles lanes.
- Special uses like curbside parking, loading zones, sidewalk occupancy, and bus stops.
- Intersection treatments and traffic controls (signs and signals)
- Streetscape amenities like trees, planters, lighting, and seating.
- Utility and infrastructure features, like fire hydrants and stormwater management facilities.

Source: NYC.gov



Source: NYC DOT




Source: NYC.gov

# 1.2 PLAN ALIGNMENT

## RELEVANT KALAMAZOO PLANS & POLICIES

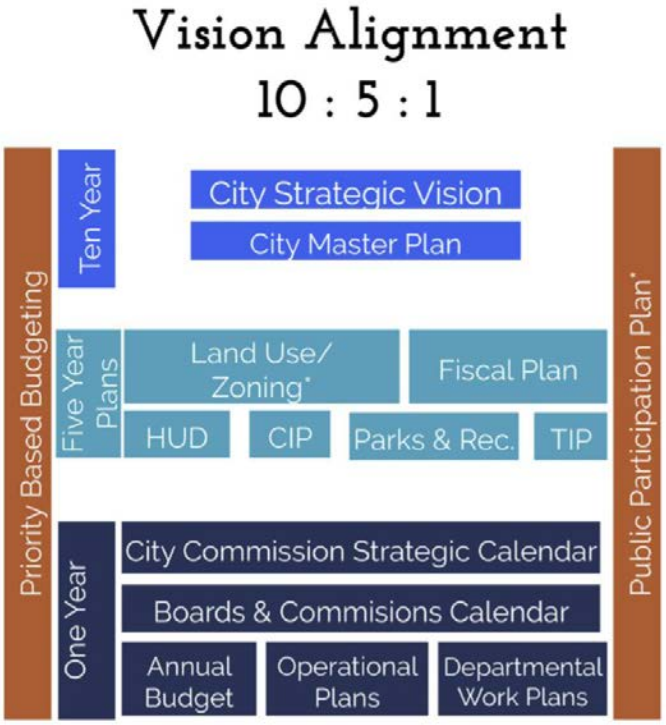
The Imagine Kalamazoo process led to the creation of the 2017 Strategic Vision and 2025 Master Plan, which collectively identifies a broad range of priorities, initiatives, policy proposals, and other efforts that will position Kalamazoo as an equitable, resilient, and sustainable place to live, work, and recreate.

The Vision Alignment diagram (right) shows the relationship between these key planning activities and decision-making within the city. The Strategic Vision provides overarching goals, while the 2025 Master Plan focuses on land use and transportation objectives at a city-wide scale. The Capital Improvement Project (CIP), Transportation Improvement Program (TIP), and annual budgets provide funding resources for plan and project implementation.

The 2025 Master Plan recognizes the critical role the city's transportation systems and connectivity networks play in making the city a safe and comfortable place where people of all ages and abilities are able to access destinations using different modes of transportation.

Critically, the physical design of streets and how different modes of travel move through and use the street grid is important for achieving the city's overall goals and aspirations. This street design has been assembled in alignment with adopted city goals and policies, and will be a critical tool for realizing the city's goals.

This section provides an overview of relevant city documents and policies that have a bearing on street design, as well identifying state and national design guidance and best practices that is alignment with Kalamazoo's goals.




*Plans are reviewed every five years for accomplishment & relevance. If deemed necessary, an update process would be used to adjust the plans.

## City Strategy, Vision, and Master Plans

The Kalamazoo Street Design Manual builds on and compliments the goals, objectives, and intent of many existing plans developed and adopted by the City of Kalamazoo. These include:

- **Imagine Kalamazoo.** The outreach to establish a comprehensive vision of Kalamazoo for the next 10 years was formed through the 16 month-long Imagine Kalamazoo 2025 planning process. This planning process was centered around three themes: Connected & Accessible Community, Equity & Opportunity for All, and Vibrant & Friendly Environment.
  - » **Kalamazoo Strategic Vision (2017).** The first document to result from the Imagine Kalamazoo 2025 planning process was the city's Strategic Vision. The Strategic Vision guides the work of the city, both internally and externally to represent the community's needs. It shapes all plans created by the city, including the master plan, as a means to implement the community's vision.
  - » **Kalamazoo 2025 Master Plan (2017).** The master plan shapes the city's future built environment by supporting growth and development, preserving Kalamazoo's unique character, and enhancing Kalamazoo's neighborhoods. This document primarily focuses on city-wide land development and transportation issues.
  - » **Kalamazoo Neighborhood Plans (on-going).** These plans give specific direction on where, what, and when goals/actions are implemented in each geographic area. These plans aim to define what a complete neighborhood means in Kalamazoo and corresponding goals that can be realized.
  - » **Sustainability Strategy (2021)**. Environmental responsibility is one of ten main goals in the city's Strategic Vision, expanded upon in the 2025 Master Plan. In an effort to progress towards this goal, city staff, stakeholders, and community partners are working to create a sustainability strategy which will incorporate Imagine Kalamazoo @ Work action items, past climate studies, global protocols, best practices, and resident input.
  - » **Parks and Recreation Plan (2019).** The City of Kalamazoo has developed this five-year parks and recreation master plan after engaging in a process of inventory, analysis, and public input collection. This plan is a road map for the parks and recreation decisions to be made over the next five years.
  - » **Kalamazoo Stormwater Management Plan (2021).** The Stormwater Management Plan regulates various city infrastructure needs, including balancing clean stormwater drainage, properly managing municipal operations such as street sweeping and winter road management, storm sewer infrastructure maintenance and cleaning, and public education and outreach.
  - » **Planning and Environmental Linkages (PEL) Study (2017-2018).** The Linkages Study aims to improve safety and operations for all users on Stadium Drive, Michigan Avenue, Kalamazoo Avenue, Westnedge Avenue, Park Street, and Michikal Street (I-94 BL/US-131 BR/M-43), and provide an integrated transportation network to support economic and quality of life benefits.
  - » **Kalamazoo Public Participation Plan and Engagement Toolkit (on-going)**. Developed alongside the Imagine Kalamazoo engagement process. Establishes the importance of meaningful engagement in all decisions that affect people's lives.
  - » **Downtown and Adjacent Street Network:** Following the PEL and the jurisdictional transfer of key streets in and around Downtown from the MDOT (Michigan Department of Transportation), the City is working to plan, budget, and design updates to the street network, including converting the one-way streets to two way, and making the streets safe and comfortable for all users.

## City Policies

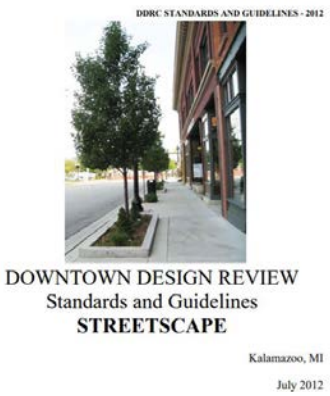
The Kalamazoo Street Design Manual advances other policies, resolutions, and initiatives underway including the resolution proclaiming the City of Kalamazoo's commitment to complete streets and multi-modal safety. Notable policies include:

- **Vision Zero:** The 2025 Master Plan recognized Vision Zero as an approach to consider for improving transportation safety for all users. No formal policy has been adopted. Vision Zero calls for the elimination of all transportation related fatalities and severe injury.
- **Housing for All:** The Housing for All initiative is an effort to provide resources to construct and preserve quality, affordable, housing that responds to our community's vision described through Imagine Kalamazoo. This fund is intended to provide loan gap funding for affordable housing projects in the City of Kalamazoo.
- **Kalamazoo Complete Streets Policy & Coalition:** The Complete Streets Policy is intended to provide for safe and convenient access to all parts of the city by respecting the needs, capabilities and limitations of all users of city rights-of-way, including but not limited to pedestrians, cyclists, transit riders, motorists, emergency, freight, and commercial vehicle operators. The policy aligns street design, reconstruction, and maintenance with the street typologies presented within this document.
- **Kalamazoo Complete Streets Advisory Committee:** The Complete Streets Policy establishes an advisory committee made up of advocates, residents, and a planning commissioner. This committee is responsible for reviewing best practices, education and outreach, and recommending priorities for street projects.

# DESIGN STANDARDS & GUIDELINES

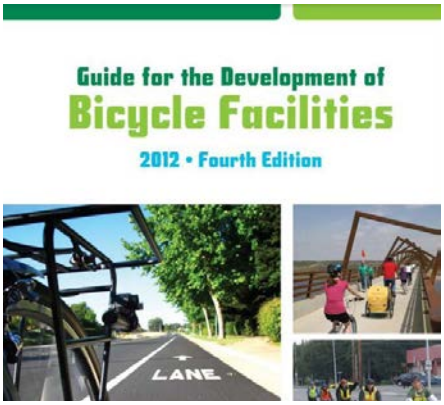
The Kalamazoo Street Design Manual utilizes national best practices, design guidance, and local standards and regulations to ensure that street projects improve the safety, comfort, and access for all users of the streets. Throughout this document, design direction or recommendations may refer to any of the following documents for further detail and clarity for how they are to be implemented in accordance with best practice.

- **Local Standards & Guidelines**
  - » **Accessible Sidewalk Requirements:** includes introduction, transition plan, definitions, applicability, standards for accessibility, bus stops, accessible pedestrian signals, on-street parking.
- **State Standards & Guidelines**
  - » **Michigan Manual on Uniform Traffic Control Devices (MMUTCD) (2013):** Specifies the design, installation, and use standards for traffic signs, road surface markings, and signals.
  - » **MDOT – Bicycle and Pedestrian Resources for Transportation Professionals (2016):** A resource with the latest research, resources, and guidance on pedestrian and bicycle planning, safety, and design.
  - » **MDOT – Best Design Practices for Walking and Bicycling in Michigan:** A toolbox of non-motorized improvements that have been shown to reduce crashes involving pedestrians and cyclists.

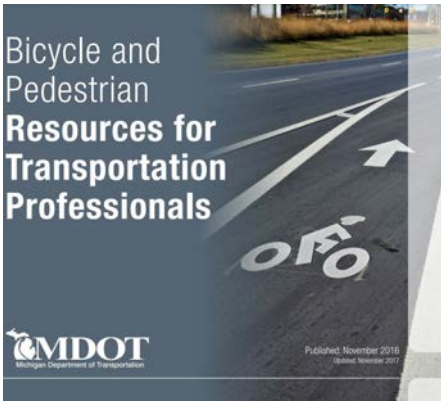




- **National Guidelines & Design Resources**
  - » **NACTO – Urban Bikeway Design Guide (2014):** Guidelines for bicycle infrastructure including lanes, cycle tracks, intersection treatments, signals, signage, bicycle boulevards.
  - » **AASHTO – Guide for the Development of Bicycle Facilities (2012):** Information on accommodating bicycle travel and operations in most riding environments.
  - » **NACTO – Urban Street Design Guide (2013):** Principles and practices of designing safe, multi-modal streets.
  - » **NACTO – Transit Street Design Guide (2014):** Guidance for the development of transit facilities on city streets.
  - » **FHWA – Separated Bike Lane Planning and Design Guide (2015):** Planning considerations for separated bicycle lanes, including a menu of design options covering typical one and two-way scenarios.
  - » **FWHA – Small Town and Rural Multimodal Networks (2016):** A resource for applying national design guidelines in a rural setting and highlights small town and rural case studies.
  - » **NACTO – Designing for All Ages and Abilities (2017):** Facility selection guide for a wide variety of urban street types to allow planners to determine how to best combine traffic calming tools to reduce fatalities and increase cycling rates and comfort.
  - » **FHWA – Bikeway Selection Guide (2019):** A resource to help transportation planners make informed trade-off decisions relating to selection of bikeway types, focusing on safety.
  - » **NACTO – Urban Street Stormwater Guide (2017):** National best practices for sustainable stormwater management in the public right-of-way.
  - » **NACTO - Don't Give Up at the Intersection (2019):** Provides design guidance on safe bike and pedestrian intersection treatments, such as protected corners.






# ORGANIZATIONS

A number of public organizations and other entities have a role or interaction in the design and management of streets and are referenced throughout the Kalamazoo Street Design Manual.

## City of Kalamazoo

The City of Kalamazoo is the public municipality that owns the right-of-way throughout the city. A number of city units are referenced in this document that have a relationship to the street.

- **Community Planning & Economic Development:** Kalamazoo's Community Planning & Economic Development Department (often referred to as CPED) works to create a healthy, safe, and sustainable community of choice through leadership, education, partnerships, and stewardship of resources and assets. The department has several areas of focus including land use and planning, the investment of federal, state, and local grant funds into neighborhoods, rental housing and building inspections, historic preservation, economic development, and the enforcement of codes and ordinances. Important divisions and initiatives within CPED include:
  - » **Community Investment:** The Community Development division invests federal, state and local funds in programs and services that benefit neighborhoods, business development, and low-income households to address critical needs in our community. This division works closely with neighborhood associations, non-profit organizations, foundations, and others community groups to build strong and sustainable neighborhoods.
  - » **Planning:** Kalamazoo's planning staff directs future growth and redevelopment in the city through land use planning and zoning to help create a better, more sustainable community. The work of the Planning division is guided by the strategic vision and master plan for the city, which is reflected and implemented through the zoning ordinance.
- **Public Works:** The Public Works Division is comprised of professional engineers and technicians who design, inspect, and maintain infrastructure components in the city. Staff focus on building and maintaining a safe, efficient, and long lasting infrastructure in Kalamazoo. The division is responsible for street improvements and maintenance, sidewalks, snow and ice removal, forestry and leaf pickup, traffic signs and signals, the snow-melt system, and right-of-way permitting.
- **City of Kalamazoo Downtown Partnership (KDP):** The Kalamazoo Downtown Partnership is a public board that develops and maintains downtown Kalamazoo. They oversee the Downtown Economic Growth Authority (DEGA), which is the TIF district downtown. Their responsibilities include keeping roads and sidewalks in good shape, making public spaces beautiful, and helping downtown's economy grow.
- **Kalamazoo Boards & Commissions:** A number of local boards and commissions have a bearing on Kalamazoo's streets:
  - » **City Commission:** Overarching elected body within the city, responsible for providing leadership, policy direction, and managing city operations and finances. Plays a primary role in approving capital projects and budgets.
  - » **Historic District Commission:** Reviews and advises projects in historic districts and properties.
  - » **Planning Commission:** Advises and makes recommendations to the city council regarding continuance of the master plan, zoning, ordinances, and other applicable codes. The Planning Commission reviews and approves Capital Improvement Project (CIP) recommendations.

## Non-City Organizations and Agencies

- **Kalamazoo Area Transportation Study (KATS):** Metropolitan Planning Organization (MPO) for the Greater Kalamazoo Area. Plays a significant role in long-term transportation planning and policy across the Kalamazoo region.
- **Kalamazoo County Transportation Authority (KCTA or "Metro"):** Operates transit bus service in Kalamazoo and surrounding municipalities.
- **Michigan Department of Transportation (MDOT):** State transportation department with jurisdiction over certain streets within the city. Coordination with MDOT is also required for railroad crossings and safety.
- **Michigan Department of Environment, Great Lakes, and Energy (EGLE):** Reviews and issues permits for projects within the floodplain.

## Partners and Resources

The City of Kalamazoo works with a variety of local organizations on its economic development initiatives, including:

- Small Business Development Center (SBTDC)
- Michigan Works! Employment Resource Center
- Universities and Colleges:
  - » Western Michigan University: Major research institution and significant property owner within the city.
  - » Kalamazoo College
  - » Kalamazoo Valley Community College


# 1.3 GOALS AND VALUES

## ESTABLISHING SHARED VALUES

Designing streets, especially when pursuing complete street objectives, can be a particularly challenging undertaking. Everyone living, working, learning, visiting, or recreating in the city relies on public streets to access destinations. However, streets also have limited public right-of-way width, yet face an ever increasing demand to accommodate multiple modes of travel in a safe and comfortable manner for all users.

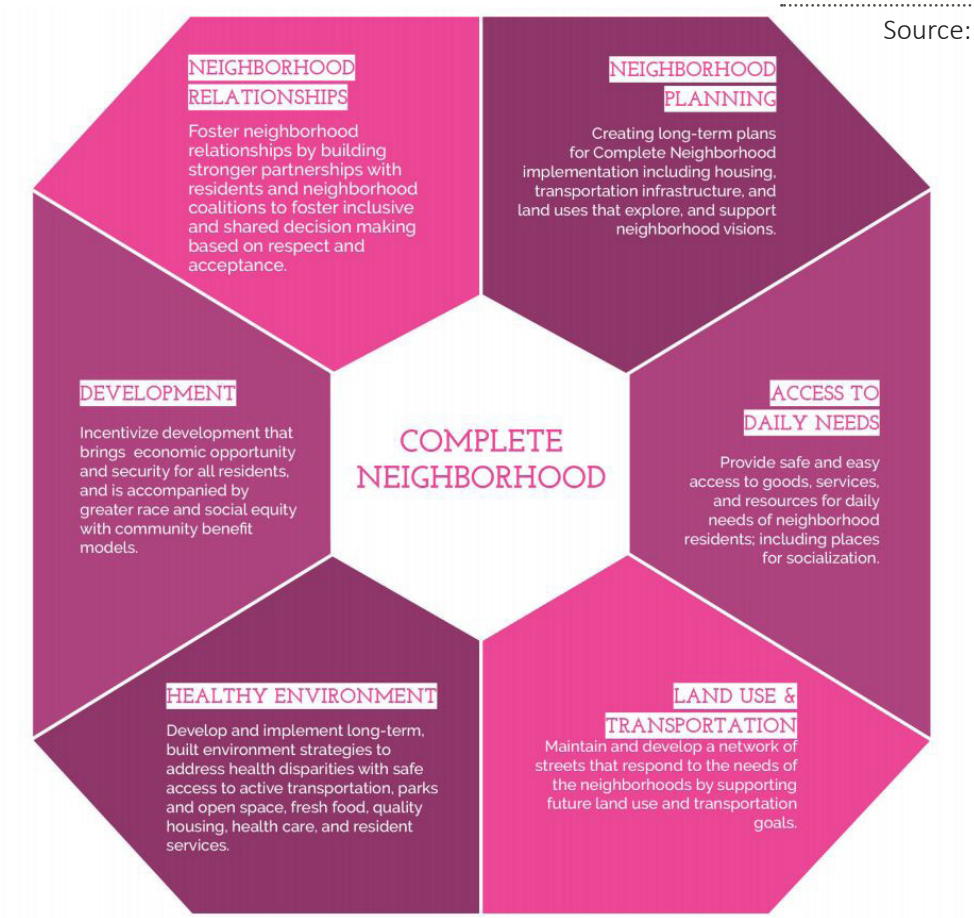

The street design process is ultimately a process that navigates tough choices and trade-offs. Most streets in the city are simply not wide enough to accommodate all modes of transportation at the highest level of service, while also being sensitive to the adjacent land use context. There is simply not enough room!

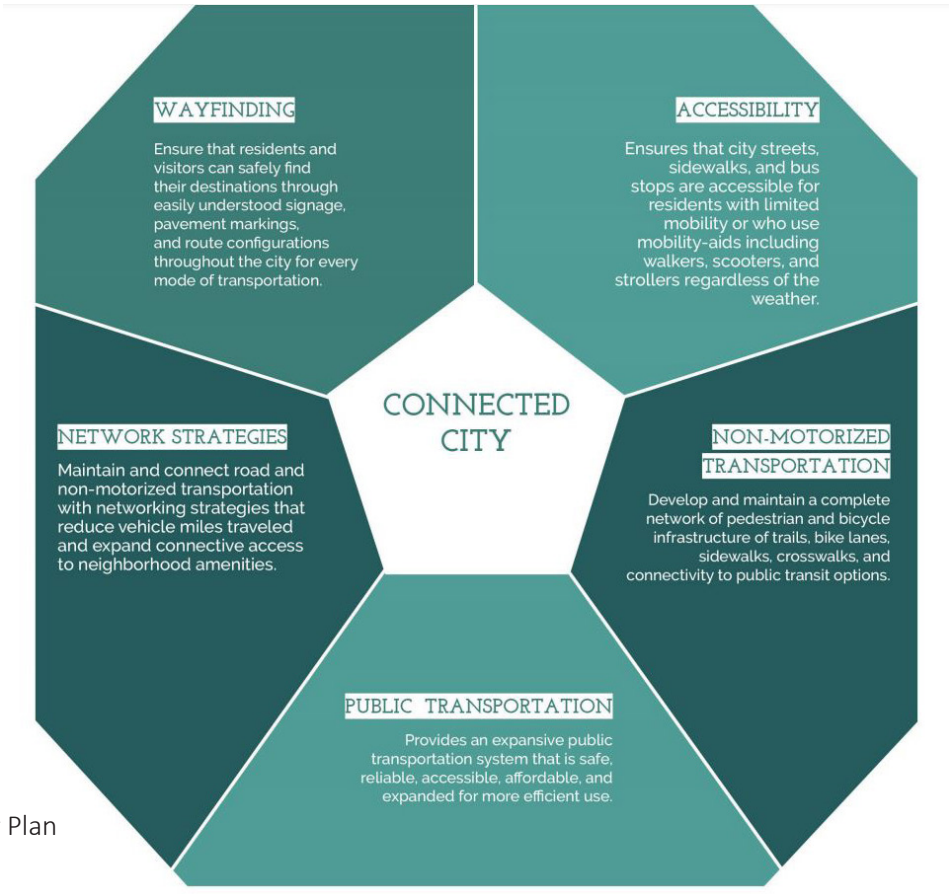
It is for this reason that utilizing shared community values, that are recognized by adopted city plans and policies, is vital for sound decision-making. When faced with tough design decisions, shared values can be used to assess which direction or choices are aligned with policy. Weaving a discussion of values into public engagement focused on transportation topics allows the community to understand the competing demands of streets and better see how certain design directions live up to their values, while other choices may not.

The 2025 Master Plan identified two key topics and value sets that relate directly to the design of public streets: the **connected city** and the **complete neighborhood**. Core tenets of these topics relate to how the City of Kalamazoo can more equitably, safely and comfortably connect people to schools, businesses, and opportunities. This in turn helps support stronger neighborhoods where people are better able to access daily needs and live in a healthy, safe, and supportive environment.

The street design values presented in this chapter build on these shared values and reinterpret them specifically in regards to street design and how this manual can provide tools for implementing projects in alignment with the city's values.

Source: Imagine Kalamazoo 2025 Master Plan




Source: Imagine Kalamazoo 2025 Master Plan

# STREET DESIGN VALUES

## CONNECTED CITY

- Strong connections between a diverse range of people and places
- A city networked for walking, biking, riding, and driving
- A reliable, accessible, and affordable public Transportation system


## EQUITY & OPPORTUNITY FOR ALL

- Street design informed by a neighborhood shared decision-making process
- Streets capable of being used by people of all ages and mobility levels
- Multi-modal networks that are equitably accessible to all neighborhoods

## ENVIRONMENTALLY RESPONSIBLE & SUSTAINABLE

- A mobility network that is sustainable and resilient, and reduces vehicle miles traveled
- Street trees and landscaping provide ecological services as well as buffers and beautification
- Reduced stormwater runoff and urban heat island

## SAFE COMMUNITY

- Streets are easy to understand and navigate
- All users can use streets safely and comfortably
- Streets prioritize the safety of vulnerable users above vehicle level of service

## COMPLETE NEIGHBORHOODS

- Connective access to neighborhood amenities
- Neighborhood commercial nodes are walkable and accessible by all modes
- Neighborhood streets are safe and walkable

## VIBRANT PLACES

- Strong connections between a diverse range of people and places
- A city networked for walking, biking, riding and driving
- Reliable, accessible, and affordable public Transportation system

## RESILIENT INFRASTRUCTURE & GOOD GOVERNANCE

- Use an integrated design approach and coordinate with utilities
- Leverage government grants, private funding and foundation support to maximize and coordinate street and mobility improvements
- Ensure that private development and institution lead initiatives that support the city's goals for vibrant streets that are walkable and multi-modal

# STREET DESIGN GOALS

The street design goals listed below build on and re-focus established city-wide goals in terms of public streets. These goals should be reviewed and returned to as transportation projects are identified, designed, and implemented, to ensure that projects are aligned with city values.

1. Design streets and provide mobility options that will change how people move through the city; prioritizing pedestrians, creating safe bicycle networks, and better access to transit to drive a shift in mode share for a more resilient, safe, and affordable city.
2. Put equity considerations front and center in the identification, design, and implementation of transportation projects to ensure that investments and improvements are grounded in and support individual communities.
3. Engineer streets for reliable, slow but steady traffic movement that prioritizes pedestrian and bicycle safety and multi-modal connectivity while minimizing traffic congestion.
4. Create a comfortable and safe pedestrian environment, regardless of the street type and designation.
5. Maintain and connect road and non-motorized transportation with networking strategies that reduce vehicle miles traveled and expand connective access to neighborhood amenities.
6. Support an expansive public transportation system that is safe, reliable, accessible, affordable, and expanded for more efficient use.
7. Develop and maintain a complete network of pedestrian and bicycle infrastructure of trails, bicycle lanes, sidewalks, crosswalks, and connectivity to public transit options.
8. Ensure that city streets, sidewalks, and bus stops are accessible for residents with limited mobility or who use mobility-aids including walkers, scooters, and strollers regardless of the weather.
9. Maintain and develop a network of streets that responds to the needs of the neighborhoods by supporting future land use and transportation goals.
10. Engage communities in the design of streets and provide equitable access to amenities, transportation choices, and multi-modal networks.
11. Ensure that investments in the city's public right-of-way maximize return on investment measured across the design manual values, and that they can articulate and document their impact.
12. Implement street designs that respect and support adjacent land uses, strengthening the safety and character of neighborhoods and business areas.
13. Ensure that residents and visitors can safely find their destinations through easily understood signage, pavement markings, and route configurations throughout the city for every mode of transportation.

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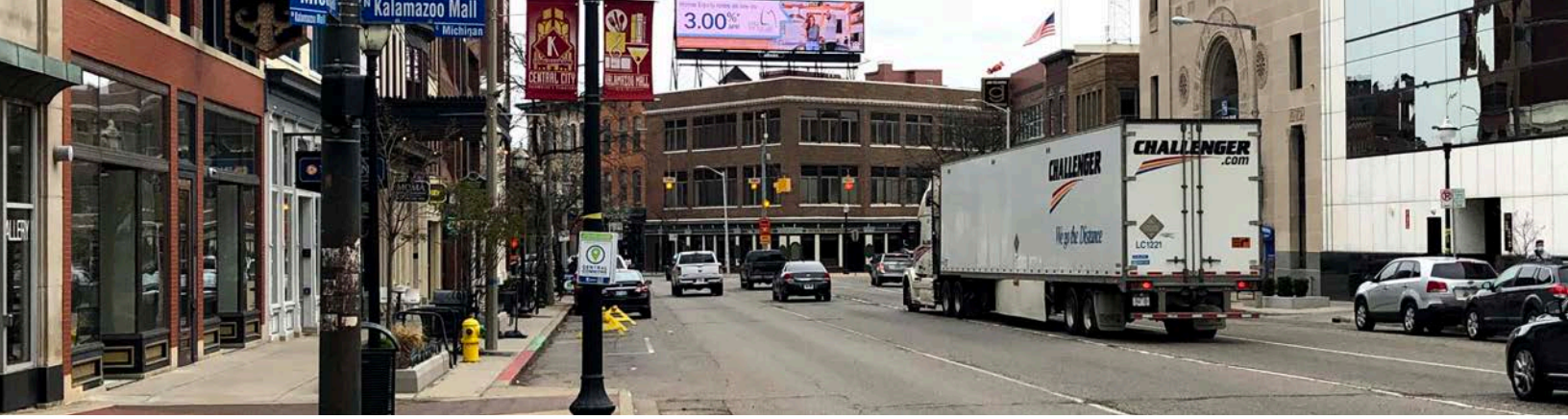
# 2.0 STREET TYPOLOGY FRAMEWORK




# 2.1 STREET TYPOLOGY OVERVIEW

## STREETS & THE PUBLIC REALM

In cities, streets and public rights-of-way are one of the predominant land uses, often accounting for a quarter or more of the land area. At a basic level, streets provide a means for the public to move throughout the city using different modes of travel – walking, biking, riding transit, or driving – in order to access destinations such as shops, jobs, schools, residences, parks, and other uses.

How different modes of transportation are accommodated in a safe and comfortable manner for all users is important to the health, vitality, and quality of life in the city. Streets are the predominant public space in most cities, and they frame how residents and visitors alike experience our urban environments. Moreover, the transportation functions of a street have an impact on the character and quality of adjacent properties, whether it is neighborhood housing, a local shopping district, an office building, or another use. The physical design of the streets govern how easily and comfortably different modes of travel are accommodated, their speed moving through the network, and the resulting sensitivity to the surrounding context.

### What is "Level of Service?"

Level of Service (LoS) is a way to measure the quality of transportation operations based on the speed, flow, and wait times of vehicles. It is traditionally applied to vehicles only as a measure of wait times at intersections and congestion. In this manual, the concept is expanded to describe level of service for other modes of transportation, such as walking and biking.

The field of street design, transportation planning, and traffic engineering is going through a period of transition, as conventional methods of practice are giving way to approaches that better address equity, resilience, sustainability, and quality of life.

### Traditional Street Design Approach

Traditionally, streets have been designed using a "centerline out" (Figure 2.1.1) approach, with determining the number of lanes and road width needed to accommodate a given volume of vehicle traffic at a desired Level of Service (LoS). This approach established a traditional hierarchy of streets from local roads, to collectors, arterials, and highways. In this traditional approach, the land use and activities occurring "behind the curb" are rarely considered or responded to, which can result in impacts to the quality of life for residents, suitability of the street for supporting commerce, and other impacts.

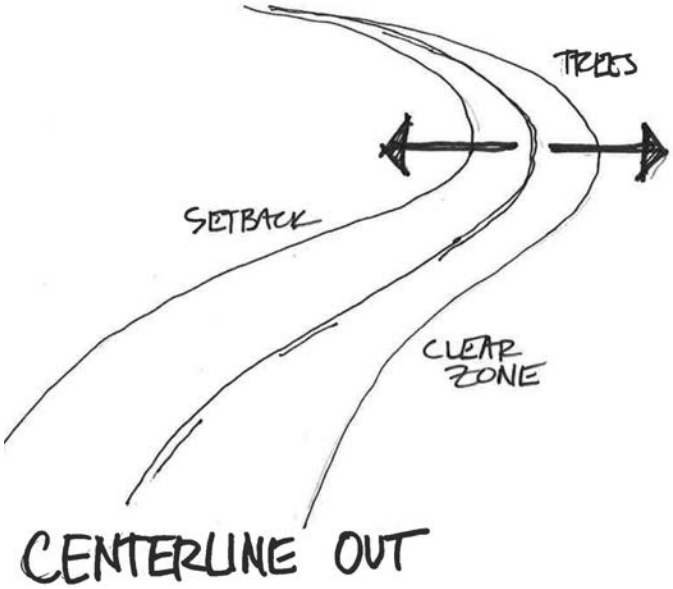



**Figure 2.1.1 - Centerline Out**

## Context-Based Street Design Approach

The land use and urban design context of the street is as critical as its transportation function. The primary objective of transportation is to achieve larger public objectives, not simply to move people around without any specific purpose. As a result, a more holistic approach for street design is to take a "building in" approach (Figure 2.1.2).

Context-based street design examines the land use activity and urban design character, along with the primary transportation function. It is a method for working from the built environment to the center of the street so that transportation is supporting and enabling the envisioned land uses both for local blocks, as well as serving larger area mobility needs.

A context-based approach will benefit Kalamazoo by:

1. Ensuring that the needs of all users of the street and adjacent properties are comprehensively considered in street design and management decisions.
2. Ensuring that single interests or modes of use do not dominate the street to the determent of others interests.
3. Help establish a modal hierarchy (refer to section 3.3) for streets, informing who the priority users are and how to balance multiple levels-of-service.


**Figure 2.1.2 - Building In**

# PURPOSE OF A STREET TYPOLOGY FRAMEWORK

A **street typology** is a method for classifying and distinguishing different types of streets in a community based on a broader consideration of the transportation functions and adjacent land use sensitivities of the street. Different communities may have their own system for defining typologies, reflecting unique local conditions, transportation patterns, and land use mixes.

A **street typology *framework*** provides a comprehensive method for classifying streets within a community and tools (typically maps) that clearly define the typology of streets in the city.

In the City of Kalamazoo, the Street Typology Framework serves the following functions:

- Provides a way to recognize the different street conditions in light of the functions and values of different road types.
- Moves beyond traditional functional classification approach to streets and is inherently more context sensitive.
- Recognizes the need for complete streets and safely accommodates all modes of transportation, establishing modal hierarchy.
- Identifies modal overlays for emphasis (pedestrian, business access, vehicle, transit, bicycle).
- Creates a map of the different street typologies and/or mode emphasis.
- Describes alignment of zoning and future land use.

### What is a "Street Typology?"

A street typology is a method for classifying different types of streets in a community based on a holistic consideration of the all transportation functions of the street AND the adjacent land use context and needs that must be considered in the design of the street.


# 2.2 KALAMAZOO STREET TYPOLOGY

## ESTABLISHING KALAMAZOO'S STREET TYPOLOGIES

Kalamazoo's unique street typologies, used in this design manual, starts with the street types identified in the 2025 Master Plan and adds additional levels of distinction based on an analysis of relevant transportation and land use data—such as traffic volumes, speeds, zoning, future land, and street connectivity.

Each street type responds to two different primary needs of the corridor:

1. The **network function** of the street and its position in the overall transportation system of the city and surrounding region; and.
2. The predominate **land use context** that occurs along the street, to which the street design must be sensitive to and support.

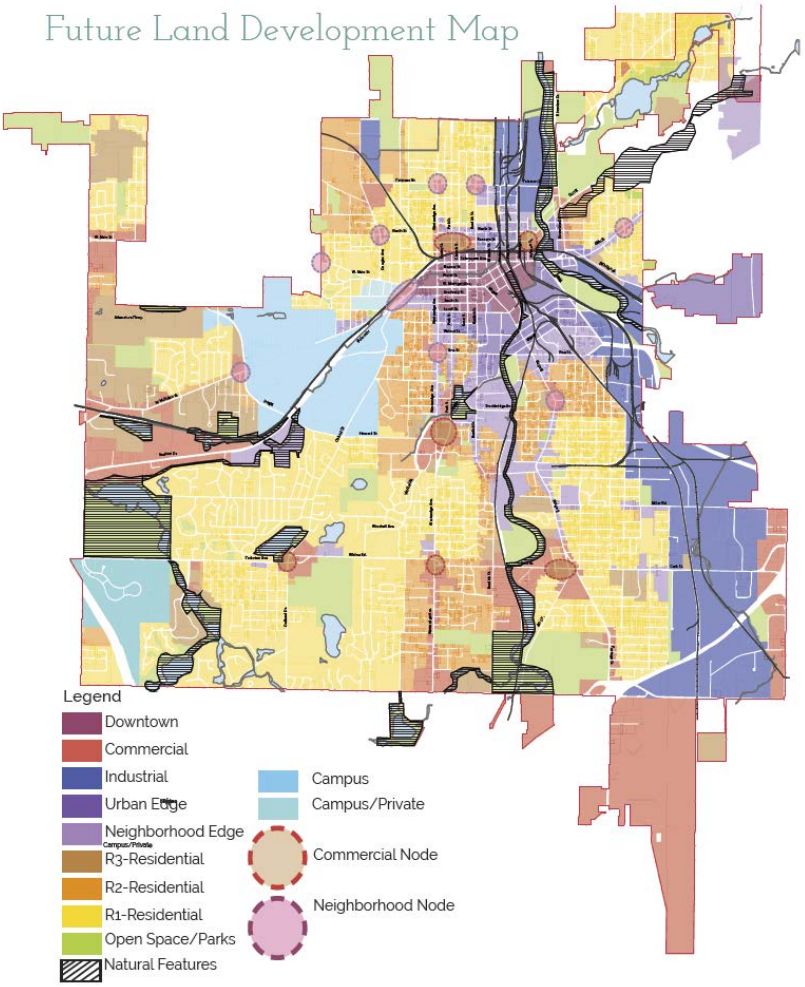
The chart below shows the relationship of these general land use contexts to different street network functions. Major and minor streets are those which carry greater volumes of traffic in the city and are typically longer-running, providing connections from the edge of the city into the center. These typically include traditional arterial and collector street designations. Local streets tend to carry less traffic and are shorter-running, emphasizing local access to residences and destinations over through transportation movements.

| | | Land Use Context | | | | |
|---|---|---|---|---|---|---|
| | **Street Network Function** | **Downtown Mixed-Use** | **Neighborhood Mixed-Use** | **Commercial Mixed-Use** | **Suburban Commercial** | **Neighborhoods** |
| **Primary Street** | **Major Street** (typically arterials and major collector streets) | Urban Center Streets | Neighborhood Business Streets | Commercial Business Streets | City Connector Streets | Neighborhood Network Street |
| | **Minor Street** (typically minor collector streets or higher volume local streets) | Downtown Main Streets | | | | Enhanced Neighborhood Streets |
| | **Local Street** | Event/Festival Streets | | | | Local Neighborhood Streets |

## MASTER PLAN STREET TYPOLOGIES

The 2025 Master Plan identified five overarching street types that consider the mix of transportation modes, connectivity, and land use context for their definition. These street types are referenced by Kalamazoo's zoning code and used as part of certain design parameters within the zoning code. As such, the expanded street types used in the design manual build on the street types used in the master plan and zoning code as show in the chart below.

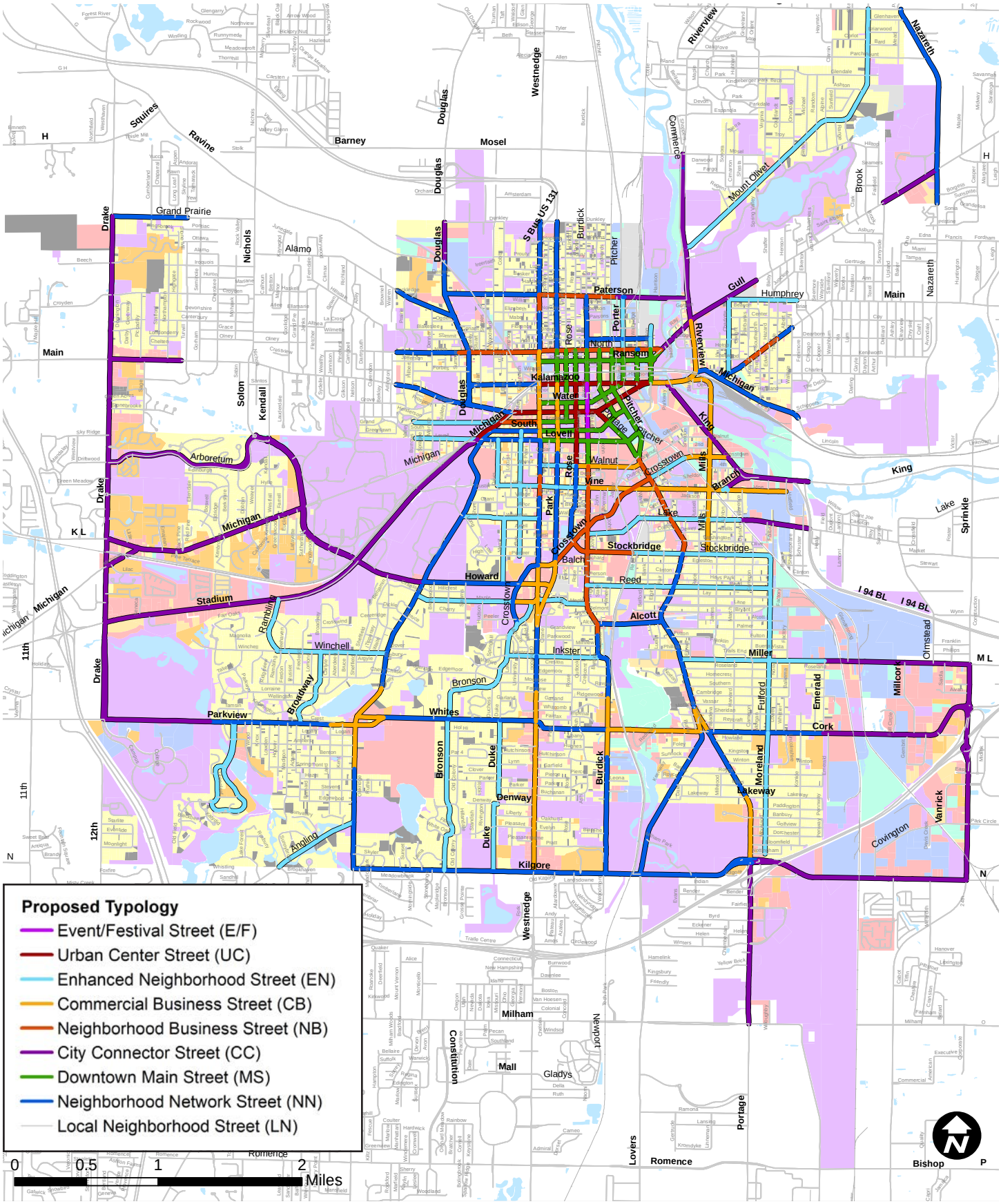
The chart below also shows typical historic roadway conditions, such as number of travel lanes, typical average annual daily trips (for vehicles), and posted speed limits. This information is listed to provide a general context for what the roadway corridors are like today.




## TYPICAL HISTORIC ROADWAY CONDITIONS (FOR REFERENCE)

| 2025 Master Plan Street Types | Design Manual Street Types (typically corresponding) | Typical AADT Ranges | Travel Lanes | Vehicle Speed Posted |
|---|---|---|---|---|
| Priority Street | Urban Center Street (UC) | 12k – 20k | 3-5 | 30-35 MPH |
| | Event/Festival Street (E/F) | Below 6k | 1-2 | Below 20 MPH |
| Main Street | Downtown Main Street (MS) | 1k – 12k | 2-3 | 25 MPH |
| Neighborhood Connector | Neighborhood Business Street (NB) | 6k – 20k | 2-3 | 25-40 MPH |
| | Commercial Business Street (CB) | 10k – 30k | 3-5 | 25-40 MPH |
| | Neighborhood Network Street (NN) | 6k – 30k | 2-3 | 25-40 MPH |
| | Enhanced Neighborhood Street (EN) | Below 6k | 2 | 25 MPH |
| Sub-Urban Corridor | City Connector Street (CC) | 6k – 20k | 2-5 | 25-45 MPH |
| Neighborhood Street | Local Neighborhood Street (LN) | Below 6k | 1-2 | 25 MPH |

Figure 2.1.6 - Street Typology Map



# STREET TYPOLOGY MAP

The Street Typology Map (facing page) shows the established street typologies for the design manual and the applicability of these street types to the zoning code (by association).

The map identifies street typologies for all non-local designated streets (i.e. arterials and collector streets). Certain local streets may also have typology designations assigned, such as downtown streets or other significant local streets that warrant a typology assignment given the transportation uses and land uses on the corridor.

### What is a modal hierarchy?

A modal hierarchy is a ranking of how different street users (pedestrians, bicyclists, transit riders, vehicle drivers, and other street users) are prioritized. This ranking typically considers the vulnerability, safety, and comfort needs of different users. Establishing a modal hierarchy for a street can help the project navigate trade-off decisions during the design process.

# STREET TYPOLOGY DESCRIPTIONS

The following pages describe the typical character, design goals, and key physical parameters of each street typology. Each street typology includes a description of the following items:

## Description

Describes the general conditions and context of the street corridor, its relative location with the city, and other important overarching considerations.

## Cross-Section Drawings

Each typology description includes a conceptual cross-section intended to show the typical elements, character, and potential configuration of that street typology.

***Indicated dimensions are for illustrative and comparative purposes***, and are not intended to be prescriptive or required dimensions. Refer to the individual design elements (Chapter 4) for detailed guidance on dimensioning.

## User Priority

Each typology description includes a chart listing the priority and relative level of importance for each type of street user. These priorities may be used as a "baseline" or starting point for that street's modal hierarchy (see ***Chapter 3*** for additional guidance on establishing modal hierarchy). As an individual street project advances, it is important to review the baseline priority and determine if any adjustments need to be made.

USER PRIORITY (***EXAMPLE DEFAULT***)

| User Type | Priority |
|---|---|
| Pedestrians | High |
| Bicycles (*) | Moderate |
| Transit (**) | Moderate |
| Commercial Activity | Moderate |
| Curbside (Parking) | Moderate |
| Vehicles | Low |

The User Priority chart (example above) shows a default listing of priorities by user type that is specific to each street typology. The priorities may be adjusted further during initial project scoping depending on local conditions and other transportation network-level considerations.

- **User Type:** The types of users and specifics related to their safe and comfortable accommodation within streets are described in detail below:
  - » **Pedestrians:** Pedestrians are the most vulnerable users within a roadway, and their safety and comfort must be provided for on all streets. All public streets should include sidewalks appropriate to the anticipated volume of pedestrians. Sidewalks should be separated from the roadway through the use of curbs and vertical features (street light posts, trees, signs, etc.) that provide physical barriers and improve pedestrian comfort.
  - » **(*) Bicycles:** People on bicycles are also vulnerable users. All streets should provide a means for bicycles to travel safely along them appropriate to the roadways' condition and context. Non-motorized plans that identify priority bicycle connections, low stress, or an "all ages and abilities facilities" are likely to put cyclists at a higher priority and may require separated facilities or low stress design treatments. Non-motorized modes also include a series of other micro-mobility choices, such as scooters, e-bikes, e-unicycles, skateboards, etc.

» **(**) Transit:** Streets with active or planned transit corridors must consider the location and available space for bus stops. Higher priority transit corridors (such as bus rapid transit or BRT routes) may require use of additional design elements that support desired transit timing in order to provide consistent service and meet schedules.

» **Commercial Activity:** Streets help support the economic vitality of the city. They allow customers to access businesses, they can provide outdoor space for dining and retail. Generally, the more pedestrian-oriented the commercial uses are, the more important it is that streets provide supporting design.

» **Curbside Uses:** Curbside uses are critical on many types of streets for providing access to businesses or residences. These spaces often need to be designed in a flexible manner in order to accommodate changing uses. Curbside uses include on-street parking, passenger pick-up and drop-off, commercial loading, and other similar uses.

» **Vehicles:** Vehicles should be accommodated on all streets, but the speed and impact of vehicle traffic should be balanced against the land use context and other street uses.

- **Priority**: Each user type is assigned a relative priority level.

  » In practice, this means that as trade-offs need to be made within a roadway (e.g. due to limited right-of-way space) the safety, comfort, and needs of higher priority users should not be compromised in order to meet the needs of lower priority users on that street.

  » Multiple user types at the same level of priority should be considered in parallel in order to ensure that needs are met.

## Design Considerations

Any specific or more general design considerations pertinent to a high level understanding of the street typology.

# URBAN CENTER STREET (UC)

## (PRIORITY STREET)

**DESCRIPTION:** Urban Center Streets represent highly active streets with an intense combination of active ground-floor uses, pedestrian activity, and vehicle volumes. These streets are desired to be the signature gateway corridors into downtown, designed at a high level of amenity.

- **High Priority:**
  - » Create a vibrant and welcoming pedestrian environment that supports commercial activity.
  - » High quality streetscape, wide pedestrian areas for outdoor dining, and gathering space is critical.
- **Moderate Priority:**
  - » Transit service with frequent stops are important for providing easy access to destinations.
  - » Curbside uses where space allows, provided pedestrian area widths are achieved, with a focus on short-term parking and drop-off zones. Loading zones should be avoided on these streets.
- **Low Priority**:
  - » Must accommodate higher volumes of vehicle traffic, but during peak hours lower levels of service is expected (LOS E acceptable).
  - » Bicycles would typically use parallel streets, although dedicated facilities should be considered where space allows or on priority bicycle corridors.

## USER PRIORITY (BASELINE)

| User Type | Priority |
|---|---|
| Pedestrians | High |
| Commercial Activity | High |
| Transit (*) | Moderate |
| Curbside | Moderate |
| Bicycles (**) | Moderate |
| Vehicles | Low |

## DESIGN CONSIDERATIONS

- Design the roadway for slower speeds (25 MPH). Lane reductions and/or narrowing should be used to the maximum extent feasible.
- Streetscape should be designed to provide flexibility in how the pedestrian area can be utilized or adapted for different purposes, depending on adjacent land uses.
- Opportunity for signature public street elements—such as public art, gateways, gathering and seating areas, landscape, etc.
- (*) Streets in priority transit corridors should consider transit operational improvements to maintain service consistency. Higher level transit stop may be desired.
- (**) On priority bikeway streets, curbside space may be reduced in order to provide appropriate low stress bicycle facilities.
- Limit driveways and curb-cuts.

**URBAN CENTER STREET**


DIMENSIONS SHOWN ARE FOR ILLUSTRATIVE PURPOSES ONLY

**TYPICAL FEATURES:**

- 2-3 vehicle lanes
- Slow speeds (25 or less)
- Two-way travel
- Curbside lanes
- Wide pedestrian zone
- High quality streetscape
- Bus stops
- Sidewalk occupancy
- Seating & gathering space
- Sharrows or buffered bicycle lanes

# EVENT/FESTIVAL STREET (E/F)

## (PRIORITY STREET)

**DESCRIPTION:** Event/Festival Streets are special streets within the city that are dominated by pedestrian-centric activity. These streets are typically curbless or designed as shared spaces, enabling flexible use of the entire street corridor for special events. Vehicles can navigate through the space, but do so at very low speeds.

- **High Priority:**
  - » Pedestrians are the priority user, and the street should be designed to look and function as a pedestrian-dominated space.
  - » Maximize flexibility and pedestrian area space for commercial activity.
  - » Streetscape should create a comfortable, welcoming, and vibrant space.
- **Moderate Priority:**
  - » Curbside uses should emphasize short-term parking and drop-off zones. Larger loading zones are not desirable.
- **Low Priority**:
  - » Bicycles typically accommodated using sharrows or non-dedicated facilities.
  - » Transit typically connects at the cross-streets.
  - » Vehicle lanes should be as narrow as possible to reinforce slower speeds.

### USER PRIORITY (BASELINE)

| User Type | Priority |
|---|---|
| Pedestrians | High |
| Commercial Activity | High |
| Curbside | Moderate |
| Bicycles | Low |
| Transit | Low |
| Vehicles | Low |

### DESIGN CONSIDERATIONS

- Curbless streets or shared streets should be designed carefully to ensure proper drainage.
- The design of the street should consider the operations of special events and/or street closures, so that the space can be readily closed to vehicle traffic and used entirely by pedestrians.
- Ample shade (using street trees) should be provided to create a cool and comfortable environment.
- Opportunity for special lighting installations to bring energy and unique aesthetics to these streets.
- Curb-cuts and driveways typically prohibited. Service should be provided from alleys.

**EVENT/FESTIVAL STREETS**


**TYPICAL FEATURES:**

- 1-2 vehicle lanes
- Very slow speeds
- One- or two-way travel
- Curbless street design and/or shared space
- Wide pedestrian zone
- High quality streetscape
- Limited curbside lanes
- Seating & gathering space
- Sidewalk occupancy uses well-supported
- Bicycle accommodated with sharrow markings

DIMENSIONS SHOWN ARE FOR ILLUSTRATIVE PURPOSES ONLY

# MAIN STREET (MS)

## (MAIN STREET)

**DESCRIPTION:** Main Streets constitute the majority of downtown streets and near-downtown areas. These streets must balance a broad range of needs and demands—an inviting pedestrian-oriented streetscape, supportive spaces for adjacent businesses, parking and loading areas, modest traffic volumes, and accessible routes for cyclists and transit riders.

- **High Priority:**
  - » Provide a safe and comfortable pedestrian environment. Quality streetscape is desirable.
  - » Pedestrian areas should be wide enough to accommodate moderate intensity outdoor commercial activity.
- **Moderate Priority:**
  - » Curbside uses are important to balance throughout these streets, including drop-off zones, commercial loading zones, and metered parking.
  - » Streets that are part of the priority bicycle network may give up parking on one (or both) sides of the street to create separated facilities.
  - » Bus stops are important to accommodate.
- **Low Priority**:
  - » Streets must be able to accommodate vehicles and property access at low/comfortable speeds. LOS during peak hours may be lower (LOS E acceptable).

### USER PRIORITY (BASELINE)

| User Type | Priority |
|---|---|
| Pedestrians | High |
| Commercial Activity | High |
| Curbside | Moderate |
| Bicycles (*) | Moderate |
| Transit (*) | Moderate |
| Vehicles | Low |

## DESIGN CONSIDERATIONS

- Reduce vehicle lane width and/or remove lanes to extent feasible to provide consistent two-way traffic. Design to achieve 25 MPH speeds.
- Street improvements should anticipate future land use change and potential demand for pedestrian area and curbside uses.
- Pedestrian areas should target a minimum width of 14-feet, to allow adequate space for clear sidewalks and sufficient space for sidewalk occupancy uses (cafe dining, etc.).
- Balance short-term patron parking (e.g. 15 minutes) with longer term metered parking (e.g. 1-hour).
- (*) On priority transit or bicycle network streets, curbside zones may be reduced in order to provide appropriate facilities and operations for transit or low stress bicycle connectivity.

**MAIN STREET**


**TYPICAL FEATURES:**

- 2 vehicle lanes
- Slow speeds (25 or less)
- Two-way travel
- Curbside lanes
- Moderately wide pedestrian zone
- Quality streetscape
- Bus stops
- Sidewalk occupancy
- Seating & gathering space
- Sharrows or buffered bicycle lanes

DIMENSIONS SHOWN ARE FOR ILLUSTRATIVE PURPOSES ONLY

# NEIGHBORHOOD BUSINESS STREET (NB) (NEIGHBORHOOD CONNECTOR)

**DESCRIPTION:** Neighborhood Business Streets are typically major connecting streets in the city where clusters of smaller scale or traditional commercial/mixed-use buildings are located. These locations align with where more walkable mixed-use nodes are desired. These street must balance a mix of transportation functions and place-making objectives.

- **High Priority:**
  - » Pedestrian safety and comfort is critical for supporting access to neighborhood commercial areas and supporting business activity.
- **Moderate Priority:**
  - » Requires carefully balancing multiple uses. Exact priority will depend heavily on the specific corridor and whether the street is a transit and/or bicycle emphasis corridor.
  - » Moderate to higher vehicle volumes must be accommodated, but roadway design should support low speeds (25 MPH).
- **Low Priority**:
  - » *** Curbside uses should be focused in front of commercial properties when space allows and it can serve to buffer pedestrian areas. Parking is often accommodated on side streets or in off-street parking lots. It may be critical to provide some level of on-street parking on this type street.

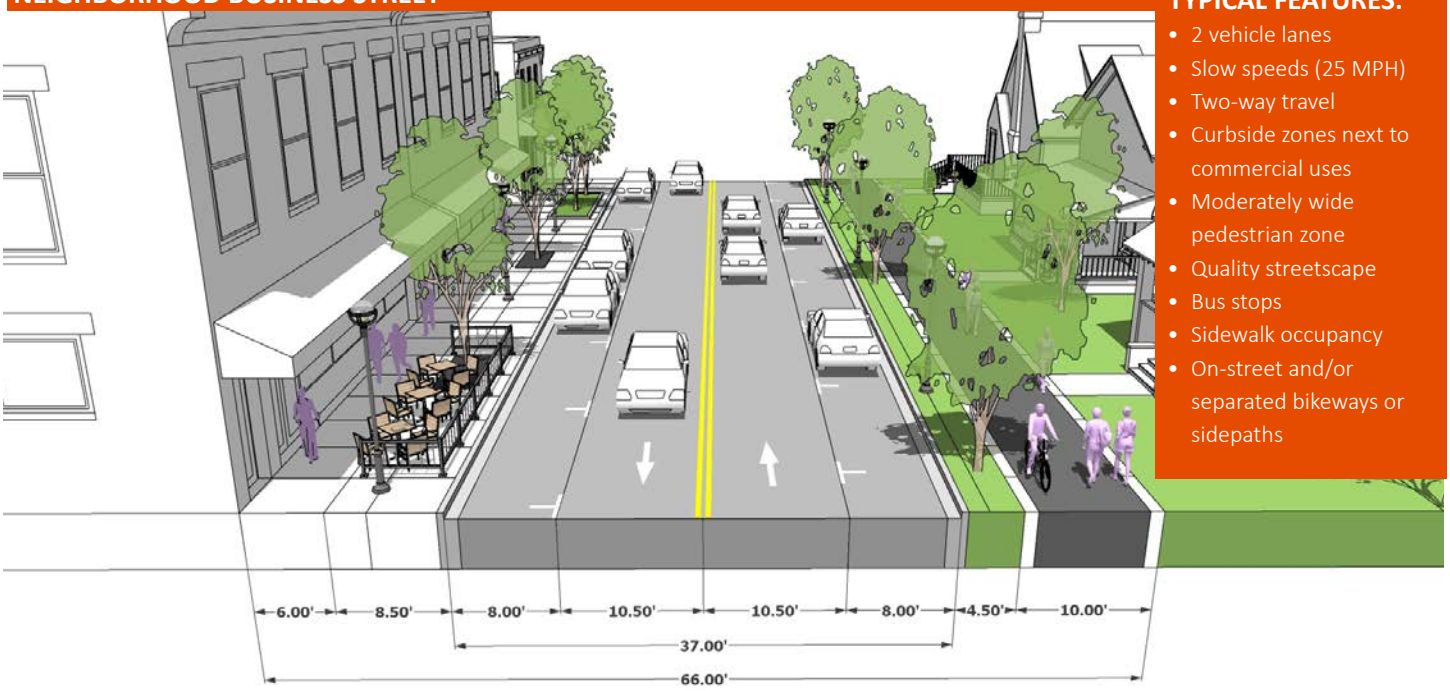
## USER PRIORITY (BASELINE)

| User Type | Priority |
|---|---|
| Pedestrians | High |
| Commercial Activity | Moderate |
| Bicycles (*) | Moderate |
| Transit (**) | Moderate |
| Vehicles | Moderate |
| Curbside (***) | Moderate |

## DESIGN CONSIDERATIONS

- (*) Bicycle facilities should be designed as a low stress facility to the extent possible. Conventional or buffered bicycle lanes should be avoided in favor of separated bicycle lanes or even shared-use sidepaths.
- (**) These streets typically serve as transit corridors. Bus stops should align with concentrations of commercial land use. Roadway level of service should be mindful of the needs of transit operations.
- Intersections should all have clear and distinct crosswalks. Mid-block crossings should be considered wherever the distances between signalized crossings are relatively long.
- Intersections should be designed to minimize pedestrian crossing distances.

## NEIGHBORHOOD BUSINESS STREET




DIMENSIONS SHOWN ARE FOR ILLUSTRATIVE PURPOSES ONLY

**TYPICAL FEATURES:**

- 2 vehicle lanes
- Slow speeds (25 MPH)
- Two-way travel
- Curbside zones next to commercial uses
- Moderately wide pedestrian zone
- Quality streetscape
- Bus stops
- Sidewalk occupancy
- On-street and/or separated bikeways or sidepaths

# COMMERCIAL BUSINESS STREET (CB) (NEIGHBORHOOD CONNECTOR)

**DESCRIPTION:** Commercial Business Streets are located along significant transportation corridors in the city, often passing through commercial nodes containing relatively small scale commercial land uses that are more suburban and/or auto-oriented (compared to Neighborhood Business streets). These roads often function as gateways into the city and so the visual character of the corridor and accommodating other modes of travel is vital.

- **High Priority:**
  - » Streets must be designed for pedestrian safety and comfort as a priority, especially at intersections. Pedestrian areas should be buffered against vehicle traffic.
- **Moderate Priority:**
  - » (*) Transit service is often a priory along these roadways. Ensure adequate shelters and amenities.
  - » (**) Bicycles should be accommodated in a separated manner, such as designing one side of the street as a sidepath.
  - » Higher volumes of vehicle traffic must be accommodated. Access management is important for minimizing conflict points.
- **Low Priority**:
  - » Commercial activity is generally accommodated outside of the public right-of-way.

## USER PRIORITY (BASELINE)

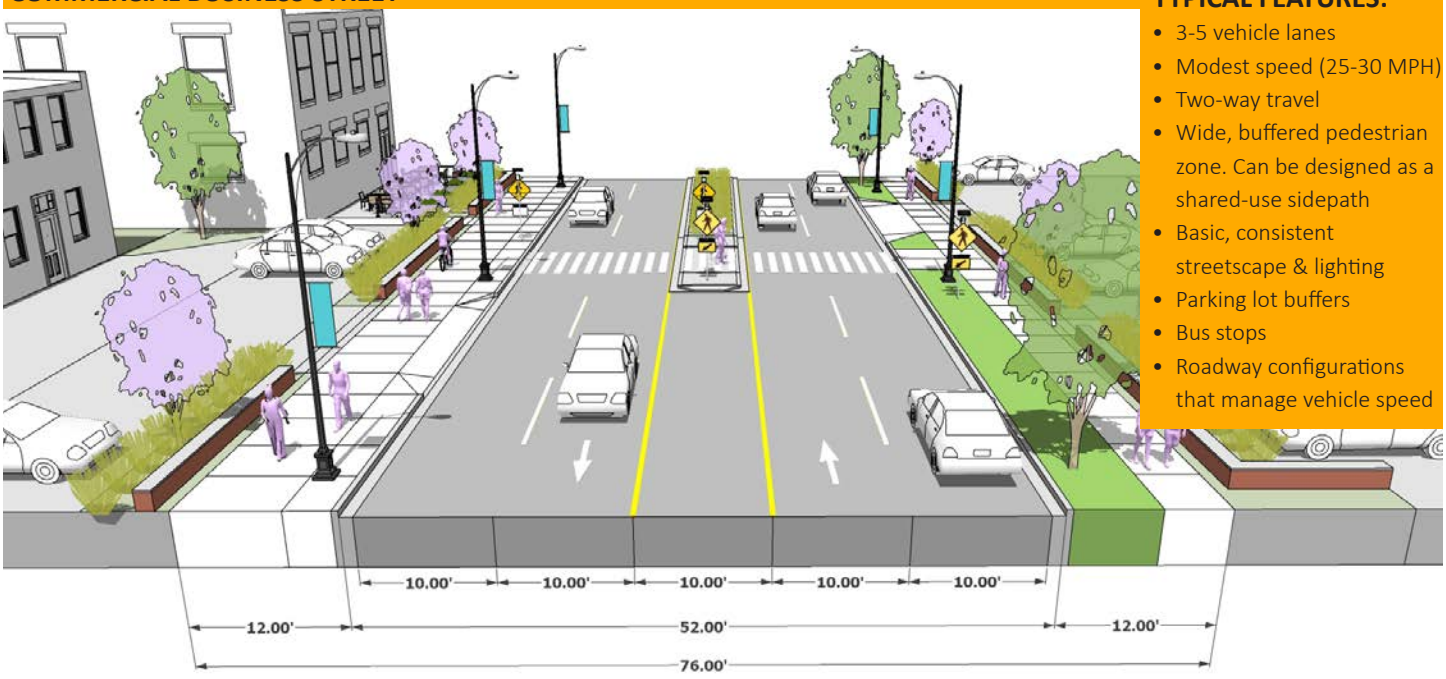
| User Type | Priority |
|---|---|
| Pedestrians | High |
| Transit (*) | Moderate |
| Bicycles (**) | Moderate |
| Vehicles | Moderate |
| Commercial Activity | Low |
| Curbside | Low |

- » On-street parking is typically not a priority given separation between roadway and storefronts. Space better utilized for wider pedestrian areas.

## DESIGN CONSIDERATIONS

- Streetscape should emphasize creating buffers and a sense of separation between pedestrians and vehicle travel lanes. Regular street lights, trees, landscape, and other elements can be used to create separation.
- Reduce vehicle speeds as much as possible (including down to 25 MPH). Use medians, narrower lanes, lane shifts, and other major street calming methods to slow speeds.
- Consistent lighting is important and an opportunity for creating a stronger visual character and/or gateway identity into the city.
- Intersections should be designed to minimize pedestrian crossing distances.
- Use buffers with landscape and/or knee walls to separate sidewalks and parking areas.

**COMMERCIAL BUSINESS STREET**




**TYPICAL FEATURES:**

- 3-5 vehicle lanes
- Modest speed (25-30 MPH)
- Two-way travel
- Wide, buffered pedestrian zone. Can be designed as a shared-use sidepath
- Basic, consistent streetscape & lighting
- Parking lot buffers
- Bus stops
- Roadway configurations that manage vehicle speed

DIMENSIONS SHOWN ARE FOR ILLUSTRATIVE PURPOSES ONLY

# CITY CONNECTOR STREET (CC)

## (SUB-URBAN STREET)

**DESCRIPTION:** City Connector Streets are typically located near the edges of the city, and often serve as a transition from highways or more rural roadways into the city proper. City Connectors frequently traverse through a mixture of land uses, including institutional, commercial, and industrial uses.

- **High Priority:**
  - » Basic sidewalks must be provided at a minimum. Consider expanding one or both sides of the street to function as sidepaths.
- **Moderate Priority:**
  - » Vehicles, including heavier truck traffic, are the predominate users on most City Connector Streets. Access management is important for minimizing conflict points.
  - » (*) Transit service is often a priory along these roadways. Ensure adequate shelters and amenities.
  - » (**) Bicycles should be accommodated in a separated manner, such as designing one side of the street as a sidepath. Especially important if route is part of a priority bicycle corridor.
- **Low Priority**:
  - » Commercial activity generally accommodated outside of the public right-of-way.
  - » No on-street parking.

### USER PRIORITY (BASELINE)

| User Type | Priority |
|---|---|
| Pedestrians | High |
| Vehicles | Moderate |
| Transit (*) | Moderate |
| Bicycles (**) | Moderate |
| Commercial Activity | Low |
| Curbside | Low |

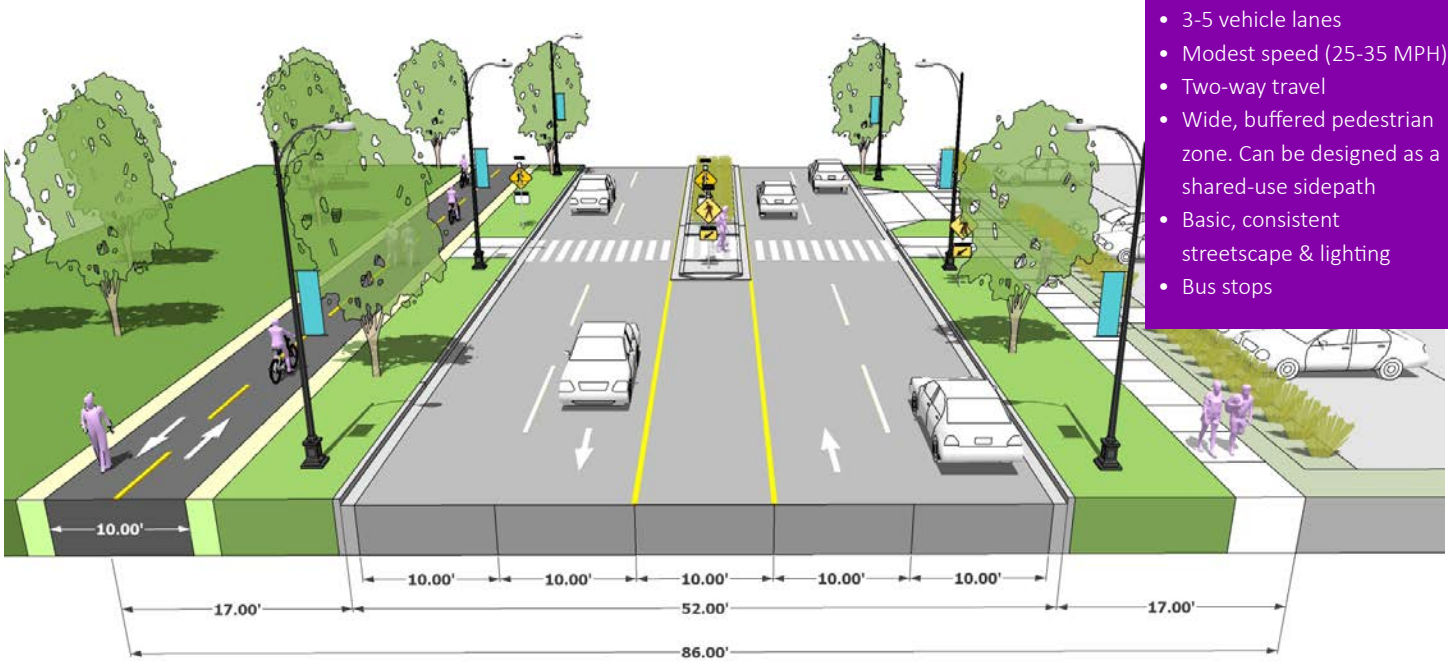
## DESIGN CONSIDERATIONS

- Roadway geometry should comfortably accommodate larger design vehicles. Minimize extraneous or pavement areas by incorporating medians or traffic islands.
- Provide consistent lighting along length of the corridor.
- Use high-visibility and well-lit mid-block crossings to increase non-motorized connectivity.

**CITY CONNECTOR STREET**

**TYPICAL FEATURES:**

- 3-5 vehicle lanes
- Modest speed (25-35 MPH)
- Two-way travel
- Wide, buffered pedestrian zone. Can be designed as a shared-use sidepath
- Basic, consistent streetscape & lighting
- Bus stops




DIMENSIONS SHOWN ARE FOR ILLUSTRATIVE PURPOSES ONLY

# NEIGHBORHOOD NETWORK STREET (NN) (NEIGHBORHOOD CONNECTOR)

**DESCRIPTION:** Neighborhood Network Streets are primary transportation corridors that provide connectivity throughout the city but traversing through predominately residential areas. Given the higher volumes of traffic, managing vehicle speeds and protecting the comfort and safety of residents is a priority.

- **High Priority:**
  - » Comfortable, buffered sidewalks must be provided on both sides of the street. Use street trees to provide shade and comfort.
- **Moderate Priority:**
  - » (*) Transit service is often a priory along these roadways. Ensure adequate shelters and amenities.
  - » (**) Streets often function as a core part of the bicycle network. Minimally should include conventional or buffered bicycle lanes. Separated facilities preferred, especially on priority bicycle corridors.
  - » Moderate to high volumes of vehicle traffic must be accommodated, but speed and behavior must be respectful of the residential context.
- **Low Priority**:
  - » Commercial activities typically not present.
  - » Curbside uses typically not present. Where excess pavement allows for on-street parking, can be used as a speed management technique.

## USER PRIORITY (BASELINE)

| User Type | Priority |
|---|---|
| Pedestrians | High |
| Transit (*) | Moderate |
| Bicycles (**) | Moderate |
| Vehicles | Moderate |
| Commercial Activity | Low |
| Curbside | Low |

## DESIGN CONSIDERATIONS

- Roadways should be designed to reinforce slower vehicle speeds (25 MPH). Typically two to three lanes. Narrow land widths to extent possible.
- Frequent pedestrian crossings important for improving walk-ability of neighborhoods. Use mid-block crossings with good lighting and medians between signalized crossing points.
- Design intersections to reduce pedestrian crossing distances.
- Street trees are important for reinforcing neighborhood character.
- Street lighting should be focused primarily at pedestrian crosswalks and intersections. Avoid spilling light directly into residences.

## URBAN CENTER STREET


**TYPICAL FEATURES:**

- 2-3 vehicle lanes
- Low speed (25 MPH)
- Two-way travel
- Sidewalks on both sides, buffered from roadway
- Street trees
- Bicycle lanes or separated bicycle lanes preferred
- Bus stops
- Roadway configurations that manage vehicle speed

DIMENSIONS SHOWN ARE FOR ILLUSTRATIVE PURPOSES ONLY

# ENHANCED NEIGHBORHOOD STREET (EN) (NEIGHBORHOOD CONNECTOR)

**DESCRIPTION:** Enhanced Neighborhood Streets are roadways that traversing through the interior of neighborhoods, often serving as an "internal spine" for neighborhood connections, and must serve modest network connectivity functions. These streets provide access to and through neighborhoods and often have higher traffic volumes than the most local neighborhood streets. Managing the volume and speeds of vehicles along these roadways is essential for protecting the neighborhood character.

- **High Priority:**
  - » Pedestrians are the priority user. Streets must create a safe and comfortable environment.
  - » (*) As the start/end point of bicycle trips for residents, streets should utilize low stress facilities. Opportunity for neighborhood greenways of bicycle boulevard treatments.
- **Moderate Priority:**
  - » Curbside uses and neighborhood parking important for supporting access to homes and function as a traffic calming tool.
  - » (**) Safe, comfortable bus stops provided where transit routes are present.
- **Low Priority**:
  - » Vehicles accommodated at low speed. Cut-through traffic discouraged through design.

## USER PRIORITY (BASELINE)

| User Type | Priority |
|---|---|
| Pedestrians | High |
| Bicycles (*) | High |
| Curbside | High |
| Transit (**) | Moderate |
| Vehicles | Low |
| Commercial Activity | Low |

  - » Commercial activity generally not present, except where neighborhood focused commercial uses exist.

## DESIGN CONSIDERATIONS

- Vehicle travel lanes typically unmarked (no centerline).
- Intersections should be designed to minimize crossing distances for pedestrians. Use bump-outs to extent feasible.
- All intersections should provide appropriate pedestrian crosswalks in each direction.
- Vehicle speed and volume management techniques are important. Consider use of traffic circles, raised crosswalks, speed tables, and other treatments.
- Street trees are important for reinforcing neighborhood character.
- Street lighting should be focused primarily at pedestrian crosswalks and intersections. Avoid spilling light directly into residences.

**URBAN CENTER STREET**


**TYPICAL FEATURES:**

- Typically unmarked vehicle lane (no centerline)
- Low speed (25 MPH)
- Two-way travel
- Sidewalks on both sides Use parking and amenity zone to provide buffer
- Street trees
- Low stress bicycle facilities appropriate to low speed & volume roadway
- Use vehicle speed & volume management tools

DIMENSIONS SHOWN ARE FOR ILLUSTRATIVE PURPOSES ONLY

# LOCAL NEIGHBORHOOD STREET (LN) (LOCAL STREET)

**DESCRIPTION:** Local Neighborhood Streets are the calmest and quietest street typology, intended to provide the most direct and localized access to residences. Such streets exhibit the lowest traffic volumes, but speeds are essential to manage in order to maintain a calm, residential atmosphere.

***Note**: These streets are not mapped explicitly in the street typology map, and are instead shown by the gray street lines. Streets without an assigned typology are assumed to be local neighborhood streets.*

- **High Priority:**
  - » Pedestrians are the priority user. Streets must create a safe and comfortable environment.
  - » As low volume and low speed streets, most bicycle users should be comfortable cycling within the roadway.
- **Moderate Priority:**
  - » Curbside uses and neighborhood parking important for supporting access to homes and function as a traffic calming tool.
  - » (*) Safe, comfortable bus stops provided where transit routes are present. Consideration of potential future transit routes should be given.

## USER PRIORITY (BASELINE)

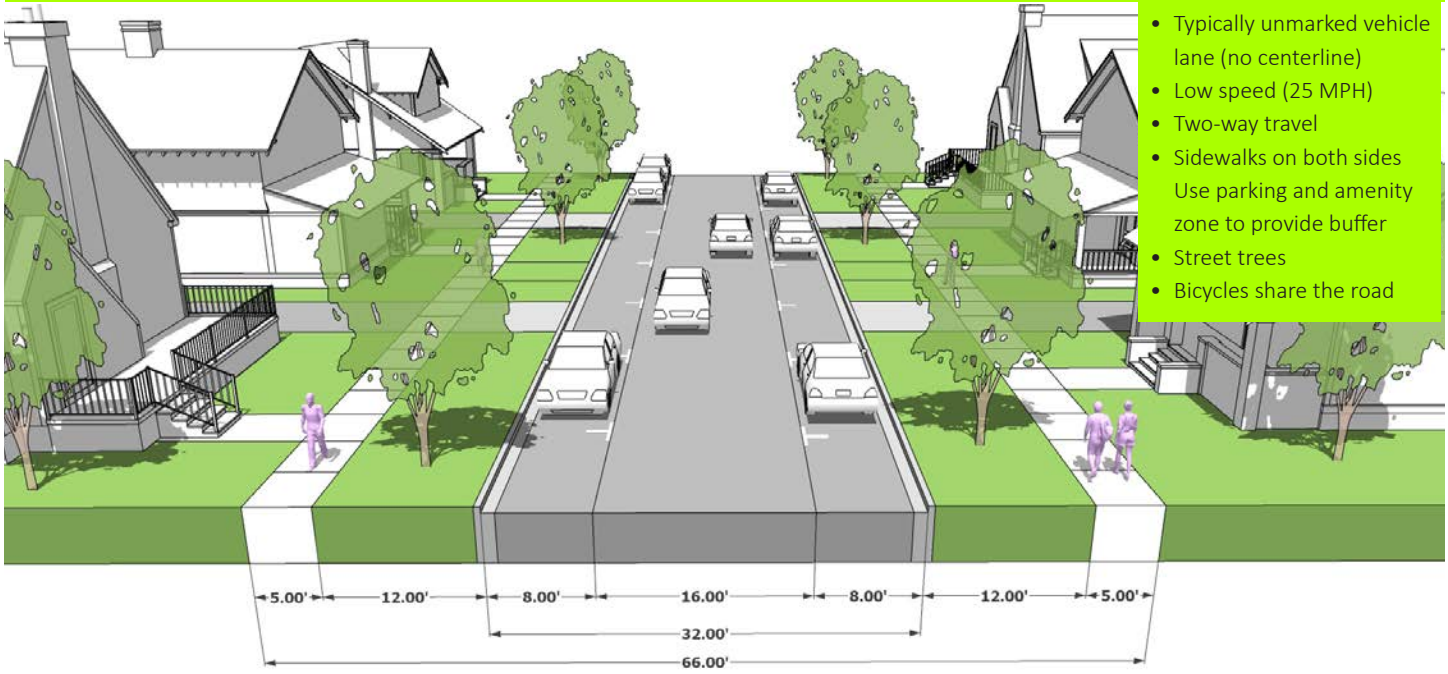
| User Type | Priority |
|---|---|
| Pedestrians | High |
| Bicycles | High |
| Curbside | High |
| Transit (*) | Low |
| Vehicles | Low |
| Commercial Activity | Low |

- **Low Priority**:
  - » Vehicles accommodated at low speeds.
  - » Commercial activity generally not present.

## DESIGN CONSIDERATIONS

- Vehicle travel lanes typically unmarked (no centerline).
- Intersections should be designed to minimize crossing distances for pedestrians. Use bump-outs to extent feasible.
- All intersections should provide appropriate pedestrian crosswalks in each direction.
- Street trees are important for reinforcing neighborhood character.
- Street lighting should be focused primarily at crossings and intersections. Avoid spilling light directly into residences.

**LOCAL NEIGHBORHOOD STREET**




**TYPICAL FEATURES:**

- Typically unmarked vehicle lane (no centerline)
- Low speed (25 MPH)
- Two-way travel
- Sidewalks on both sides Use parking and amenity zone to provide buffer
- Street trees
- Bicycles share the road

DIMENSIONS SHOWN ARE FOR ILLUSTRATIVE PURPOSES ONLY

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# 3.0 STREET DESIGN PROCESS

# 3.1 PROCESS OVERVIEW

## USING THE DESIGN MANUAL TO DESIGN COMPLETE STREETS

Designing public streets is a complex process, doubly so when designing complete streets that strive to be safe, accessible, and comfortable for all users of the street and sensitive to the surrounding land use context.

This section of the design manual provides guidance on how to use the manual itself as a tool for designing streets.

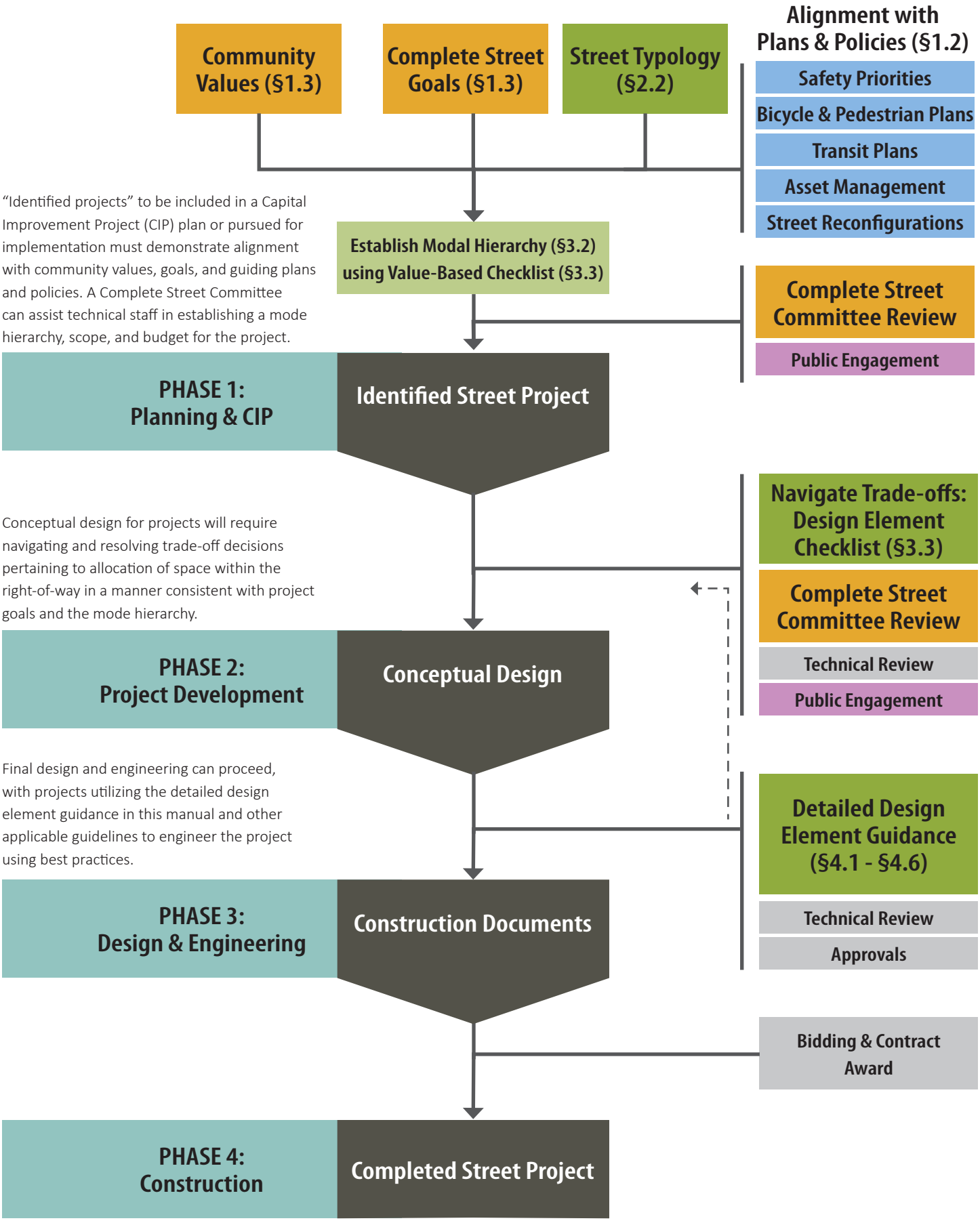
### The Life of a Complete Street Project

The digram on the next page provides an overview of how complete street projects should be identified, conceptualized, designed, engineered, and implemented. The digram provides references to specific sections of this street design manual, where information and guidance can be provided at each step in the process. In addition, this section and section 3.2 (Design Strategies) can be utilized to provide high-level guidance during the design process.

The bullet points below provide additional guidance on navigating the chart on the following page:

- **Community Values and Goals:** Complete street projects must be implemented in accordance with established community goals and values. Goals and values should be stated and reinforced throughout the design process.
- **Street Typology:** The street typology in section 2.2 provide an effective starting point for thinking about a given street's design—including consideration of the range of users, roadway condition, and what types of treatments might be needed to provide safe access for all users.
- **Alignment with Plans and Policies:** Street projects are often identified through one specific "source," such as a non-motorized plan or an asset management plan that indicates a need for a infrastructure repair or upgrade. Each project should examine all related plans at the onset to identify needs and opportunities for leveraging joint funding.
- **Establish Mode Hierarchy and Using the Value-Based Checklist:** These are fundamental tools in the street design process that should be used to help scope a particular project, ensure that user needs are met, and that the project is in alignment with goals, values, and related plans.
- **Complete Street Committee Review:** The complete street committee should be engaged twice during a street design process, once as the project scope is being established and once as part, of determining a conceptual design. The committees role is to ensure that projects are in alignment with and fully realize community goals and values.
- **Public Engagement:** Public engagement should include communication, as well as direct engagement with project stakeholders and users to understand their needs and identify opportunities.
- **Detailed Design Guidance:** Once a conceptual design direction is established, Chapter 4 of this manual provides detailed guidance to aid during the engineering phase. This guidance should be consulted as needed in earlier phases as well to ensure that conceptual designs are feasible.

# THE LIFE OF A COMPLETE STREET PROJECT



# STREET PROJECTS: PUBLIC PROCESS

Regardless of origin and whether public or private, every project that impacts the street is required to follow the Kalamazoo Street Design Manual. Small- and large-scale projects should be examined and considered for opportunities to advance the vision and goals of the Kalamazoo Street Design Manual.

For public projects, the design manual provides a process showing how a street project moves from a planning-level phase into project development, design and engineering, and eventually construction and operation. This process is defined in order to provide consistency and transparency of decision-making for city staff, agency partners, and the community at large.

The digram below shows the four primary phases of work, which are described in more detail on the following pages.

## Project Types

Kalamazoo's Complete Street Policy notes that all types of street and transportation projects are an opportunity to advance complete streets goals and values.

While full street reconstruction projects typically affords the greatest opportunity to transform streets and make improvements for all users, even simpler maintenance projects (like resurfacing or re-striping projects) are an opportunity to change the form and function of streets.

All projects identified in the city's CIP process should be reviewed for potential complete streets enhancements consistent with this design manual. This includes:

- **Full street reconstructions:** These projects typically include replacement and/or relocation of curbing and drainage structures, which affords the greatest opportunity to re-think street cross-section and allocation of uses. These projects are typically triggered by major utility projects, such as waterman or sanitary replacements.
- **Street reconfiguration projects:** These projects include things like road diets, two-way restoration projects, or others that reconfigure travel lanes. Often these project can be implemented through pavement markings, and are an opportunity to incorporate bicycle lanes or other amenities.
- **Streetscape projects:** Streetscape projects may be implemented purely "back of curb" or may be part of a larger full reconstruction. Opportunities for improving the amenity zone, street lighting, stormwater management, and pedestrian areas are often the focus.
- **Bikeway and non-motorized projects:** These projects range from implementation through re-striping to streetscape or full construction, depending on the type of facility and level of user stress that is desired.
- **Road resurfacing and re-striping:** These projects are often routine maintenance type projects. When these projects are advanced, they should always be used as opportunity to revisit striping patterns in the roadway to better align with best practice.

## PHASES OF STREET DESIGN PROCESS - PUBLIC PROJECTS

### 1 PLANNING

- Project identification
- Asset management
- CIP planning
- Transportation plans and initiatives
- Master plans, neighborhood plans
- Planning-level engagement

### 2 PROJECT DEVELOPMENT

- Establish project scope and goal
- Understand local needs and opportunities
- Explore conceptual alternatives and recommendations
- Project-level engagement

### 3 DESIGN & ENGINEERING

- Detailed design and engineering phase
- Engagement typically limited to property owner coordination
- Project bidding and bid award

### 4 CONSTRUCTION & OPERATIONS

- Stakeholder notification of construction
- Construction phasing and work undertaken
- Post-construction evaluation or follow-up
- Maintenance begins

# 1 PLANNING PHASE

## Overview

The planning phase is primarily focused on identifying potential street projects at city-wide level, drawing on planning, asset management, or capital improvement processes that are used by the City, as outlined below.

## Inputs

- Transportation plans (local/regional) that identify mobility, transportation, and infrastructure projects.
- Projects identified through asset management programs, such as road surface condition, and utility condition assessments.
- Annual city staff meeting to discuss and CIP planning.
- Master plans, neighborhood plans, and other community-driven plans that identify mobility projects.
- City-wide analyses and assessments, such as safety studies, parking studies, non-motorized plans.

## Tasks & Outcomes

- **Coordination:** Cross-departmental coordination is essential for ensuring that prospective street projects are considered all departments. Coordination with funding agencies is essential.
  - » **Complete Streets Review Process** requires the Complete Street Committee to review projects
  - » **Planning Commission** may also be engaged in the identification and review of potential projects.
- **Analysis:**
  - » Establish a process for regular analysis of city-wide transportation data (such as pedestrian/bicycle/vehicle volumes, safety/crash data, traffic stress, transit ridership, parking utilization, etc.) to support project identification and efforts for funding.
  - » Establish a modal hierarchy to help drive the scope and support decision-making on the project. Use street design tools (checklist and element matrix – section 3.3) to navigate design decisions.
- **Community Engagement:** Community engagement typically occurs through established parallel planning processes, such as community-wide or neighborhood planning efforts.
  - » Utilize city's Public Participation Plan and toolkit to review potential projects or CIP plans with the community.
  - » Coordination with the Disability Network
- **Products**: Identification of priority projects in CIP plans or other processes.

# 2 PROJECT DEVELOPMENT PHASE

## Overview

Once a project has been identified, the project development phase is an opportunity to dig further into an assessment of opportunity, needs, and constraints for a specific project. This commonly entails targeted stakeholder engagement and specific analysis tasks or studies necessary for establishing a clear scope of work and project budgets.

## Inputs

- Corridor specific studies, potentially including: safety assessments/audits, volume counts and traffic analysis for pedestrians, cyclists, and vehicles.
- Exploration of conceptual alternatives and evaluation relative to project goals.

## Tasks & Outcomes

- **Coordination:** Cross-departmental coordination continues to be essential during this phase of work. It is during this phase, as project budgets and timelines are established, where developing a shared scope and clear understanding of project needs is most critical.
- **Permitting:** This phase of work typically identifies needed project permits and approvals
- **Community Engagement:** Engaging residents and stakeholders along the study corridor is essential for understanding local needs and opportunities at the start of this phase, and where feasible to garner input on preferred options or directions for the project. Engagement primarily focused on reconstruction projects or where other significant changes are anticipated.
- **Products:** Project scope documents, conceptual cost opinions to establish budgets, conceptual design direction.

# 3 DESIGN & ENGINEERING PHASE

## Overview

The design and engineering phase typically proceeds in a more straightforward manner. Once a clear project scope, budget, and design direction has been established (Phase 2), then the design work can begin in detail.

## Inputs

- Findings from Phase 2
- Geotechnical and environmental investigations
- Topographic survey of the corridor

## Tasks & Outcomes

- **Coordination:** Design team is typically established in this phase (may carry over from the prior phase). The design team should continue to engage identified partners to keep them informed of the state of the design and continue coordination on technical aspect of the project.
- **Analysis:** Design and engineering phase tasks usually include stormwater/hydraulic modeling, establishing signal timing plans, maintenance of traffic plans, other technical requirements of the project.
- **Permitting:** Required permits are applied for and worked through the approval process during this phase. Departmental/internal review of projects to be identified and scheduled during this phase.
- **Community Engagement:** Engagement is not typically part of this phase of work. May be targeted coordination to key stakeholders (i.e. adjacent property owners) as part of design and engineering work.

  Engagement usually focused around communicating the status of the design work and informing the public about what changes to expect, the timeline for construction, and construction impacts.
- **Products:** Construction drawings, specifications, completed permit applications, bidding documents.

# 4 CONSTRUCTION & OPERATIONS PHASE

## Overview

This phase includes the bidding and construction process, as well as operational and maintenance efforts once the project construction is completed.

## Inputs

- Design and engineering documents, bid documents, final pricing from selected contractor, construction phasing and schedule.

## Tasks & Outcomes

- **Coordination:** Continue cross-departmental coordination. Plan for a post-construction follow-up to understand project outcomes and impacts from different perspectives and inform future street designs.
- **Monitoring:** Opportunities to monitor projects and/or conduct post-occupancy evaluations and analyses should be considered whenever feasible. Conducting post-construction traffic assessments (for example) may help inform and refine future analysis efforts.
- **Community Engagement:** Engagement leading up and during construction should be focused on clearly conveying construction sequencing, impacts to accessing properties, and timelines for completion.
  - » Winter before construction: reminders and notices go out to the community and neighborhood. Opportunity to reiterate benefits of the project.
  - » 1-3 weeks before construction starts: door hangers and/or postcards distributed to target to provide notice of traffic detours, service interruptions, and points of contact.
  - » Consider post-construction surveys or engagement to better understand impacts and resident attitudes. Helps inform future projects.
- **Products:** Completed street project. Follow-up studies and assessment reports.

# STREET PROJECT: PRIVATE PROCESS

Private development projects often impact the street during construction. It is important that streets are rebuilt or restored in a manner consistent with their designated street typology, which may differ from the design of the street prior to development impacts.

The site plan review process within CPED includes Projects meetings, pre-application, and site plan review meetings. It is through this process that projects impacting public streets will be reviewed and approved by CPED, Public Services (e.g. traffic and utilities), and the Fire Marshall.

**CONCEPTUAL STAGE:** Prior to beginning the formal process and steps outlined below, developments impacting public ROWs should review the Kalamazoo Street Design Manual (this document), determine if their project falls within a TIF district, brownfield, or other public improvement location. Potential street and ROW restoration elements may be reimbursed and/or may be opportunity for aligning public and private projects to advance complete street implementation.

The general process, with specifics called out relative to street design, is described below:

**STEP 1 - PRE-APPLICATION MEETING:** Private projects can meet with city staff as parts of a "Project Meeting" which can help align the scope of the private project with needs from a site plan review, and ultimately street design, standpoint.

- Review site plan review checklist.
- Consideration of adjustments to property/right-of-way lines, establishing any building frontage zones, desired width for pedestrian areas relative to building placement and anticipated curb location.
- Consideration of whether the project also requires approval of boards and commissions (e.g. planning commission).

**STEP 2 - SITE PLAN DOCUMENTATION:** The private entity is required to develop site plans for review. Site plans must adhere to the site plan review checklist and any specifics identified in the pre-application meeting for full documentation. Fees submitted.

**STEP 3 - SITE PLAN REVIEW COMMITTEE MEETING:** Submit site plans for review by city staff across multiple departments. A review meeting is held, following city-review, to discuss feedback.

- Committee comments provided back to the applicant in advance of the review meeting, allowing the applicant to consider feedback in advance of meetings.

**STEP 4 - REVISED SITE PLAN:** Plans must be revised to appropriately respond to committee comments. If resubmitted within one month, final review will occur within five business days.

**STEP 5 - FINAL SITE PLAN:** Final approval of plans with an accompanying letter and signed.

- Once all approvals are in place, construction permits can be issued.

# 3.2 DESIGN STRATEGIES

This section describes a series of overarching strategies and guiding principles. These strategies should be reviewed and well-understood by team members and partners working to implement transportation projects in the City of Kalamazoo, so that there is a shared approach and understanding of important needs and methods of work.

## ESTABLISH A MODAL HIERARCHY

### What is a modal hierarchy?

A Modal Hierarchy is a ranking of how different street users are prioritized. This ranking is a tool to help navigate trade-off decisions in the design of a complete street. The modal hierarchy is based on an understanding of which users are most vulnerable and most in need of facilities from an equity perspective.

### How to determine user priority for a street project?

- When a project is first identified, during the planning or project development phase, the street design checklist (see ***Section 3.3***) should be used. This checklist identifies basic and/or more in-depth analysis that will aid in determine the user priorities and if deviations from the priorities identified for a street's typology are warranted.
- Engage with key stakeholders on the corridor, especially residents, property owners, and business owners.
- Review relevant city-wide and regional transportation plans, including non-motorized plans and transit plans, to understand both current and anticipated user and their needs. Street designs are especially successful when they can anticipate future needs and/or build in flexibility.
- Align street design decisions with zoning and the adjacent land use context in an aspirational manner. Consider what land uses are desired and/or likely in the future, and focus on how street designs can support those transformations.

# EQUITY & STREET DESIGN

Creating a City where mobility and transportation infrastructure drive equity and are implemented in an equitable manner is essential to realizing the vision and goals set forth in the Imagine Kalamazoo 2025 Master Plan.

Fundamental to the city's process and to achieving equity is listening, understanding community values, and shaping a vision and solutions through co-creation. It goes beyond balancing needs and prioritizing the most vulnerable populations to actively planning and designing to compensate for long-term disinvestment, and providing opportunities to disadvantaged populations.

Equitable mobility tailors solutions to address the unique needs of a community and addresses the triple bottom line while recognizing that not all communities are starting from an equal playing field. Some specific strategies include the following:

- Prioritizing projects in areas where people have limited mobility choices or where the economic impact of those mobility choices represents a larger percentage of household income.
- Prioritizing the needs, safety, and comfort of vulnerable users and under-served populations.
- Working closely with neighborhood residents and local leaders to understand unanticipated project impacts and hardships, and establish a plan for addressing those concerns as part of the project.
- Directing resources to areas where disproportionate amounts of the accidents, fatalities and/or injuries occur among minority populations.
- Assessing the balance of road types available in disadvantaged communities and developing specific plans to compensate for disparities.
- Understanding the needs of a community outside of transportation infrastructure and mobility and align programs to address those benefits to the extent possible.
- Developing specific metrics to address outcomes and measuring to ensure that they are actually being obtained and benefits being received, especially in communities of color and disinvestment.
- Listening to community voices early and often to check assumptions, align values, and determine desired outcomes. This often means going to the community versus asking the community to come to you.
- Aligning job opportunities and other economic and social benefits with projects to build community capacity and economic mobility.

# COMMUNITY ENGAGEMENT: SUPPORTING TRANSPARENT & DEFENSIBLE DECISION-MAKING

Everyone that lives, works, or recreates in Kalamazoo utilizes public streets directly or indirectly. They have a significant impact on how people experience the city and how they access destinations every day. As part of the city's public infrastructure, city residents and businesses must have a voice in how the design of streets can meet local needs, as well as the broader needs of the entire community and the greater Kalamazoo area.

The City of Kalamazoo Public Participation Plan outlines requirements and recommendations for how to meaningfully and equitably engage stakeholders. In addition, Section 3.1 of this design manual identifies typical steps in the street design process and where stakeholders should be engaged.

This section provides general recommendations and strategies to consider for engaging the community on transportation related topics.

- **Education and Communication:** Streets are complex places with many competing uses. Establishing and using a general education campaign around transportation safety and best practices should be pursued in order to grow the community's level of understanding and ability to engage deeply on transportation topics. In order to build transparency, incorporating local transportation data and trends into the communication program can be beneficial.
- **Community-Wide Plans and CIP Planning:** Broad community engagement is important when establishing community-wide transportation plans and discussing how those plans can translate into actionable projects. Understanding how the community would like to get around via different modes of travel, barriers they experience, and priorities they may have are important. A few techniques to consider for advancing regular conversations at the community-wide level:
  - » Yearly transportation focused public meetings or workshops, where information can be shared and public input solicited.
  - » Interactive mapping tools and/or surveys where community ideas and priorities can be tracked and shared over time.
  - » Dedicated transportation "idea boards" in a public location where people can share ideas and desires.
  - » Public meetings and presentations as part of developing CIP plans, allowing citizens to review projects, add to the list, and shape priorities.
- **Project-Specific Engagement:** All project types, during the project development and scoping process is an opportunity to garner public input, in a manner aligned with the City's Public Participation Plan (PPP). Feedback from stakeholders in close proximity to the corridor is especially important for determining localized needs. Consider the following approaches:
  - » Engage business area organizations, neighborhood organizations, block groups, and school PTO's as a mechanism for connecting with local stakeholders. Reach out early before the project scope is fully defined to discuss needs and establish any bounds or parameters for the project.
  - » Provide a clear location (e.g. project page) that tracks the current status of the project and makes it easy for stakeholders to share their ideas or concerns.
  - » Engage the stakeholders in a conversation around their values in order to inform decisions regarding preferred alternatives, when there are tough trade-offs to or design alternatives .

# DESIGN FOR ALL-AGES & ABILITIES

Designing for all ages and abilities means, in particular, that pedestrian spaces and bicycle facilities be designed for and usable by all members of a community.

From a pedestrian standpoint, projects must minimally meet Americans with Disabilities Act (ADA) guidelines. However, more enabling designs that utilize universal design principles should be pursued on all street projects to the extent possible.

An all ages and abilities bicycle network is one where all bicycle-willing people feel safe and comfortable on that network. While conventional bicycle lanes have been instrumental in advancing adoption of dedicated bicycle facilities in communities across the country, they often fail to provide a suitable facility for more cautious and/or less confident bicycle riders. As such, communities are placing increased emphasis on building "low stress" bicycle facilities that are comfortable for a broader range of users.

Facilities comfortable for a broader range of users can increase the share of people cycling in a community. This can help realize a greater range of benefits through positive public health outcomes, reduced transportation costs, improved safety for all roadway users, and equitable access to transportation choices.

The 2017 NACTO design guide *Designing for All Ages & Abilities* provides guidance on the types of bicycle facilities that should be considered based on roadway conditions and achieving an all ages and abilities goal. Table 2.1.1. provides a decision-making tool that considers the speed of the roadway, traffic volumes, numbers of vehicle lanes, and other critical considerations. These considerations inform a minimum level of facility that should be used to serve all ages and abilities.

See **Section 4.3 - Bicycle Facility Section** for additional guidance.

**Contextual Guidance for Selecting All Ages & Abilities Bikeways**

| Roadway Context | | | | All Ages & Abilities Bicycle Facility |
|---|---|---|---|---|
| Target Motor Vehicle Speed* | Target Max. Motor Vehicle Volume (ADT) | Motor Vehicle Lanes | Key Operational Considerations | |
| *Any* | | *Any* | *Any of the following:* high curbside activity, frequent buses, motor vehicle congestion, or turning conflicts‡ | **Protected Bicycle Lane** |
| < 10 mph | Less relevant | No centerline, or single lane one-way | Pedestrians share the roadway | **Shared Street** |
| ≤ 20 mph | ≤ 1,000 – 2,000 | | < 50 motor vehicles per hour in the peak direction at peak hour | **Bicycle Boulevard** |
| ≤ 25 mph | ≤ 500 – 1,500 | | | |
| | ≤ 1,500 – 3,000 | Single lane each direction, or single lane one-way | Low curbside activity, or low congestion pressure | **Conventional or Buffered Bicycle Lane, or Protected Bicycle Lane** |
| | ≤ 3,000 – 6,000 | | | **Buffered or Protected Bicycle Lane** |
| | Greater than 6,000 | | | **Protected Bicycle Lane** |
| | Any | Multiple lanes per direction | | |
| Greater than 26 mph† | ≤ 6,000 | Single lane each direction | Low curbside activity, or low congestion pressure | **Protected Bicycle Lane, or Reduce Speed** |
| | | Multiple lanes per direction | | **Protected Bicycle Lane, or Reduce to Single Lane & Reduce Speed** |
| | Greater than 6,000 | *Any* | *Any* | **Protected Bicycle Lane, or Bicycle Path** |
| High-speed limited access roadways, natural corridors, or geographic edge conditions with limited conflicts | | *Any* | High pedestrian volume | **Bike Path with Separate Walkway or Protected Bicycle Lane** |
| | | | Low pedestrian volume | **Shared-Use Path or Protected Bicycle Lane** |

**Table 2.1.1 - All Ages & Abilities Bikeways (NACTO – Designing for All Ages and Abilities, 2017)**

# TACTICAL PROJECTS

Tactical projects, sometimes called quick-build or temporary installation projects, can be an effective tool for "testing" changes to streets and roadways before full implementation. This "try before you buy" approach can provide more real world feedback for how changes might operate, and can even be lower cost than paying for expensive modeling and analysis.

Different types of tactical projects can be utilized, which are described below.

## Demonstration Projects

The primary purpose of Demonstration Projects are to showcase and raise awareness of the idea.

- Demonstration projects are the shortest lived type of tactical projects. These projects may by installed for as little time as a day up to a few weeks (although longer term demonstrations are possible).
- Typically low cost, using cheap non-permanent and flexible materials.
- Typically do not have robust data collection and pre- and post-analysis. Focused on communication instead.

## Pilot Projects

Pilot Projects are generally more involved than demonstration and strive to actually test, analyze, or evaluate the performance of an idea in a low-cost manner before more significant investments are made.

- Remains in place long enough for behaviors to normalize around the pilot project so that data can be collected. Typically one to two months at a minimum.
- Typically low cost and quick to install. Use pavement markings, semi-attached materials, planters, temporary curbing, signage.

## Interim Installations

The last category relates to projects that are installed using an initial lower cost set of treatments, that are intended to remain in place long-term until more permanent changes can be made.

- Remains in place indefinitely until upgraded to a full installation or the project is determined to be undesired and/or ineffective.
- Design and layout should be observed and assessed regularly, with adjustments and fine tuning made on regular basis to improve the operation. Establish clear process for determining long-term outcome.

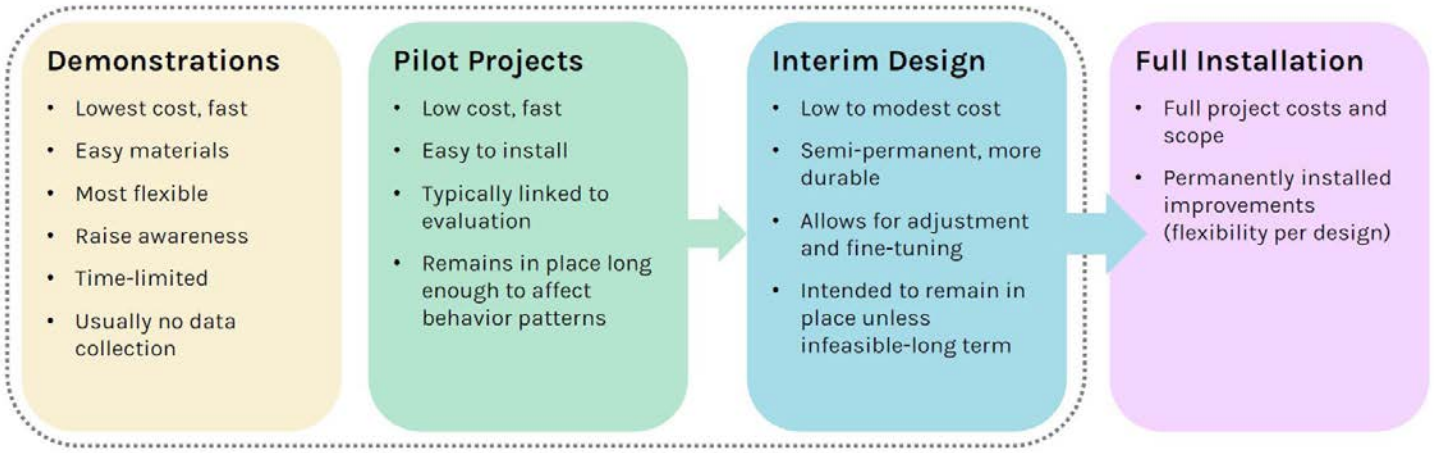
## Tactical Project Considerations

The following types of projects are good candidates for tactical projects:

- Re-purposing curbside lanes for other uses (i.e. expanded pedestrian area or bikeways)
- Crosswalk improvements and crossing length reductions (e.g. temporary bumpouts or mid-block crossings)
- Separated bikeways
- Traffic lane reconfigurations (e.g. testing road diets)
- Public art installations

Best practices to consider for tactical projects:

- Have a clear communication plan and signage in place before and during the project to explain the purpose and expectations to potential users and stakeholders.
- Establish measures for success. Know what data or attributes are being analyzed and how follow-up decisions will be made.
- Be nimble and flexible. While construction costs may be low, staff time for monitoring, adjusting/maintaining, observing, and following up on tactical projects can be considerable.



# ADDITIONAL GUIDING PRINCIPLES

Designing streets is a complicated process and must balance the need of many different street users across a diversity of land use contexts. As public or private development projects are identified, designed, and reviewed, a number of key strategies can be utilized to aid the design process and make informed, holistic decisions regarding the future of Kalamazoo streets.

1. **Be honest about trade-offs.** We are so used to thinking about streets as places to move cars that we often fail to notice when the trade-offs we are negotiating are only between the non-auto elements. We often make tough choices between quality pedestrian facilities, trees, parking, bicycle facilities or transit accommodation, while failing to scrutinize vehicle demands, to the same extent. While vehicles are an important and even vital user of Kalamazoo streets, giving equal consideration to each street user type will lead to a more balanced network and better streets overall.

2. **Integrate street and urban design.** The best streets compliment what is on the pavement and what is along the block. High vehicle volume is kept out of quiet neighborhoods, adequate lighting is provided on heavy pedestrian streets, large canopy trees are provided on high speed streets, crosswalks are on all streets, on-street parking is available for storefront commercial, driveways are restricted along destination commercial streets. Street and urban design must compliment one another.

3. **Strive for consistency.** Consistency in facility design increases the legibility of a street and makes it more predictable and inviting for travelers. However, the context of a street commonly changes as it transitions from one area of Kalamazoo to another. The street design may also change along the corridor. If implementation is incremental, as through maintenance or development projects, ensure transitions are logical and intuitive.

4. **Understand the circulation network.** Streets do not exist in isolation. They are part of networks, such as stormwater drainage, bus routes, shopping district, bicycle routes. If a particular element does not "fit" on a particular street, perhaps it can be moved to another. Conversely, some elements are necessary to complete a network. Working in multiple scales helps to understand a street and its network.

5. **Consider maintenance.** Each of the elements includes consideration of maintenance, but good street design must consider the maintenance of the total street design as a whole. Does it introduce any complications for snow removal? Will it add additional cost when the street must be repaved? How many pavement markings, signs, signals and lights are there that must be kept up? Are there opportunities for efficiencies? Are there partnerships in place to maintain landscaping, art or other unique elements?

6. **Consider maintenance tasks.** Maintenance tasks include snow clearing, sweeping, waste management, repairs, patching, utility maintenance, cleanouts, landscape care, furnishings upkeep, pavement markings repainting.

7. **Phase in funding.** Streets are expensive and budgets are limited, but with strategic phasing, collaboration, and creative approaches to design, budget constraints do not have to preclude street improvements. Pavement markings and non-permanent fixtures (e.g. bicycle corrals, planters, and rubber curbing) dramatically change the character of a street quickly and at relatively low cost. More permanent improvements can be phased over time as development projects come on line, utility upgrades are conducted, or routine maintenance projects advance.

8. **Design for future adaptation.** Wherever possible, streets should be designed with flexibility and adaptability in mind. Where safety, accessibility, and other project goals can be achieved, minimizing permanent improvements and/or designing flexible spaces that respond to changing needs overtime can reduce infrastructure costs and allow for greater resilience.

9. **Control traffic stress based on the target users**. The amount of traffic stress influences the way people use streets and the modes by which they travel. Streets should be designed to control traffic stress for the target users.

10. **Establish design vehicles for each street project.** The type of design vehicle (and the occasionally "accommodated vehicle) that is chosen should be driven by the specifics of the project. Generally single passenger cars or Single Unit 30-foot Truck (SU-30) are appropriate for most streets . However, streets on transit routes or where heavier truck traffic is anticipated, may require different design vehicles to be considered.

11. **Plan for emergency vehicles and access.** Fire, police, and ambulance routes should be considered.


# 3.3 DECISION-MAKING TOOLS

## A VALUES-BASED CHECKLIST

This checklist provides a comprehensive set of questions for the project team (whether public or private) to ask when changes to a street are considered. Organized around the six values that align the city's efforts, this checklist helps to identify data and analysis tasks that can support defensible decision-making aligned with best practices and ensures that both aspirational, as well as more practical and operational considerations, are fully explored.

Each value-based set of questions are further organized around the four phases of the street design process—planning, project development, design and engineering, and construction and operations—to help guide the process. These questions can and should, however, be used iteratively throughout the life of a project to check assumptions, ensure needed data and metrics are generated, and create outcomes that advance the city's values.

Checklist items with a diamond (♦) indicates those questions that can help determine what the modal hierarchy for a project should be, which in turn will help determine priorities when making scoping and design trade-offs.

## A Connected City

- **Strong connections between a diverse range of people and places**
- **A city networked for walking, biking, riding, and driving**
- **A reliable, accessible, and affordable public Transportation system**

### Phase 1: Planning and CIP

- ☐ (♦)**What is the desired modal hierarchy for the street?** Will this modal hierarchy achieve the goals of the project and support the desired land uses? Will it provide the desired level of safety for the identified users?
- ☐ (♦) **PEDESTRIANS:** Is the street a high pedestrian traffic area? Are there pedestrian generators present such as parks, schools, libraries, health care facilities, etc? Are there special populations such as youth, seniors, people with disabilities present? Pedestrians are the most vulnerable users, and their safety should be prioritized. Is there any compelling reason to not prioritize pedestrians?
- ☐ (♦) **BICYCLES:** Is the street part of the city's, Michigan Transportation Planning Association (MTPA) or Kalamazoo Area Transportation Study (KATS) non-motorized network? Is it a target for a low stress connection? Do bicycle lanes already exist? As vulnerable users, is there enough safety measures provided to make cyclists of all ages feel comfortable?

- ☐ (♦) **TRANSIT:** Does the street have designated bus routes? Is there a multi-modal transit hub within the project area? What is the frequency of service? The number of transit lines? Is the project near a train station? Are there regional/national buses serving the area? Transit riders are also pedestrians, how might this impact their prioritization?
- ☐ (♦) **TRUCKS:** Does the street carry or allow truck traffic? Is it a designated truck route? Are there major distribution or industrial uses that require heavy truck traffic? Is there frequent on-street loading required? Are there loading zones present, and if so, how many? Can loading be accommodated off-street or on side streets?
- ☐ (♦) **PASSENGER VEHICLES:** What is the current and projected average daily traffic (ADT) in the corridor and at cross streets? Is it consistent throughout the corridor? Do the number of vehicles per lane mile exceed the maximums allowed? If so, how often? How does the average and 85th percentile travel speeds compare to the posted speed limit? Is there an odd or even number of lanes? Is it a high crash corridor? What types of accidents are occurring and where? Are high crash intersections located within the project area?
- ☐ (♦) **MICRO-MOBILITY/SHARED-USE VEHICLES:** Are there shuttle services operating in the project area? Is there a car share service nearby or on street? Is this a location with frequent taxi or on-demand transportation stops or stands? Are bicycle share stations present? Are scooters present? Is their a mobility hub located in the corridor?
- ☐ (♦) **Who are the primary roadway users?** Who are the most vulnerable roadway users?

## Phase 2: Project Development

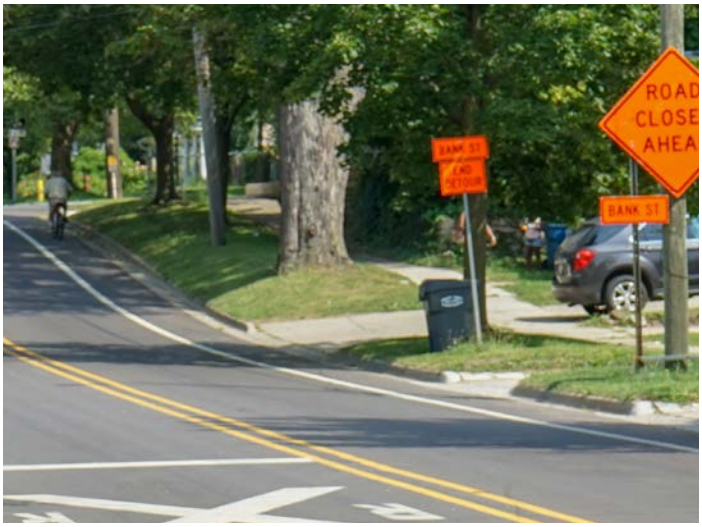
- ☐ **CURBSIDE USES: What unique curbside uses are present?** Valet? Outdoor café's? Loading zones? Standing zones? Drop-off/pick-up zones? Parklets? On street parking?
- ☐ **BICYCLE VOLUMES:** Have bicycle counts or observations been conducted to determine current level of use? If so, what level of protection does existing infrastructure provide and is it adequate for the need and desired outcome?
- ☐ **PEDESTRIAN VOLUMES:** Are there pedestrian counts? If not should counts be performed? What is the experience of a pedestrian walking along the corridor? Crossing streets? How far apart are stop controlled intersections?
- ☐ **TRANSIT RIDERSHIP:** What are the boardings and alightings at bus stops? Are shelters present? Is there good lighting, signage, and pavement? Can you easily cross the street to access?
- ☐ **VEHICLE TRAFFIC:** How do traffic volumes vary during the day, throughout the week? Is the design being driven by peak hour traffic or persistent volumes throughout much of the day? Does ADT justify the number of existing/proposed lanes, or is it more important to accommodate turning movements, loading, and bus stops to mitigate traffic concerns and allow for reduced or similar travel lanes?
- ☐ **ON-STREET PARKING:** Is street parking present and, if so, how often is it being utilized? What is the turnover rate? Is it the highest and best use of public space for the area?

## Phase 3: Design and Engineering

- ☐ **SIDEWALK GAPS:** Are there gaps in the sidewalk network? Are the sidewalks wide enough?
- ☐ **DESIGN VEHICLE:** What is your design vehicle?
- ☐ **BUS TURNING:** Are buses turning onto or off of the roadway? Have turning movements been designed to allow for safe bus turning?

## Phase 4: Construction

- ☐ If there are existing bicycle lanes, have safe accommodations been made for cyclists during construction?
- ☐ Are pedestrian paths maintained during construction? If a sidewalk must be closed, are pedestrians forced to cross the street?
- ☐ Are bus stops clearly marked and safe waiting areas maintained?



# Equity and Opportunity for All

- **Street design informed by a neighborhood shared decision-making process**
- **Streets capable of being used by people of all ages and mobility levels**
- **Multi-modal networks that are equitably accessible to all neighborhoods**

## Phase 1: Planning and CIP

- ☐ **NEIGHBORHOOD CONTEXT:** Is the street located in a disadvantaged neighborhood?
- ☐ **NEIGHBORHOOD/BUSINESS ASSOCIATIONS:** Are their neighborhood or business associations (or other potential partners) to engage? Are underserved and disinvested parts of the community receiving improvements that address their needs and provide them with economic opportunity, access to services, improved safety, and strengthen beauty and community?
- ☐ **CIP ALIGNMENT:** How does the project align with other CIP projects in the corridor or on nearby streets? Does it build networks to improve access?


## Phase 2: Project Development

- ☐ **STAKEHOLDER ENGAGEMENT:** What property, business owners, and residents need to be involved in the process (planning, design, review, implementation correspondence?) What strategies will be required to give everyone a chance to provide input into the process?
- ☐ What Traffic Control Orders (TCO) will be needed?

## Phase 3: Design and Engineering

- ☐ **ADJACENT PROPERTIES AND CONSTRUCTION EASEMENTS:** How will the project affect adjacent properties? What construction easements or grading permits are needed? Are they disproportionately effecting communities of color?
- ☐ **BIKEWAY USERS:** Are bicycle lanes comfortable for all ages and abilities for the roadway typology and design?
- ☐ **ADA ACCESSIBILITY:** Do the sidewalks, crosswalks, signals, and curb ramps meet ADA requirements?

## Phase 4: Construction

- ☐ What is the anticipated construction phasing and timeline? Who will be most impacted, and have steps been taken to mitigate that impact?
- ☐ Have temporary curb ramps been put in place to maintain accessibility during construction?

# Environmentally Responsible and Sustainable

- **A mobility network that is sustainable and resilient, and reduces vehicle miles traveled**
- **Street trees and landscaping provide ecological services as well as buffers and beautification**
- **Reduced stormwater runoff and urban heat island**

## Phase 1: Planning and CIP

- ☐ **FLOODPLAIN:** Is the project in the floodplain? Will it require a floodplain permit through Michigan Department of Environment, Great Lakes, and Energy, (EGLE)?
- ☐ **IMPERVIOUS AREAS:** Is the project in an area of high imperviousness where urban heat island effects are likely to be a concern?
- ☐ **HEAVY TRAFFIC:** Is the project in an area that receives heavy industrial traffic that generates noise, dust, roadway debris?

## Phase 2: Project Development

- ☐ **STORMWATER MANAGEMENT TARGET:** What is the target level of stormwater management that is needed? What level is desired?
- ☐ **GREEN INFRASTRUCTURE TYPE:** Is the project an opportunity for above ground, below ground, or both types of green infrastructure?
- ☐ **TREE CANOPY:** What is the condition and extent of tree canopy along the corridor?
- ☐ **ELECTRIC VEHICLE (EV) CHARGING:** Can EV charging be accommodated?

## Phase 3: Design and Engineering

- ☐ What sizes and types of new street trees are suitable for the project?
- ☐ What type of soils are present? What is the infiltration rate?
- ☐ How much runoff can be retained? Detained? Can it be sent to a storm sewer versus a sanitary sewer and if so can it be cooled and cleaned first?
- ☐ Is LED lighting an option?
- ☐ Can high recycled content and low cement pavement mix designs be used?
- ☐ Can permeable pavements be used?
- ☐ What measures are being used to maximize tree soil volumes and ensure a mature tree canopy?

## Phase 4: Construction

- ☐ Are there trees that will be impacted and/or removed by construction? Are any of these landmark or otherwise protected trees? Is existing vegetation being properly protected?
- ☐ Are streams and stormwater drains protected during construction?
- ☐ Are their dust control measures in place?
- ☐ How can construction waste be diverted from landfill?
- ☐ Can materials be procured locally?

# Complete Neighborhoods

- **Connective access to neighborhood amenities**
- **Neighborhood commercial nodes are walkable and accessible by all modes**
- **Neighborhood streets are safe and walkable**

## Phase 1: Planning and CIP

- ☐ (♦) **LAND USE:** What is the existing and proposed/ future land use? Is it changing from existing conditions?
- ☐ (♦) **NODES:** Is the project in an identified Neighborhood or Commercial Node? Is the project in a Commercial or Neighborhood Node? Is the project in downtown?
- ☐ **SCHOOLS:** Do children play and walk to school along the street?

## Phase 2: Project Development

- ☐ **PAVEMENT WIDTHS:** Are there areas of excess pavement (e.g. overly wide travel lanes, over-sized turning areas)? Can excess pavement areas be repurposed (e.g. converted to additional sidewalk space, bicycle lanes, landscape buffers)?
- ☐ Are additional turn lanes warranted and/or is there an opportunity to repurpose turn lanes?
- ☐ Is there an opportunity to advance a road diet or lane narrowing project?
- ☐ How does traffic flow, generally, through intersections? Is there evidence for frequent disruptive backups? Is it because of traffic volumes, signal timing or lack of turning lanes?
- ☐ What are the neighborhood trip generators? Destinations?

## Phase 3: Design and Engineering

- ☐ How is the curb lane being utilized? Does it balance the needs of the different users? Is it designed for a single purpose or is it customized to achieve multiple objectives? Does it allow for flexibility to accommodate changing needs over time?
- ☐ Can all modes safely access and traverse commercial nodes?
- ☐ Will the design slow cars down so they are more likely to travel at or below the speed limit? Will it improve sight lines for all users?
- ☐ Will crossing distances be minimized?

## Phase 4: Construction

- ☐ Are businesses loading and delivery needs able to be accommodated during construction?
- ☐ Are limits on working hours and types of work prescribed to minimize noise levels in the mornings and evenings?
- ☐ Is construction phased in a rolling operation to minimize closures in front of businesses and homes?

# Vibrant Places

- **Streets support a diversity of life, culture, and activity**
- **Streets support formal and informal social exchanges**
- **Streets support a variety of retail, restaurants and entertainment venues**

## Phase 1: Planning and CIP

- ☐ (♦) **COMMERCE:** Are their businesses along the street that want to conduct commercial activity on the sidewalk (e.g. outdoor dining or retailing)?
- ☐ (♦) **EVENTS:** Is the road currently or anticipated to be used for special events, street closures, festivals, etc.?
- ☐ Is there a partner organization to support maintenance and activation?

## Phase 2: Project Development

- ☐ Are there opportunities for new public art installations?
- ☐ Is there a desire or opportunity/need for pocket parks, parklets, plazas or gathering spaces?
- ☐ Is there a desire or need for outdoor seating? How frequent?
- ☐ Are there opportunities and/or a desire for specialty lighting?
- ☐ How can decorative planting best be accommodated within the project? Planters? Pots? Parkway? Hanging baskets?
- ☐ Have travel paths and desired lines been investigated? Are there places where people regularly jaywalk? If so can a mid-block crosswalk be added in that location?

## Phase 3: Design and Engineering

- ☐ Is there a desire for banner poles and banners to be used along the corridor? Is there a need for banners to stretch across the street?
- ☐ Is there special signage (beyond required regulatory signage) that is needed or desired? Branding? Gateways?
- ☐ Are wayfinding signs and information displays needed?
- ☐ Is there real time transit information available?
- ☐ Is there space for shared-use mobility and a mobility hub?
- ☐ Is there existing public artwork in the corridor that must be protected and/or relocated?
- ☐ Are there special, existing materials (paving, historic curbs, markers, plagues, etc.) that need to be maintained, salvaged, or reinstalled?
- ☐ Can transit accommodations be added or enhanced?
- ☐ Are corners and sidewalks generous enough to support conversation, a range of amenities, and a feeling of safety?
- ☐ Do the amenities and street configuration create a sense of place and pride?

## Phase 4: Construction

- ☐ Do special events need to be accommodated during construction? Do they need to be relocated?
- ☐ Can outdoor dinning be maintained during construction?
- ☐ Has there been careful coordination with existing businesses to understand their hours of operation, are ramps and other features provided to maintain access during construction?

# Resilient Infrastructure and Good Governance

- **Use an integrated design approach and coordinate with utilities**
- **Leverage government grants, private funding and foundation support to maximize and coordinate street and mobility improvements**
- **Ensure that private development and institution-lead initiatives support the city's goals for vibrant streets that are walkable and multi-modal**

## Phase 1: Planning and CIP

- ☐ Is there major utility work planned in the area in the next 5 years?
- ☐ Has major utility work recently been completed?
- ☐ Are there improvements that need to be made to the sanitary sewer, storm, or water infrastructure?
- ☐ Do water mains need to be upsized and/or is there an opportunity to upsize? Is there an opportunity to consolidate water main services in the corridor?
- ☐ What is the condition of the roadway paving? Can it accommodate new pavement markings without being resurfaced?
- ☐ Are underground building or large utility vaults present?
- ☐ What is the proposed funding source(s) for the project? Are there objectives/requirements of the funding source? If so, what are they?
- ☐ Is this project eligible for state or federal funds? Is the project looking to use state or federal funds?
- ☐ Is the project privately funded? Are there private funds that can be leveraged?
- ☐ What cost share agreements are needed with project partners?
- ☐ Are there upcoming development projects that are an opportunity to coordinate public infrastructure improvements?

## Phase 2: Project Development

- ☐ What is the condition of water mains and other utilities? Should they be televised?
- ☐ Do vaults need to be maintained?
- ☐ Is street flooding present or frequent? Do basement back ups or adjacent property flooding occur regularly during major rain events?
- ☐ Is the project in a location where more consistent and/or brighter pedestrian-level lighting is needed? What are existing street light levels? Do they need to be improved?
- ☐ Is the project identified by the city's IT infrastructure plan? Does IT conduit need to be provided?
- ☐ What resurfacing treatments/methods would be used to restore the pavement condition to an acceptable level?
- ☐ What overhead utilities (power lines, telecom, fiber optics etc.) are present? Does the project provide an opportunity to bury overhead lines?
- ☐ Who will be responsible for the maintenance of this project? Doe the stewardship of the project require public/private/non-profit partnerships?

## Phase 3: Design and Engineering

- ☐ Do existing fire hydrants provide proper coverage? Are new fire hydrants needed? How do these impact the layout and/or curb side uses?
- ☐ Can existing lighting circuits be used for supplying power? Are new electrical supply connections needed?
- ☐ Can new utilities be placed in an utility trench to minimize future roadway/utility maintenance costs and durations?

## Phase 4: Construction

- ☐ How is property access and safety being addressed when vaults are being repaired or filled in?
- ☐ How is utility work impacting the phasing and duration of the project and its impacts to local residents and businesses? Has this been minimized and coordinated in advance?

# DESIGN ELEMENT CHECKLIST

This table provides a checklist for all design elements covered in Chapter 4, and identifies how a given element applies to each street typology.

- **Required:** Design element must be included as part of the street design process and appropriately follow the detailed guidance in Chapter 4.
- **Recommended:** The design element recommended in all applicable cases, as described in the detailed guidance. Justification for not utilizing recommended elements must be clearly stated as part of the project documentation.
- **Optional/Situation:** The design element may be utilized based on applicable site conditions or at the discretion of the project team. Typically good to have and should be closely considered.
- **Limited/Restricted:** The design element is generally not suitable to the street typology and is discouraged. Justification for including the element should be documented and well supported based on site conditions or other requirement.

KEY — Required | Recommended | Optional/Situational | Limited/Restricted | N/A

## PEDESTRIAN ELEMENTS

| | Urban Center | Event/Festival | Main Street | Neighborhood Business | Commercial Business | City Connector | Network Neighborhood | Enhanced Neighborhood | Local Neighborhood |
|---|---|---|---|---|---|---|---|---|---|
| **Pathways** | UC | E/F | MS | NB | CB | CC | NN | EN | LN |
| Pedestrian Areas & Sidewalks | | | | | | | | | |
| Crosswalks | | | | | | | | | |
| Curb Ramps | | | | | | | | | |
| Mid-Block Crossings | | | | | | | | | |
| Pedestrian Refuge Islands | | | | | | | | | |
| Bumpouts | | | | | | | | | |
| Pedestrian Signals | | | | | | | | | |
| **Amenities & Uses** | UC | E/F | MS | NB | CB | CC | NN | EN | LN |
| Public Art | | | | | | | | | |
| Public Seating | | | | | | | | | |
| Waste Receptacles | | | | | | | | | |
| Sidewalk Occupancy | | | | | | | | | |

## CURBSIDE ELEMENTS

| | UC | E/F | MS | NB | CB | CC | NN | EN | LN |
|---|---|---|---|---|---|---|---|---|---|
| Curbside Occupancy: Platforms & Parklets | | | | | | | | | |
| Commercial Parking & Loading | | | | | | | | | |
| Drop-off Zones | | | | | | | | | |
| Neighborhood Parking | | | | | | | | | |
| Metered Parking | | | | | | | | | |

KEY Required Recommended Optional/Situational Limited/Restricted N/A

## BICYCLE ELEMENTS

| **Bicycle Facilities** | UC | E/F | MS | NB | CB | CC | NN | EN | LN |
|---|---|---|---|---|---|---|---|---|---|
| Bicycle Facility Selection | | | | | | | | | |
| Sidepaths | | | | | | | | | |
| Separated Bicycle Lanes | | | | | | | | | |
| Buffered Bicycle Lanes | | | | | | | | | |
| Conventional Bicycle Lanes | | | | | | | | | |
| Advisory Bicycle Lanes | | | | | | | | | |
| Sharrows | | | | | | | | | |
| **Bicycle Intersections** | UC | E/F | MS | NB | CB | CC | NN | EN | LN |
| Bicycle Boxes | | | | | | | | | |
| Two-Stage Turn Queues | | | | | | | | | |
| Protected Intersections | | | | | | | | | |
| Bicycle Signals | | | | | | | | | |
| **Mobility Support** | UC | E/F | MS | NB | CB | CC | NN | EN | LN |
| Bicycle Racks | | | | | | | | | |
| Bicycle Corrals | | | | | | | | | |
| Micro-Mobility | | | | | | | | | |

## TRANSIT ELEMENTS

| | UC | E/F | MS | NB | CB | CC | NN | EN | LN |
|---|---|---|---|---|---|---|---|---|---|
| Bus Queue Jumps | | | | | | | | | |
| Transit Lanes | | | | | | | | | |
| Bus Stops & Shelters | | | | | | | | | |
| Bus Bulbs | | | | | | | | | |

## ROADWAY ELEMENTS

| | UC | E/F | MS | NB | CB | CC | NN | EN | LN |
|---|---|---|---|---|---|---|---|---|---|
| Travel Lanes | | | | | | | | | |
| Corner Geometry & Design Vehicles | | | | | | | | | |
| Driveways & Curb Cuts | | | | | | | | | |
| Medians | | | | | | | | | |
| Volume & Speed Management | | | | | | | | | |
| Intersection Strategies & Traffic Signals | | | | | | | | | |

KEY Required Recommended Optional/Situational Limited/Restricted N/A

## STREETSCAPE & INFRASTRUCTURE

| | UC | F/E | MS | NB | CB | CC | NN | EN | LN |
|---|---|---|---|---|---|---|---|---|---|
| Street Lighting | | | | | | | | | |
| Street Trees | | | | | | | | | |
| Stormwater Management | | | | | | | | | |
| Landscape/Lawn Panels | | | | | | | | | |
| Landscape Planters | | | | | | | | | |
| Utilities | | | | | | | | | |

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# 4.0 STREET DESIGN ELEMENTS

CHERRYS
CHOCOLART

# 4.1

# PEDESTRIAN ELEMENTS

## PATHWAYS



## AMENITIES & USES

| STREET TYPOLOGY | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| UC | E/F | MS | NB | CB | CC | NN | EN | LN |
| Req. | Req. | Req. | Req. | Req. | Req. | Req. | Req. | Req. |

PATHWAYS

# PEDESTRIAN AREAS & SIDEWALKS

## DESCRIPTION & INTENT

Pedestrian areas provide physical space at the sides of the public rights-of-way for people to access adjacent land uses, including housing, shops, jobs, and public properties.

Pedestrian areas must be safe, comfortable, and accessible places for people of all ages and abilities. All public streets in the city should provide pedestrian areas and associated sidewalks, to ensure that all people have the opportunity to move through the city without reliance on a vehicle.

On public streets, pedestrian areas should provide adequate lighting and shade to support comfort and safety at all times of day and seasons. Sidewalks must, at a minimum, provide a clear, unobstructed pathway sufficient to accommodate persons with disabilities.

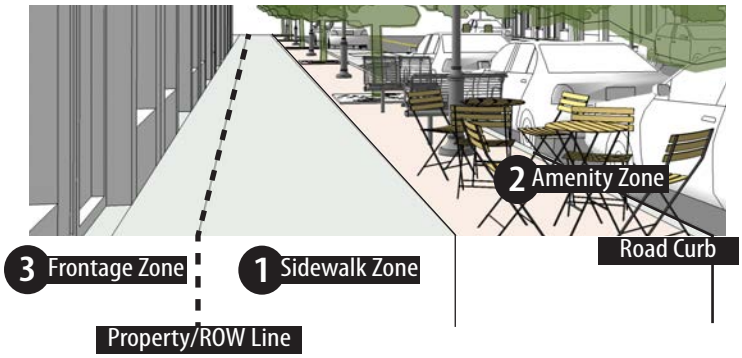
The design of pedestrian areas should support and reinforce adjacent land uses and is a vital component of encouraging active transportation and public health. Well-designed sidewalks support and enable walking as an appealing form of urban transportation. More people using sidewalks creates a greater sense of activity and "eyes on the street"- further improving the sense of safety.

Appropriate designs are wide enough to enable small groups to walk side-by-side engaging in conversation and passing oncoming pedestrians without significant conflict.

### Pedestrian Area - Key Terms

This pedestrian area typically extends from the roadway curb to the adjacent property / ROW line. Pedestrian areas may also extend beyond the property line to building frontages where those areas are intended for public use and access.

**Figure 4.1.1 - Pedestrian Areas**




The pedestrian area is typically comprised of the following zones:

1. **Sidewalk Zone:** This refers specifically to the paved, continuous, walking zone for use by pedestrians when moving along the street, aka sidewalks. Sidewalks are typically located directly along the property line/right-of-way line.

2. **Amenity Zone:** This zone is located adjacent to the street curb and extends to the sidewalk zone. Street fixtures such as street lights, street trees, parking meters, bicycle racks, bus stops and shelters, signage, signal poles, and landscaping are typically located within the amenity zone. The amenity zone also supports curbside uses such as parking and loading.

3. **Frontage Zone:** This zone, when present, refers to the space between the property line and building walls, which may be intended for general pedestrian use depending on the land use context and physical conditions. In commercial districts, this zone may include items such as building breezeways or entries, door wells, recesses, and step backs.

# USE & APPLICATION

## Street Type and Placement

- **Pedestrian areas are required on all pubic streets, on both sides of the street, for all street typologies.** Gaps in the sidewalk network should be identified and filled overtime by establishing pedestrian areas and associated sidewalks on both sides of the street. Exceptions may be considered where pedestrian areas cannot be physically located within the public right-of-way.
- **Continuous:** Sidewalks shall be continuous throughout the city, connecting to one another via well marked crosswalks (with curb ramps) at roadway intersections and mid-block crossing locations.

## Users

- Pedestrians (including wheelchair users) are the priority users of the sidewalk. However, other means of mobility may need to be accommodated on sidewalks, such as bicycles, skaters, scooters, joggers, people with strollers, etc.
- While cycling on the sidewalk is not ideal for all but the most vulnerable bicycle riders, riding on the sidewalk is not prohibited in Kalamazoo. When cycling on the sidewalk, low speeds must be encouraged and bicycles are required to yield to pedestrians.
- Sidewalks should not be used for parking or travel by any motorized vehicle except assistance devices for persons with disabilities.

## Related Design Elements

- **Street Tree Accommodations**: Amenity zones shall provide adequate space for street trees to provide shade and buffer for pedestrian comfort (*see **Street Tree Design*** section for more details).
- **Lighting:** Pedestrian areas shall be well lit, preferably with pedestrian-scaled lighting rather than relying on ambient light from roadway lighting systems or building windows. Reliance on privately owned buildings to light the sidewalk via building-mounted lights is not a desirable alternative to pedestrian lighting (see ***Lighting*** section for more details).

## References

- Americans with Disabilities Act Accessibility Guidelines (ADAAG)
- City of Kalamazoo Code Chapter 33
- The National Association of City Transportation Officials (NACTO) urban Street Design Guide provides guidance on urban sidewalk design to support downtowns.
- The American Association of State Highway and Transportation Officials (AASHTO) “A Policy on Geometric Design of Highways and Streets.” 6th Edition, (2011), also known as the Green Book, offers detailed guidance on the appropriate placement and configuration of sidewalks.
- Americans with Disabilities Act Accessibility Guidelines (ADAAG)

# DESIGN & OPERATIONS

## Design Requirements

- **Alignment:** Sidewalks must be as straight running as possible over the entire length of the block, and should not make unnecessary bends or jogs that impede straight movement.

**Pedestrian Area Widths**

- The table below provides target and minimum widths for zones in the pedestrian area. ***Widths less than target widths may only be used with clear documentation for why that width cannot be achieved.***

A **Sidewalk Width:** Width varies based on the street typology (see ***Table***).

B **Amenity Zone Width:** Width varies based on the street typology (see ***Table***).

C **Frontage Zone Width:** The width of frontage zones may be contingent on zoning code requirements for building step backs from the from public rights-of-way. Where pedestrian space in the public right-of-way is limited, buildings should include a step back in order to achieve the overall dimensions listed below.

- **Overall Pedestrian Area Widths:** The overall pedestrian area width must provide adequate separation from the roadway. The "A" minimum width is where a curbside lane exists and provides a buffer against the roadway. The "B" minimum width is where the pedestrian zone is adjacent to a vehicle travel lane. This overall width can also include frontage zone width for buildings that are stepped back, provided the space is designed and intended for public access.

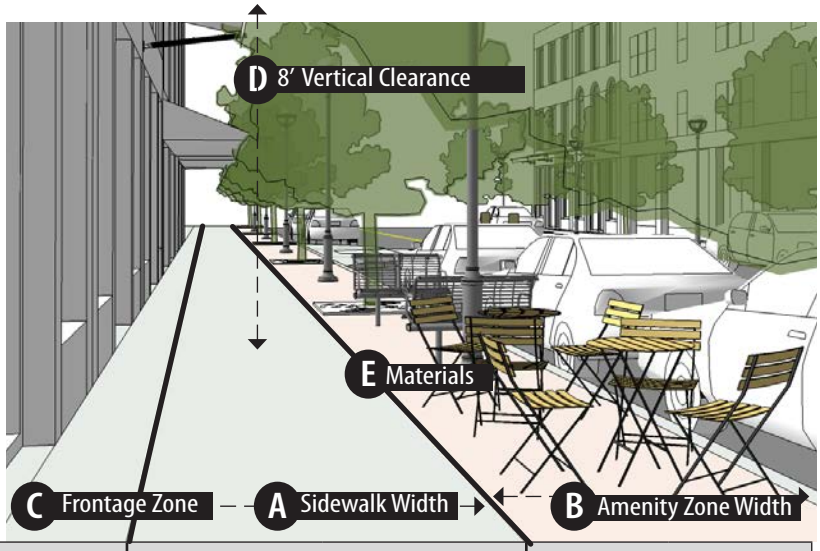
**Other Design Requirements**

D **Height Clearance:** Objects overhanging the sidewalk, such as signs, banners, planter boxes or baskets, or other features shall provide at least 8-feet of clear vertical height.

E **Materials:** Materials in the sidewalk and amenity zone as follows:

» Sidewalk: Concrete with basic (i.e. broom) finishes. Provides greatest accessibility and easy maintenance and snow clearing.

» Amenity Zone: Materials can be more flexible. Concrete to be used as a default material. Concrete unit pavers (porous and non-porous versions) or brick pavers may be used, subject to engineers approval.




| Table 4.1.1A | Overall Widths | | | Sidewalk Width | | Amenity Zone Width | |
|---|---|---|---|---|---|---|---|
| Street Typology | Target | Min. "A" (parking) | Min. "B" (no park.) | Target | Minimum | Target | Minimum |
| Urban Center (UC) | 22'+ | 18' | 19' | 10-12' | 8' | 12'+ | 10' |
| Event/Festival (E/F) | 16'+ | 12' | 19' | 10-12' | 8' | 8-12' | 4' |
| Downtown Main (MS) | 14'+ | 12' | 19' | 6-10' | 6' | 8'+ | 6' |
| Neighborhood Business (NB) | 14'+ | 12' | 19' | 6-10' | 6' | 8-10' | 6' |
| Commercial Business (CB) | 16'+ | 12' | 19' | 8-10' | 6' | 8-12' | 4' |
| City Connector (CC) | 16'+ | 12' | 19' | 8-10' | 6' | 8-12' | 4' |
| Neighborhood Network (NN) | 14'+ | 12' | 19' | 6-10' | 6' | 8'-12' | 6' |
| Enhanced Neighborhood (EN) | 12'+ | 9' | 12' | 6-8' | 5' | 6'-12' | 4' |
| Local Neighborhood (LN) | 12'+ | 9' | 12' | 6' | 5' | 6'-12' | 4' |

- **Cross-slope**:
  - » Sidewalks must have a positive cross-slope away from buildings, with a maximum cross-slope of 2% to achieve ADA accessibility.
  - » The amenity zone should maintain the same cross-slope to the extent possible, but may increase to 5% maximum where pedestrian activities/uses are anticipated (e.g. cafe dining, curbside uses).

## Additional Design Considerations

- **Separation and Buffers:** Pedestrian areas shall be separated from the vehicular travel way via a raised curb. Exceptions may occur where the street is specifically designed to share space freely between all street users including vehicles and pedestrians. Street fixtures such as trees, lights, meter posts, and landscape should be used to provide additional buffers and sense of separation.
- **Sidepaths and Shared-Use Trails:** Where sidewalk widths are 8-feet or more in width, consideration should be given for designing the sidewalk as a sidepath or shared-use trail in order to better accommodate bicycles in addition to pedestrians. This approach is appropriate on more commercial business streets.
- **Snow Melt:** Downtown area sidewalks should be coordinated with the City's snow melt system plans.

## Utility Considerations

- Utility vaults should be avoided in the sidewalk area. Where vaults cannot be avoided, they should be located in the frontage or amenity zones of the sidewalk. Vaults should be discrete and, where possible, screened by landscaping. The tops of vaults should favor solid materials over grates. Materials should not be slippery when wet or during cold conditions.

## Sustainability Considerations

- Lighter color sidewalk materials that increases the reflectivity lowers the urban heat island effect. Avoid using dark colors for sidewalk materials and finishes.
- Amenity zones provide opportunities for landscaping and stormwater management features. The frontage zone may also provide space for landscaping and stormwater management where buildings are set back from the right-of-way and there is adequate space available for landscaping.
- Street trees can dramatically lower the urban heat island effect and retain stormwater.

# MAINTENANCE & MANAGEMENT

- **Construction Impacts:** Continuous pedestrian accommodation and connectivity should be maintained where feasible. Refer to applicable city and building code documents for further information on sidewalk protections and closures.
- Sidewalks are prone to many incidences that degrade accessibility and the quality of the walking environment. Sidewalk heaving due to tree roots and shifting sidewalk pavers, including historic bricks, are two very common special maintenance needs. Providing adequate soil volume, quality non-compacted soil, and sufficient growing space can minimize the potential for adverse impacts on sidewalk pavement.
- Sidewalk pavers, even in historic areas, may be reset to smooth sidewalk surfaces. Quality workmanship at installation is essential.
- Innovative materials, such as porous concrete or rubber pavement blends, provide some distinct advantages but require special monitoring and maintenance. Maintenance plans and commitments must be in place prior to the use of these materials.

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PATHWAYS

# CROSSWALKS

## DESCRIPTION & INTENT

Crosswalks are designated and marked locations where pedestrians and other sidewalk users should cross the roadway. Marked crosswalks provide a safe, clear, place to cross the street and combine with appropriate intersection controls that require motorists to stop for pedestrians using crosswalks. Crosswalks signal to other road users, especially motorists, that pedestrians are, or may be, present. Frequent crossings support greater walkable and encourage more active transportation choices.

## USE & APPLICATION

### Location

- Marked crosswalks should be provided on streets with traffic volumes above 3,000 Average Daily Traffic (ADT), speeds higher than 20 MPH and/or with multiple travel lanes. It is especially important that crosswalks be provided in the vicinity of schools, parks, senior centers or other facilities that have concentrations of more vulnerable pedestrians.
- When crosswalks are used at an intersection, crosswalks should be provided across all legs of all intersections and must have a curb ramp and sidewalk to land on.
- Crosswalks should be provided at the ends of every block, which is typically every 300- to 400-feet. Longer distances between crossings may prompt pedestrians to choose unsafe and unprotected crossing points if marked crosswalks are too far apart. When crossings are needed between intersections, mid-block crossings should be used (see ***Mid-Block Crossings***).

### Related Design Elements

- **Bumpouts:** Bumpouts reduce the length of crosswalks, and thus the crossing time for pedestrians. Use bumpouts with crosswalks either at intersections or at mid-block crossings (see ***Bumpouts***).
- **Mid-Block Crossings**: Mid-block crossings must use crosswalk markings (see ***Mid-Block Crossings)***.
- **Signs and Signals:** At high volume or high concern crossings where there is no signal or other traffic stop controls, use other appropriate means of highlighting crosswalks, such as hybrid beacons, rapid flash beacons, raised crossings, medians, and other safety measures (see ***Pedestrian Signals***).
- **Medians:** Medians used in the roadway, at either mid-block or intersection approaches, are an opportunity to integrate with crosswalks (see ***Pedestrian Refuge Islands*** *and* ***Mid-Block Crossings***).

# DESIGN & OPERATIONS

## Design Requirements

- **Alignment:** Crosswalks should be in line with the center of the connecting sidewalk, to provide as direct and clear a route as possible across the street.

A **Width:** Crosswalks shall be at least 8-feet wide, or equal to the width of the connecting sidewalk plus an additional 1-foot on either side.

B **Length:** Street designs should strive to shorten the length of crosswalks to the extent feasible to reduce exposure. Utilize bumpouts, medians, or crossing islands where appropriate to narrow crossing lengths.

C **Curb Ramps:** Curb ramps with detectable warnings shall lead to all marked crosswalks to meet accessibility requirements (see ***Curb Ramps***).

D **Stop bars:** At stop or signalized intersection approaches for vehicle and bicycle lanes, solid white bars 18 to 24 inches wide must extend across all lanes approaching a crosswalk. These should be placed at least 4-feet behind of the crosswalk line.

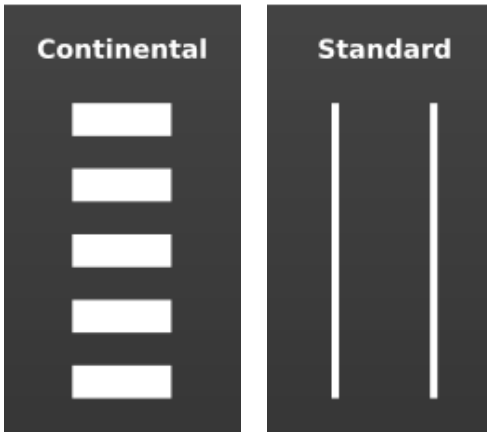
- **Materials:** Underlying crosswalk material should be constructed of asphalt or concrete. Unit pavers or bricks should be avoided in crosswalks due to impacting the clarity of markings and/or for creating trip hazards resulting from loose materials.

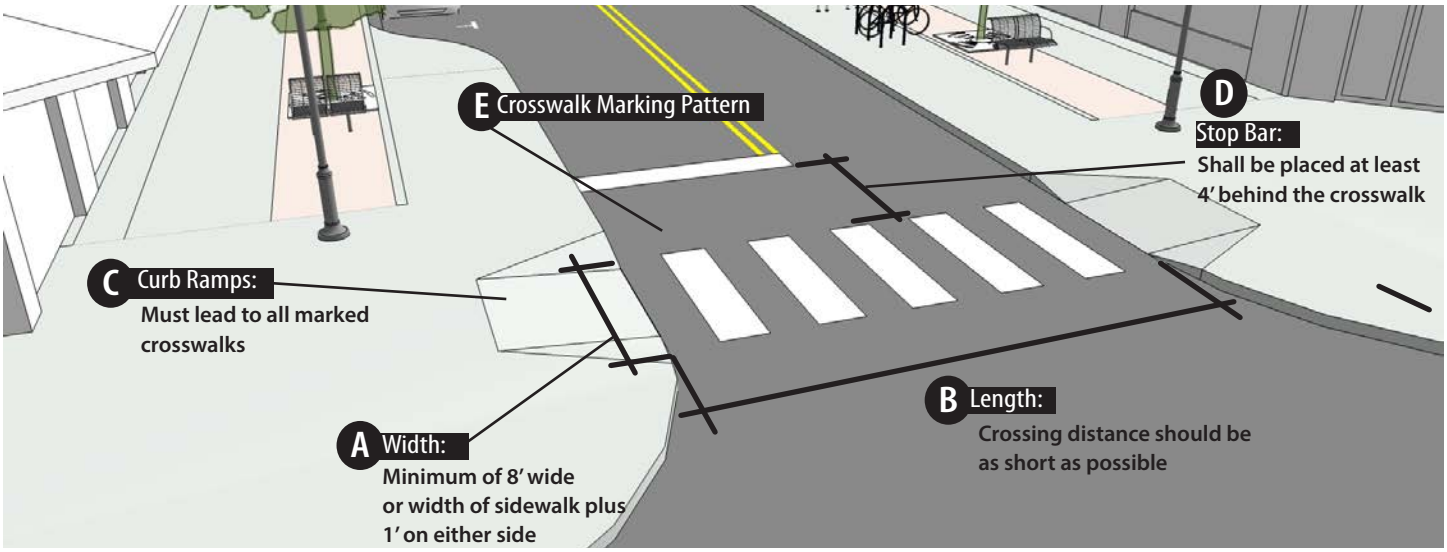
E **Crosswalk Marking Pattern:** High visibility pavement markings, using a reflective material, shall be used to mark crosswalks. The type of crosswalk marking pattern used depends on the roadway conditions as follows:

» **Continental Pattern:** This pattern should be used at all signalized intersections and at uncontrolled (non-signalized) crossings that cross over a primary road (all street typologies except Enhanced Neighborhood and Local Neighborhood). Continental crossings may also be used at any crossing where there are visibility concerns. The white bars should be 12 inches wide with 24-inch spacing. Bars should be aligned parallel with the direction of the vehicle travel lane. Angled crossings should be stepped along the crossing with markings parallel to the travel lane.

» **Standard Pattern:** The standard pattern should be used when crossing enhanced neighborhood or local neighborhood streets at stop controlled and uncontrolled crossing points. This pattern uses a pair of 6-inch wide bars to indicate the crossing zone.

**Figure 4.1.2 - Crosswalk Marking Pattern**



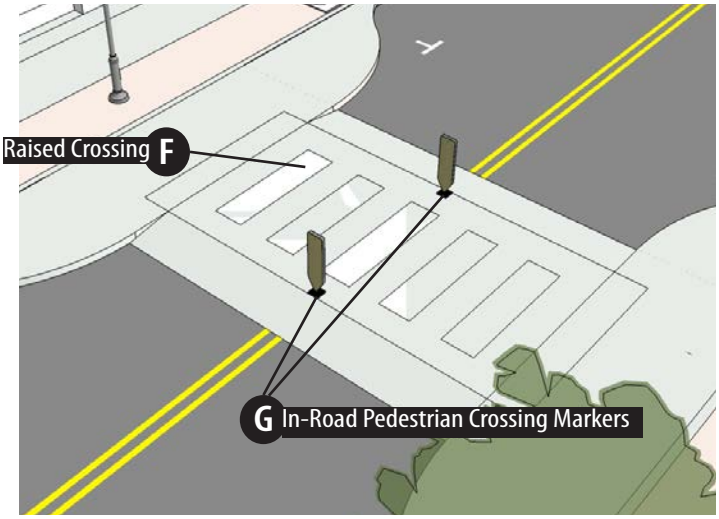
## Additional Design Considerations

**F** **Raised crosswalks** should be considered in locations where high volumes of pedestrian crossings occur and/or at locations where managing vehicle speeds is critical.

- » Raised crossings are typically used as part of a mid-block crossing and function as a speed table to reduce vehicle speeds (see ***Volume and Speed Management***). Raised crossings may also be considered at crossings over side streets that run parallel to a free-running primary street. In these cases, raised crossings force slower vehicle turning speeds and better awareness of pedestrians.
- » Raised crossings help elevate the visibility of pedestrians and prioritize pedestrian users. Raised crosswalks can also make the sidewalk and crossing zones more accessible, due to not requiring pedestrians to navigate curb ramps. Detectable warning must still be used on crosswalk approaches.
- » Geometry: Raised crossings must cover the entire crossing distance. Slopes for vehicle ramp should be between 1:10 to 1:25

**G** **In-Road Pedestrian Crossing Markers (R1-6):** In-road pedestrian markers (or "Gateway Treatments") may be utilized at normal crossings and mid-block crossings to alert drivers and constrain the perceived lane width, thereby encouraging lower speeds and greater compliance with stopping for pedestrians.

- » Markers should be placed minimally on the centerline of the roadway, typically on both sides of the crossing point. Markers may also be placed in the road gutter or just outside of the travel lanes.





**H** **Hardened Centerlines/Corners:** This treatment uses small speed bumps and/or tight groupings of delineator posts positioned before and after a crosswalk on a road centerline in order to force drivers to take sharper and slower turns. This is particularly applicable for vehicles turning left onto a multi-lane receiving road.

- » Typical treatment is to apply 6- to 20-foot long sections of speed bumps/delineators following the centerline. Where larger vehicle traffic is expected, use of speed bumps only allow larger vehicles to turn and travel over the bumps.

- **Special Crossing Pavings/Materials**:
  - » Projects can utilize temporary decorative crosswalk treatments to enhance place making or introduce public art elements (e.g. such as crosswalk tattoos). However, no part of the decorative treatments may cover up intersection or touch the actual crosswalk markings.
  - » Stamped or colored asphalt or concrete crosswalks treatments can increase maintenance requirements and decrease night time visibility and legibility. These treatments are typically discouraged.

## Utility Considerations

- There should be a clear path from the crosswalk to the curb ramp and onto the sidewalk. Ensure that utility infrastructure, such as signal boxes, signal poles, light fixtures, or fire hydrants are outside of the walking zone at the end of the crosswalk to create a clear path.

# MAINTENANCE & MANAGEMENT

## General Maintenance

- **Crosswalk Re-Striping**: Crosswalks are in the travel way of the roadway. As such, they are subjected to substantial wear and tear and fading. Crosswalk markings should be refreshed at regular intervals.
- **Street Resurfacing:** After repaving, crosswalks should be remarked as soon as possible. Use repaving as an opportunity to install higher-visibility patterns.

## Seasonal Use and Maintenance

- **Snow Removal:** Crosswalks must be cleared of snow and ice. Crosswalk curb ramps should not be blocked by obstacles of snow, ice or large pools of water.

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PATHWAYS

# CURB RAMPS

## DESCRIPTION & INTENT

Curb ramps are a short ramp cutting through a curb or built up to it. Curb ramps provide the transition from the sidewalk to the street, and benefit all users, especially those in wheelchairs, people pushing strollers or luggage, and children on bicycles.

## USE & APPLICATION

### Location

Curb ramps are appropriate, encouraged, and required on all streets of all street types. Curb ramps are required to be installed during road resurfacing projects or corner construction impacts. They are also required by law with any sidewalk construction or reconstruction at intersections or other crossing points.[1]

As part of a creating an accessible sidewalk network, pedestrian crossings on public streets must include a curb ramp, regardless of whether the crossing is marked or not.

Curb ramps should be used along a sidewalk length if the sidewalk is cut by vehicle paths located below the grade of the sidewalk, such as alleys. However, in general, driveways and curb cuts should maintain the sidewalk at grade across them.

Curb ramps, including temporary ones, should be provided when a pedestrian detour is needed to maintain access during sidewalk closures.

### Related Design Elements

- **Crosswalk Markings:** See ***Crosswalk Markings*** for details on which crossings should be marked and what pattern of marking to use.
- **Bumpouts:** Bumpouts can provide an opportunity to create more pedestrian space to accommodate curb ramps and level landings where sidewalk conditions are constrained (see ***Bumpouts***).
- **Pedestrian Refuge Islands:** Curb ramps should be used as part of the design of pedestrian refuge islands (see ***Pedestrian Refuge Islands***).
- **Pedestrian Signals:** Crosswalk pushbutton location should be coordinated with the crosswalk, curb ramp and level landing in accordance with PROWAG [3] (see ***Pedestrian Signals***).
- Curb ramps should be designed as an integral part of an overall intersection. They should work in concert with crosswalks, pedestrian refuge islands, stormwater drainage and all other features of the intersection.

### Policy References

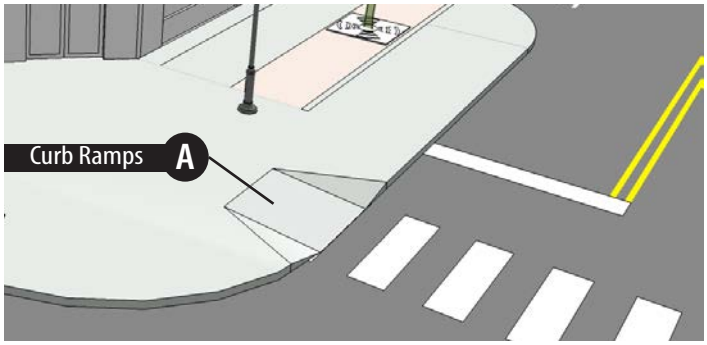
- Title II of the Americans with Disabilities Act (ADA) requires state and local governments to provide access for persons with disabilities to utilize pedestrian crossings. The U.S. Access Board provides detailed guidance on the use, design and location of curb ramps. [2]

[1] Michigan Public Act 8 of 1973

[2] http://www.ada.gov/pcatoolkit/chap6toolkit.htm#fn1

[3] Revised Draft Public Rights-of-Way Accessibility Gudelines (PROWAG), November 23, 2005.

[4] http://www.fhwa.dot.gov/environment/bicycle_pedestrian/publications/sidewalk2/sidewalks207.cfm




# DESIGN & OPERATIONS

## Design Requirements

A **Standard Design:** Curb ramps must be ADA accessible and in compliance with Public Right-of-way Accessibility Guidelines (PROWAG).

  » The City's preference is for directional curb ramps in-line with the adjoining sidewalk and perpendicular to the centerline of the crosswalk. Curving or blended curb ramps should only be used where this is insufficient space for separate directional curb ramps.

- **Crosswalk Alignment:** The curb ramp shall lie within the centerline of the crosswalk. Side flares may extend beyond the width of crosswalk if necessary.

  » Curb ramps should provide an individual directional ramp for each crossing direction that is oriented perpendicular (not angled) to the crossing path and lines up with the "receiving" ramp on the opposite side of the street, to provide clear directionality for visually impaired users. At intersections where there is not sufficient space for separated curb ramps at the corner, a combined curb ramp (aka blended transition ramp) may be used.

- **Crosswalk Accessibility:** Where curb ramps provide access to a crosswalk, they shall be provided at both ends of the crosswalk to prevent entrapment within the intersection.

- **Materials:** Curb ramp shall be constructed from concrete pavement when possible. Do not install pavers at curb ramps.

- **Detectable Warning Tiles:** Curb ramps should have prefabricated composite detectable warning tiles with truncated domes meeting ADA standards. Color: Colonial Red.

## Additional Design Considerations

- Curb ramps should be designed to avoid pooling of water at the base of the ramp along the gutter pan.
- Increase the width of the curb ramp in areas of high pedestrian volume and crossing activities. Curb ramps facilitate the movement of all pedestrians and their benefit is not limited only to pedestrians with mobility impairments.
- Strengthen the curb section and curb ramp to handle heavy vehicles (e.g. trucks and buses) that may frequently mount the curb during turning movements.
- Do not use pedestrian actuated signals at downtown crossings. Frequent pedestrian crossings should be common and expected.

## Utility Considerations

- Provision of ADA curb ramps take precedence and utilities should be moved to permit the provision of the ramp.
- Do not install curb inlet within ramp and crosswalk limits.

## Design References

- Public Right-of-way Accessibility Guidelines (PROWAG).
- The FHWA has developed detailed guidance on the design and installation of curb ramps.[4]

# MAINTENANCE & MANAGEMENT

## Maintenance

- **Snow Removal:** Perpendicular curb ramps on tangent or directional ramps on radius of corner aid snow removal because plows are traveling straight along the edge of the ramp. Ramps that are located on the radius of the ramp are more susceptible to plows leaving a wedge of snow in front of ramp from traveling past.

  » Snow clearance of sidewalks should also include clearing of curb ramps to ensure that snow does not block access from the sidewalk to and across the street at crosswalk locations.

  » City ordinance require the adjacent property owner to ensure the sidewalk and any curb ramps are clear from snow and ice.

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PATHWAYS

# MID-BLOCK CROSSINGS

## DESCRIPTION & INTENT

Mid-block crossings allow pedestrians to safely cross the street away from the intersection. These crossings are used where there is a destination or gap in the street network that generates demand for a crossing. Marking mid-block crossings indicates to both pedestrians and motorists where to cross and tend to concentrate pedestrian activity in that location, thus decreasing jaywalking. Mid-block crossings increase predictability and safety for both pedestrians and motorists.

## USE & APPLICATION

### Location

- Mid-block crossings should be located wherever there is significant pedestrian demand, such as at mid-block bus stops, parks, building entrances to major destinations, or mid-block passageways.
- Mid-block crossings are ideal for corridors with pedestrian access or bicycle transport emphasis, but are an opportunity on all street types.
- AASHTO recommends mid-block crossings where there are already a substantial number of uncontrolled mid-block crossing movements, where a new development is expected to produce many mid-block crossings, or where the nearest intersections are at least 660-feet (1/8 mile) apart.

### Related Design Elements

- **Raised Crosswalks:** Raised crosswalks (see ***Crossings Design Element***) can increase the visibility of the mid-block crossing. At crossings without signals, raised crosswalks can encourage greater compliance on roads where average traffic speeds may exceed posted speeds.
- **Lighting:** Use high-visibility lighting and markings to highlight unsignalized mid-block crossings.
- **Curb Cuts:** Crossings should be carefully placed when close to driveways or loading zones due to potential for conflicts with motor vehicles.
- **Curb Ramps:** Crossings should be paired with curb ramps (see ***Curb Ramps Design Element***).
- **Landscaping:** To maintain visibility, landscaping around mid-block crossings should be limited to low vegetation.
- **Bumpouts and Curbside Uses:** Where a curbside zone is present along the block, the mid-block crossing should be integrated with a bumpout in order to enhance visibility to waiting pedestrians around parked vehicles.
- **Refuge Islands:** Where the crossing involves three or more vehicle lanes, mid-block crossings should include pedestrian refuge islands, which make it easier for pedestrians, especially those with limited mobility, to cross safely (see ***Pedestrian Refuge Islands***).

# DESIGN & OPERATIONS

## Design Requirements

A **Crosswalk Marking:** Mid-block crossings shall conform to the requirements of the crosswalk design element for markings. Mid-block crossings shall feel like a deliberate part of the pedestrian network and should show where pedestrians have priority and where motorists should yield. Crossings shall be visible and easily distinguished from other street features. They are an opportunity to calm traffic and reduce speeds.

- **Visibility:** Mid-block crossings can be used to increase visibility, restrict parking, or extend the curbs around a crossing at least 20-feet to either side of the crosswalk.

B **Width:** Mid-block crossings shall be at least 8-feet wide but ideally 10-feet in width.

C **Stop bars or yield lines** shall be provided at mid-block crossings. Stop bars shall be between 12 and 24 inches wide.

  » Stop bars or yield lines should be set back at least 20-feet back from the crossing to increase the visibility of pedestrians, especially on multi-lane roadways. At signalized mid-block locations, the 2009 MMUTCD recommends the stop line be placed a least 40-feet from the nearest signal indication.

- **Signal Controls:** Mid-block crossings over primary roads should evaluate the appropriateness of using additional signal indication to increase pedestrian visibility and control vehicles, such as HAWK Signals or RRFBs (see ***Pedestrian Signals***).

- **Special paving** materials or markings can visually highlight the crossing and alert motorists that pedestrians are present. They can also be used to extend streetscape elements from the sidewalk.

## Utility Considerations

- Maintain a clear path from the crosswalk to the curb ramp and onto the sidewalk. Ensure that utility infrastructure, such as signal boxes, signal poles, light fixtures, trash receptacles, and fire hydrants are outside of the walking zone at the end of the crosswalk.

## Sustainability Considerations

- Mid-block bumpouts and refuge islands that are part of a mid-block crossing provide an opportunity to incorporate stormwater management facilities into the street design (see ***Stormwater Management***).

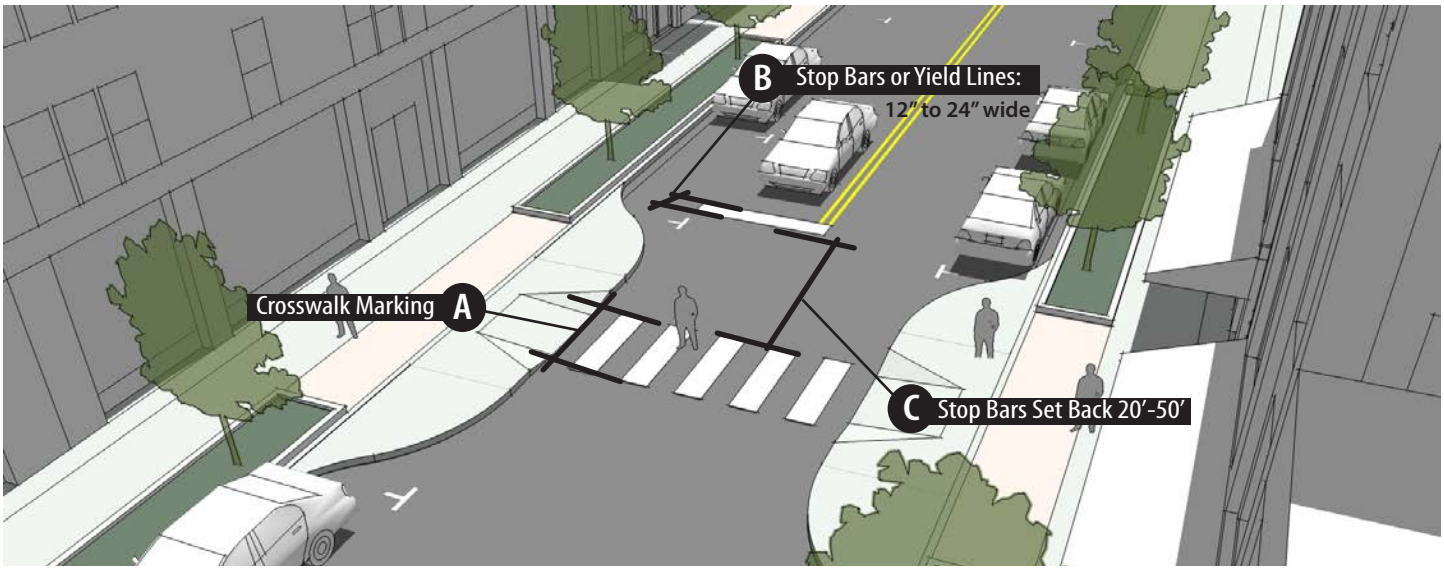
## Design References

- The MMUTCD recommends providing a signal at mid-block crossings where pedestrian demand is high.

# MAINTENANCE & MANAGEMENT

## Seasonal Use and Maintenance

- Keep crosswalks and curb ramps clear of snow to facilitate pedestrian movement after a snowfall.

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PATHWAYS

# PEDESTRIAN REFUGE ISLANDS

## DESCRIPTION & INTENT

Pedestrian refuge islands are protected sections within the roadway that provide a safe landing zone for pedestrians to use while crossing a street. These protected spaces reduce pedestrian risk by reducing the crossing distance and breaking up longer crossings into two or more stages. Because the pedestrian is crossing fewer lanes of traffic, pedestrians more easily find gaps to cross at unsignalized crossings. At signalized crossings, it provides a safe place to wait between cycles if a pedestrian is unable to make it across the street in one signal cycle.

Pedestrian refuge islands improve safety and also function as a traffic calming device. The Pedestrian and Bicycle Information Center, a FHWA project, reports that "crossing islands have been demonstrated to decrease pedestrian-vehicle incidents by 46% at marked crossings, and by 39% at unmarked crossings." [1]

Existing medians can often be redesigned to accommodate pedestrian refuge islands both mid-block and at intersections. Both new and existing medians should accommodate pedestrian refuge islands at intersections whenever possible, and should be the default solution.

When implementing a three lane road diet or introducing a continuous left turn lane, all intersections should be studied to see if pedestrian refuge islands can be accommodated. This is often the case when intersecting roadways are one-way, staggered, or if left turns are banned.

It is vital that pedestrians are visible to vehicles and vise versa. Best practice in higher speed roadways is to angle or jog the pedestrian waiting area to allow the pedestrian to be slightly facing on-coming traffic.

1 Pedestrian and Bicycle Information Center, Facility Design, http://www.ped-bikeinfo.org/planning/facilities_crossings_islands.cfm Accessed December 2014

## USE & APPLICATION

### Location

- Pedestrian refuge islands are appropriate to consider on all street types.
- Pedestrian refuge islands are most often used on multi-lane roadways where a pedestrian must cross three or more lanes. They are highly recommended at mid-block crosswalks.

### Related Design Elements

- **Mid-Block Crossing:** Pedestrian refuge islands may also be used as part of a mid-block crossing.
- **Bumpouts and Protected Intersections:** Pedestrian refuge islands may be used in conjunction with bumpouts, raised crossings or other applications as a traffic calming device. They may be used to create a pedestrian waiting area between protected bicycle lanes or bus lanes and the regular travel lanes.
- **Traffic Calming:** Pedestrian refuge islands may also be used as a channelization device, often in concert with mini roundabouts. See ***Volume and Speed Management***.

# DESIGN & OPERATIONS

## Design Requirements

**A** **Crosswalks:** Pedestrian refuge islands shall have marked crosswalks leading to and from them. The pedestrian walk should continue at-grade through a pedestrian island when too narrow to accommodate curb ramps. Use detectable warnings such as ADA domed tiles where crosswalks intersect islands.

**B** **Elevation:** Pedestrian refuge islands need to be protected. At a minimum, they require paint, bollards and signage. Whenever feasible the crosswalk/waiting area should be raised above the level of the roadway and protected with a vertical curb and made accessible with ADA compliant curb ramps. If there is not enough width to accommodate curb ramps the pedestrian zone can be kept at street level with a raised island on either side.

**C** **Width:** Pedestrian refuge islands shall be at least 6-feet wide and preferably 10-feet wide in order to comfortably accommodate single pedestrians, pedestrians with strollers or assisted mobility devices, or pedestrians with bicycles.

- **Signage:** Shall include placement of MMUTCD "Stop Here for Pedestrians" signs and stop bars as needed per crosswalk requirements.
- **Landscaping:** Landscaping on pedestrian refuges shall be less than 18 inches, so as not to impeded sight-lines and visibility. If the refuge is part of a larger median, taller landscaping, such as trees and large shrubs should be designed to allow for proper sight lines.

## Utility Considerations

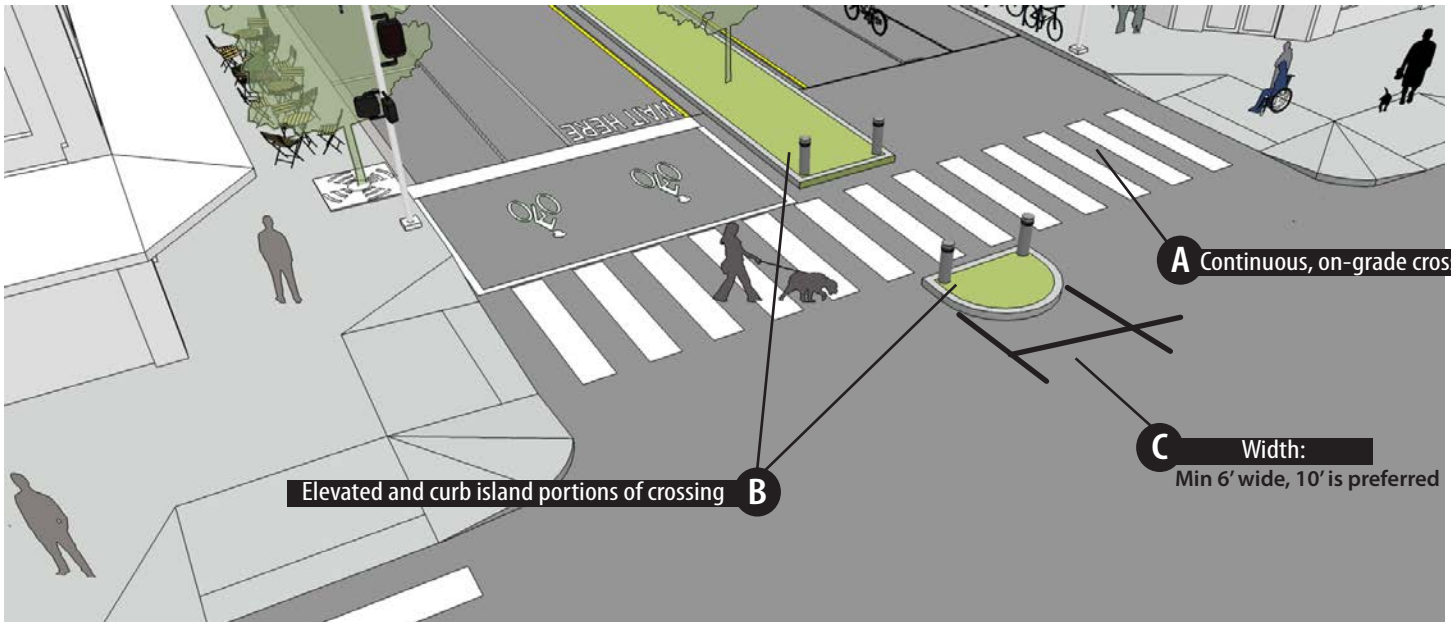
- Pedestrian refuge islands should be carefully coordinated to minimize conflicts. Do not place utility vaults in pedestrian waiting areas if possible and ensure that any lids or manholes are ADA compliant.

## Sustainability Considerations

- Pedestrian refuge islands provide opportunities to introduce stormwater management systems such as infiltration pits, rain gardens, or pervious areas in the roadway.

## Design References

- The NACTO Urban Street Design Guide provides additional guidance on the design of pedestrian islands.
- The MMUTCD provides standards for the design of pedestrian islands and refuges.
- The AASHTO Guide for the Planning, Design, and Operation of Pedestrian Facilities provides additional guidance.



# MAINTENANCE & MANAGEMENT

## Special Maintenance

- **Repaving:** Pedestrian refuge islands will introduce some additional costs to routine maintenance such as street repaving. However, during repaving is a great time to add needed pedestrian refuge islands.
- **Landscape:** Landscaped pedestrian refuge islands will need regular landscape maintenance and may need irrigation. Due to their location in the middle of the street, hardy plant material that is salt, drought, and pollution tolerant should be specified.

## Seasonal Use and Maintenance

- **Snow Removal:** Pedestrian refuge islands can introduce some complications for snow removal if not properly designed.

» Islands should accommodate the turn radii of snow clearance equipment. Pedestrian refuge islands that are lane diverters or channelization features must provide adequate width from curb-to-curb to enable snow plows to proceed through the gap.

» Pedestrian refuge islands should not generally be used for snow storage; however, portions of the island not used for a walking surface may accommodate some temporary snow storage as long as it does not impede sight lines.

» Clearly assign responsibility for removing snow from walking surfaces on pedestrian islands.

» Walking surfaces should be designed for adequate drainage to avoid the pooling of water and propensity to ice over. Walking surfaces should be wide enough to accommodate snow removal equipment.

» Use vertical reflective delineators to alert snow removal crews to the presence of the island, median or refuge.

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PATHWAYS

# BUMPOUTS

## DESCRIPTION & INTENT

Bumpouts, also known as curb extensions or bulb-outs, visually and physically narrow the street by extending the sidewalk and reducing pedestrian crossing distances. Bumpouts increase safety and pedestrian comfort by increasing visibility.

At signalized locations, reduced crossing distance enables shorter walk phases and greater flexibility in signal timing. At intersections, the narrower street profile, coupled with the tighter turn radii, can encourage slower driving, calm traffic, and increase safety for everyone. Bumpouts can also be used as part of a mid-block crossing.

Bumpouts can also be used to create additional space for landscape or stormwater management facilities to be located, especially where the width of amenity zones is narrow and precludes such features. Trees near corners and in bumpouts can create a calmer street atmosphere.

Multiple types of bumpouts exist and have different applications.

- **Corner bumpouts**, located at intersections and typically wrap around the corner extending the curb into both intersecting streets, are the most common type of curb extension.
- **Mid-block bumpouts** are installed in the curbside zone along a block. Mid-block bumpouts can be used to narrow a street for traffic calming, additional sidewalk space, or in conjunction with a mid-block pedestrian crossing. Mid-block bumpouts may also be used to define entrances to alleys or other curb cuts and to preclude curbside parking from encroaching on and blocking these access points.

## USE & APPLICATION

### Location

- Bumpouts are recommended on most street types. Street types with curbside use lanes are natural candidates for bump outs.
- Streets with travel lanes directly against the curb are generally not suitable for bumpouts.

### Related Design Elements

- **Curb Ramps:** Bumpouts intended as pedestrian crossings must include curb ramps and marked crosswalks.
- **Bus Stops:** Bumpouts can be integrated with bus stops to create a bus bulb or boarding island (see ***Bus Bulbs***).
- **Bicycle Facilities:** Bumpouts should carefully consider the design and function of on-street bicycle facilities. Bumpouts can be used to provide protected intersections for cyclists (see ***Protected Intersections***).
- **Parklets and Platform Dining:** Bumpouts may be used in conjunction with sidewalk platforms, which can temporarily expand the sidewalk in the parking lane.
- **Street Trees:** Street trees should only be used in corner bumpouts where placement does not impact sight visibility at the intersection.

# DESIGN & OPERATIONS

## Design Requirements

**A** **Width:** Bumpouts shall not narrow any bicycle or general traffic lanes to an unsafe width. The width of bumpouts shall preserve 1- to 2-feet of shy distance between the curb face and the first travel lane or bicycle lane (or the width of the gutter pan). When applied to streets with on street parking, bumpouts are typically 6-feet wide.

**B** **Length:** Corner bumpouts or mid-block bumpouts with crosswalks shall be at least as wide as the crosswalk, and ideally extend to the stop bar. The curve of bumpouts must fit outside of any crosswalks.

» Bumpouts are an effective way to restrict parking near intersections and maintain or increase visibility at corners. Consider making bumpouts at least 20-feet long, from the intersection side of the crosswalk back, to prevent motorists from parking within 20-feet of an intersection.

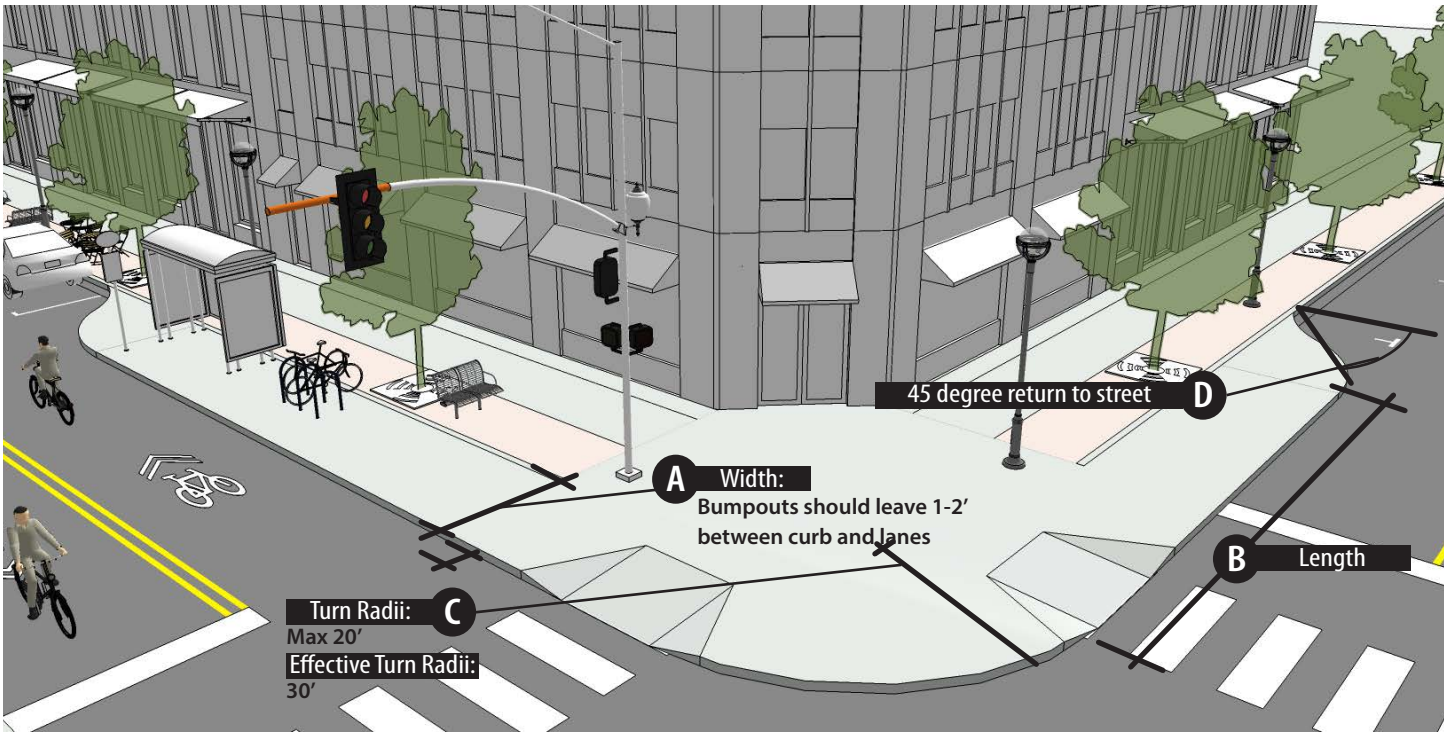
**C** **Corner Radius:** Bumpouts are intended to narrow pedestrian crossing distance and slow traffic speeds. To accomplish this, maintain tight turning radii no more than 20-feet. The effective turning radius, however, must still be 30-feet.

**D** **Returns:** Bumpouts shall have a 45-degree return to the street.

- **Sight Lines:** Any street furniture or landscaping in a bumpout shall maintain clear pedestrian paths and access to ramps. Any objects located in the bumpout such as furnishings or landscaping, must not interfere with corner sight triangles.

## Additional Design Considerations

- **Turn Restrictions:**
  - » At corners with turn restrictions, use the turning radii of the bumpout to make that turn more difficult, ensuring that transit vehicles or through traffic is not delayed by motorists turning.
  - » Carefully design bumpouts at intersections where turning movements by transit vehicles or long wheel base trucks are common. Curb radii may need to be adjusted wider to accommodate the tracking patterns of these vehicles and/or other design or management solutions explored.
  - » Where vehicles may frequently mount the curb during turning, stronger concrete materials should be used to ensure durability.



- **Stormwater:** Bumpouts must be cognizant of stormwater drainage and avoid pooling of water at the curb. Where bumpouts conflict with storm drains, storm drains must be relocated and/or additional inlets provided to enable proper drainage.
- **Floating Bumpouts:** These bumpouts are built in a manner that leaves the existing roadway curb and drainage lines intact, and is separated from the sidewalk. These are generally not preferred but may be considered where project constraints preclude normal construction. Floating bumpouts are best used where the bumpout area is used for landscape plantings and/or stormwater management.
- **Temporary Installation:** Bumpouts can be a temporary installation, using low-cost materials such as paint, bollards, and planters. This may be useful for a location where a more expensive installation may not be warranted, or as a trial for a permanent solution.
- **Bicycle Parking:** Bumpouts may be ideal locations for bicycle parking. Ensure parked bicycles do not obstruct pedestrian paths nor block the sight triangle at corners.
- **Outdoor Space Use:** Bumpouts may be used for public seating or outdoor dining, again with careful attention paid to paths of movement and required sight lines.
- **Curbside Uses:** Bumpouts may have an impact on business loading, delivery access, garbage removal, and street sweeping. If well-managed and designed, bumpouts serve as a location to consolidate business waste for removal where alleys do not exist.
- **Flexibility:** Bumpouts may limit the ability to change the street design in the future, such as the location of bus zones, lane layout, and crosswalks. Bumpouts also make the street less flexible for construction routing.

## Design References

- The NACTO Urban Street Design Guide provides additional guidance on how to design a bumpout.
- The Institute of Transportation Engineers “Designing Walkable Urban Thoroughfares: A Context Sensitive Approach” describes in detail how to design a bumpout as part of a complete street.

## Sustainability Considerations

- Combine bumpouts with stormwater management features, such as rain gardens or bioswales, to absorb and collect rainwater and reduce impervious surface area.
- Create opportunities for additional plantings through bumpouts, particularly mid-block bumpouts. Plantings at corner bumpouts must not block driver or pedestrian vision. Plantings at bus bumpouts must not conflict with bus doors or transit operations.
- All green applications in bumpouts should have well developed and committed maintenance plans prior to installation.

## Utility Considerations

- Bumpouts are good locations for fire hydrants, as they can provide direct curbside access to hydrants and avoids hydrant conflicts with curbside uses.
- Bumpouts may require relocating utilities or storm drains. They may also require moving a fire hydrant closer to the extended curb to ensure emergency vehicle access, which may increase cost. If a bumpout impacts a storm drain, the storm drain must be moved.

# MAINTENANCE & MANAGEMENT

## Seasonal Use and Maintenance

- **Temporary Use:** Temporary bumpouts defined by rubber curbing, flexible posts or similar, should be removed in winter months to facilitate snow removal.
- **Snow Removal:**
  - » Bumpouts may make snow removal more complicated, though special equipment should not be necessary if bumpouts are designed with turn radii adequate to accommodate snow removal vehicles.
  - » Bumpouts may be appropriate locations for temporary snow storage if pedestrian pathways and crossings remain clear. Bus bulbs are not generally appropriate locations for snow storage.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# PEDESTRIAN SIGNALS

## DESCRIPTION & INTENT

This section describes different types of signals, signal timing, and signal technology that is used to provide safe, accessible, and comfortable street crossings for pedestrians, improving safety outcomes for all users.

Intersection operations should anticipate the presence of pedestrians, ensure that pedestrian crossings are logical and predictable to all users, and provide adequate time for pedestrians to fully cross the street.

All street types must consider the appropriate method for providing safe access for pedestrians in consideration of the roadway conditions, types of pedestrians, and surrounding land use.

The following treatments are described on the following pages:

- Countdown Pedestrian Signals
- Pre-timed vs. Actuated Signals
- Accessible Pedestrian Signals (APS)
- Leading Pedestrian Intervals
- All Walk/Scramble Phase
- Rectangular Rapid Flashing Beacons (RRFBs)
- HAWK Signals

## COUNTDOWN PEDESTRIAN SIGNALS

Countdown pedestrian signals are similar to conventional pedestrian signal heads, but in addition to the standard WALK/DON'T WALK symbols, the signal also includes a numeric display showing how many seconds remain in flashing DON'T WALK phase. This countdown timer better allows pedestrians to gauge whether they will have time to cross an intersection, and can improve safety for all users.

- **Location and Applicability:** Countdown timers should be used for all pedestrian signal heads at all signalized intersections and associated crosswalks.
  - » Replacement of non-countdown pedestrian heads should occur when signal modifications or upgrades take place, during street reconstruction projects, or as part of a safety improvement.
- **Crossing Timing:** Pedestrian crossing time shall, minimally, meet the current MMUTCD standard, but additional pedestrian time may be needed or desired, especially at crossings with high pedestrian volumes or crossings used by a number of children, seniors, or persons with disabilities.
  - » Pedestrian time should be increased at areas with significant volumes of pedestrians or where pedestrians are the dominant users and/or areas where leisurely pedestrian speeds are welcomed or desired.
  - » Installation of pedestrian refuge islands and bumpouts can affect the length of crosswalks, and must be consider with signal timing adjustments as part of installation.



**Example of an accessible push button for an activated crosswalk**

## PRE-TIMED VS. ACTUATED SIGNALS

- **Pre-timed signals** provide pedestrian walk phases as part of the regular signal phasing scheme, whether pedestrians are present or not. These do not requite push-button activation, but may be supplemented with APS activation to provide extra assistance crossing (see APS later in this section).
- **Actuated signals** provide a walk phase only when pedestrians are present. Most actuated signals require the pedestrians to explicitly request the phase by pushing a button.
- **Applicability:** In locations with frequent and regular pedestrian crossings, crossings should be pre-timed and part of the regular signal phasing.
  - » Pre-timed signals should be utilized for the following street typologies: urban center, event/festival, main street, neighborhood business, and commercial business.
  - » Other locations may consider using actuated signals, but pre-timed signals are still preferred.
- **Button Placement:** All actuated signal buttons and/or APS signal buttons must be located in-line with the edge of the clear sidewalk zone and within 1.5-feet to 6-feet of the face of the road curb. Buttons should be located 3.5- to 4-feet in height above the sidewalk surface.
  - » Actuated signals require signage indicating that the button must be pushed in order for the WALK indication to be phased into the cycle.

## ACCESSIBLE PEDESTRIAN SIGNALS (APS)

**Accessible Pedestrian Signals (APS)** provide push-button activated audible and vibrotactile (sense of touch) notifications of the signal status (e.g. WALK / DON'T WALK) at regular intervals to aid pedestrians with visual impairments in making safe crossings. APS signals are always pre-timed as part of the normal signal phasing, regardless of whether the APS button is used to provide notification.

- **Applicability:** The land use context for APS signals is an important consideration. In quiet areas close to residences or dwellings, use of APS systems should be considered carefully to ensure they do not create a noise nuisance in quieter contexts.
- **Push-button integrated APS:** Audible queues that are emitted from the push-button box are preferred over audible queues from the signal head, the latter of which tends to be louder and carry over longer distances.

Photo Credit: John J. Kim

## LEADING PEDESTRIAN INTERVALS

**Leading Pedestrian Intervals (LPIs)** is a signal timing treatment that provides the WALK indication typically 3 to 4 seconds in advance of the parallel vehicle GREEN/GO signal.

This treatment allows pedestrians to enter the crosswalk and be more visible (and have the clear priority) ahead of vehicles that may wish to turn across the crosswalk. LPIs have been shown to improve safety and reduce crash rates.

- **Applicability:** LPIs are recommended at all signalized intersections. Priority should be given to installing LPIs where there are safety concerns and/or regular, higher volumes of pedestrian traffic.


## ALL WALK / SCRAMBLE PHASE

**All Walk Phases:** All Walk Phasing allows pedestrians to cross any leg of the intersection during the phase. This can be useful at high volume pedestrian crossings where large numbers of pedestrians may be queuing and clear walking paths for opposing foot traffic. An All Walk phase allows all movements to occur and can reduce conflicts.

- **Applicability:** All Walk phasing can be a tool for improving vehicle consistency, as vehicle movements (including left and right turns) can be phase separated from pedestrian crossing movements, reducing conflicts and delays for vehicles that must wait for pedestrians to clear the crosswalk.
- Signal timing must be adjusted to consider the timing required for the longest leg of the crossing.

**Scrambles:** A scramble is a specific type of All Walk Phase that allows pedestrians to cross diagonally through the intersection.

- **Applicability:** Scramble should only be considered at high pedestrian volume intersections and where pedestrians frequently desire to make diagonal crossings.
- Signal timing must be adjusted to consider the length of the longest diagonal crossing.
- **Crosswalk Markings:** Standard crosswalk markings can be used to indicate the allowed diagonal crossing distances. Other markings approaches include “striping out” the entire intersection with elongated crosswalk bars.
- Supplemental signage, such as those indicating that diagonal crossings are allowed, may be considered.


## RECTANGULAR RAPID FLASHING BEACONS

**Rapid flashing beacons** (RRFBs) are a pedestrian activated light that flashes brightly and rapidly to alert drives that a pedestrian is waiting to cross at a location and should yield to crossing pedestrians. RRFBs are typically mounted onto the standard pedestrian crossing signage.

- **Applicability:** RRFBs should be considered for all mid-block crossing locations that cross primary streets (non-enhanced neighborhood or local neighborhood streets) in order to increase pedestrian visibility and better alert drivers. RRFBs are especially important to consider on multi-lane roadways, higher volume streets, and where speeds are over 25 MPH.
    - » RRFBs may also be suitable at intersections where side streets are stop controlled by the primary street if operating in a free-flow condition. In this situation, the crossing should be treated similar to a mid-block crossing, but additional care must be taken to ensure that the cross-street traffic also has clear visibility throughout the crossing.

## HAWK SIGNAL

**HAWK signals**, or High-intensity Activated crosswalk, is a lighted beacon that displays a flashing yellow signal to motorists when a pedestrian is attempting to cross the street pushes a button.

The beacon runs through a series of cycles ultimately giving approaching motorists a red light. This allows pedestrians to safely cross on their own cycle. A separate pedestrian signal provides information to pedestrians. This type of signal is dark to the roadway users when not in use, which may be confusing for motorists. It typically shows a "DON'T WALK" signal to pedestrians when not activated.

- **Applicability:** Consider in mid-block locations where it can be difficult for pedestrians to find a gap in traffic to cross and/or where it is a large multi-lane roadway where visibility to pedestrians may be difficult for drivers.

## REFERENCES

- MDOT Best Design Practices for Walking & Bicycling in Michigan provides usage considerations for many of the pedestrian signal and crossing treatments in this section.

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AMENITIES & USES

# PUBLIC ART

## DESCRIPTION & INTENT

Public art can create more vibrancy and interest for pedestrians and other users of the public right-of-way.

Public art can assume many different forms, from murals on the sides of buildings, to fixed sculptures, artistic crosswalks, community identity banners, to temporary exhibits and installations. Public art may also include street painting, artistic crosswalk treatments (provided they do not disrupt required crosswalk marking patterns), painted medians, and painted intersections.

Incorporating public art into other street elements, such as light post banners, the sides of waste receptacles, and signal boxes, can transform common street elements into unique features. Public art helps activate less intensely used areas and fosters care and investment.

## USE & APPLICATION

### Location

- Public art can be freestanding works in the amenity or frontage zones, visible to pedestrians and road travelers alike. Artwork can also be horizontal surface treatments on walking surfaces, parking surfaces, or travel lanes provided it does not cause hazards or confusion for street users.
- Public art can be used to create a focal point at plazas or used to create gateways to a community. It can help create an identity or brand for a corridor or be part of a temporary activation. Most importantly it should reflect and enhance its context and the community's values.
- When possible, artists should be involved in the design of a street as soon as possible. This allows for creative opportunities to incorporate art into the standard elements that make a good streetscape, from pavement design to seating and crosswalks. Also art can help drive community engagement and incorporate the community in the design and even the implementation of the art when appropriate.

### Review and Approvals

- Public art installations will require a Public Right-of-Way Permit, applying for a "Temporary Encroachment" on the right-of-way.

## DESIGN & OPERATIONS

### Design Requirements

- Works of public art shall not infringe or impede on the free flow of pedestrian traffic in the walking zone.
- **Clearances:**
  - » A minimum clear zone in the sidewalk shall be maintained depending on the street type (see ***Pedestrian Areas and Sidewalks***).
  - » At least 8-feet of vertical clearance must be provided below art installations located above sidewalks, crossings, or other pedestrian areas where pedestrian movement is required.
  - » Vertical clearance above roadways should be at least 16-feet or as required by local fire codes.
- Public art shall not interfere or obstruct the safe use and operations of the public streets for vehicles, pedestrians, cyclists, and other users of the street.

- Artwork on horizontal surfaces, such as sidewalks, crosswalks, or roadways, should be temporary installations, recognizing that street projects and general wear will degrade the art work overtime.

### Utility Considerations

- Works of public art cannot impede access to utility access panels, vaults, or other infrastructure services areas.

## MAINTENANCE & MANAGEMENT

### General Maintenance

- Works of public art are required to be maintained for the duration of their installation and it is important to identify who will perform that maintenance before installation. Public art must be maintained so that it does not pose on-going safety concerns or other nuances on users within the city and to ensure it continues to be an attractive asset to the community.
- If the art is to be temporary, make sure that this is clear both to the artist and to the community in advance and define a clear time limit and determine how and when the art will be removed. If the art is to be permanent, ideally a plan for future restoration is determined in advance.

### Seasonal Use and Maintenance

- Temporary works of public art are allowed.
- Sponsors of public art are responsible for maintaining the condition of installed works during the winter months.

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AMENITIES & USES

# PUBLIC SEATING

## DESCRIPTION & INTENT

Public seating includes benches, chairs, seat-walls, and other fixed structures that provide places for pedestrians to sit and rest. Street furnishings make using the public streets more accessible for all users and especially those with mobility challenges by providing places to stop and rest, to wait for services, or just to pause and relax and enjoy the street environment.

Street furnishings include the following types of fixtures:

- Benches (with or without backs)
- Single seats (with or without backs)
- Seat-walls (typically integrated with landscape planters)

## USE & APPLICATION

### Location

- In required and recommended street types, at least two seating areas (each providing at least two seats) should be provided along each block face.
- In areas with higher volumes of pedestrian traffic, site furnishings can be particularly beneficial although they should be so they do not block major pedestrian movements, building entries, loading zones or other street functions.
- In locations with lighter volumes of pedestrian traffic, locations should be carefully evaluated to ensure that they will be visible, and regularly used.
- Public seating should be located within the amenity zone. Furnishings may be located in the frontage zone where adequate width exists for placing the furnishing. Furnishings and their clear zones should never encroach into the sidewalk.

### Related Design Elements

- **Street Trees:** Ideally, seating should be placed below street trees or other shading elements to provide more comfortable places to rest.
- **Bus Stops:** Public seating should be provided near bus stops, especially at locations where there are higher volumes of bordering and greater numbers of people likely to be waiting.

## DESIGN & OPERATIONS

### Design Requirements

- **Durability:** Prefabricated furnishings must be built from long-lasting and durable materials and finishes that are backed by a minimum 3-year standard warranty.
  - » Allowable materials include metal (with galvanized and powder-coated steel or stainless steel finished) or composite lumber.
  - » Seat-walls must be constructed from concrete.
- **Number of Seats:** When seating is provided, at least two seats shall be provided adjacent to each other. Single seats placed in isolation are not permitted.

- **Clear Zones and Placement**:
  - » A 3-foot minimum clear zones shall be provided to the sides and front of the seat to provide ADA accessibility and clearance for wheelchairs.
  - » Benches shall have a 5-foot minimum distance from fire hydrants and 1-foot minimum distance from other street fixtures.
  - » Seating must not be placed in such a way where people's legs would hang into planting beds, landscape areas, to the required clear zone of a sidewalk.
  - » Generally, seating should be oriented perpendicular to the roadway, so that pedestrians are able to sit and look down the sidewalk in one direction and so that pedestrians are not walking directly behind people using seating.
- **Seating Depth:** Benches and seats shall have a seating depth of at least 18 inches.
- **Installation:** Street furnishings shall be cast-in place or otherwise fixed into the street to prevent unauthorized removal.
- **Free-Floating Seating:** Non-fixed in place tables and chairs should only be used as part of dedicated street furnishings in locations that are actively managed by a public or private entity that can ensure furnishings are not stolen or vandalized. Generally, this type of seating would be maintained by private businesses using the seating for outdoor dining (for example).
- **Special Character Districts:** Selection of specific street furnishings shall consider the style of established or preferred site furnishings within specific districts and/or historic districts and choose a style that matches or is deemed compatible.
- **Manufactured Furnishings:** Selected furnishings shall be standard manufactured designs that are readily replaceable. Custom designs and other special order receptacles should not be used without special permission
- **Seat-walls:** See ***Landscape Planter Design Element*** for dimensional guidance on seat-wall design.

### Additional Design Considerations

- Provide a mixture of seating types, where multiple street furnishings are used in close proximity, to accommodate different users needs. Include both backed and backless bench seating and seating both with and without armrests.
- Cluster groups of seating to face each other to allow for small groups to converse.
- Seating can be integrated into building facades or other street elements provided clear zones remain open.
- Concrete seat-walls can integrate metal banding or obstructions to discourage use for recreational activities (e.g. skateboarding) but shall still allow use as seating.

### Utility Considerations

- Do not placed seating on top of utility covers, vaults, or infrastructure elements that require access.

### Sustainability Considerations

- Use site furnishings made from recycled, reclaimed, or salvaged materials whenever possible.

## MAINTENANCE & MANAGEMENT

- Street furnishings installed as part of a public project shall be maintained by the City of Kalamazoo.
- Street furnishings installed and approved as part of a development project through the site plan review process must be maintained by the developer/property owner.
  - » Also requires a Public Right-of-Way Permit to be secured prior to installation of fixtures.

### Seasonal Use and Maintenance

- **Snow Removal:** Do not pile or store snow on top of street furnishings, both to prevent damage to the furnishings as well as to keep them accessible and usable throughout the year.
  - » Sidewalk snow removal is the responsibility of adjacent property owners; care should be taken to keep the ground below and leading up to seating free of snow and ice. The ground below and leading up to seating should be kept clear and free of snow.

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AMENITIES & USES

# WASTE RECEPTACLES

## DESCRIPTION & INTENT

Waste and recycling receptacles keep the city environment as clean as possible and free from loose trash and refuse. Waste and recycling receptacles should be provided regularly in high pedestrian traffic areas and near concentrations of commercial businesses so that pedestrians encounter them frequently when walking. Receptacles should be durable, visible, and placed conveniently. In addition, receptacles should be easy for maintenance workers to access and empty.

## USE & APPLICATION

### Location

- Waste receptacles are required on all downtown street types (urban center, event/festival, and main streets). Waste receptacles should be placed at each street corner or on opposing corners where pedestrian volumes are lighter.
- On neighborhood or commercial business streets, waste receptacles should be located on opposing corners of intersections.
- Waste and recycling receptacles must be placed such that they do not block major pedestrian movements (sidewalk clear zones), building entries, loading zones, or other street functions.
- Place receptacles in locations accessible for curbside pickup and waste management crews.

## DESIGN & OPERATIONS

### Design Requirements

- **Durability:** Waste and recycling receptacles shall be constructed out of durable materials (metals) and finishes with a minimum standard warranty of 3-years.
- **Style:** The style and character of the selected receptacles shall convey a sense of quality consistency with the character of the city.
- **Functional Design:** Receptacles shall be closed on the top or otherwise covered such that rain, snow, and other precipitation does not enter the receptacles and mix with refuse.
  - » Where recycling receptacles are provided, separate receptacles are required with a different design style and/or coloration to clearly signify the receptacle for recyclable refuse.
  - » Recycling receptacles shall indicate the types of refuse that are recyclable.
- **Security:** Ideally, receptacles shall be secured to the ground and be designed with an inner container or other mechanism that can be removed to facilitate collection of refuge.
  - » Receptacles shall be able to be unlocked and relocated when needed to accommodate special events or maintenance activities.

- **Manufactured Furnishings:** Selected receptacles shall be standard manufactured designs that are readily replaceable. Custom designs and other special order receptacles should not be used due to replacement challenges.

### Additional Design Considerations

- Solar powered compacting receptacles with wireless notification can be considered for use. Such receptacles can reduce the need for such frequent pick-ups.

### Utility Considerations

- Do not place receptacles directly on top of utility covers, vaults, or infrastructure elements that require access.

### Sustainability Considerations

- Use receptacles made from recycled, reclaimed, or salvaged materials when possible.
- Receptacles that increase the efficiency of collection can minimize energy consumption by collection vehicles.

## MAINTENANCE & MANAGEMENT

- **Public Container Waste Collection:** Responsibility of the City of Kalamazoo waste management

### Seasonal Use and Maintenance

- **Snow Removal:** Snow should not be piled or stored on top of receptacles, both to prevent damage as well as to keep receptacles accessible and usable throughout the year.
  - » The ground below and access to receptacles should be kept clear and free of snow and ice to facilitate efficient collection.

### Installer Responsibility

- Street furnishings installed as part of a public project shall be approved and maintained by the City of Kalamazoo.
- Street furnishings installed and approved as part of a development project through the site plan review process must be maintained by the developer/property owner.

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AMENITIES & USES

# SIDEWALK OCCUPANCY

## DESCRIPTION & INTENT

The pedestrian area of the street must often provide space for supporting commercial activity and other special uses that bring activation and energy to the street environment.

**Sidewalk Occupancy** refers to the process by which private businesses or individuals request use of public right-of-way space in the pedestrian area in order to host certain uses. Most commonly, these uses include outdoor dining or outdoor retailing. Cafe dining enables restaurants, bars, and other establishments to provide outdoor seating space to serve patrons. Outdoor retail enables the display and sale of retail goods within the public right-of-way.

Sidewalk occupancy typically occurs within the amenity zone of the pedestrian area, although depending on the position of adjacent buildings, may also occur in the frontage zone or curbside zone.

## USE & APPLICATION

### Location

- Sidewalk occupancy is generally preferred to be located in pedestrian oriented business/commercial areas, such as urban center, event/festival, main street, and neighborhood business streets.
- Space for cafe dining and outdoor retail is encouraged within areas of relatively high levels of pedestrian and commercial activity in order to support businesses as well as increase the life, energy, and activity on the street.
- Other street types are generally less appropriate for sidewalk occupancy given adjacent land uses and the overall character of the street (higher speed and traffic volumes or quieter residential streets). Special exceptions should be considered.

### Related Design Elements

- **Platform Dining and Parklets:** Platform Dining and parklets are two types of special uses that can occur in an adjacent curbside zone, providing a contiguous area of use connected to sidewalk occupancy (see ***Curbside Occupancy*** for additional details).
- **Parking Spaces and Meters:** Public access to parking meters, pay stations, and from parking spaces to the sidewalk needs to be considered in the layout and design of any sidewalk occupancy activities.

### Review and Approvals

- The City of Kalamazoo Public Right-of-Way Permit provides detailed instructions for making an application for sidewalk occupancy as a “Temporary Encroachment” on the right-of-way.

# DESIGN & OPERATIONS

## Design Requirements

- **Placement:** The area of sidewalk occupancy must be within the amenity zone of the street, in-between the sidewalk and road curb.
  - » Note: Sidewalk occupancy may occur in the frontage of the street, but only when located on private property and/or where the street has been designed such that the clear zone of the sidewalk is not aligned directly along the right-of-way line.

A **Sidewalk Clear Zone:** The minimum width sidewalk (see ***Pedestrian Areas and Sidewalks***) must be maintained along the length of the block in a straight and clear line.

- » This clear zone shall be free of any encroachments such as tables, chairs, fencing, planters boxes, sales racks, signs, or any other physical obstructions.
- » In locations where doors into buildings swing out into the clear zone, the minimum clear zone shall take into account the door swing areas and provide additional clearance.

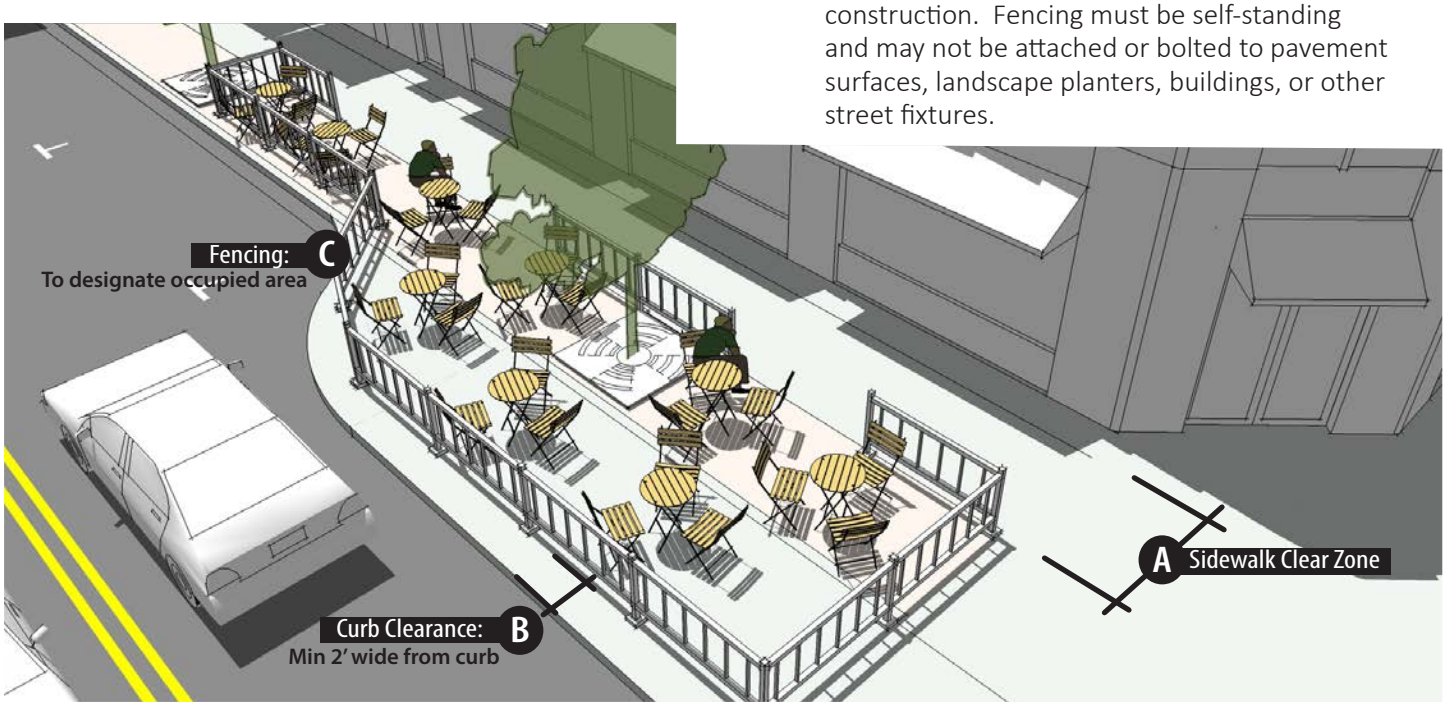
B **Curb Clearance:** A minimum of 2-feet from the edge of curb adjacent to active travel lanes or active curbside uses with vehicles present (parking and loading zones) shall be kept clear at all times from occupancy uses. This is to provide a minimum buffer from the vehicle encroachment and enable people to enter/exit parked vehicles.

- » This clearance may be waived or modified if the entire street is closed to vehicle traffic (e.g. for special events).

- **Other Clearance Considerations**
  - » Occupied areas must provide free and clear access to parking meters and/or parking pay stations.
  - » Occupancy uses may not occur within 5-feet of a fire hydrant or block the pathway from the street to the fire hydrant.

C **Fencing:** Sidewalk occupancy uses that serve alcohol must provide a ridged fence enclosure around the service area.

- » Fencing must be ridged (no chains or ropes) with at least two horizontal stringers along the entire run to define the edges of the occupied zone.
- » Fencing shall run completely along the curbside edge of the occupied area and maintain the 2-foot clear zone from the curb.
- » Fencing is required along the edge of the sidewalk clear zone to maintain separation between sidewalk traffic and the occupied area, with gaps allowed for service access.
- » Fencing must be made of durable materials and construction. Fencing must be self-standing and may not be attached or bolted to pavement surfaces, landscape planters, buildings, or other street fixtures.



## Additional Design Considerations

- **Amenity and Frontage Zone Width:** The width of amenity zone or frontage zone needed for sidewalk occupancy will vary depending on the specific uses. Typically an 8-foot wide zone is needed to accommodate 4-person outdoor dining tables. Narrower widths may accommodate 2-person tables or smaller cafe-style tables.
- Streets where cafe dining and outdoor retail is recommended should consider providing a wider amenity and/or frontage zone to accommodate outdoor retail.
- **Heaters:** Outdoor heaters may be used within occupied areas provided they are free-standing, do not generate noise, and do not require cables, wires, or other hookups to cross the clear walking zone.
    - » Use of heaters requires compliance with fire code and must be identified and included as part of the Public Right-of-Way permit application.
- **Structures/Enclosures:** Any semi-permanent structures (aside from fencing) that are desired must be approved by the Kalamazoo Building Department to ensure adequate safety assurances and access are provided.

## Utility Considerations

- Provide ready access to utilities if needed for maintenance or other utility operations. Occupied areas must make note of where utility access panels, vault covers, and other utility connection points are located.

# MAINTENANCE & MANAGEMENT

## General Maintenance

- Sidewalk occupants are required to ensure that their occupancy conforms to the layout stipulated in their permit at all times. Fencing, seating, sales racks, or other features must be maintained and checked to ensure that no encroachment into clear zones occur.
- Sidewalk occupants are required to keep areas free from trash, debris, food scraps, or other refuse on a daily basis.
- Sidewalk occupants are required to clear snow from the sidewalk and occupied space as soon as is feasible, consistent with Kalamazoo's snow clearing requirements of property owners.

## Seasonal Use and Maintenance

- The period of sidewalk occupation should be contingent upon the occupiers desire and capability to manage and maintain their occupied space throughout the seasons. Historically, sidewalk occupancy for commercial uses would be from April into November, although year-round occupancy should be allowed when the applicant can demonstrate their ability to utilize and maintain the space year-round.

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# 4.2

## CURBSIDE ELEMENTS

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CURBSIDE ELEMENTS

# CURBSIDE OCCUPANCY: PLATFORMS & PARKLETS

## DESCRIPTION & INTENT

**Curbside occupancy** refers to non-parking or non-vehicle uses of a curbside zone. Typically, curbside occupancy occurs when a business or private entity utilizes the curbside zone for conducting outdoor commercial activity, such as additional outdoor dining or retail extending out from the pedestrian area. Curbside occupancy can also take the form of parklets, which are curbside areas designed as public space, often providing seating or other amenities open to the public.

Curbside occupancy is useful tool for further activating street environments, especially in denser urban commercial areas and/or where space to accommodate active street uses is constrained by narrow pedestrian areas. Curbside occupancy is flexible, and can allow areas to be used for activity during parts of the year (e.g. warmer months when outdoor space is in demand) and convert back to vehicle uses (e.g. parking) during colder months.

### What are "Parklets?"

Parklets are curbside zone areas that are temporarily re-purposed as additional public space, often incorporating seating areas, planters, shade, public art, or other pedestrian-oriented amenities. These are typically built in conjunction with platforms (see above).

### What are "Platforms?"

Platforms are structures built with decking and fencing (or other vertical barriers) in order to provide a flush extension of the pedestrian area into a curbside zone, in order to make that area usable for pedestrian-oriented uses, such as outdoor dining, retail, or seating areas.


Image Credit: NYC DOT

Parklets provide an solution to narrow sidewalks and a lack of public space by using underutilized street parking. By extending the pedestrian space temporarily into the parking lane, parklets can play a role in fostering a sense of ownership within the public realm, enhancing the overall quality of life for residents and visitors. By activating the street and pedestrian walking zone, nearby businesses and commercial corridors benefit from an enhanced pedestrian experience.

Curbside occupancy typically requires the construction of platforms to provide a more usable and contained space for pedestrian activity when next to active roadways.

# USE & APPLICATION

## Location

- Curbside occupancy is only allowed where a curbside lane is present and on streets where the posted speed limit is 25 MPH or less in speed.
- Curbside occupancy should be limited to the curbside zone (e.g. parking spaces) directly in front of the business and/or property seeking curbside occupancy. Typically this will be one to two parking spaces in length (approximately 40-feet).
- If more than three on-street parking spaces are desired or use of spaces fully or partially in-front of adjacent properties, written permission from adjacent business and property owners must first be secured.
- Parklets, designed as open public seating or gathering areas, may only be installed by a private entity when they are sponsoring the parklet and agree to maintain and manage the space and any installed platforms.
- Curbside occupancy should not block major pedestrian movements, bus stops, building entries, loading zones or other essential street functions.
- May not be located in front of fire hydrants (must have a clear line from the fire hydrant to the travel lane). May not otherwise encroach to within 5-feet of a fire hydrant.

## Related Design Elements

- Curbside occupancy is typically combined with sidewalk occupancy to provide maximum space for outdoor pedestrian uses where it is in greatest demand and/or where pedestrian area space is limited.
- Bumpouts should be installed, where feasible, on streets where curbside occupancy is most anticipated to provide protection and buffering at the ends of occupied curbside zone from intersections.
- Parklets should incorporate benches, tables and chairs, seat-walls, and landscape in order to create an inviting space that functions as an extension of the pedestrian area.

## Reviews and Approvals

- The City of Kalamazoo Public Right-of-Way Permit provides detailed instructions for making an application for sidewalk occupancy as a “Temporary Encroachment” on the right-of-way.

# DESIGN & OPERATIONS

## Design Requirements

**A** **Length:** Platform length tied to the length of curbside zone that is allowed to be occupied (typically one to two parking spaces in length, see ***Location*** *above*).

**B** **Parking Separation:** Where parking is adjacent to the ends of a curbside occupancy area, there must be a 2-foot setback from the edge of parking and the occupied area. The end of the occupied area must have barrier fencing (see below).

» **Intersection Separation:** Where a occupied curbside zone is adjacent to an intersection, the occupied area must be a minimum of 8-feet back from the nearest edge of the crosswalk.

**C** **Width:** The width of the occupied area may not be closer than 1-foot from the edge of the adjacent travel lane.

**D** **Grade Transitions:** The entire length of occupied curbside and platform must be level with the adjacent street curb and provide no more than 1/2-inch gap or lip when transitioning from the pedestrian area onto the platform.

» If site conditions (such as streetscape elements) prevent continuous access, the platform must ADA accessible and provide multiple points of entry that are at least 36 inches wide.

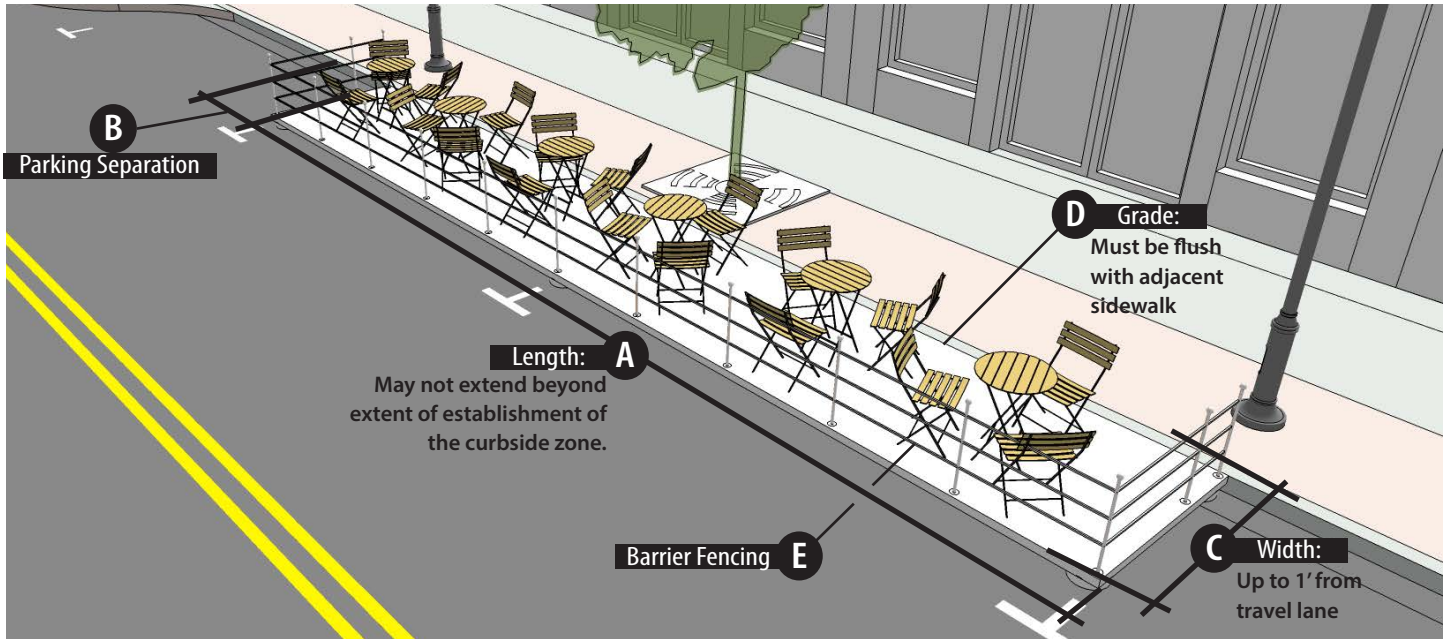
**E** **Barrier Fencing:** Any sides of the occupied curbside zone and/or platform that are exposed to on-street parking areas or adjacent travel lanes must utilize barrier fencing to provide additional protection.

» Barrier fencing must be 36 to 42 inches tall, measured from the top surface of the platform.

» Barrier fencing must be constructed with solid framed panels that are least 4 inches thick.

» Two continuous bands of reflective tape (one at the upper edge and one in the middle of the barrier) must extend fully around all perimeters of barrier fencing.

» **Vehicle Path Protections:** Any sides of the occupied curbside area that are directly exposed to on-coming vehicle paths (e.g. sides facing into an intersection), must be further protected by plastic.



### Additional Design Considerations

- **Snow Sticks:** If platforms are used during winter months or when snowfalls are expected, all corners of occupied area must include snow sticks to aid visibility and snow clearing operations.
- **Drainage:** Any platforms or other features in the curbside zone must not impede flow along the gutter line and access into inlet structures. Inlet structures must be accessible for maintenance.
- **Platform Assembly:** Platforms and other structures must be constructed in a manner that is self standing and self-supporting. Platforms may not be bolted or anchored down to existing surfaces. Platform must be able to be disassembled quickly in case of emergency.
- **Parklet Public Uses:** Parklets are intended for open public use. Signage must be included indicated that the parklet is open to all users and not restricted for use by any individual businesses or user group.

## MAINTENANCE & MANAGEMENT

### Seasonal Use and Maintenance

- Occupied curbside areas must be maintained in safe operating order per approved permits and guidelines.
- The period of curbside occupation should be contingent upon the occupiers desire and capability to manage and maintain their occupied space throughout the seasons. Historically, sidewalk occupancy for commercial uses would be from April into November, although year-round occupancy should be allowed when the applicant can demonstrate their ability to utilize and maintain the space year-round.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CURBSIDE ELEMENTS

# COMMERCIAL LOADING ZONES

## DESCRIPTION & INTENT

A commercial loading zone is a dedicated space at the curbside intended for short duration use to directly service nearby businesses or properties. In this context, loading zone primarily refers to use of the curbside space for material deliveries. Zones for the loading and unloading of passengers are addressed in the “drop-off zone” section; however, loading zones may serve both purposes.

Loading zones help promote a strong economy and a vibrant retail environment. A sufficient number of loading zones, appropriately located and designed, can dramatically improve the safety, operation, and vitality of a street. Loading zones may reduce the incidence of truck double-parking and the cost of goods delivery borne by local businesses and their consumers. However, loading zones also take up space that could otherwise be used for parking, pedestrian, or transit space and therefore should be well managed to optimize use.

## USE & APPLICATION

### Location

- Loading zones are generally used by a number of businesses or properties on a block and are a shared resource. The need for new spaces should be reviewed in the context of a block or neighborhood.
- Loading zones can be located wherever curbsides are not used as travel lanes.
- Special caution should be used on pedestrian, bicycle and transit emphasis streets.
- Loading zones are intended for short duration parking—typically 30 minutes or less. Loading zones are typically reserved for only a portion of the day and used for general parking or travel at other times. If loading zone installations impact on-street parking, parking removal may be subject to meter removal and loss revenue fees.
- Place loading zones near intersections, and preferable on the far side of intersections to facilitate access to and from the rear of trucks and to have close access to curb ramps for moving materials into buildings.
- Alleys should be used for loading whenever possible. Off-street loading facilities are generally required for new developments and should be designed and managed to facilitate their use. Despite the presence of alleys and/or off-street loading, on-street loading zones may still be required.

### Related Design Elements

- **Sidewalks:** Sidewalks near loading zones should be wide enough to accommodate delivery people moving items from the vehicle to the business without disrupting pedestrian traffic.
- **Crosswalks:** Loading zones at all hours must not block crosswalks. Loading zones should not be located within 20-feet of the nearest edge of a crosswalk.
- **Bicycle Lanes:** Loading zones should not block any part of an adjacent bicycle lane.
  - » Adjacent travel lanes should be wide enough to permit passing a commercial vehicle parked at curbside.

- **Bumpouts**: On streets where a parking lane may no longer be warranted, consider bumpouts or flexible use of parking lane around the loading zone to expand pedestrian space.
- **On-Street Parking:** If loading zone installations impact on-street parking, parking removal may be subject to meter removal and loss revenue fees.
- **Cafe Seating and Outdoor Retail:** Cafe seating should not be placed near loading zones, as movement from deliveries may negatively impact dining activities.
- **Bicycle racks** should not be placed adjacent to loading zones, as deliveries may prevent cyclists from accessing their bicycles.
- **Transit/Protected Bicycle Lanes:** Do not use loading zones on curbsides where a transit lane or protected bicycle lane is present.

# DESIGN & OPERATIONS

## Design Requirements

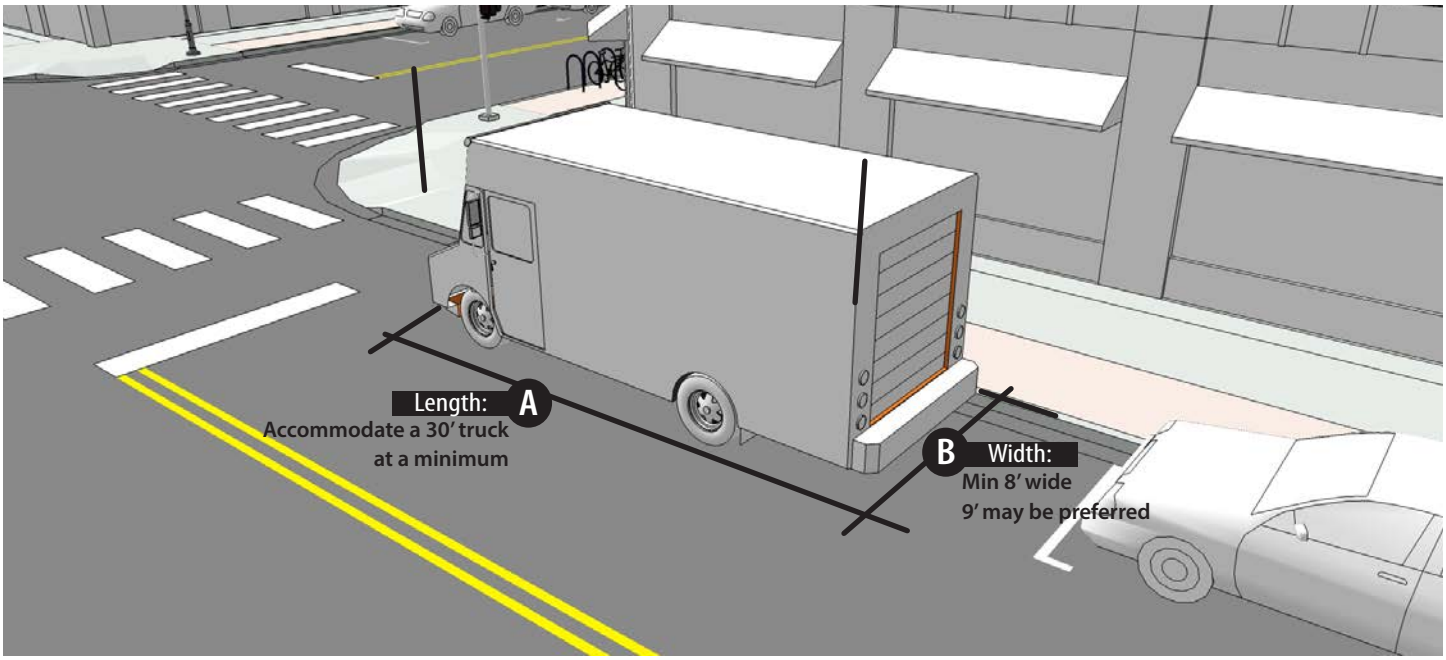
A **Length**: Loading zones intended for material deliveries shall be designed to accommodate, at minimum, a single unit 30-foot delivery vehicle (SU-30). Typically leading zones should be 40-feet long (equivalent to two normal parallel parking spaces).

B **Width:** Loading zones shall be a minimum of 8-feet wide; however, 9-feet is desirable. If 9-feet cannot be accommodated, travel lanes on streets with loading zones should anticipate potential affects from loading vehicles.

- **Markings and Signage:** Loading zones must be signed to clearly indicated the hours of enforcement and types of uses that are allowed within the commercial loading zone.
  - » Loading zones may be "boxed out" with a 6-inch wide white pavement marking band. They may also include marking legend symbols indicating the zone is reserved for commercial loading.
- **Street Trees:** Do not plant street trees adjacent to loading zones due to potential conflicts with delivery vehicles; unless adequate space is provided for the tree canopy to grow without contacting delivery trucks.

## Additional Design Considerations

- **Sidewalk Obstructions:** Sidewalk space adjacent to loading zones should be reasonably clear of furnishings, landscaping, and other obstacles.
- Operations and Timing:
  - » **Use Time Limit:** Restrict deliveries in the loading zone to 30 minutes maximum to ensure turnover and prevent double-parking from other delivery vehicles. Consider metering loading zones to encourage turn over.



» **Coordination:** Encourage collaboration among businesses to coordinate and/or stagger delivery times to discourage double-parking if multiple businesses are sharing the loading zone.

» **Off-Peak Loading:** Encourage loading during off-peak hours (typically early morning or late evening). Consider reserving zones for loading only during these preferred times.

- **Non-Loading Uses:** Non-commercial loading uses may be allowed during certain hours of operation and/or concurrently with commercial loading zones, and must be clearly signed to indicate (see ***Drop-Off Zones*** section).

# MAINTENANCE & MANAGEMENT

## General Maintenance

- **Enforcement:** Enforcement can be a significant concern and challenge for loading zones. Clear signage is necessary, but reliable enforcement is also required to ensure loading zones are not used for auto parking or longer duration parking by commercial vehicles.

## Seasonal Use and Maintenance

- **Snow Removal:** Clear loading zones of snow. Do not use for snow storage.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CURBSIDE ELEMENTS

# METERED PARKING

## DESCRIPTION & INTENT

**Metered parking** is a form of on-street parking intended to support commercial activity along the street by providing close access to storefronts and businesses.

The availability and placement of metered parking can have a significant impact on the balance of uses within the roadway. While on-street metered parking is often present on most commercial streets—especially in the downtown area—consideration must be given to the highest and best use for public street space.

## USE & APPLICATION

### Location

- **Main Streets:** On-street parking is appropriate and beneficial to most Main Streets in the downtown, for providing relatively proximate access to destinations. Supply of on-street parking should be considered after addressing loading zone and drop-off zone needs.
- **Urban Center and Event/Festival Street:** On-street parking on urban center and event/festival streets should not generally be utilized, as higher turn over parking spaces (e.g. drop-off zones) can provide more benefit to the function of these pedestrian centered streets.
- **Neighborhood Business/Commercial Business:** Generally, these districts do not need to rely on metered parking, as they are outside of the downtown zones and often have adequate off-street parking resources.
- Other street types are generally not suitable for metered parking due to a lack of commercial centered parking needs.
- On-street parking can be designated or managed to provide curbside access for persons with disabilities. In the State of Michigan, people who need handicap parking can apply for a Free Parking Application. This placard allows them to park for free.

### Related Design Elements

- **Bicycle Lanes:** Curbside parking conflict with cyclists within the first 2- to 3-feet of a parked car. This is known as the “dooring zone,” the area where vehicle drivers or passengers may inadvertently open their door into a passing cyclist. Parking lanes and adjacent facilities should be designed with adequate space, such as a 2- to 3-feet wide buffer zone between the parking lane and the bicycle lane, to minimize this risk.
- **Curbside Occupancy:** Access into and out of vehicles parked at the curbside may conflict with curbside occupancy in the amenity zone of the sidewalk. Similarly bicycle racks, parking meters, street light poles, and other fixtures in the amenity zone should provide sufficient space to enable access and egress from vehicles parked curbside. Typically 18 to 24 inches is sufficient clearance between parked vehicles and amenity zone elements.
- **Curbside Zone Uses:** On-street parking may be combined with bumpouts, parklets, platform dining, bicycle corrals or other curbside zone uses to enhance the pedestrian experience, safety and multi-modal access.

# DESIGN & OPERATIONS

## Design Requirements

- **Limits of Parking:** Restrict curbside parking within 20-feet of intersections to maintain clear site lines.

A **Parking Angle:** On-street parking should be aligned parallel to the curb.

  » Perpendicular or angled parking (preferably back-in-angled parking) may be utilized on roadways where right-of-way width allows while not compromising the desired widths of pedestrian areas or the roadway zone.

B **Parking Space Size:** Parallel curbside parking spaces shall be a minimum of 7-feet of width (measured from the face of curb and including the gutter) and 20-feet of length. The overall width of the parking space and adjacent travel lane should be at least 18-feet.

C **ADA Accessibility:** Parking spaces designated for use by persons with disabilities should be located adjacent to curb ramps to facilitate access to and from the sidewalk.

- **Meters and Pay Stations:** Parking meters should clearly indicate the hours of operation and provide multiple methods of payment, including coins and credit cards.

## Additional Design Considerations

D **Pavement Markings:** Individual parking spaces may be marked with "T" pavement markings at their outside edge.

  » Alternatively, a row of parking may be defined with a solid white line going around each space. This approach should be used when parking is adjacent to a bicycle lane to encourage better parking positioning.

## Design References

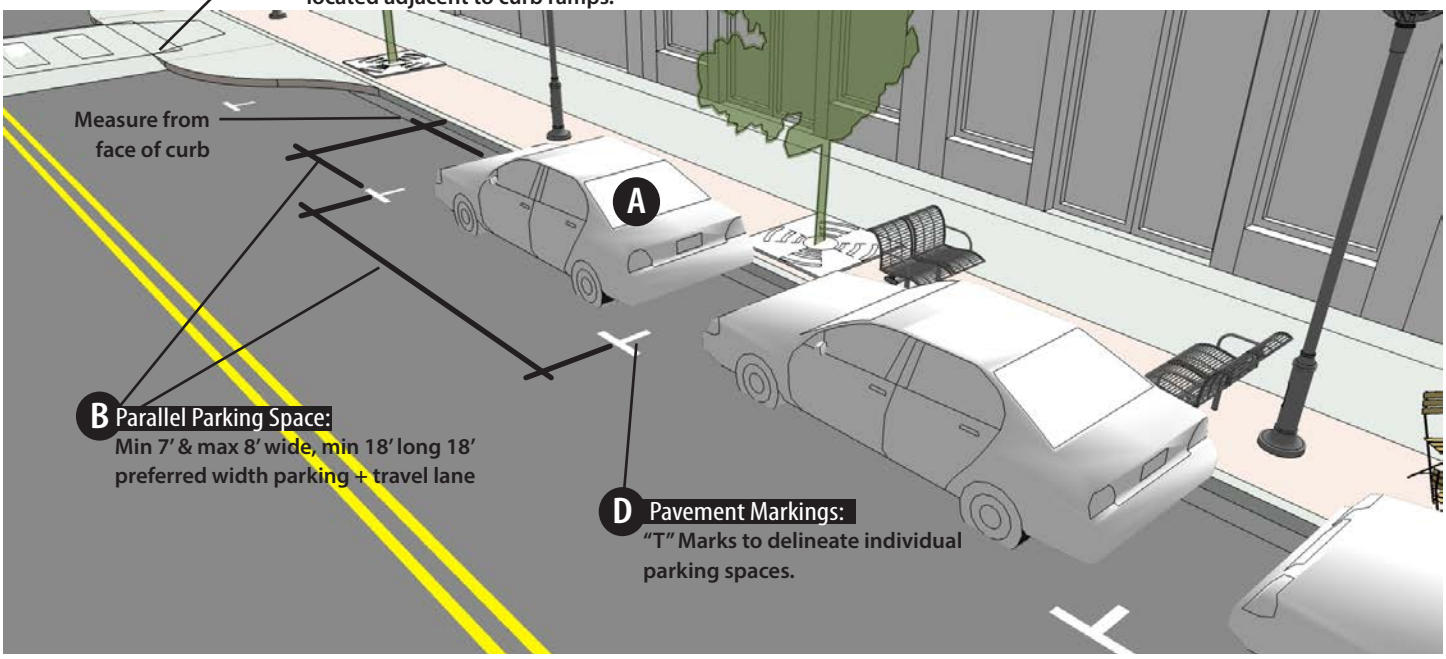
- The U.S. Access Board Draft PROWAG provides guidance for on-street accessible parking spaces.

## Sustainability Considerations

- Alternative uses of on-street parking, such as bicycle corrals, can encourage other modes of transit and reduce vehicle emissions and fuel consumption.

## Utility Considerations

- Ensure that curbside parking elements (meters, stall markets, and pay stations) do not obstruct access to underground utilities or electrical transformer vaults.

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CURBSIDE ELEMENTS

# DROP-OFF ZONE

## DESCRIPTION & INTENT

A drop-off zone is a dedicated space at the curbside for passenger-sized vehicles to drop-off or receive passengers. Drop-off zones can receive taxicabs or private vehicles, and increase the accessibility of a pedestrian-oriented district, accommodating visitors with limited mobility who may not be able to walk long distances. Drop-off zones are generally open to the public and are sometimes used for quick commercial loading uses.

Drop-off zones may also accommodate short-term parking, usually less than 10 minutes, allowing people to pick up goods (e.g. carry-out orders) without having to park in a more remote location or search extensively for an open parking space.

## USE & APPLICATION

### Location

- Drop-off spaces are located in the curbside zone of the street. On streets where drop-off zones are recommended, at a minimum one on-street parking space per block should be designated as a drop-off zone.
- Drop-off zones established to exclusively serve a particular property will be subject to fees and/or revenue replacement.
- Drop-off zones are appropriate near buildings that may receive a large number of visitors, particularly visitors with limited mobility, or a high number of short-term trips (i.e. medical or institutional buildings, hotels or large residential buildings).
- Drop-off zones and the vehicles entering and exiting them must not degrade safe and efficient operation of the adjacent travel lanes, including bicycle facilities and walking zones.
- The curb should be reserved for drop-off for the shortest duration possible. Drop-off zones may be used for other purposes during the balance of the day. Common uses include commercial loading, taxi stands, and metered parking.

### Related Design Elements

- **Street trees** should not be planted in passenger drop-off zones.
- **Cafe seating** should not be placed near drop-off zones due to conflicts between diners and passenger loading.
- **Bicycle racks** should not be placed adjacent to drop-off zones due to conflicts between bicycle access and passenger loading.
- **Drop-off zones** should not be placed on curbsides where a transit lane or protected bicycle lane is present.

# DESIGN & OPERATIONS

## Design Requirements

- **Length:** Drop-off zones shall be at least 25-feet long and located in front of the building entrance where the zone is requested. If multiple buildings on a block request a drop-off zone, consider a single, common loading area.
- **Width:** The width of drop-off zones, plus the adjacent travel lane, should be a minimum of 18-feet. Typically this means a 10-foot travel lane and a 8-foot wide drop-off zone. Under constrained conditions, drop-off zones may be reduced to 7-feet. Widths are measured from the face of the curb and include the width of any gutters as part of the overall width.
- **Sidewalk Clearance:** Maintain an 8-foot wide clearance zone on the sidewalk adjacent to loading zones, restricting site furnishings to allow passengers to enter and exit vehicles. Exceptions can be made for benches, which allow passengers to sit and wait for their ride.
- **Location:** Passenger drop-offs should generally be located at the curb line. Exceptions may be made where the curb lane is used for travel.
- **Time Limits:** Limit drop-offs to 15 minutes to encourage turnover and discourage double parking.
- **Markings and Signage:** Drop-off zones should be well-marked to indicate to drivers that they cannot park there.

# MAINTENANCE & MANAGEMENT

## Seasonal Use and Maintenance

- **Snow Removal:** Loading zones do not require any special equipment for snow removal. The adjacent property owner is responsible for snow removal in the walking zone. Drop-off zones should not be used for snow storage.

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CURBSIDE ELEMENTS

# NEIGHBORHOOD PARKING

## DESCRIPTION & INTENT

In Kalamazoo, neighborhood parking refers to curbside zones where on-street parking is permitted, typically on local and other neighborhood streets. Such parking is intended to provide parking spaces primarily for use by adjacent or nearby residences. Depending on the location and proximity to other land uses, such as the downtown area or higher intensity commercial areas, neighborhood parking may have additional requirements or restrictions on its use and application.

Neighborhood parking can play an important role not only for providing space for vehicles to park, but also in changing how drivers traverse down neighborhood streets. Higher volumes of on-street parking have the effect of narrowing the perceived width of the roadway, which prompts drivers to travel more slowly and cautiously. On narrower roads without centerline markings, on-street marking may cause the center of the roadway to function as a bidirectional shared-lane, which can considerably slow down travel speeds.

The following types of neighborhood parking are considered in this section:

- **Open Parking:** These are parking areas that available to any users at any time of day or night during posted operating hours.
  - » Operating hours may be up to a 24-hour period, allowing people to remain parked overnight.
  - » During non-operating hours, no cars may be parked in the zone.
- **Neighborhood Permit Parking:** These are parking areas that are only allowed to be used during enforcement hours by vehicles with permits indicating that it belongs to a nearby resident. This is an approach to allowing neighborhood parking in areas where there is a high likelihood of non-neighborhood users competing for demand.
  - » Typically,neighborhood permit parking would allow permit holders to leave their vehicles parked overnight in such zones.
- **Time Limited Neighborhood Parking:** These are parking areas that are un-metered but time limited (e.g. 2-hour parking) during certain peak hours but may allow for longer parking periods during off-peak hours.
  - » Exceptions may be granted for neighborhood residents to park at all times, even over night.

## USE & APPLICATION

### Location

- Neighborhood parking is highly recommended and encouraged on all local neighborhood and enhanced neighborhood streets, in order to provide additional parking to benefit residents, as well as function as a traffic calming devise.
- On neighborhood business and network neighborhood streets, on-street parking may also be desired, in particular where it aligns with adjacent commercial businesses and provides potential customer parking.

» On-street parking in these areas can also function as a buffer between pedestrian areas and the active travel lanes, creating a calmer pedestrian environment.

» On-street parking fronting business or commercial areas should generally be time limited in order encourage regular turnover in parking spaces.

## Related Design Elements

- **Bicycle Lanes:** Neighborhood parking, as with other curbside parking uses pose a risk to people cycling, especially when bicycle lanes as located tight against parking zones. Wherever possible, bicycle lanes adjacent to parking should be widened by at least 2-feet (3-feet preferred) in order to provide a buffer against door swing. This buffer can be periodically striped with diagonal lines.
- **Curbside Zone Uses:** On-street parking may be combined with bumpouts, parklets, platform dining, bicycle corrals, or other curbside zone uses to enhance the pedestrian experience, safety and multi-modal access.
- **Waste Collection:** Solid waste collection (trash, recycling, etc.) must be considered as part of determining which type of neighborhood parking is appropriate for a given area.
  - » Typically, waste bins can be positioned within the curbside zone directly adjacent to curb cuts/ driveways and before the on-street parking zone begins. Larger multi-family properties may require limiting on-street spaces in front of the property in order to provide space for waste collection.

# DESIGN & OPERATIONS

## Design Requirements

- **Size of Parking Spaces:**
  - » Parallel curbside parking spaces shall be a minimum of 7-feet wide and 18-feet of length. 20-feet long is a preferred length.
  - » On roads with centerline markings, the total width of the parking area and adjacent travel lane should be 18-feet. 7-foot parking and 11-foot lanes encourages parking closer to the curb where larger vehicles (e.g. buses) are anticipated. Wider parking lanes (8-feet) and narrower travel lanes (10-feet) conversely encourages slower travel speeds.
- **Limits of Parking:** Curbside parking may not occur within 30-feet of the nearest edge of crosswalks (including mid-block crossings) in order to maintain sight lines at intersections.
- **Curb Cuts and Driveways:** On-street parking should not occur within 5-feet of the edge line of a driveway or curb cut, in order to provide clearance for vehicles.
- **Parking Angle:** On-street parking shall be parallel to the curb.
- **ADA Accessibility:** Parking spaces designated for use by persons with disabilities should be located adjacent to curb ramps or driveways to facilitate access to and from the sidewalk space.

## Additional Design Considerations

- **Pavement Markings:** Individual parking spaces may be marked with "T" pavement markings at their outside edge.
  - » Alternatively a row of parking may be defined with a solid white line going around each space. This approach should be used when parking is adjacent to a bicycle lane to encourage better parking positioning.
- **Signage:** Neighborhood parking must utilize clear signage to indicate what type of parking exists (e.g. open, neighborhood permit only, time limited) as well as indicate the operating hours for enforcement.

### Sustainability Considerations

- On-street parking can also provide spaces for locating bicycle corrals, applicable near business areas, schools, or other concentrated land uses.

### Utility Considerations

- On-street parking cannot be located within 15-feet of a fire hydrant.

## MAINTENANCE & MANAGEMENT

### Seasonal Use and Maintenance

- **Snow Removal:** During snow events, on-street parking may be prohibited in order to provide maintenance crews opportunities to clear snow from the roadway. Parking signage can indicate restrictions on on-street following snow events.

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# 4.3

# BICYCLE ELEMENTS

## BICYCLE FACILITIES



## BICYCLE INTERSECTIONS



## MOBILITY SUPPORT

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BICYCLE FACILITIES

# BICYCLE FACILITY SELECTION

## DESCRIPTION & INTENT

Inherent to establishing **Complete Streets** across the City of Kalamazoo is ensuring that people on bicycles are able to safely access neighborhood and city-wide destinations using the public street network.

The challenge with accomplishing this is two fold. First, each roadway is unique and how cyclists can be accommodated safely and comfortably given site constraints will vary from street to street. There is not a one-size fits all solution. Second, not all bicycle riders have the same level of comfort and risk tolerance when cycling on streets, which means that a facility that works for one type of cyclist may not work for another.

When implementing bicycle facilities, it is important to consider connectivity and the overall routes. More specifically, determining which type of facility is appropriate given project's target audience and its role within the bicycle network is critical. Bicycle facilities fall broadly into two categories:

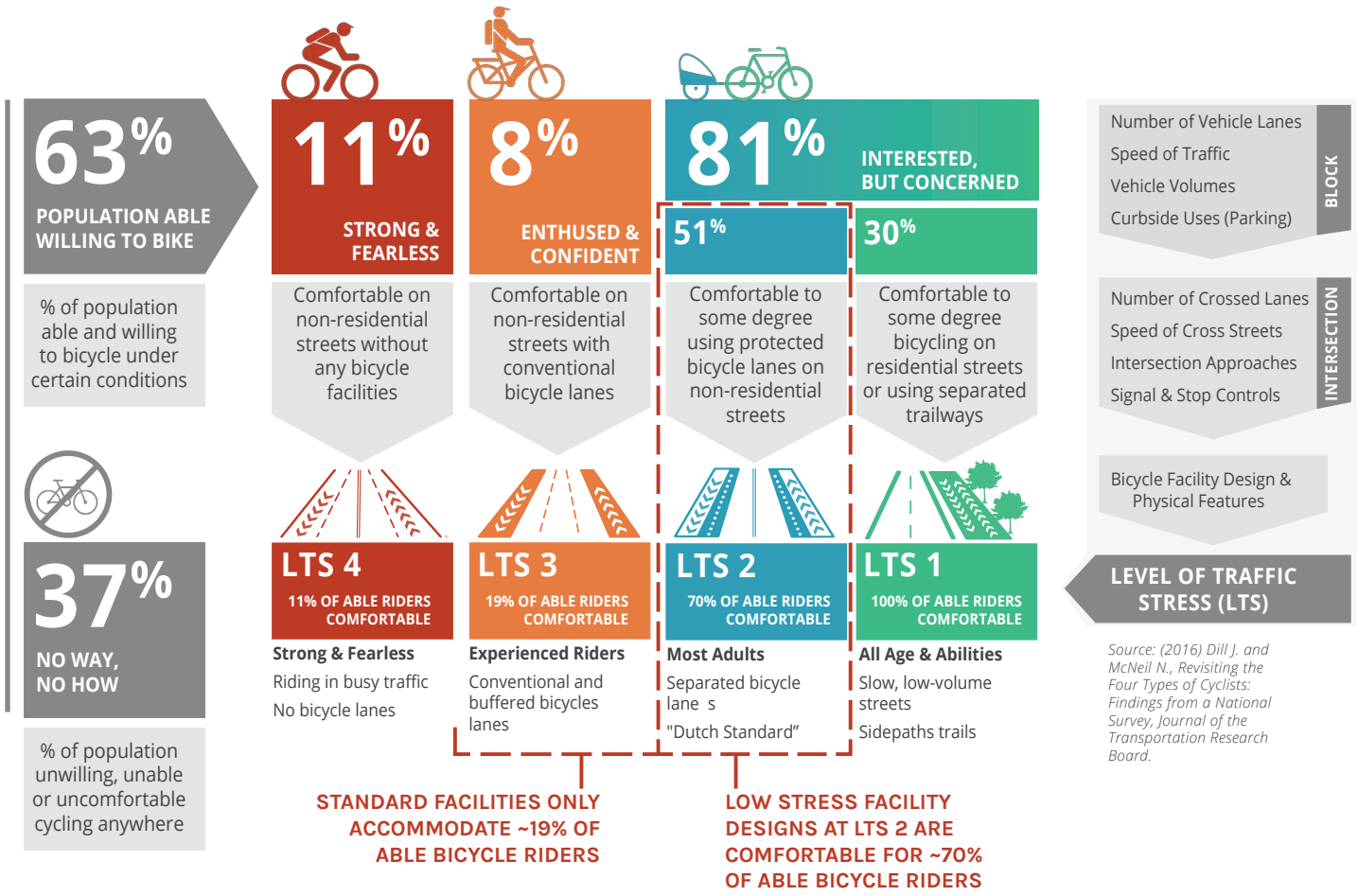
- **Low Stress Bicycle Facilities:** Low stress facilities, sometimes called "all ages and abilities" facilities, are those that are designed to be safe, comfortable, and welcoming to the majority of the bicycle-inclined populace. This includes people are that "interested but concerned" with riding their bicycles on major roads, the youth, elderly, and other less confident but willing riders—typically reflecting 50% or more of a city's population. Selecting the appropriate low stress facility depends on the roadway conditions and context, intersection treatments, and careful attention to the overall route.
- **Standard Facilities:** Standard bicycle facilities are those where the design treatments seek to reduce stress and maximize safety and comfort to the greatest extent, yet due to site conditions or constraints, may not be comfortable for the majority of riders. Standard facilities on major roads typically serve only about 19% of the willing bicycle riding population.

The graphic on the next page summarizes the relationship between type of bicycle rider and their stress tolerance and associated facility types.

## USE & APPLICATION

- How cyclists are accommodated on streets must be assessed on every street project. Even simple resurfacing and re-striping projects can be an opportunity to improve bicycle access, comfort, and safety, through the following methods:
  - » Providing more dedicated space for bicycles to travel by creating dedicated facilities;
  - » Raising the visibility and awareness of bicycle rider presence to drivers through pavement markings, signage, and other treatments; and,
  - » Creating calmer, safer street environments for all users but employing best practices for safe roadway design (e.g. appropriate lane widths, speed management techniques).

STANDARD VS LOW STRESS BICYCLE FACILITIES & RIDER ALIGNMENT




*Source: (2016) Dill J. and McNeil N., Revisiting the Four Types of Cyclists: Findings from a National Survey, Journal of the Transportation Research Board.*

- Non-motorized network or connectivity plans in the city should identify bicycle routes and a desired level of traffic stress. Determining which routes should be "low stress" versus which are "standard" is vital.
- Non-motorized plans should consider establishing two distinct bicycle networks within the city, one that is low stress focused and one that uses more standard approaches.
- Routes that connect directly to schools and parks should utilize low stress facilities.
- The level of stress of a bicycle route is only as low as its most stressful location. Intersections design is vitally important for achieving low stress routes.
- Routes identified as desired neighborhood greenways or bicycle boulevards should emphasize use of appropriate low stress facilities in combination with traffic volume and speed management measures.

## BICYCLE INFRASTRUCTURE TOOLS & REFERENCES

- Designing for All Ages & Abilities: Section 3.2 provides a chart (NACTO, 2017) for aligning roadway conditions (traffic volume, speed, lane configuration, curbside uses) with potential facility types.
- Southwest Michigan Region Non-Motorized Transportation Plan 2020: Identifies regional trails and connections.
- KATS Pedestrian, Greenways, and Transit Plan: Identifies proposed (and existing) greenways or shared use paths, bicycle boulevards, and buffered/protected bicycle lanes.

# FACILITY SELECTION GUIDANCE

The chart below identifies City of Kalamazoo street typologies and indicates a typical "low stress" versus "standard" facility that should be considered.

- This chart should be used as a starting point for establishing a baseline approach for accommodating bicycles and in consideration of the street's network role.
- Depending on the available right-of-way space, scope of the street project (e.g. full reconstruction versus repaving and re-striping), and specific roadway conditions, different facilities may be used to achieve the desired stress target.

## Bicycle Facility Types

Detailed design guidance for each of the listed facility types are described subsequently in this section. Briefly, these facility types include the following:

- **Sidepaths:** Sidepaths are shared-use facilities for non-motorized use, mixing both bicycle and pedestrian traffic. Sidepaths are separated from the roadway and are typically located in the sidewalk zone of the street, often being substituted for normal sidewalks.
- **Separated Bicycle Lanes:** Separated bicycle lanes are either one-way or two-way dedicated bicycle lanes which are separated from vehicle travel lanes by a physical, vertical buffer, such as delineator posts, curbing, bioswales, landscape or decorative planters.
- **Buffered Bicycle Lanes:** Buffered bicycle lanes are one-way dedicated bicycle lanes with a painted buffer zone in between the bicycle lane and vehicle lane, providing additional separation and clearance between bicycle riders and motor vehicles.
- **Bicycle Lanes/Conventional Bicycle Lanes:** Conventional bicycle lanes are dedicated one-way bicycle lanes that are typically positioned between the curb and a vehicle travel lane. There are no buffers between the bicycle and vehicle lanes, so the level of comfort for cyclists can vary significantly based on vehicle speeds, traffic volumes, and the proximity of passing vehicles.
- **Advisory Bicycle Lanes:** Advisory bicycle lanes are one-way bicycle lanes demarcated with a dashed line and combined with shared bi-directional vehicle lanes. The advisory bicycle lane is periodically shared with motor vehicles during passing operations. Advisory bicycle lanes are typically used on low volume and low speed (25 MPH or less) neighborhood streets to help raise the visibility of cyclists and manage vehicle behaviors.
- **Sharrows:** Sharrows or "share the road" markings are pavement markings placed within a vehicle travel lane to indicate the potential presence of cyclists.

| Typical Bicycle Facilities | Low Stress Facility | Standard Facility | Notes |
|---|---|---|---|
| Urban Center (UC) | Separated Bicycle Lanes | Bicycle Lanes or Sharrows | See note (1) below |
| Event/Festival (E/F) | Sharrows typically appropriate | | Low speed/volume or shared space streets |
| Downtown Main (MS) | Separated Bicycle Lanes | Bicycle Lanes or Sharrows | See note (1) below |
| Neighborhood Business (NB) | Separated Bicycle Lanes or Sidepaths | Conventional Bicycle Lanes | Separated bicycle lanes vs. sidepaths depends on overall connectivity and curbside uses. |
| Commercial Business (CB) | Sidepaths | Conventional Bicycle Lanes | |
| City Connector (CC) | Sidepaths | Conventional Bicycle Lanes | |
| Neighborhood Network (NN) | Separated Bicycle Lanes or Sidepaths | Conventional Bicycle Lanes | |
| Enhanced Neighborhood (EN) | Separated or Buffered Bicycle Lanes, Advisory Bicycle Lanes | Sharrows | |
| Local Neighborhood (LN) | Advisory Bicycle Lanes | Sharrows or no facility | |

- *(1) Sharrows may be preferred where space does not allow bicycle lanes to be buffered from door swing when next to parking lanes*

# GENERAL BICYCLE FACILITY DESIGN CONSIDERATIONS

## Pavement Markings

Bicycle facilities, particular more elaborate ones such as separated bicycle lanes, requires additional pavement markings and the maintenance of such markings should be considered during project development.

- Where bicycle facility markings cross between vehicle travel lanes, consider recessing pavement markings so that snow plows traverse over them and do not wear them down more quickly.
- Durable markings materials should be used. Avoid using waterborne paint products. Polyurea, MMA, epoxy, and polymer cement surfacing (e.g. Endurablend) should be used.
    - » Green paint markings used in larger solid areas (such as within bike boxes, turn boxes, or intersections) should be specified with materials that reduce loss of traction for cyclists.

## Winter Maintenance and Snow Clearing

- Bicycle facilities that are within the roadway zone, including separated bicycle facilities, are the responsibility of the city to clear. The design of bicycle facilities should consider available maintenance equipment to ensure that it can be cleared efficiently.
    - » When curb islands, concrete medians, or other permanent elements are used as part of the bikeway design, horizontal clearance widths should be considered relative to available maintenance equipment. Pick-up sized plows are generally around 7-feet wide, and so clear widths of 8-feet may be suitable. Narrower widths or lack of available equipment may require hand clearing or use of smaller specialized equipment.
    - » Non-permanent bikeway treatments, such as signage, rubber curbing, or delineator posts should be removable if needed. Items can be removed on a regular seasonal basis or temporarily as needed, to assist with snow clearing operations.
- Snow should never be piled on or stored on top of bicycle facilities. Care should be taken to ensure that drainage structures are not blocked and that ice does not form within a bicycle lane.
- Where on-street parking is present, it is important that snow is cleared all the way to the curb face, at a minimum, so that parking does not drift away from the curb and encroach on bicycle facilities.
- It is important for sidepaths to be promptly cleared of snow. Sidepaths should be maintained consistent with other designed shared-use trails in the city and/or installed with a maintenance agreement with adjacent property owners or other sponsoring entities.

## Utilities

- Where the bicycle lane must travel over inlet structures, use bicycle-friendly grate designs, such as Type-L vane inlet covers or ADA accessible inlet covers. Must ensure that selected inlet covers meet required drainage criteria in consideration of stormwater flows.
- If trenching or pavement removals are done within the bicycle lane, repair the entire width of the bicycle lane so there is not an uneven surface or longitudinal seam that can catch bicycle tires.
- Avoid locating manholes within bicycle lanes (if feasible).
- Ensure any utility or vault covers are flush with the road surface and properly set and maintained.

## Sweeping

- Separated bicycle lanes require street sweeping and should be designed to accommodate the width of available street sweeping equipment.

## Stormwater Drainage

- Where bicycle facilities incorporate curbed medians, planters, concrete medias/dividers, or other linear vertical elements, the design must address stormwater flows and ensure that drainage can be maintained.

| STREET TYPOLOGY | | | | | | | | |
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BICYCLE FACILITIES

# SIDEPATHS

## DESCRIPTION & INTENT

Sidepaths are paved areas within a street right-of-way but outside of the roadway zone that are intended for non-motorized travel. They are wider than typical sidewalks and are designed as shared-use trail facilities, which provides space for pedestrians, cyclists, and other non-motorized users.

Sidepaths can be an important tool for providing lower stress bicycle facilities by provided a space to ride that is fully separated from the roadway. Sidepaths can be particularly beneficial where there is a higher frequency of younger children, senior, or less confident cyclists anticipated.

Sidepaths function as an alternative to a standard sidewalk and implementing them typically consumes less overall right-of-way space than having both sidewalks and dedicated bicycle facilities. However, as a shared-use facility, care must be given to ensure that pedestrians remain safe and that the speed of bicycle travel is managed appropriately.

## USE & APPLICATION

### Location

- **Usage:** Sidepaths may be utilized on nearly any street type within the city, in consideration of the below (see ***Bicycle Facility*** selection):
  - » Sidepaths are most suitable in locations where there is ample room in the pedestrian area (minimally 14-feet, ideally at least 20-feet) to accommodate a sidepath and where other competing uses that might conflict with sidepaths users are minimal (e.g. cafe dining, curbside parking or loading areas). Typically these include commercial business, city connector, and neighborhood network street types.
  - » Sidepaths are less suitable on streets with higher volumes of pedestrian traffic moving both along and crossing the sidepath. Urban center streets, main streets, and neighborhood business streets where active ground floor uses front directly onto to the sidewalk are generally not well-suited for sidepaths.

### Related Design Elements

- **Parking and Loading Zones:** Sidepaths should be considered carefully where on-street parking is present and frequently utilized. Frequent crossings of the sidepaths by curbside users can create conflicts with bicyclists on the sidepath.
- **On-Street/Dedicated Bicycle Facilities:** Sidepaths on only one side of the street can transition to two-way separated bicycle facilities on the same side of the street more readily than single direction bicycle lanes. Transitions to single direction bicycle lanes should occur at signalized or all-way stop intersections to allow cyclists to cross to other side of the street in a controlled manner.
- **Lighting:** Sidepaths should be well lit, especially at intersections or crossing points. Pedestrian scaled street lighting located between the sidepaths and the edge of the roadway can help provide a vertical buffer and improve comfort. See ***Street Lighting*** section for applicable lighting targets by street type.
- **Trees:** Trees should be planted along sidepaths wherever feasible to create a comfortable atmosphere. Trees also help provide a buffer between the sidepath and adjacent roadways.

# DESIGN & OPERATIONS

## Design Requirements

**A** **Travel Path Width:** Sidepaths should provide a minimum width of 10-feet clear as the travel path. Exceptions to this minimum may be considered, reducing the width to a minimum of 8-feet, where right-of-way conditions are constrained and/or usage and volumes are expected to be low [1].

**B** **Clear Zone:** Sidepaths should have a 2-foot clear zone on both sides of the main travel path. This clear zone may be paved or a maintained lawn area. This clear zone should be free from signage, posts, tree trunks, or other obstructions [1].

**C** **Separation from Roadway or Curbside Zone:** The sidepath should be separated at least 4-feet from the face of an adjacent roadway curb or the edge of roadway pavement for curbless streets. This separation area encompasses the clear zone listed above.

- » This separation zone allows for placement of signage and site fixtures while meeting clearances for both the sidepath and adjacent roadway. This separation zone can be paved or landscaped and is part of the amenity zone of the street.
- » A narrower zone may be considered under constrained circumstances, so long as horizontal clearances from the roadway (typically 2-feet from the face of curb) can be maintained. This may require reducing the width of the sidepath.
- » Wider separation (8-feet or more) is generally desired on higher speed (30 MPH or higher) and volume roadways and on streets with curbside zone uses (e.g. parking and loading) where users may cross the sidepath.

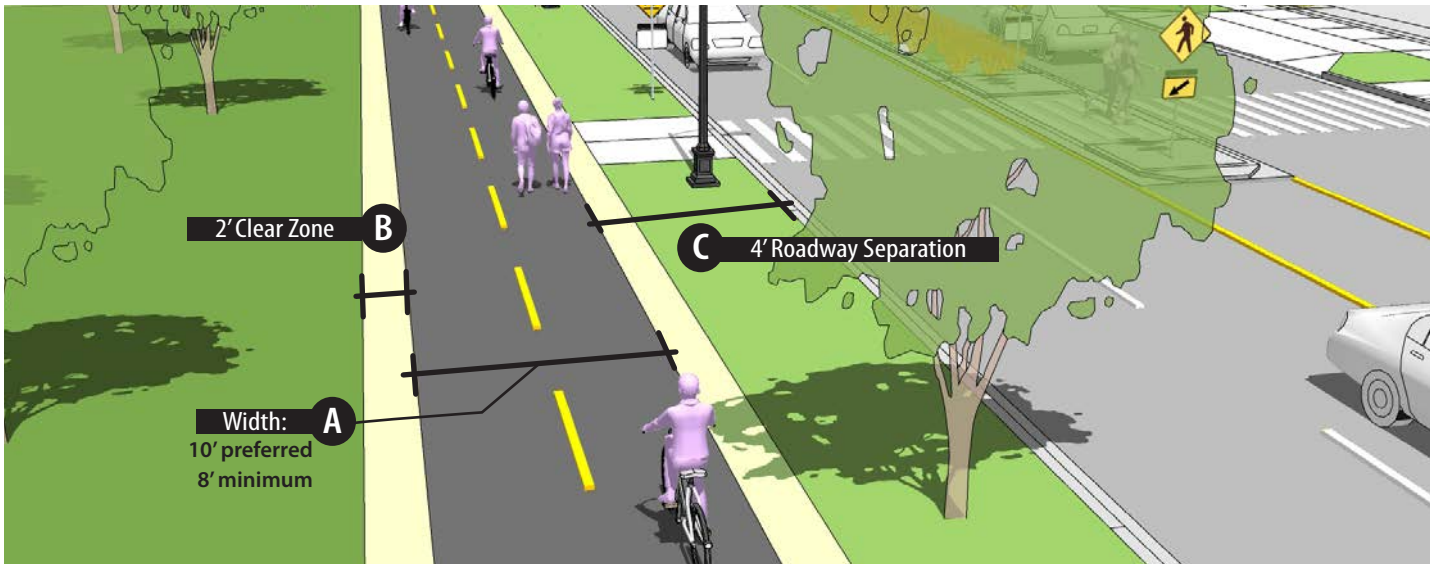
- **Materials:** Sidepaths should be constructed from concrete or asphalt. Concrete is preferred in denser urban areas and/or where heavy vehicles are regularly crossing the sidepath, whereas asphalt may be used on other street types.
- **Pavement Markings and Signage:** Sidepaths should use signage and pavement markings consistent with those used on shared-use trails. Centerline marks are recommended in order to guide travelers in opposing directions.
- **Crossings, Driveways and Curb Cuts:** The design of sidepaths should consider the spacing and frequency of use for curb cuts, driveways, or other crossings over the sidepath. AASHTO provides detailed guidance on the design of safe, visible, sidepath crossings [1].

## Design References

- AASHTO (2012) Guide for the Development of Bicycle Facilities provides details guidance on the construction of shared-use trails and sidepaths.

# MAINTENANCE & MANAGEMENT

- It is important for sidepaths to be promptly cleared of snow. Sidepaths should be maintained consistent with other shared-use trails in the city.



| STREET TYPOLOGY | | | | | | | | |
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BICYCLE FACILITIES

# SEPARATED BICYCLE LANES

## DESCRIPTION & INTENT

Separated bicycle lanes are bicycle facilities that provide physical barriers and separation between the bicycle lane and adjacent travel lanes.

Physical separation can be provided using delineator posts, curbing, raised medians, raised bicycle lanes, planter boxes, or other treatments depending on the available space and overall roadway context.

The physical protection increases the sense of safety and comfort for cyclists. Separated bicycle lanes correlate positively with increased cycling activity, as separated facilities improve comfort for more timid, less experienced, and/or more vulnerable cyclists. Separated facilities dramatically reduce the risk of bicycle/vehicle conflicts, as well as the risk of "dooring" from parked vehicles.

Separated bicycle lanes may be one directional with one separated lane on each side of the street, or may be designed as a two-way facility with both directions in a combined facility.

## USE & APPLICATION

### Location

- **Usage:** Separated bicycle lanes are appropriate where there is a desire for a low stress bicycle facility and where the roadway conditions (traffic volume, speed, etc.) require separation to comfortably accommodate bicycle users (see ***Bicycle Facility*** section).
- Separated bicycle lanes have the most attraction and impact when implemented for multiple contiguous blocks.
- While separated bicycle lanes offer more protection and attraction than standard on-street bicycle lanes, they also require a greater amount of street space. Separated bicycle lanes often require the conversion of curbside parking or a travel lane. These trade-offs should be resolved as part of establishing a modal hierarchy for the street project and in considering the full range of street users.

### Related Design Elements

- **Crosswalks:** Separated bicycle lanes are exclusively for bicycle travel and should not be used as pedestrian walkways or waiting areas. Pedestrian medians may be provided near the separated bicycle lane to provide additional refuge opportunities for pedestrians when crossing the street (see ***Protected Intersections***).
- **Two-stage Turn Queues or Bike Boxes** should be used to facilitate left turns from separated bicycle lanes to other bicycle corridors or facilities (see ***Bike Boxes*** and ***Two-Stage Turn Queues***).
- **On-Street Parking:** On-street parking, located between the separated bicycle lane and the roadway can pose visibility concerns to bikers in the separated bicycle lanes. They can limit bicycle maneuvering space, lead to vehicle encroachment into the bicycle lane, creating conflict points with pedestrians and situations for "dooring" bicycle riders. Due to the above concerns, it is generally not recommended.
    - » If on-street parking is necessary, consider using a two-way separated facility on one side of the road with a lane of parking on the other side.

- **Bicycle Parking:** Provide bicycle parking regularly along separated bicycle lanes.
- **Sidewalk Furnishings**: Place sidewalk curbs and furnishings in such a way to discourage pedestrians from walking on the separated bicycle lane.
- **Curb Cuts**: Driveways, alleys, curb cuts and frequent loading activity introduce conflict into a separated facility. Separated bicycle lanes work best on corridors with minimal conflicts.
- **Mid-block and Pedestrian Crossings:** Pedestrians crossing separated bikeways, either at an intersection or as part of a mid-block crossing, should treat the crossing as if it were a vehicle crossing and provide appropriate curb ramps and detectable warnings when approaching the separated bicycle lane.
- **Bus stops:** Separated bikeways can pose a challenge for transit vehicles trying to access street curbs. Integrating a raised bicycle lane into a transit bus bulb or bumpout can provide curb height access for buses and still accommodate the bicycle lane.

# DESIGN & OPERATIONS

## One-Way Separated Bicycle Lanes

A **Lane Width:** Separated bicycle lanes should have a minimum of 5-feet of with for a one-directional facility. 7-feet of width should be considered where higher bicycle volumes are anticipated to allow for bicycles to pass.

## Bicycle Lane Separation

B Separated bicycle lanes should be separated from vehicle traffic and clearly distinct from pedestrian zones.

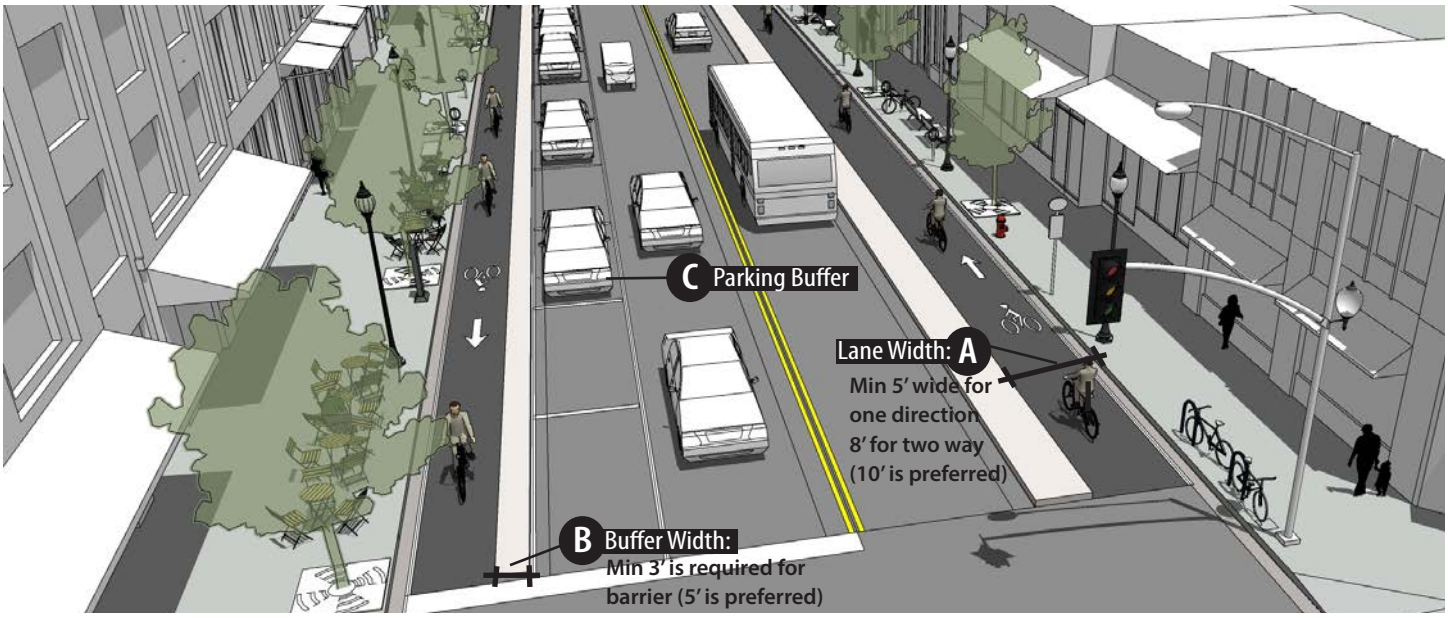
» A minimum of 3-feet is desired for the buffer (5-feet is preferred) between the bicycle lanes and travel lanes.

» Separation should use delineators and painted buffers, curbing, planters, and/or raised medians. Gaps in the buffer should be minimized to the extent possible.

C **Parking Buffer:** A parking lane may be used as a buffer treatment.

» Rigid curbing, concrete medians, or curb stops should be provided to prevent vehicles from encroaching into the bicycle lane. These features can create additional obstacles for pedestrian access.

» The overall width of parking and the buffer should be a minimum of 11-feet wide and parking should be stopped at least 30-feet from the edge the nearest crosswalk to provide for adequate sight lines to cyclists at the intersection approach [1].



## Two-Way Separated Bikeways

Where available right-of-way width precludes using one-way separated bicycle lanes and/or in locations where sidepaths and trails (with two-way movement) need to transition onto the roadway zone, two-way separated bicycle lanes (called bikeways) may be used. Two-way bikeways introduce additional complexities in the design and operations, discussed below.

**D** **Lane Width:** Each direction of bicycle travel in the bikeway must be a minimum of 4-feet wide (8-feet total width). 5-foot wide lanes are preferred (10-feet total).

**E** **Centerline:** The centerline of the bikeway should be a single dashed yellow line, 4 or 6 inches wide. When approaching intersections, the centerline should be solid within 20-feet from the stop bar.

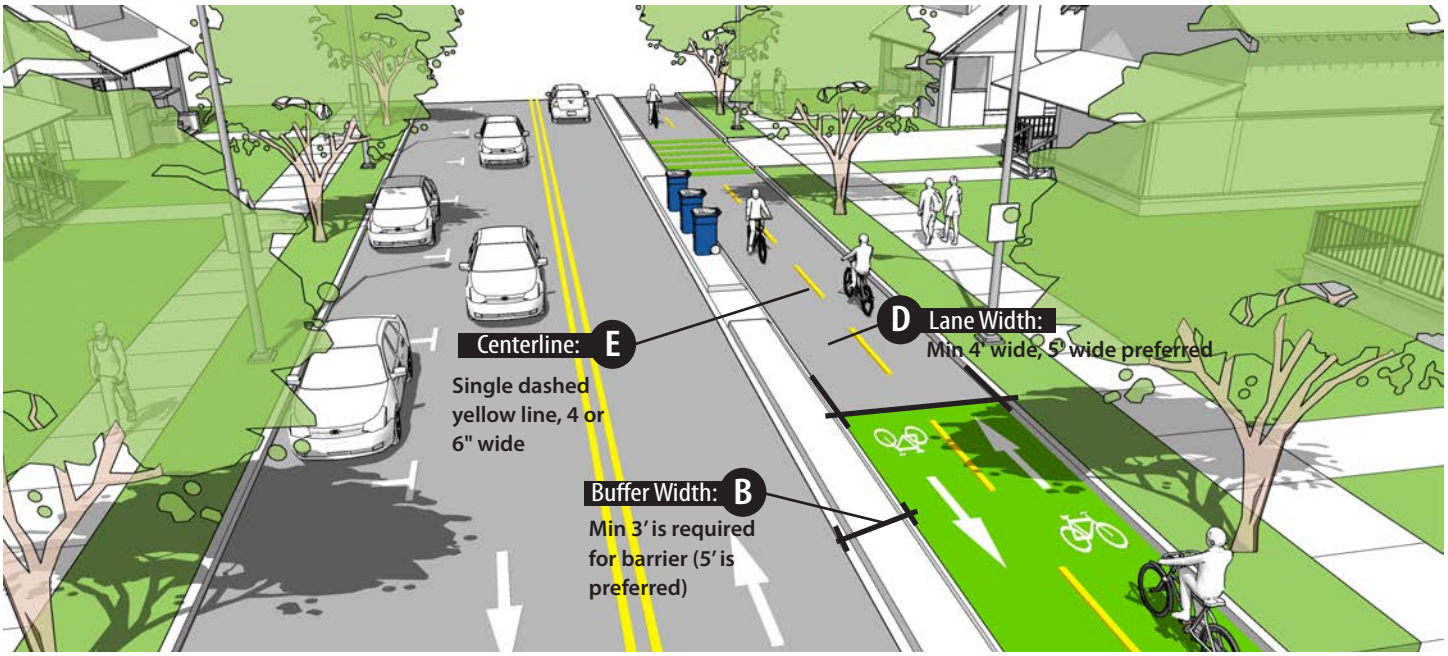
- **Bicycle Turning Movements:** For two-way bikeways, turning movements into and out of the bikeway require careful consideration. Use two-stage turn queues located in a manner clear from cross street traffic where cyclists can wait for a signal change (see ***Two-Stage Turn Queues*** for additional guidance).
- **Vehicle Management:** Encroachment by vehicles into the wider two-way bikeway should be prevented.
  - » Use delineator posts placed on the centerline of the bikeway to prevent vehicles from entering.
  - » If delineators are used to provide separation, where there are concerns about vehicles parking in the bikeway, they should be placed 10-feet apart.
  - » **No Turn on Red:** No Turn on Red signage should be used where right turning may cross over the two-way bikeway and/or turn queue boxes.

## Pavement Markings and Signage

- **Pedestrian Crosswalks** should cut through buffers or barriers to provide a continuous ADA accessible path of travel for pedestrians.
- **Intersection Markings:** To raise visibility of bicycle riders in intersections, separated bicycle lanes should be painted solid green traversing through an intersection and within 20-feet of the approach.
  - » One-way facilities should include dashed white lines highlighting the edge of the bikeway.
  - » Two-way facilities should use “elephant feet” (12x12 or 18x18) white squares along the edge of the painted crossing zone.
- **Driveways and Curb Cuts:** Use dashed green bars where the bicycle lanes cross driveways, alleys, curb cuts, or minor street crossings.

## Intersections

- **Intersections:** Separated bicycle lanes require careful design at intersections to minimize conflicts with turning vehicles and improve legibility, visibility, and predictability for all travelers.



- **Bicycle Signals:** Bicycle signals may be necessary for two-way separated bicycles lanes. A traffic and signal analysis should be conducted to determine the necessity for bicycle signals.
- **Sight Lines:** Maintain visibility and sight triangles at driveways, alleys, or intersections.
- **Traffic Signal Timing:** On streets where signals are coordinated, consider adjusting timing to account for bicycle travel times to encourage continuous bicycle movement.

## Raised Bikeways

- Separated bicycle lanes may be flush with the street-level, raised to the sidewalk-level, or at an intermediary-level between street and sidewalk.
- For sidewalk-level bicycle lanes, use different colors, materials or pavement markings to differentiate the bicycle lanes from pedestrian space. At conflict points, use yield-marks and "Bikes Yield to Peds" signage to indicate that pedestrians have the right-of-way.
- Two-way bikeways can be raised up to the sidewalk-level, using ramps to transition back down to street-level at intersections.

## Additional Design Considerations

- **Curbing:** The face of new curbs directly adjacent to the bikeway should be designed with a chamfered 45-degree angle to reduce pedal strikes.

## Utility Considerations

- Configure gutter seams, drainage inlets, and utility covers so they do not impede bicycle travel. Make the separated lane wider where gutter seams extend more than 12 inches from the curb. Barriers should be designed as not to impede effective roadway drainage.

## Sustainability Considerations

- Curbed medians or buffer areas can be designed to capture stormwater runoff and provide additional storage or infiltration capacity.

## Design References

- The NACTO Urban Bikeway Design Guide provides additional guidance on how to design separated bicycle lanes and where to use them (see ***Cycle Track*** section in the guide book).
- The MMUTCD offers standards on signage and pavement markings for separated bicycle facilities.

# MAINTENANCE & MANAGEMENT

- See ***Bicycle Facility*** section for overall guidance on maintenance of bicycle facilities.

| STREET TYPOLOGY | | | | | | | | |
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BICYCLE FACILITIES

# BUFFERED BICYCLE LANES

## DESCRIPTION & INTENT

Buffered bicycle lanes are on-street bicycle facilities with a painted buffer zone between the bicycle facility and other roadway uses. Buffered bicycle lanes are distinct from separated bicycle lanes in that no physical separation or protection is provided. Buffering is provided by a flush, painted zone between the bicycle facility and vehicular travel lanes.

Buffered bicycle lanes increase comfort over conventional bicycle lanes by providing greater separation from adjacent travel lanes and wider operating space for bicycles. Buffered bicycle lanes may not offer the same level of comfort as separated bicycle lanes, but may be installed at a lower cost, and impose fewer maintenance challenges.

Buffered bicycle lanes allow cars to travel across them to enter curbside zones (i.e. for on-street parking or loading). The buffered lanes can be designed with additional buffers between the bicycle lane and parking area to minimize the risk of getting "doored" by people existing parked vehicles.

## USE & APPLICATION

### Location

- **Usage:** Buffered bicycle lanes are most appropriate on moderate traffic volume roads and where lower travel speeds can be achieved (ideally 25 MPH). While they provided greater separation and reduce bicycle rider stress, they do not provide physical separation (see ***Bicycle Facility*** section).
- The flexibility of the painted buffer area can make buffered lanes more viable in commercial areas with active curbside uses.
- Buffered lanes should be considered as an alternative to conventional bicycle lanes whenever bicycle lanes are proposed.
- Buffered lanes are more effective and appealing on streets with longer blocks and few interruptions, such as driveways or bus stops. Buffered facilities should ideally extend for several contiguous blocks along a corridor.

### Related Design Elements

- **Travel Lane Width:** Buffered bicycle lanes can be used as a tool for narrowing travel lane width. Where existing conventional lanes are adjacent to overly wide travel lanes, consider re-striping as buffered bicycle lanes.
- **Intersections**: Buffered bicycle lanes require additional considerations in the design of intersections and associated pavement markings. Consider using a bicycle box and/or two-stage turn queues at intersections to give cyclists in the buffered bicycle lane additional protection (see ***Bicycle Boxes*** and ***Two-Stage Turn Queues***).
- **Traffic Signal Timing:** On streets where signals are coordinated, consider adjusting timing to account for bicycle travel times to encourage continuous bicycle movement.
- **Bus Bulbs**: Buffered bicycle lanes can conflict with bumpouts, especially at bus stops. When approaching a bus bulb, a buffered bicycle lane should move between the sidewalk and bus bulb so cyclists do not cross paths with passengers stepping on or off the bus (see ***Bus Bulbs***).

- **Curb cuts** and driveways can erode the attraction and operation of buffered bicycle facilities. Curb cuts should be avoided or minimized wherever possible.

# DESIGN & OPERATIONS

## Design Requirements

**A** **Lane Width:** The preferred lane width for the bicycle lane is 5-feet wide, outside of any gutter line. This may be reduced to 4-feet in highly constrained areas [1].

**B** **Buffer Width:** The buffer shall be a minimum of 2-feet wide (3-feet preferred) measured from the center of the bicycle lane stripe. Buffers may be up to 6 feet wide in the event of a converted travel lane [1].

- » When adjacent to on-street parking, an additional buffer on the parking side of the bicycle lane should be used to minimize "dooring." This buffer should be 3-feet in order to provide effect clearance, and where space is limited and on-street parking frequent, may be preferred over a travel lane buffer.
- » The combined bicycle lane and widths of buffers should be no less than 7-feet overall.
- » Buffered area consists of two solid painted lines (6- to 8-inch parallel lines) with diagonal stripes in between at 45-degrees and spaced 10- to 40-feet apart on center.

## Additional Design Considerations

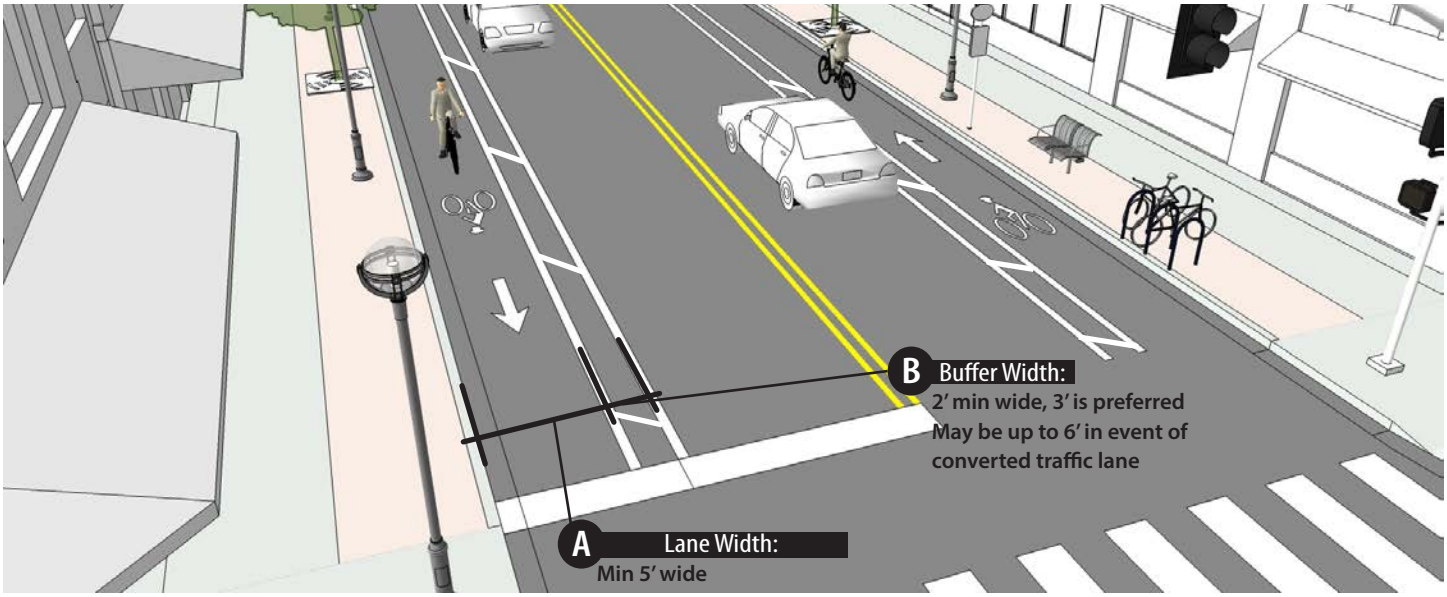
- **Recessed Pavement Marking:** Consider recessing markings to improve longevity of pavement markings.
- **Parking Lane Markings:** Use "T" markings or solid lines next to a parking lane to show where parked cars should be placed.
- **High Visibility Paints:** Green paint should be used to raise the visibility of the buffered bicycle lanes.
  - » Use 2-foot wide green bars spaced in alignment along the bicycle lane path through intersections and across driveways or curb cuts.
- **Delineators**: Delineators can be added to buffered bicycle lanes over time, converting them into separated bicycle lanes.

## Design References

- The NACTO Urban Bikeway Design Guide provides additional design guidance on buffered bicycle lanes.

# MAINTENANCE & MANAGEMENT

- See ***Bicycle Facility*** section for overall guidance on maintenance of bicycle facilities.



| STREET TYPOLOGY | | | | | | | | |
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BICYCLE FACILITIES

# CONVENTIONAL BICYCLE LANES

## DESCRIPTION & INTENT

Bicycle lanes are dedicated bicycle facilities delineated by striping, signage, and pavement markings. Distinct from buffered or separated bicycle lanes, conventional bicycle lanes are typically immediately adjacent to a vehicle travel lane.

On-street lanes alert motorists to the presence of a bicycle route, allow cyclists to use the street with less interference from traffic, and increase comfort for cyclists and predictability for all roadway users.

The provision of bicycle lanes or other dedicated bicycle facilities may reduce the incidence of cyclists riding on sidewalks in Kalamazoo. However, conventional bicycle lanes alone may not provide a high enough level of comfort for the most risk intolerant or vulnerable cyclists who desire a higher level of separation from traffic.

Bicycle lanes are typically located on the right-hand side of the street running in the same direction as motor vehicle traffic, but alternative configurations are possible.

## USE & APPLICATION

### Location

- **Usage:** On priority bicycle routes or designated low stress bicycle routes, conventional bicycle lanes may only be appropriate when adjacent vehicle volumes, speeds, and points of conflict are low enough to achieve low stress target. See ***Bicycle Facility*** section.

### Related Design Elements

- **Transit:** Buses and bicycles may conflict at curbside bus stops. For high frequency stops, consider using a bus bulb that allows the bicycle lane to continue through (see ***Bus Bulbs***).
- **Bumpouts:** Additional consideration is required where bicycle lanes intersect with bumpouts, both at corners and mid-block, due to potential conflicts with pedestrians. Bumpouts should stop short and provide enough width for bicycle lanes to continue up to the intersection (see ***Bumpouts***) or else the corner can be designed as a protected intersection (see ***Protected Intersection***).
- Bumpouts should not extend into the bicycle lane.
- **Driveways and Curb Cuts:** Motorist entering or exiting may not see approaching cyclists. Dashed pavement markings can identify conflict zones.

## DESIGN & OPERATIONS

### Design Requirements

**A** **Lane Width:**

» The preferred operational width of bicycle lanes is 5-feet (minimum 4-feet), free from any longitudinal pavement lines (i.e. gutters) and obstructions.

» Wider lanes should be provided where higher volumes are anticipated or where conflicts (i.e. door swings) are present.

**B** **Markings:** A solid white 6-inch wide line shall be used to differentiate the bicycle lane from the general traffic lane. At intersections, place bicycle lane markings outside of the vehicle path to prevent car tires from wearing them down.

- **Location:** Bicycle lanes shall be placed on the right-hand side of the street, between the travel lane and the parking lane, or between the travel lane and the curb.
  - » Avoid placing bicycle lanes to the right of a right turn lane or the left of a left turn lane.

### Additional Design Considerations

- **Parking Lane Marking:** Use a continuous solid line or place "T" marks between the bicycle lane and the parking lane to mark the inside of the bicycle lane and discourage motorist from encroachment.
- **Lane Markings:** Use dotted/dashed lines to indicate areas of bicycle/vehicle conflict, such as bicycle lane markings continuing through intersections or where right turning lanes cross bicycle lanes.
- **Surface Transitions:** Make gutter seams, drainage inlets, and utility covers flush with the ground to prevent conflicts with bicycle tires. Ensure openings in grates are perpendicular to the bicycle direction of travel to avoid trapping bicycle tires.
- **High Visibility Paint:** Use white sharrow markers/outlines to emphasize bicycle only lanes.
- **Signs:** Additional signage may be used to indicate presence of bicycle lanes.

### Design References

- The MMUTCD provides standards for bicycle lane markings.
- The NACTO Urban Bikeway Design Guide provides additional guidance on the use and design of conventional bicycle lanes.

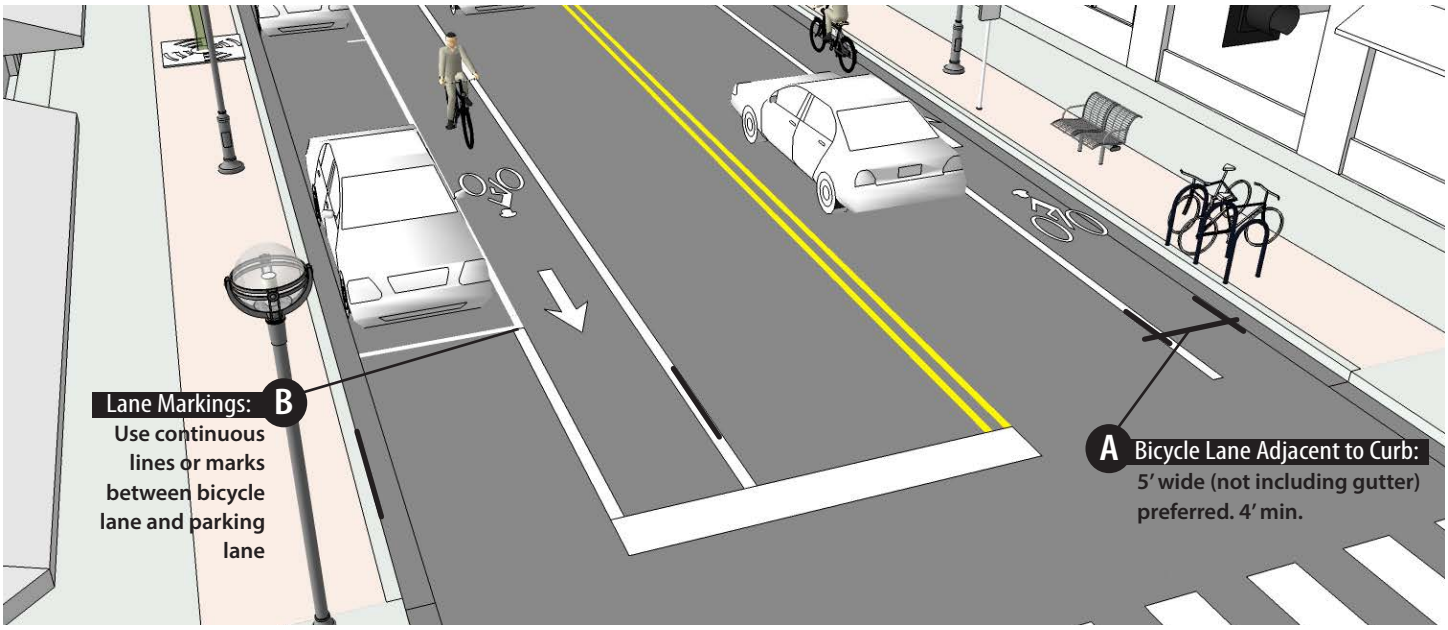
## MAINTENANCE & MANAGEMENT

### General Maintenance

- Bicycle lanes and associated signs and symbols are additional markings that will require maintenance and replacement.

### Seasonal Use and Maintenance

- Bicycle lanes should always be plowed during snow events and should never be used for snow storage.
- See ***Bicycle Facility*** section for overall guidance on maintenance of bicycle facilities.



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BICYCLE FACILITIES

# ADVISORY BICYCLE LANES

## DESCRIPTION & INTENT

On lower volume neighborhood streets without lane markings, vehicles tend to drive in the middle of the roadway (staying clear of any on-street parking). When vehicles approach in opposing directions, they both slow down and bear right to pass each other.

Advisory bicycle lanes is a way to formalize the above behavior through pavement markings and to incorporate a designated zone for cyclists to ride. When vehicles traveling in only a single direction are present, bicycles effectively have dedicated lanes in which to travel. When opposing car traffic is present, vehicles will slow down and share a portion of the bicycle lane (yielding to cyclists if they are ahead of the vehicle) until the vehicles pass each other.

Beyond formalizing roadway behaviors on such neighborhood streets, the use of a narrow defined travel lane can incite vehicles to drive at calmer speeds and help raise the visibility of cyclists along the corridor, putting drivers on the alert.


## USE & APPLICATION

### Location

- **Usage:** Advisory bicycle lanes are only appropriate on streets that do not have delineated and marked travel lanes. Typically this will be on lower volume and lower speed (25 MPH or less) residential streets (see ***Bicycle Facility*** section).
- Advisory bicycle lanes should be considered along low stress neighborhood routes, and as part of neighborhood greenways or bicycle boulevards. Advisory bicycles lanes are a treatment that can go beyond merely signing “designated bike route” in that the pavement markings can change driver behavior and create a street condition where the priority of cyclists is elevated.

### Related Design Elements

- **On-Street Parking:** Advisory bicycle lanes can be designed alongside on-street parking on one or both sides of the street.
- **Bumpouts:** At intersections with bumpouts, the approach to the intersection should transition to more conventional demarcated travel lanes with sharrow markings or kept wide enough to allow the bicycle lane to carry through the intersection in a conventional manner.

# DESIGN & OPERATIONS

## Design Requirements

**A** **Vehicle Lane Width:** The shared travel lane for vehicles should be a minimum of 10-feet and a maximum of 18-feet wide, with a preferred range of 13.5- to 16-feet [1].

- » Narrower shared lanes (closer to 10-feet) have a greater impact on controlling vehicle speeds.
- » Widths wider than 18-feet should consider using narrow but fully delineated separate travel lanes.

**B** The overall clear width between the edge of any parking lanes or gutter lines, including both the shared travel lane and the bicycle lanes, should not be less than 20-feet, in order to allow the full range of vehicles to pass each other.

**C** **Advisory Bicycle Lane Width:** The advisory bicycle lanes should be a minimum of 5-feet wide.

- » Where space allows, provide a 2-foot buffer adjacent to on-street parking to reduce dooring risk.
- » Excess vehicle lane width can be allocated to bicycle lanes to provide greater passing space.

**D** **Pavement Markings:**

- » The line separating the vehicle travel lane and the bicycle lane should be a white dashed line (3-foot segments with 6-foot gaps) [1].
- » For the shared vehicle lane, do not use centerline markings during the mid-block portions of the roadway. When approaching an intersection that is stop or signal controlled, terminate the advisory lanes 30- to 50-feet from the stop bar and use sharrow markings (see ***Sharrows***) with a normal vehicle lane centerline on the approach.

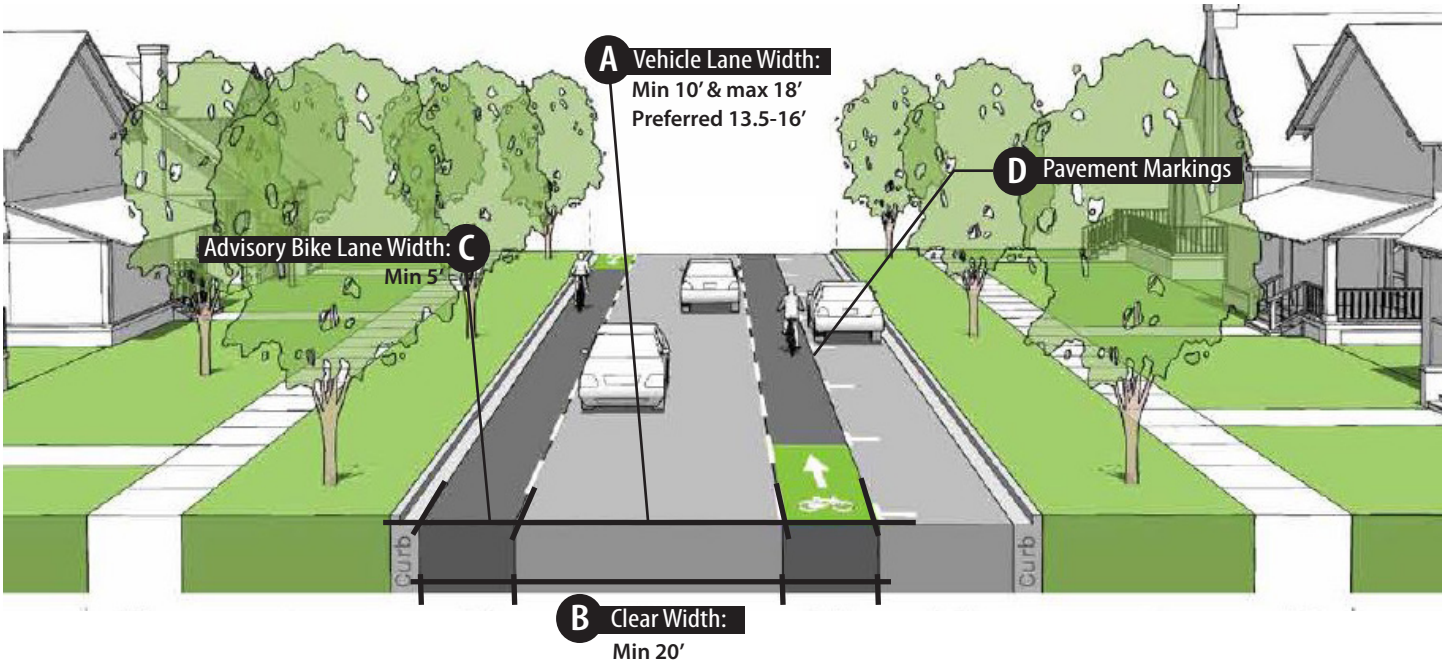
- **Signage:** Use signage (see example on prior page) to indicate the proper yield behavior for drivers. Using two-way traffic signs can also help reinforce that the roadway is intended for two-way travel.

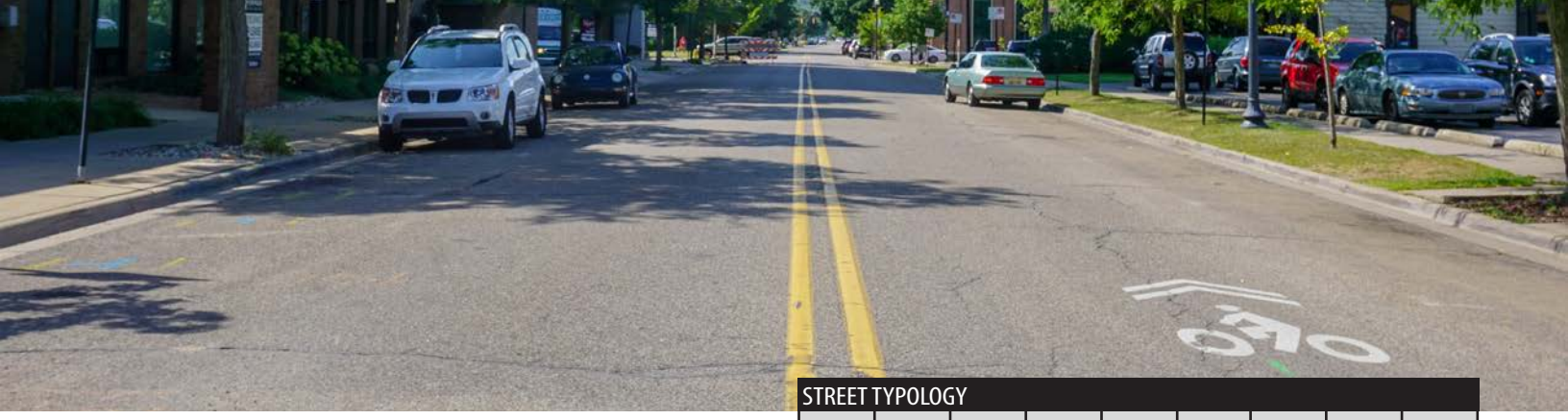
## Design References

- Small Town and Rural Multi-modal Network (FHWA, 2016) document provides additional design and geometric guidance on "advisory shoulders," which are advisory bicycle lanes.
- Advisory Bike Lanes in North America (Alta, 2017) provides extensive review of case studies and findings, supporting effective design and implementation of advisory bicycle lanes.

# MAINTENANCE & MANAGEMENT

- See ***Bicycle Facility*** section for overall guidance on maintenance of bicycle facilities.





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BICYCLE FACILITIES

# SHARROWS

## DESCRIPTION & INTENT

Sharrows, also called shared lane markings, are pavement markings that indicate that a vehicle travel lane is intended to be shared with bicycle riders.

Sharrows remind drivers to expect the presence of cyclists and orient bicycles to the preferred line of travel along the roadway. Sharrows also remind cyclists to ride with traffic, not against it.

Sharrows are not a dedicated bicycle facility and not all cyclists will be comfortable riding in travel lanes and relying on sharrows.

## USE & APPLICATION

### Location

- Sharrows are most appropriate for streets with modest traffic volumes and slower travel speeds, including many downtown streets where slower driving speeds can be achieved.
- Sharrows are not appropriate on streets with high traffic volumes and higher speeds. Dedicated bicycle facilities should be used or bicycle traffic routed onto other streets.
- Sharrows should be used on roadways where the travel lane width is as narrow as possible (e.g. 10-feet) so that cars do not have adequate width to pass bicycle riders without crossing double-yellow centerline markings.
- Because cyclists remain in mixed traffic, sharrows generally do little to enhance comfort for the most vulnerable or risk intolerant cyclists and should be used cautiously on streets with high traffic volumes and higher speeds, such as vehicle emphasis streets.

### Related Design Elements

- **Travel Lanes:** Sharrows are applied in otherwise typical vehicle travel lanes and do not affect overall dimension or assembly of the typical section.
- **Intersection Treatments:** Bicycle boxes or two-stage turn queues may be used in conjunction with sharrows.

# DESIGN & OPERATIONS

## Design Requirements

- **Marking Pattern:** Sharrows markings are two chevrons positioned above a bicycle symbol. See MMUTCD for detailed marking design.

A **Position from Curb:** Sharrows should be positioned in the center of the travel lane to encourage bicycles to utilize the full lane width where they will be more visible and better protected against door swing from parked vehicles.

  - » The MMUTCD specifies minimum (but not maximum) distances from center of the marking to the face of the curb as 11-feet where on-street parking is present and 4-feet where there is no on-street parking. These are the listed minimums, but there is maximum, which therefor allows placement within the center of the travel lane [1].

B **Placement along Street:** Sharrows shall be placed in both directions of travel (unless other dedicated lanes are provided on just one side of the street). Sharrows should be placed at the start of a lane after an intersection, and spaced at 250-foot intervals or less (down to a minimum of 100-feet) [1].

- **Signage:** At the start of each block where sharrows are used, install a "Share the Road" sign to properly alert drivers.

## Sustainability Considerations

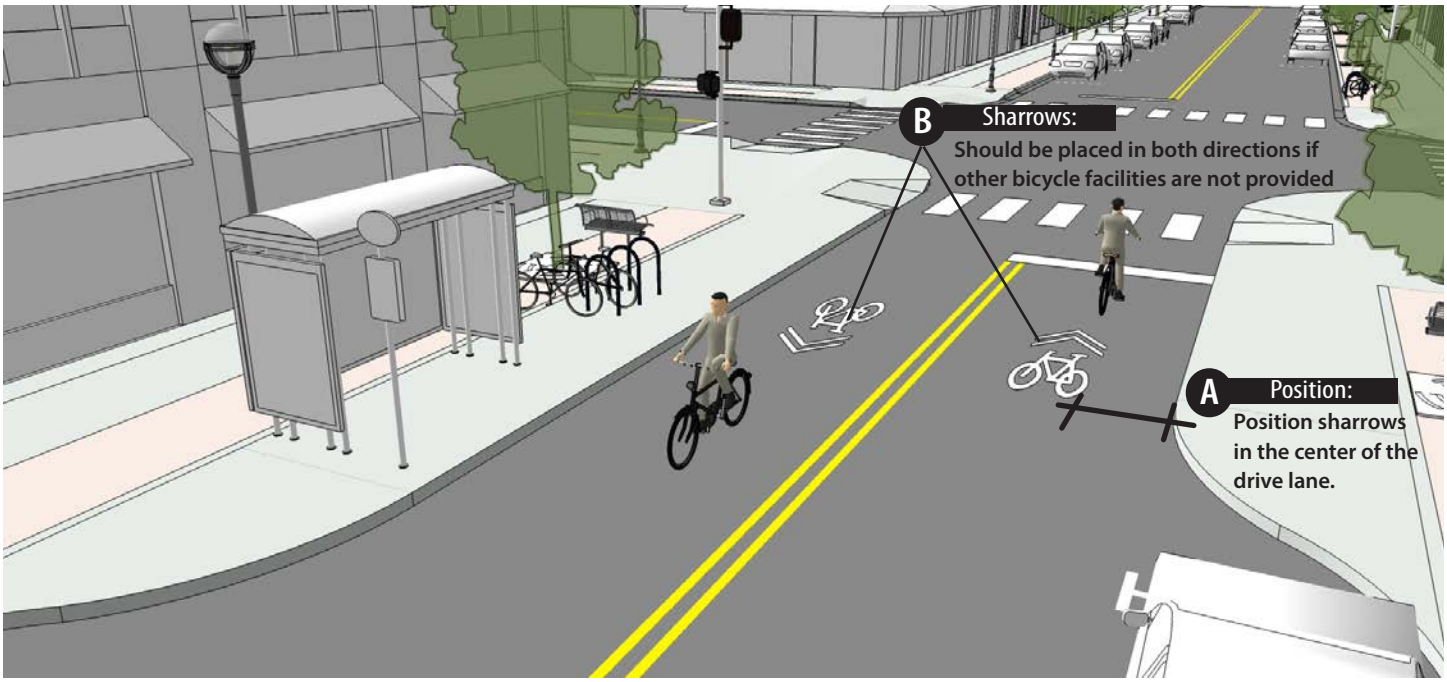
- Because sharrows are located in an otherwise typical vehicle travel lane, they do not present any obvious opportunities for green street treatments.

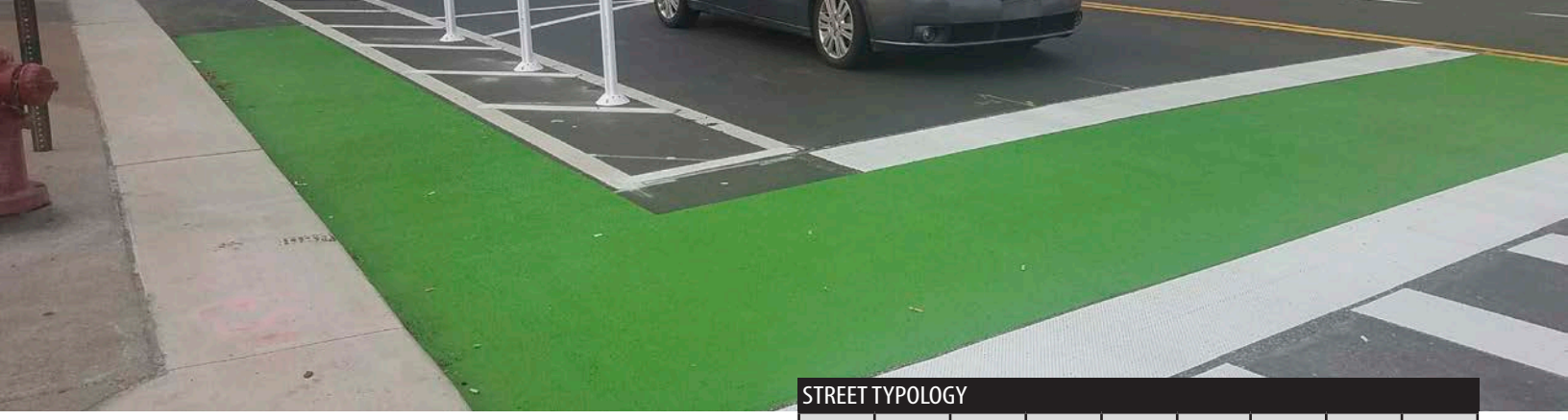
## Design References

- The MMUTCD provides standards on shared lane markings (Part 9, Shared Lane Markings).
- The NACTO Urban Bikeway Design Guide provides additional guidance on designing and using sharrows.

# MAINTENANCE & MANAGEMENT

- See ***Bicycle Facility*** section for overall guidance on maintenance of bicycle facilities.





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BICYCLE INTERSECTIONS

# BICYCLE BOXES

## DESCRIPTION & INTENT

A bicycle box (or bike box) is a dedicated area at the front of a traffic lane at a signalized intersection, which cyclists can maneuver within while waiting at the light in order to position themselves ahead of vehicles and in a proper position to turn.

Bike boxes make cyclists more visible to drivers by positioning them at the head of a queue during a stop cycle. They provide a space for cyclists to queue outside of crosswalk areas. Bike boxes enable cyclists to safely position for a left turn during a stop cycle at an intersection.

In corridors of high bicycle activity, bike boxes cluster multiple cyclists and enable them to progress forward at the onset of the green signal cycle. This clears a bicycle lane more quickly allowing for a sooner progression of right turning vehicles. Bike boxes can improve safety by reducing or eliminating the need for bicycles to weave across travel lanes to make a left turn and reducing conflicts with right turning vehicles, "right hooks."

## USE & APPLICATION

### Location

- Bike boxes are used only at signalized intersections.
- Bike boxes are most beneficial on streets with high bicycle volumes (five or more in queue during peak hours), locations with significant left turn bicycle activity, and/or intersections where conflicts between right turning vehicles and bicycles are common.
- Bike boxes may be appropriate in any street type but generally should be reserved for areas where high bicycle activity is anticipated or desired, such as on bicycle emphasis streets.
- Bike boxes may also be desirable in high pedestrian zone areas to protect crosswalks from encroachment by bicycles or vehicles.
- While relatively logical, straightforward and easy to use, education and outreach to motorist, cyclists and pedestrians may be necessary to ensure their safe and appropriate use.

### Related Design Elements

- **Right on Red:** Bike boxes must be used in conjunction with "No Right Turn on Red" (and "No Left Turn on Red") restrictions. This limitation must be considered when determining appropriate locations for the use of bike boxes.

## DESIGN & OPERATIONS

### Design Requirements

A **Box Size:** The bike box is formed by two parallel pavement marking lines at least 6 inches wide forming a box at least 10-feet or more in depth and extending from the outside of the bicycle lane across all travel lanes in the direction of travel [1].

  - » Green paint should be used to raise the visibility of the bike box.

- **Placement:** Bike boxes are located between the crosswalk and the vehicle stop bar.

**B** The vehicle stop bar is placed at the rear of the bike box. Vehicle stop bars may be moved back up to an additional 7-feet to provide additional clear space at intersections where there are high volumes of bicycle traffic.

**C** Bike boxes should be set back at least 1-foot from the nearest edge of a crosswalk, but can be setback further to create more separation and prevent cyclists from blocking the crosswalk.

**D** **Bicycle Markings**: Bicycle symbol pavement markings are located within the bike box in all lanes which it extends.

- **No Right Turn on Red:** Right turn on red shall be prohibited where bike boxes are used and shall be signed accordingly.
- **Signage:** To manage the stop positioning for vehicles, use a "STOP HERE ON RED" sign accompanied by an "EXCEPT FOR BICYCLES" sign (1).

## Additional Design Considerations

**E** **"Wait Here"** pavement marking or signs may be used to reinforce the proper stopping location for vehicles and to avoid encroachment on the bike box.

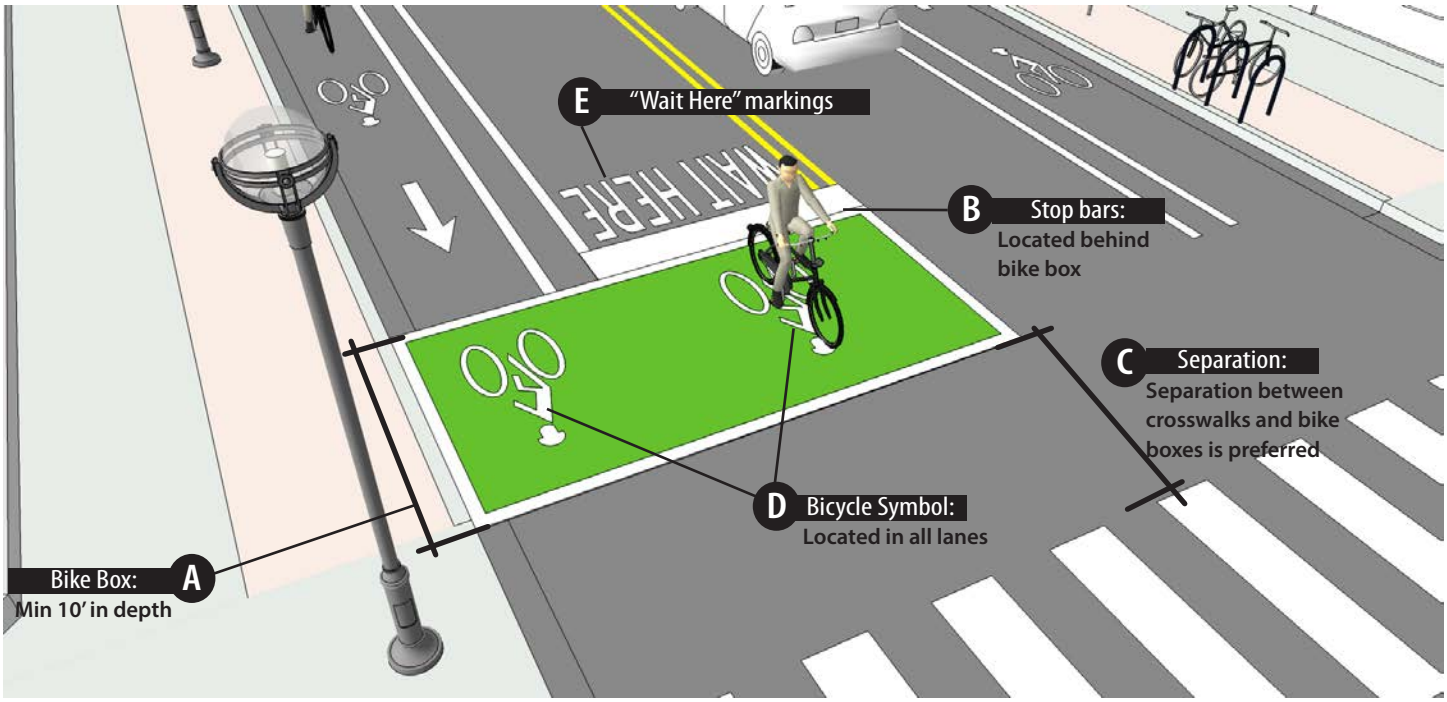
- **Special Pavement Markings:** Green pavement markings is commonly used in bike boxes but is not required.
- **Bike Boxes without Bicycle Lanes:** When bicycle lanes are not present, bike boxes can still be used by providing a short ingress bicycle lane to provide bicycles access to the bike box as they approach the intersection.

## Design References

- Bike boxes are currently authorized for use as an Interim Approval by FHWA. See MUTCD document IA-18 for approval information and design guidance.
- The NACTO Urban Bikeway Design Guide provides further guidance on the use and design of bike boxes.

# MAINTENANCE & MANAGEMENT

- See ***Bicycle Facility*** section for overall guidance on maintenance of bicycle facilities.



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BICYCLE INTERSECTIONS

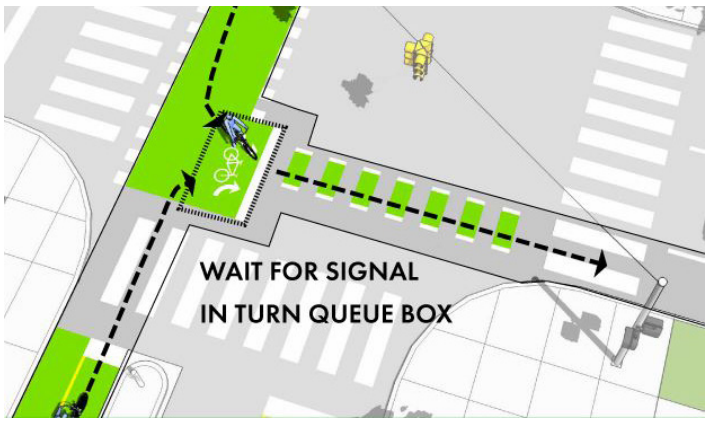
# TWO-STAGE TURN BOX

## DESCRIPTION & INTENT

Two-stage turn boxes (also called two-stage turn queue boxes or simply "turn boxes") provides a mechanism for cyclists to make turning movements through an intersection, especially left turns, in ways that reduce the need to mix with turning or cross vehicle traffic within an intersection.

Two-stage turn boxes work by creating a designed waiting or queuing space outside of the flows of traffic (including bicycle lanes) where cyclists can wait for a signal change. When the signal changes, cyclists are already positioned ahead of vehicle traffic in a visible location where they can complete their turning movement.

Two-stage turn queues reduce bicycle/vehicle conflicts and provide a less stressful turn option for users. While two-stage turn queues increase bicycle comfort, they do require two separate stages to complete a left turn (first proceeding across, then proceeding through to the left). This may increase travel time for cyclists, although the benefit of comfort typically outweighs the time penalty.




Even where two-stage turn boxes are provided, their use is optional. Cyclists may still lawfully complete a left turn from the left most travel lane where vehicular left turns are permitted.

## USE & APPLICATION

### Location

- **Usage:** Two-stage turn boxes should be utilized alongside other dedicated bicycle facilities as part of their design. Where low stress facilities are implemented (e.g. separated bicycle lanes in the downtown environment) two-stage turn boxes are an essential component of the overall facility design.
- Two-stage turn queues are especially beneficial on multi-lane streets, where cyclists would otherwise need to cross over multiple lanes of traffic in order to make a left turn.

### Related Design Elements

- **Two-way Separated Bikeways:** Two-way separated bikeways create some additional complexity in managing how cyclists enter or exit the bikeway, depending on direction of travel. Turn boxes may also be needed to accommodate certain right turn movements.
- **No Turn on Red:** Two-stage turn boxes should be used in conjunction with No Turn on Red to prevent stopped vehicles from turning right on red across the turn box where cyclists may be waiting.

# DESIGN & OPERATIONS

## Design Requirements

A **Turn Box Position:** The turn box should be positioned between the crosswalk and nearest edge of the crossing bicycle lane or travel lane (whichever is closest). This ensures that the turn is box out of the flow of crossing traffic.

B **Turn Box Size - Depth:** The two-stage turn box must be at least 6-feet deep, measured from the nearest edge of the crossing bicycle or travel lane. The turn box should be further deepened as space allows

- **Turn Box Size - Width:** The turn box should be at least 6-feet wide (oriented in the direction of the second stage of movement). Preferably, it should be as wide as the travel lanes behind the turn box where bicycle movements are desired (e.g. 10-feet wide to the match the travel lane width).
- **Pavement Markings:** The turn box must be painted green, with a 6-inch white border around it. The departing edge of the turn box must have a 12-inch wide stop bar.
  - » Inside the turn box, a bicycle symbol and turn arrow must be provided, indicating the receiving and departing direction for bicycle movements.
  - » At complex intersections, such as those with two-way separated bikeways, a single turn box may combine multiple flows of turning movements.

## Additional Design Considerations

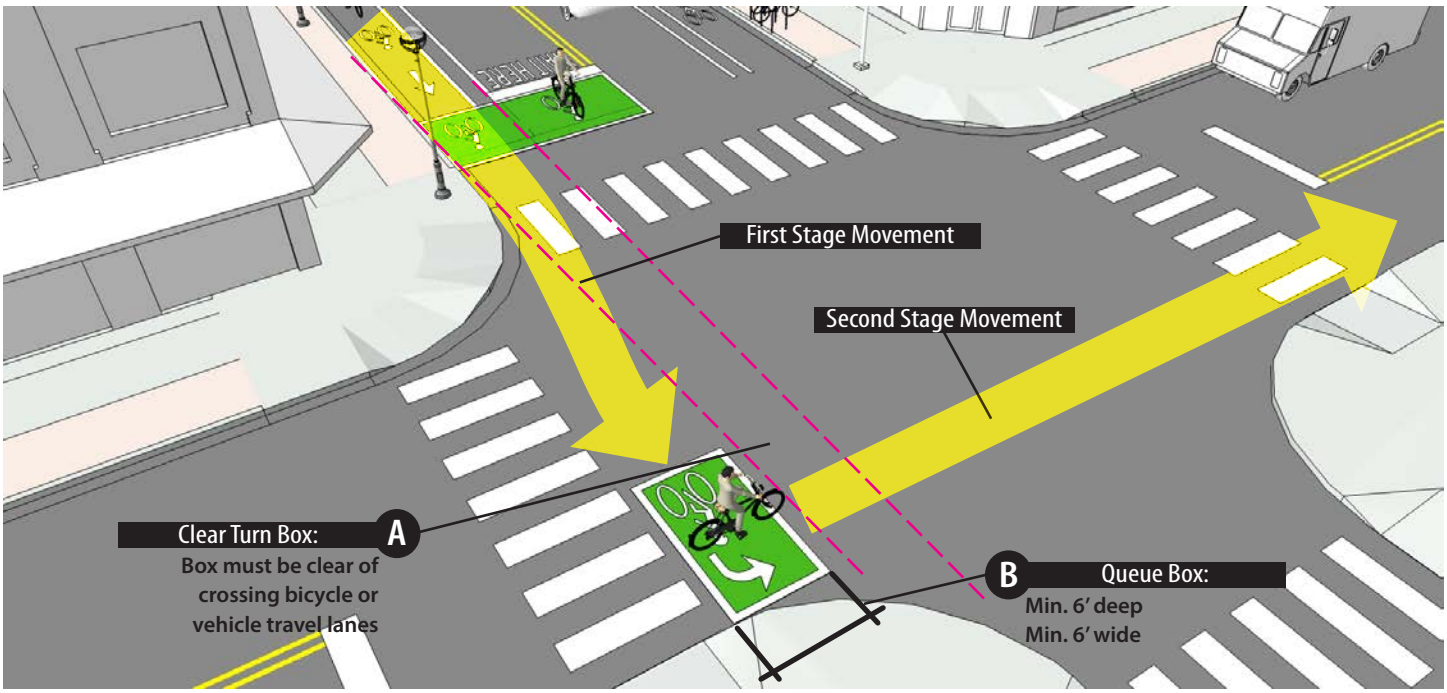
- **Crosswalks and Bike Boxes:** Under constrained circumstances, crosswalks may be adapted to enable space for bicycle queuing. Alternatively a standard bike box (see ***Bicycle Boxes***) may be used; this, however, requires cyclists to cross the pedestrian line of travel and should only be used where pedestrian volumes are low.

## Design References

- Two-stage turn queue boxes are currently authorized for use as an Interim Approval by FHWA. See MUTCD document IA-20 for approval information and design guidance.
- The NACTO Urban Bikeway Design Guide provides further guidance on the use and design of turn queue boxes.

# MAINTENANCE & MANAGEMENT

- See ***Bicycle Facility*** section for overall guidance on maintenance of bicycle facilities.



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BICYCLE INTERSECTIONS

# PROTECTED INTERSECTIONS

## DESCRIPTION & INTENT

Protected intersections are special corner treatments that create waiting and queuing space for cyclists behind raised curb islands. This treatment helps extend protections provided by separated bicycle lanes into the intersection area, although they may also be used with other bicycle facilities.

Protected intersections guide cyclists to more controlled and demarcated crossing points. The corner geometry changes can also be designed to reduce turning speeds for motor vehicles, but must still accommodate designated design vehicles.

## USE & APPLICATION

### Location

- Protected intersections should be considered as part of the design for low stress bicycle routes, especially at intersections where buffered or separated bicycle lanes are used.
- Protected intersections are especially beneficial at larger intersections, multi-lane intersections, and/or locations with wider rights-of-way, such as on urban center, commercial business, city connector, and network neighborhood streets types.

### Related Design Elements

- **Corner Geometry:** Protected intersections function similar to bumpouts, except that they extend further into the intersection zone. Turning radii for vehicles must consider the intended design vehicle on the street and ensure that vehicle movements are accommodated.
- **Bumpouts:** Protected intersections work well alongside bumpouts, and typically require the additional depth provided by bumpouts to create the waiting space for cyclists (see ***Design Diagram*** on the next page).

# DESIGN & OPERATIONS

## Design Requirements

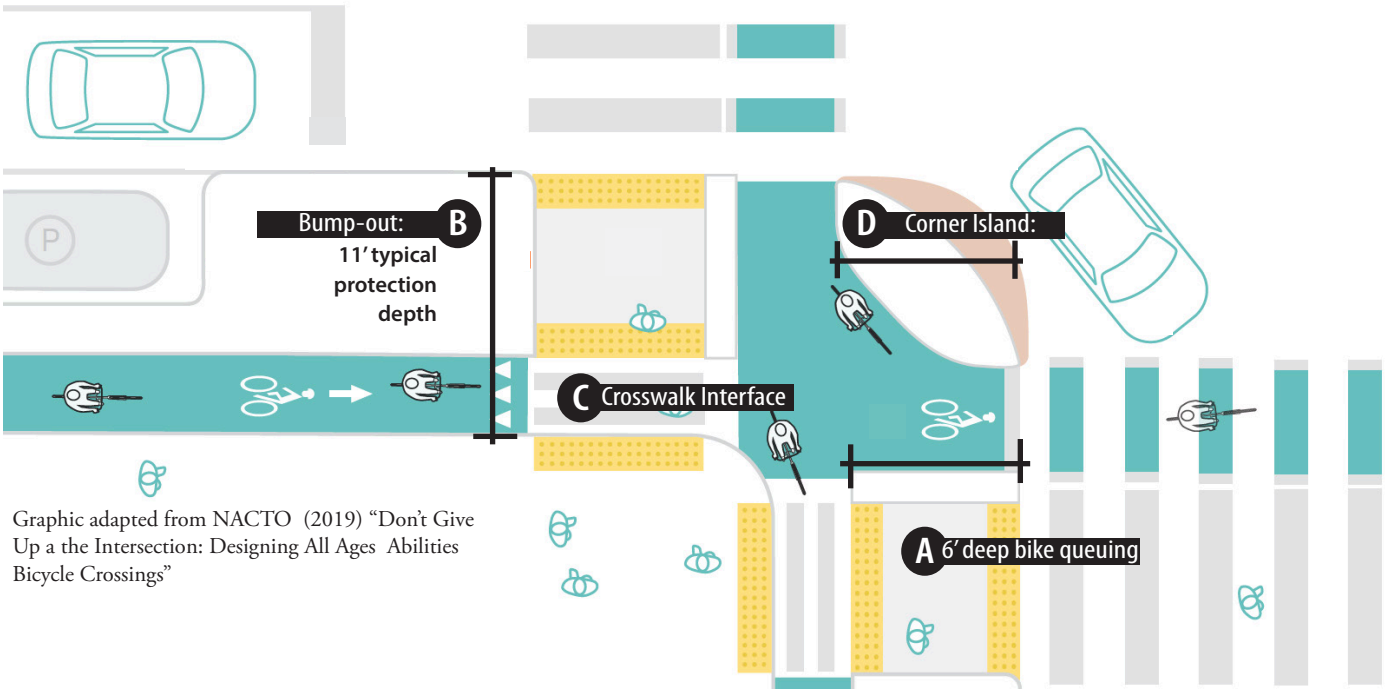
**A** **Bicycle Queuing Area:** The bicycle queuing area should be at least 6-feet deep to provide space for cyclists to wait and be clear from cross traffic. This also provides adequate width for a pedestrian waiting zone between the roadway curb and bicycle lanes.

**B** **Protection Depth:** The overall depth will depend on the queuing depth plus the width of the incoming bicycle lane. This should be a minimum of 11-feet (6-feet for the bicycle queuing area plus 5-feet for the bicycle lane width).

» It may be necessary to shift the approaching bikeway towards the sidewalk (reducing the amenity zone width) in order to achieve the necessary width.

**C** **Crosswalk Interface:** Approaching bicycle lanes should use yield markings and signage ahead of pedestrian crosswalks. Crosswalks should use detectable warning pavement flanking the bicycle lane crossing and at the normal edge of the roadway.

**D** **Corner Island:** The corner island should be designed to accommodate the roadway design vehicle based on an appropriate effective turning radius. Where larger vehicles must be accommodated, use a mountable apron adjacent to the curb to accommodate larger turning radii.




Graphic adapted from NACTO (2019) "Don't Give Up a the Intersection: Designing All Ages Abilities Bicycle Crossings"

## Design References

- Don't Give Up at the Intersection (NACTO, 2019) provides detailed guidance on the design of protected intersections and corners.

# MAINTENANCE & MANAGEMENT

- See ***Bicycle Facility*** section for overall guidance on maintenance of bicycle facilities.

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BICYCLE INTERSECTION

# BICYCLE SIGNALS

## DESCRIPTION & INTENT

Bicycle signals are separate traffic signals used to guide and direct cyclists at intersections. Dedicated bicycle signals enable more complex and controlled timing at complex intersections, allowing for dedicated bicycle turning phases and/or allowing for concurrent bicycle travel with other roadway users. Bicycle signals are designed to reduce conflicts by separating bicycle and motor vehicle movements.

At present, there are no nationally established thresholds or warrants for bicycle signals.

## USE & APPLICATION

### Location

Bicycle signals are used only at signalized intersections and when bicycle-only and/or leading bicycle intervals are required during a signal cycle. The situations below may suggest the use of a bicycle signal:

- Where bicycle and pedestrian volumes are sufficiently high that a bicycle leading interval would be advantageous to safety and/or operations.
- At intersections with separated bicycle lanes where the volumes of vehicle turning movement counts exceed those listed in the chart below, bicycle signals and phase separation should be considered.

| Separated Bike Lane Operation | Motor Vehicles per Hour Turning across Separated Bike Lane | | | |
|---|---|---|---|---|
| | Two-way Street | | | One-way Street |
| | Right Turn | Left Turn across One Lane | Left Turn across Two Lanes | Right or Left Turn |
| One-way | 150 | 100 | 50 | 150 |
| Two-way | 100 | 50 | 0 | 100 |

Source: MassDOT Separated Bicycle Lane Planning & Design Guide (Chapter 6, Signals) [1].

- Where two-way separated bicycle lanes are used, intersections are geometrically complex, and other intersection controls are not desired.
- As an alternative to bicycle signals, "BIKES USE PED SIGNAL" signage may be used where the need for phase separation is reduced. In these cases, it is important that the geometrics of the bicycle lanes be close to crosswalk and visible to pedestrian signal.
    - » If this treatment is used, it should be combined with leading pedestrian intervals (LPIs) to allow cyclists to enter intersections ahead of vehicles and be more visible.

### Related Design Elements

- Bicycle signals shall not be used in conjunction with sharrows.
- Bicycle signals and their associated stop zone should not impede the sidewalk or crosswalk zones.
- Bicycle signals may necessitate prohibition of right on red.

## DESIGN & OPERATIONS

### Design Requirements

- **Orient signal heads** to be clearly visible to on coming cyclists.
- **Signal Activation:** Automatic detection is preferred. If manual activation is required, push buttons shall be located where cyclists can easily access them without leaving the bicycle facility. If the bicycle signal is not programmed into each light cycle, actuate bicycle signal manually (e.g. push-button) or automatically (e.g. in-pavement loop detector or video detection).
- **Bicycle Symbol Face:** Use of the bicycle symbol face inside of the signal head requires obtaining FHWA interim approval. Alternatively, solid color signal faces may be used in conjunction with a sign next to the signal indicated that it is a "BICYCLE SIGNAL."

### Additional Design Considerations

- **Right Turn On Red:** If the bicycle signal separates bicycle movements from motor vehicle turning movements, right turn on red should be prohibited.
- **Signage:** Bicycle signals may be accompanied by unique signage targeted at the cyclist to explain the function and use of the signal. This is particularly valuable if bicycle signals are uncommon or if the movement governed by the signal is unique to bicycles.
- **Signal Timing:** The introduction of bicycle signals may require overall signal re-timing and periodic timing reassessment. There is no specific established guidance at present as to bicycle clearance intervals or other phasing.

### Design References

- MassDOT Separated Bike Lane Planning & Design Guide (Chapter 6, Signals).
- The FHWA has provided interim approval for the optional use of a bicycle signal face (December 2013).
- The NACTO Urban Bikeway Design Guide provides additional guidance on the use and design of bicycle signals.
- MMUTCD provides standards for traditional traffic signals, however not all guidance may be applicable specifically to bicycle signals.

## MAINTENANCE & MANAGEMENT

- Bicycle signals will require additional infrastructure and maintenance and long-term maintenance will be the same as other signalized intersections.`


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MOBILITY SUPPORT

# BICYCLE RACKS

## DESCRIPTION & INTENT

Bicycle parking provides cyclists with a safe, secure, and reliable place to park bicycles whether commuting, running errands, or patronizing businesses. Bicycle parking is an essential component of the city's multi-modal transportation network.

## USE & APPLICATION

This design element section primarily considered short-term bicycle parking (type C) provided by bicycle racks located within the street right-of-way.

### Location

- Bicycle parking should be plentiful, dispersed, visible and conveniently located near nodes, parks, schools and mixed-use districts.
- Bicycle parking should facilitate transfers between modes. It should be accessible to major bus stops and transfer points
- Locating bicycle parking near to corners improves visibility, access to curb ramps, and accessibility to more block frontages. Parking should be located far enough away from the corner to avoid conflicts with curb ramps or sight lines.
- **Bicycle Lanes:** Bicycle parking complements bicycle travel facilities and should be amply located along bicycle routes, lanes, separated bicycle lanes, and trails.

### Related Design Elements

- **Pedestrian Area:** Bicycle parking must be located and aligned in a way that does not impede the pedestrian sidewalk zone or block access between the curbside and clear walking zone.
- **Bumpouts:** Bicycle parking works well in bumpouts or bicycle corrals that extend the pedestrian environment into the parking lane, freeing up space on the sidewalk for circulation or other amenities.
- **Loading Zones:** Bicycle parking should avoid being placed next to loading zones (when possible) in order to minimize impacts to loading operations or damage to bicycles.

## DESIGN & OPERATIONS

### Design Requirements

- **Bicycle Rack Orientation and Clearance: Bicycle racks may be placed parallel, perpendicular, or** at an angle to the curb line singly or in groups of two or more.

A **When perpendicular to the curb**, racks shall be at least 36 inches apart on center and shall be at least 36 inches from the face of curb and edge of the sidewalk.

B **When placed parallel to the curb**, racks shall be at least 5 feet apart at their nearest point. Bicycle racks shall be at least 24 inches from the face of curb (30 inches is preferred where width permits) and 18 inches from the edge of the sidewalk.

» **When at a 45-degree angle,** hoops should be at least 42 inches apart at center and shall be at least 34 inches from the face of curb at the closest point.

C **Clearance from Other Objects:** Install racks with a minimum clearance of at least 36 inches between the center of the rack and any other fixed object.

- **Bicycle Rack Durability:** Racks shall provide secure parking for a bicycle. Bolted down racks (utilizing anti-theft bolts) are preferred. In brick environments, embedding poles into concrete will be necessary. Racks shall resist cutting, damage, or disassembly with typically available implements.
- **Bicycle Rack Design:** Racks shall support a bicycle in an upright position, supporting a bicycle frame in at least two places for common bicycle frame types.
  - » Rack design and installation shall enable bicycles to be easily, intuitively, and securely locked. If artistic bicycle rack designs are used, ensure that U-locks or other typical locking devices can be conveniently used securing both wheels and frame of a bicycle.

## Additional Design Considerations

- Bicycle parking may be integrated with other street features such as parking meter posts, light poles, planters, parklets or tree guards.
- **Lighting:** Adequate lighting around bicycle parking is important for safety and security.
- Consider unobtrusive ways to provide cover or shelter to bicycle parking.

## Utility Considerations

- Ensure that bicycle racks do not block access to utility boxes or hand holes.

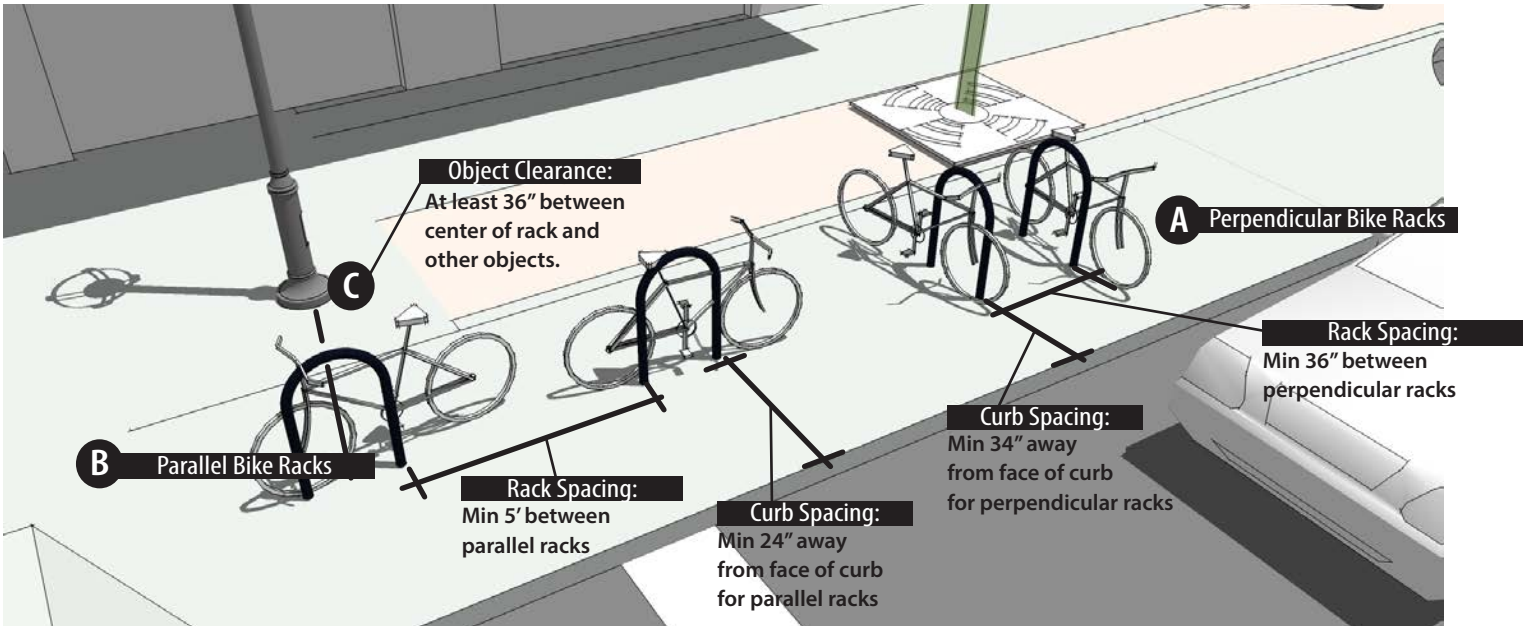
## Sustainability Considerations

- Bicycle parking promotes and enables human-powered, emission-free travel options, providing a number of environmental benefits.
- Bicycle parking should be located proximate to street trees to avoid the temptation to lock bicycles to street trees and reduce damage to the tree.
- Where bicycle parking is covered, consider incorporating solar panels, green roofs, and white roofs.

# MAINTENANCE & MANAGEMENT

## Seasonal Use and Maintenance

- Bicycle parking should be available year-round and in all types of weather. Covered bicycle parking can promote year-round cycling.
- Property owners are responsible for snow removal adjacent to their property; bicycle parking should be kept clear after a snow event.



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MOBILITY SUPPORT

# BICYCLE CORRALS

## DESCRIPTION & INTENT

A bicycle corral is a designated area for short-term bicycle parking. Bicycle corrals provide parking for a number of bicycles in a compact area. Bicycle corrals may be located on sidewalks, in parking lots, or other areas behind the curb, but are often placed in the curbside zone of the street.

By converting a parking space into space for a bicycle corral, cities can accommodate parking for 12 to 20 patrons on bicycles in the space typically used to park one automobile.

Bicycle corrals can replace bicycle hoops, bicycle racks, freeing up sidewalk space for other uses such as additional pedestrian space or cafe dining. Bicycle corrals are an excellent solution for accommodating a large number of bicycles near specific activity areas and in areas with narrow sidewalks.

Bicycle corrals can be used seasonally where there is greater demand for bicycle parking. During colder months, the space can be converted back to other curbside zone uses.

Bicycle corrals are often highly valued by ground floor businesses. Despite removing a valuable curbside parking space, many businesses have found that bicycle corrals improve accessibility and visibility to their establishment(s) in addition to relieving pressure on limited sidewalk space.

## USE & APPLICATION

### Location

- Bicycle corrals should be used in areas of high volume of bicycle traffic, or near significant destinations such as mixed-use districts/nodes, schools, civic buildings and parks.
- Bicycle corrals shall be placed within a standard on-street parking space. Corrals placed at the end of a bank of parking can prevent parked cars from creeping too close to the intersection area.

### Related Design Elements

- **Bicycle Lanes:** Bicycle parking complements bicycle travel facilities and should be amply located along bicycle routes and facilities proximate to major generators or destinations.
- **Bumpouts:** Bicycle parking works well in bumpouts that extend the pedestrian environment into the parking lane, freeing up space on the sidewalk for circulation or other amenities.
- **On-Street Parking:** On-street bicycle corrals may only be used on streets where the curb lane is not used for travel.
- **Loading Zones:** While bicycle corrals convert an on-street parking space, they should not be located in spaces reserved for loading.
- **Bus Stops:** On-street bicycle corrals should not be placed adjacent to locations where large trucks or transit vehicles stop, such as loading zones or bus stops.

# DESIGN & OPERATIONS

## Design Requirements

A Racks shall be oriented perpendicular to the curb. There should be openings facing the sidewalk to enter the corral and secure bicycles.

B Corrals should fit into a parking space comfortably and set back from the edge of the nearest travel lane by a minimum of 1-foot.

- Bicycle corrals shall be immovable once placed, but capable of being removed and stored during winter months.

C The ends of the bicycle corral should provide a barrier or fencing to prevent vehicles from pulling into it.

## Additional Design Considerations

- **Shelters:** Bicycle corrals with roofs may provide sheltered bicycle parking as long as they do not interfere with sight lines.
- **Bumpouts:** Bicycle corrals may be located on bumpouts or where there is adequate space outside of the roadway or curbside zone.
- **Bicycle Repair Stations:** Consider placing a bicycle repair station adjacent to or integrated with the corral. A repair station is an outdoor frame that contains tools for fixing a bicycle, such as a tire pump. Individual tools can be secured to the station with a flexible band that allows cyclists to use them on their bicycle without the potential for theft.

## Utility Considerations

- Do not locate bicycle corrals over utility vaults that need frequent access.
- Consider stormwater facilities when siting. Corrals should not obstruct stormwater flows.

## Sustainability Considerations

- Bicycle corrals not only accommodate demand for bicycle parking but also promote the visibility of this low-emission form of travel.
- If bicycle corrals are covered, consider incorporating solar panels, green roofs, and white roofs.

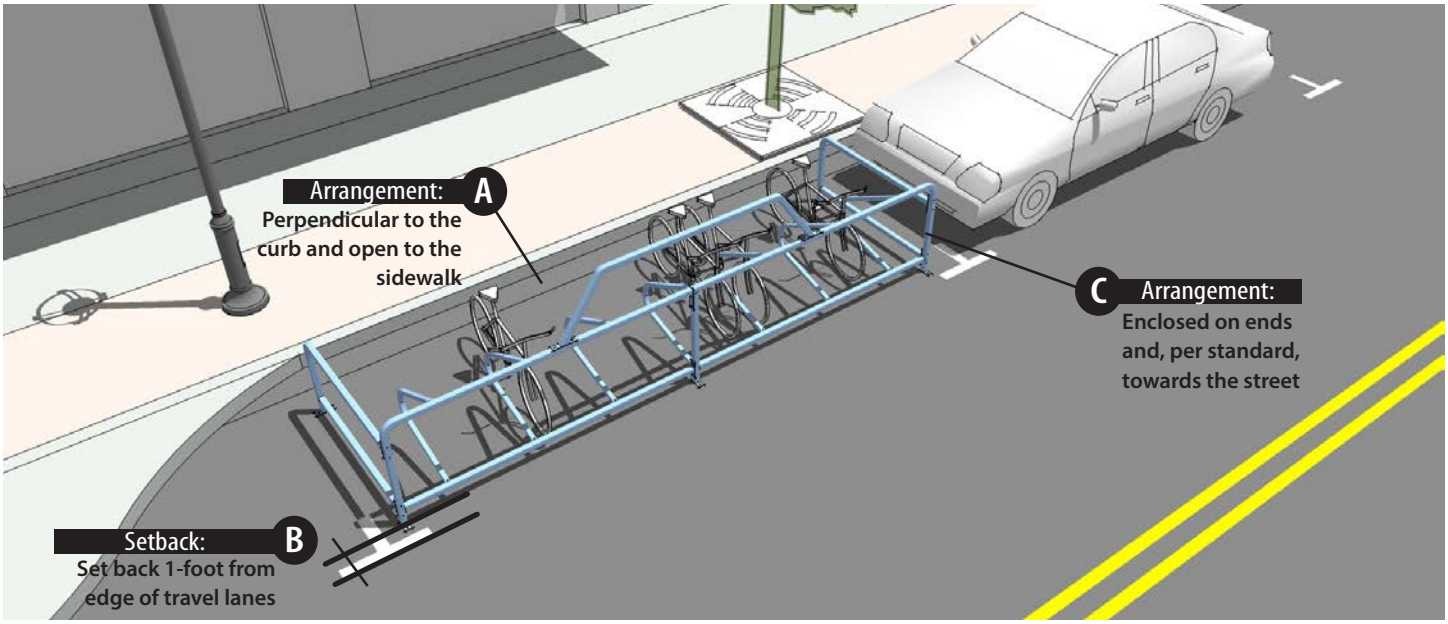
# MAINTENANCE & MANAGEMENT

## Special Maintenance

- Durable material and quality installation can reduce maintenance demands for bicycle corrals.

## Seasonal Use and Maintenance

- On-street bicycle corrals are typically removed and stored during winter months to facilitate snow removal.



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MOBILITY SUPPORT

# MICRO-MOBILITY

## DESCRIPTION & INTENT

Micro-mobility provides access to goods and services through personal, non-motorized modes of transit like shareable bicycles, e-bicycles, scooters, and e-scooters. Micro-mobility helps to address issues of sustainability, public health, environmental justice, and transportation equity within the city system.

Bicycle or scooter sharing is a system that uses affordable, for-rent bicycles/scooters for point-to-point trips throughout the city. They are intended to connect with other transportation services like transit, parking, and ride sharing.

Various communities have introduced year-long pilot projects for bicycle/scooter sharing within a specific service area of the city, collecting bicycle ridership data and implementing a more permanent solution based on demographic and destination data accumulated.

## USE & APPLICATION

### Location

- Identify optimum locations for micro-mobility docking stations based on population density, job rates, car ownership rates, commercial activity, and pedestrian frequency.
- Locate docking stations near frequently traveled areas like colleges/universities, residential linkages, hospitals, employment centers and recreational, and tourist destinations.
- Micro-mobility docking stations may be located in areas typically used for on-street parking or in the amenity or frontage zones of the sidewalk.

### Related Design Elements

- **Bicycle Lanes:** Micro-mobility relies on adjacent bicycle lanes to provide accessibility and safety for its users. Micro-mobility docking stations should be amply located along bicycle lanes proximate to major destinations.
- **Dedicated Transit Lanes:** Dedicated transit lanes allow buses to run more efficiently and reliably, better managing street space for bikers and micro-mobility users.
- **On-Street Parking:** On-street micro-mobility docking stations may only be used on streets where the curb lane is not used for travel.

- **Pedestrian Area:** Micro-mobility docking stations must be located and aligned in a way that does not impede the pedestrian clear zone or block access between the curbside and clear walking zone.
- **Bumpouts:** Micro-mobility docking stations work well in bumpouts that extend the pedestrian environment into the parking lane, freeing up space on the sidewalk for circulation or other amenities.

### Incompatible Elements

- **Loading Zones:** Docking stations should not be located next to loading zones due to potential conflicts with vehicles loading or unloading materials.
- **Cafe Seating:** Docking stations can compete with other amenity zone uses such as sidewalk cafes or sidewalk vending or retail.
- **Bus Stops:** On-street docking stations should not be placed adjacent to locations where large trucks or transit vehicles stop, such as loading zones or bus stops.

## DESIGN & OPERATIONS

### Design Requirements

- Micro-mobility docking stations should observe similar design requirements as the bicycle corral design elements.

### Additional Design Considerations

- E-scooter/e-bicycle charging stations may be located outside of the right-of-way within public parking lots/ garages. If this applies, ensure visibility and identifying signage from the right-of-way.

### Utility Considerations

- Locate docking stations at least 1-foot from manholes and other utility access and 10-feet from fire hydrants.

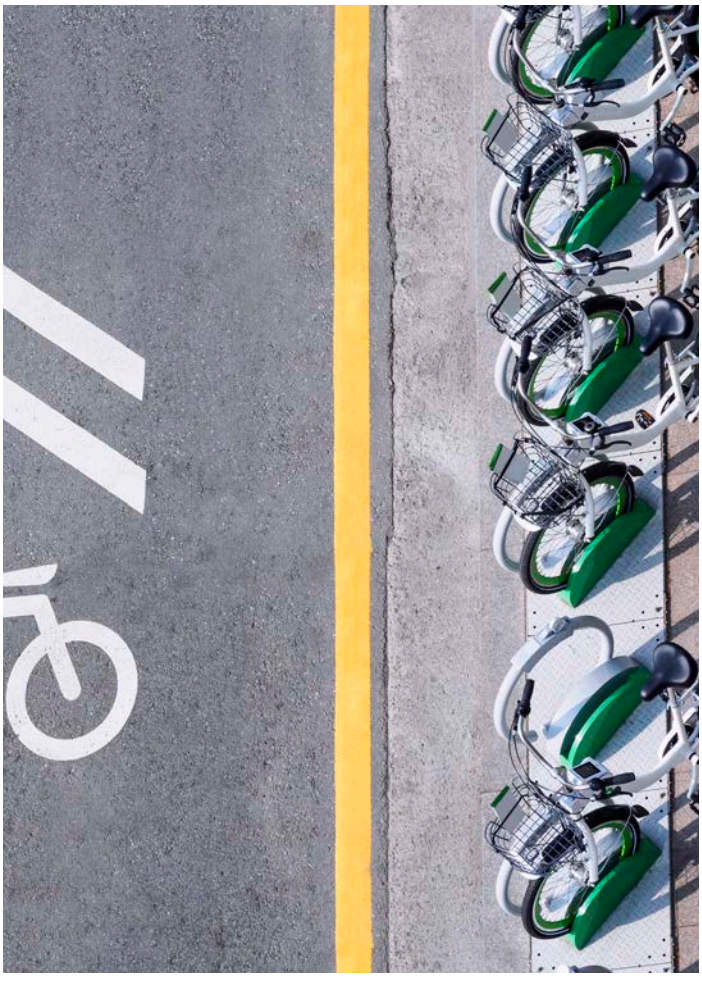
### Sustainability Considerations

- Consider providing solar-powered charging and docking stations.

## MAINTENANCE & MANAGEMENT

### Seasonal Use and Maintenance

- On-street bicycle/scooter docking stations are typically removed and stored during winter months to facilitate snow removal.



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## TRANSIT ELEMENTS

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TRANSIT ELEMENTS

# BUS QUEUE JUMPS

## DESCRIPTION & INTENT

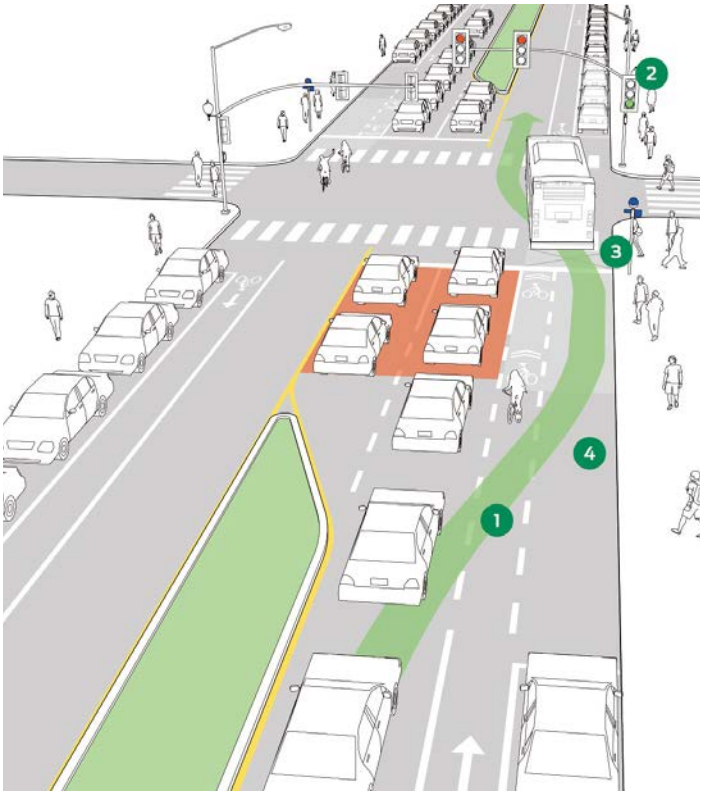
A bus queue jump lane, also known as a bus bypass lane, is a short bus lane located at the approach to a traffic signal. Buses use a bus queue jump lane to bypass waiting traffic queues, significantly improving transit travel time. While other vehicles must turn right, the bus is allowed to proceed straight through from the turn lane to the bus lane.

These facilities may need to be combined with a dedicated transit signal, such as an advanced green light for buses, and a merge lane to permit transit vehicles to reenter general travel lanes on the other side of the intersection.

There are three configurations of bus queue jump lanes that may be appropriate for Kalamazoo:

- **Transit Exemption for Right Turn Lanes:** The bus queue jump lane shares space with the right turn lane, but transit vehicles are allowed to proceed straight through the intersection.
- **Advanced Stop Bar:** In this configuration, the main stop bar is pushed back several car lengths and a transit-only or "right and transit" lane is placed along the curb ahead of the stop line so that transit vehicles can pull ahead of other traffic.
- **Shared Right Turn/Bus Lane:** The entire curbside lane is reserved for transit vehicles, but drivers are allowed to use it for right turns at intersections. This gives buses even more priority, but requires the removal of parking or travel lanes.

Bus queue jump lanes can contribute to faster, more reliable transit service that increases ridership and supports the development of a more vibrant public realm. However, they also may require additional street space for buses, which may mean narrowing general traffic lanes or re-purposing general traffic lanes or parking, which may have a negative effect on the street environment.



# USE & APPLICATION

## Location

- Bus queue jump lanes are only applicable on transit emphasis and vehicle emphasis streets at congested intersections where transit vehicles are likely to experience significant delays.

## Related Design Elements

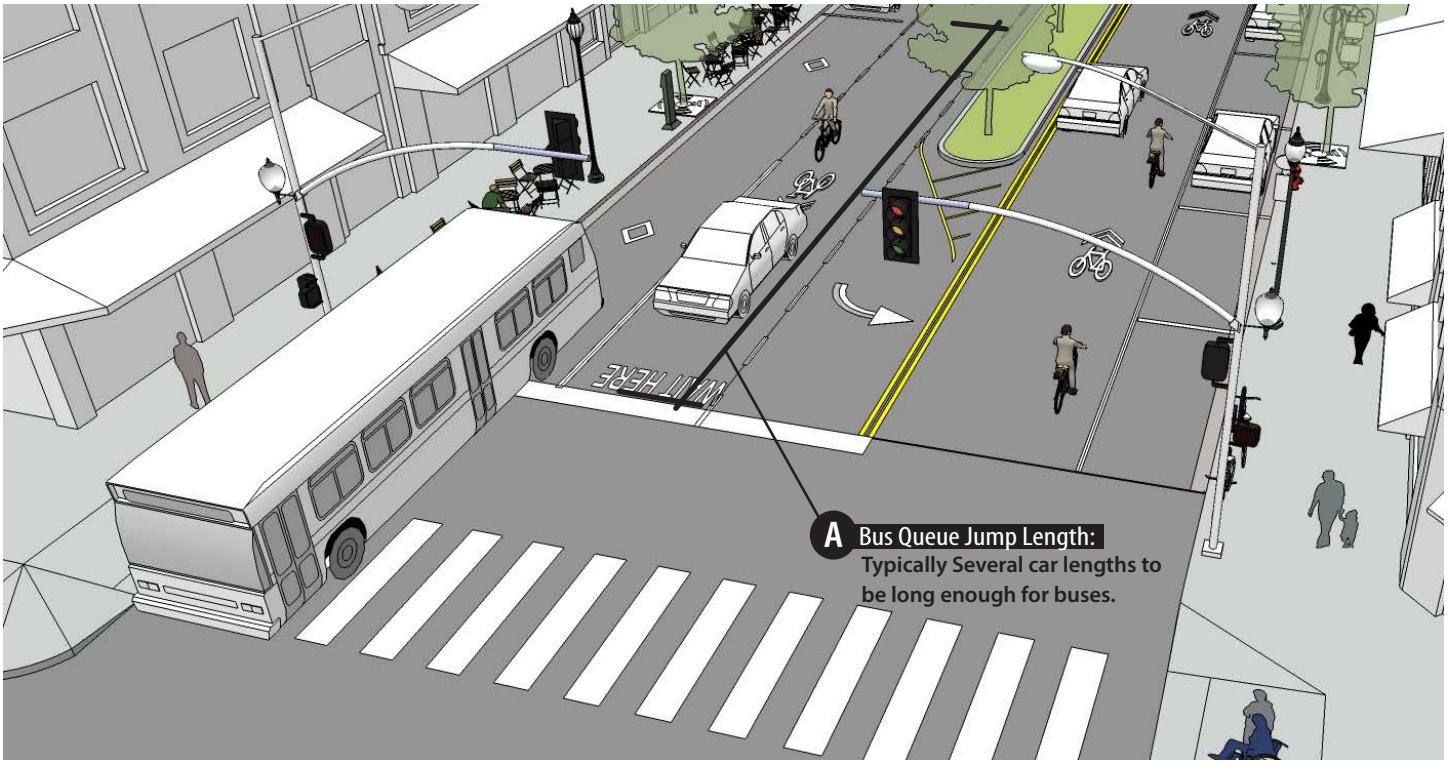
- **Traffic Signals:** To be fully effective, use a Transit Signal Priority (TSP) activated signal in conjunction with a bus queue jump lane to speed buses through the intersection.
- **Transit Lanes:** Where right-of-way is available, consider upgrading bus queue jump lanes to full transit lanes, which increase the speed and reliability of transit and reduce the risk of drivers encroaching on the lane.
- **On-Street Parking:** Place bus queue jump lanes in a parking lane, which preserves parking space while creating an opportunity to give transit priority over other vehicles.
- **Bus Stops and Shelters:** Provide substantial bus stops with shelters, seating areas, and real-time information. Consider instituting other elements of bus rapid transit, such as off-board fare collection that can reduce wait time at stops.

# DESIGN & OPERATIONS

## Design Requirements

A Design bus queue jump lane long enough so that buses can move ahead of vehicles stopped at an intersection.

- Place an advanced stop bar in the bus queue jump lane to give buses a head start. The stop bar shall be placed at least two car lengths ahead of the main traffic stop bar, depending on the length of the queue.
- Consider special pavement markings for the bus queue jump lane to indicate that the space is exclusively for transit vehicles.
- Provide space on the other side of the intersection for the bus to reenter traffic.
- Place bus stops at the far-side of the intersection to allow buses to take advantage of the bus queue jump lane on the near-side of the intersection. If the bus stop is on the near-side, place it behind the bus queue jump lane.
- Use signal timing to allow right turning drivers to clear the bus queue jump lane in order for transit vehicles to use it. This may require an additional right turn signal phase. Shorter traffic phases may also help to reduce backups at the intersection, making transit signal priority more efficient.



## Additional Design Considerations

- Bus queue jump lanes can give priority to both transit vehicles and cyclists. However, if the bus queue jump lane is physically separated from the rest of the street, bicycles should not be allowed to share the lane due to the higher speeds transit vehicles will be able to achieve.
- Exercise caution when placing bicycle lanes next to shared bus queue jump lane/right turn lanes due to conflicts with drivers merging in and out of the lane. Use colored pavement markings to identify the conflict zone.
- Where a bus queue jump lane is added in place of on-street parking, any on-street parking that remains should stop far enough back from the intersection to allow the bus to transition into and be properly positioned within the queue lane.

## Utility Considerations

- Ensure that the construction of a bus pad does not interfere with underground utilities. Bus queue jump lanes may require a bus pad or other strengthening of the road surface to support standing or waiting transit vehicles.

## Design References

- The NACTO Transit Street Design Guide (2016) provides guidelines on how to design a bus queue jump lane.

# MAINTENANCE & MANAGEMENT

- Frequent police enforcement is required to ensure that drivers do not attempt to use the queue jump lane.

## Special Maintenance

- Maintain signage and markings for bus queue jump lanes to ensure visibility and encourage driver compliance.

## Seasonal Use and Maintenance

- Bus queue jump lanes can be cleared of snow using regular snow equipment. Bus queue jump lanes should never be used for snow storage.

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TRANSIT ELEMENTS

# TRANSIT LANES

## DESCRIPTION & INTENT

Transit may operate in lanes shared by general traffic or in dedicated facilities. Dedicated bus lanes are used to speed up bus service on busy streets with frequent transit service. A single bus can carry 40 or more passengers, allowing a bus lane to drastically increase the amount of people a street can move.

Transit lanes reduce traffic delays for transit vehicles and increase the reliability of high-quality transit service. Transit lanes can be an important part of encouraging transit use, making the service faster, more reliable, and more enjoyable.

Transit lanes can occupy several different places on a street, depending on the type of service offered and the available space. A variety of options are described here, though curbside and offset lanes are the most likely in the downtown area.

- **Curbside lanes** are immediately adjacent to the curb on the right-hand side of the street. They work best on streets with few driveways and high volume right turns.
- **Offset lanes** operate outside of a parking lane. Bus stops are located in bumpouts in the parking lane. Offset lanes are compromised by vehicles entering, exiting, and waiting for curbside parking.
- **Median lanes** occupy the center of the street. They may operate within a median, typically then separated from general traffic by median islands, or adjacent to a median with doors on both sides of the transit vehicle to permit left and right side boarding.
- **Contra-flow bus lanes** are generally implemented on one-way streets where the transit lane operates in the opposite direction of general traffic and is located adjacent to the curb.
- **Transit streets or plazas** are street segments that prohibit private vehicle traffic and reserve the entire travel way for transit vehicles only. Bicycles and pedestrians are generally permitted. Transit plazas are typically used where transit services are extremely frequent, transit use is concentrated, and rights-of-way are severely constrained.

## USE & APPLICATION

### Location

- Transit lanes should only be used on corridors where transit service is very frequent (10 minutes or less), ridership is high, and traffic congestion significantly and routinely impedes transit operations.
- Transit lanes should be considered on any high priority transit corridor streets, as identified in local transit authority plans.
- Transit lanes may be permanent or temporal—reserved for transit vehicles only at peak hours of the day and permitted for other uses (such as parking or general traffic) at other times. They may be reserved exclusively for the use of transit vehicles or may have shared-use.

## Related Design Elements

- **Vehicle Travel Lanes**: Transit lanes may be exclusive for transit use or may be in mixed traffic. Although high-occupancy vehicle (HOV) facilities are not common in Michigan at present, MDOT continues to explore their use. In some instances bus lanes are shared with HOV vehicles to provide advantages to both.
- **Transit Signals:** See ***Bus Queue Jump Lanes*** section.
- **On-Street Parking:** Offset bus lanes where the curbside is used for parking can cause conflicts with drivers entering and exiting the parking lane. Drivers parking can cause significant delays to the bus service, reducing its reliability and efficiency.
- **Loading Zones:** Removing parking for a bus lane can make loading access difficult for commercial buildings. Give additional consideration to the design of bus lanes in areas with curbside loading.

# DESIGN & OPERATIONS

## Design Requirements

A **Lane Width:** The minimum acceptable width for a bus lane is 10-feet, with 11-foot lanes typically preferred for transit. For curbside lanes, these widths do not include the width of an adjacent gutter. [1].

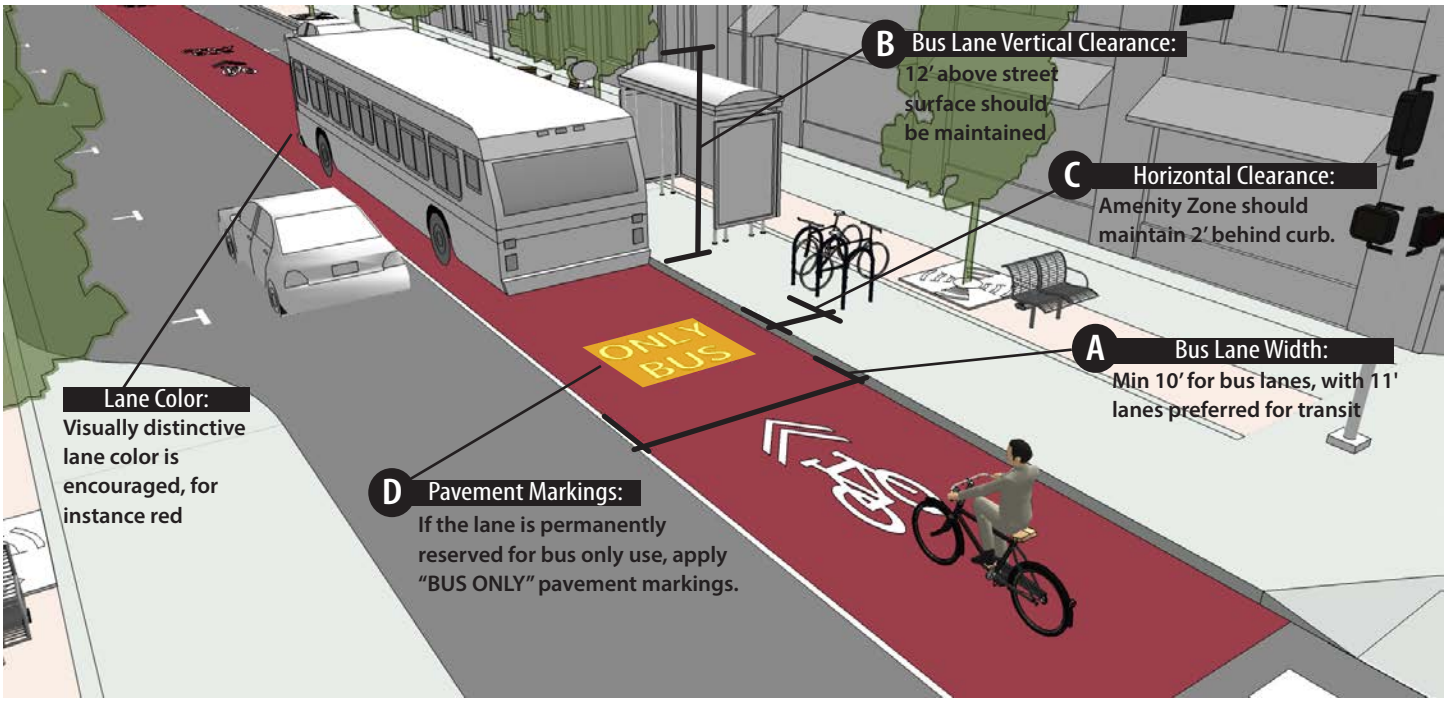
  - » Gutters may be included in the calculated dimension of a curbside transit lane.

B **Vertical Clearance:** The street shall be clear for a vertical distance of 17-feet above the street surface. Banners or trees overhanging a curbside zone used for bus travel shall be maintained above this height. [4].

C **Horizontal Clearance:** Fixtures or plantings in the amenity Zone shall maintain a 2-foot clear zone from the face of the curb where buses or other vehicles travel in the curb lane.

D **Pavement Markings:** If the lane is permanently reserved for bus only use, apply "BUS ONLY" pavement markings. If the transit lane is shared for HOV or bicycle use, include appropriate markings.

- **Shared Bus-Bicycle Lane:** Should only be considered where dedicated bicycle facilities can not be accommodated and where buses are operating at lower speeds (20 MPH or less).
- **Signage:** Street signage indicating "BUS ONLY" should be used adjacent to the bus lane. At intersections, lane signs and any overhead signs should also indicate "BUS ONLY" lanes.



## Additional Design Considerations

- **High Visibility Marking:** Making bus lanes visually distinctive may discourage encroachment by other road users. Red paint can color dedicated transit lanes, but is not required.
- **Right Turn Lanes:** At intersections, bus lanes may become right turn only lanes. Use a dotted line to denote where private vehicles may enter the bus lane.
- If the dedicated lane is only in effect for certain hours, consider restricting right turns to keep the lane clear.
- **Barriers:** Transit lanes may be separated from general traffic by soft barriers, such as rumble strips or physical barriers like concrete curbs or rubber bumpers.

## Utility Considerations

- When utility work requires occupying part or all of a dedicated transit lane, have a plan in place to prevent a significant disruption of transit service. Consider re-purposing a general traffic lane temporarily, signal changes, or other efforts to reduce delays.

## Design References

- NACTO Transit Street Design Guide (2016) provides recommendations on how to design bus lanes and necessary considerations for installing them.
- The AASHTO Green Book describes how to design transit lanes, including operational issues, dimensions, and metrics for measuring success.
- The TCRP Report 19 provides guidance for roadway design factors for bus service.
- MUTCD, Part 2, Mounting Height for Signs.

# MAINTENANCE & MANAGEMENT

- Colored pavement may require more frequent maintenance than regular pavement.

## Seasonal Use and Maintenance

- **Snow Removal:** Transit lanes should not be used for snow storage.
- Keep access to transit lanes and bus stops clear for both the vehicles and riders.
- Physically separated transit lanes may require additional or special equipment for snow removal.

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TRANSIT ELEMENTS

# BUS STOPS & SHELTERS

## DESCRIPTION & INTENT

Bus stops are designated places where riders can board or alight the bus. Bus stops may be as simple as a signpost along a curb edge or may be a distinct sub-place that includes distinct features such as a shelter, seating and/or public art.

Bus stops typically occur in the pedestrian zone of the street. Bus stops may be located at the curb line or may be accommodated on a bus bulb, an extension of the curb that permits the bus to safely board passengers from the travel lane. The location and design of bus stops depends on passenger volume and available space, among other factors. Bus stops typically share space on the sidewalk with other uses and should be considered in the overall context of the sidewalk area.

Bus stops should be located proximate to designated crosswalks since riders often cross the street to get to or return from the bus stop. Bus stop design should also consider cyclist access to the stop including bicycle route connections and bicycle parking.

Bus stops are most successful when they are appropriately scaled to the volume of riders, provide comfortable places to wait, and deliver sufficient information to transit riders to understand the services provided. A well-designed stop calls attention to the availability of transit service, explains how it works, and makes transit an appealing travel option.

## USE & APPLICATION

### Location

- Bus stops are appropriate and recommended for all street types and are essential to provide access and mobility for all users.
- The type of bus stop (sign only or shelter) and provided amenities will depend largely on the number of passengers utilizing that location (primarily waiting to board), as well as the width and pedestrian volume of the adjacent curbside and sidewalk areas, whether the space can accommodate transit amenities.
  - » On transit emphasis streets and in locations with high ridership, stops should provide an enhanced waiting environment, such as covered waiting shelter, formal seating, informal seating, rider information, and real-time information.
- Bus stops may be located at near-side, far-side, or mid-block locations.
  - » Where buses operate in mixed traffic and stop at the curb line, far-side stops are generally considered preferable unless located at a stop-controlled intersection or if a bus bulb is utilized.
  - » The location of the bus stop will be the result of multiple factors including operations, routing and transfers, and local land use and right-of-way context.

## Related Design Elements

- **Sidewalks:** Bus stops must be co-located with continuous ADA accessible sidewalks and adjacent crosswalks connecting them to the larger pedestrian network.
- **Bus Bulb:** In locations where sidewalk space is tight, buses have difficulty re-merging into travel lanes, and/or large volumes of pedestrians wait, bus bulbs may be used.
- **Bicycle Parking:** Where possible, bus stops should include bicycle racks to accommodate bicycle access. Bicycle share stations should be located proximate to bus stops and/or provide wayfinding to nearby bus stops.
- **Bicycle Lanes:** On bicycle priority streets, bus stops should be designed to minimize conflicts with cyclists. This may include routing bicycle lanes onto the sidewalk and behind the bus stop to reduce conflicts between cyclists and transit passengers.

# DESIGN & OPERATIONS

## Design Requirements

- **Stop Location:**

A The "front" of the bus stops shall be at least 50-feet past (downstream from) a crosswalk whenever possible.

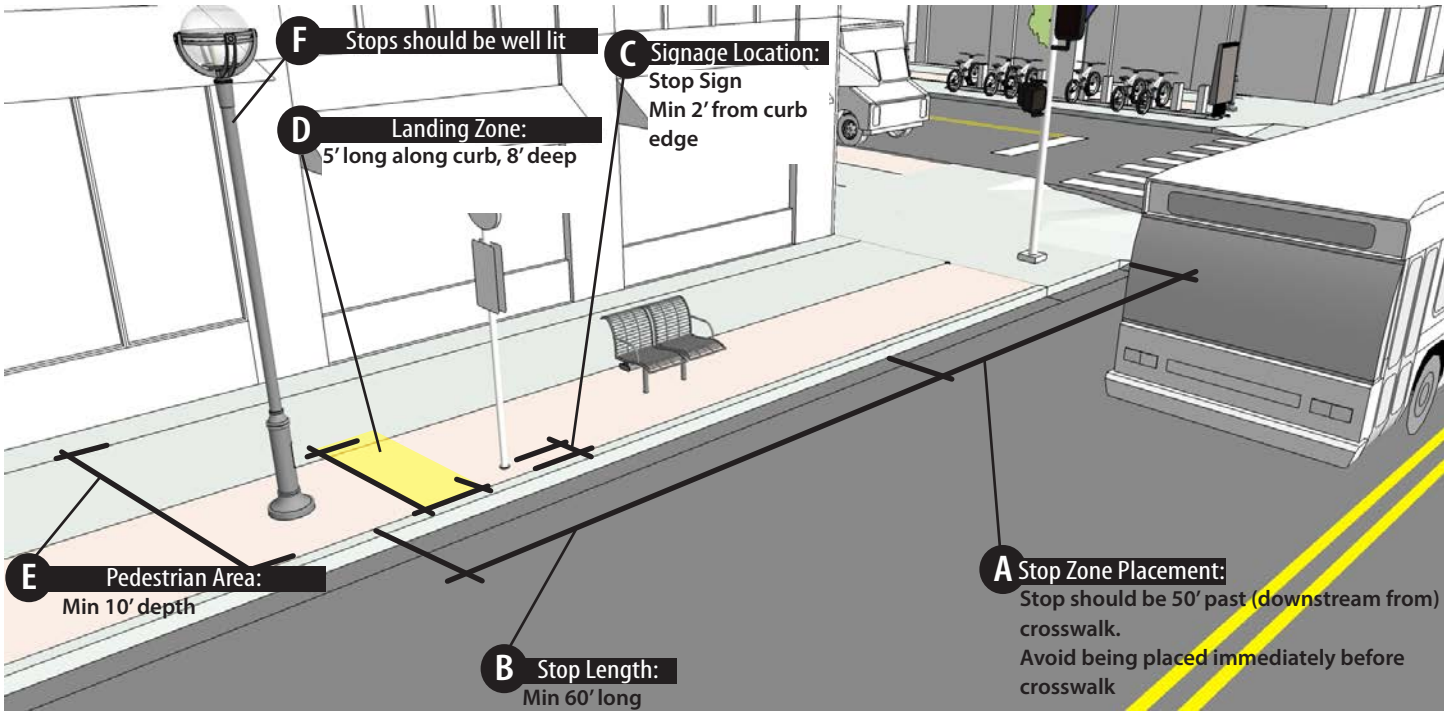
» Bus stops should not be placed immediately before (upstream of) a crosswalk as the stopped bus can prevent pedestrians and traffic from seeing each other.

» Bus stops should be located at least 100-feet from alleys or frequently used curb cuts, such as those servicing parking decks, to minimize conflicts with vehicles entering and exiting, however, in dense urban contexts such as downtown Kalamazoo, this is not always possible.

B **Stop Length:** Bus stops shall be at least 60-feet long.

» Longer stops may be necessary if articulated buses are used and/or there is a high volume of buses utilizing a stop location. The bus zone is longer than the bus to accommodate buses maneuvering to the curb and/or back into the travel lane.

C **Signage Location:** Bus stops should have a flag sign on a sign post embedded in the sidewalk a minimum of



2-feet from the curb edge.

  - » At far-side or mid-block stops, the sign should be located 25- to 35-feet from the front edge of the bus zone to give the bus room to pull out from the stop and reenter traffic from its stopped position
  - » Basic route information shall be provided including service operator, route(s) servicing that stop, schedule information, and major stops serviced.

D **Landing Zone:** Bus stops shall have a landing zone at every door that is at least 5-feet wide parallel to the curb and 8-feet deep. This allows enough room for the bus to extend its ramp for riders with mobility impairments.

  - » Landing zones shall be clear of any curbside obstacles, such as street trees, planters, planting beds, light poles, or sign posts.

E **Pedestrian Area:** Adjacent pedestrian areas (amenity and walking zones) shall be at least 10-feet in total depth. 10-feet provides adequate space for passenger waiting, while still providing comfortable room for pedestrians to travel through the bus stop zone.

  - » Along sidewalks with greater pedestrian density, the width may need to be larger.

F **Lighting:** Bus stops shall be well lit by the surrounding street light system.

- **Sidewalk Connectivity:** Bus stops shall be contiguous with a continuous sidewalk network.
- **ADA Accessibility:** Bus stops shall meet accessibility requirements including providing a smooth, level, and clear zone for boarding, alighting, waiting, and access and egress from the bus stop.

## Additional Design Considerations

- **Safety:** Bus stops should be located and oriented to promote real and perceived personal safety for passengers waiting for transit service.
- **Shade:** Ideally, bus stops will have some degree of shade, whether provided by adjacent buildings, street trees, or bus shelters.
- **Bus Shelters Design:** Bus shelters may be provided at higher volume stops where sidewalk space permits.
  - » Shelters are typically 10- to 12-feet wide and between 5-feet deep.
  - » Shelters can be fully or partially enclosed on one or more sides to provide protection from wind and rain.
  - » Bus shelters should use transparent materials like glass, to improve security and reduce sight obstructions.
  - » Bus shelters provide the opportunity for additional information such as real time bus arrival displays, advertising panels, and larger maps of the stop area and/or transit system.
- **Bus Shelter - Position and Clearances:**
  - » Shelters should be located in the amenity zone, with at least 4-feet of clear space between the shelter and the curb.
  - » Alternatively, shelters may be placed in the frontage zone at least 1-foot from a blank building face and/or be integrated features of the building wall, such as an alcove or awning.
  - » Shelters can be oriented facing out to the street or out to the sidewalk. When located close to the curb, sidewalk facing shelters can provide pedestrian protection against vehicle splashes.
  - » Shelters should be located 10-feet, parallel to the curb, from any vertical obstructions such as street trees, street lights, and utility poles.
  - » Shelters should not be utilized where they would result in less than 6-feet of pedestrian through zone for the adjacent sidewalk.
  - » Use of a bus bulb may be an appropriate treatment

to provide for shelter siting and sufficient sidewalk clear space.

- **Amenities:** Bus stops may include additional passenger amenities such as waste or recycling receptacles, benches or leaning rails, wayfinding signs, street trees, and/or special lighting.
  - » Fixtures should be at least 18 inches from landing zones and 3-feet from benches to accommodate circulation.
  - » Trees should be planted no closer than 10-feet from landing zones.
- **Information Displays:** Increasingly, major bus stops are designed to be "mobility hubs," providing information on the range of area transportation services, including nearby bicycle share and car share services, information for taxis and ride sharing providers, and wayfinding to local civic destinations or businesses.
- **Special Materials:** Stops may use special paving patterns, plantings, public art, or street furniture to further highlight and distinguish the bus stop. This would be most common on transit priority corridors or at the most significant bus stops.

## Utility Considerations

- Coordinate bus shelters, tree pits, and any amenities anchored in the pavement of the sidewalk with underground utilities.
- Locate bus shelters at least 1-foot from manholes and other utility access and 10-feet from fire hydrants.
- Do not locate utility vaults in bus stop areas.

## Sustainability Considerations

- Consider green roofs, white roofs, or include solar or wind generators to power advertising displays or real time information.

# MAINTENANCE & MANAGEMENT

- Simple bus stops introduce few significant maintenance needs.
- Bus stops are used year-round. Bus stops may be temporarily relocated to accommodate seasonal events such as festivals or other street closures; however, significant advance notice should be provided to riders and signage placed at the stop indicating the location of the temporary stop.
- Bus shelters require rapid repair if glass panels are broken or damaged. The shelter must also be regularly washed and any litter accumulating in and around the shelter should be removed.
- If waste or recycling receptacles are provided, clear responsibilities for waste removal must be established.

## Seasonal Use and Maintenance

- **Snow Removal:** Bus stops must be cleared of snow and ice both in their landing zones as well as clear pathways provided to cleared sidewalk paths. Adjacent property owners are responsible for snow and ice clearing at bus stop.
  - » A pathway from the landing zone to the cleared roadway space must be maintained at a width sufficient to enable deployment of wheelchair lifts. This can be particularly challenging as roadway plowing tends to pile snow up at the curb line. This berm of snow must be cut through to enable a clear path for passenger boarding and alighting.

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TRANSIT ELEMENTS

# BUS BULBS

## DESCRIPTION & INTENT

Bus bulbs extend the bus stop space into the roadway space for the length of the bus stop. Physically, they can be constructed similar to a bumpout, except they are positioned at a bus stop.

Bus bulbs provide additional space for passenger waiting and queuing and transit amenities. They can increase the visibility of waiting transit riders, while keeping them further away from the adjacent travel lanes.

## USE & APPLICATION

### Location

- Bus bulbs may be warranted on any street type where sidewalk space is constrained given the volume of pedestrians (transit riders and walkers) and where bus operations are reduced due to difficulty re-merging into travel lanes.
- On transit emphasis streets, bus bulbs are recommended to increase the visibility and efficiency of transit service.
- Bus bulbs should only be used in locations where there is a curbside zone and/or dedicated on-street bicycle facilities.
- Bus bulbs, like bus stops, may be located at near-side, far-side, or mid-block locations. Bus bulbs located at near- or far-side locations are typically integrated with and appear as elongated bumpouts.

### Related Design Elements

- **Bicycle Lanes:** Bicycle facilities should be routed behind the bus bulb and bus stop area. If bus bulbs are used at near-side locations, careful design is necessary to ensure safe bicycle progression through the intersection.
- **Travel Lanes:** Bus bulbs are utilized on two-lane roadways that have only one travel lane in each direction, causing buses to stop traffic during boarding operations. Bus bulbs can reduce the vehicle flow of that lane. Traffic operations must be considered carefully the installation of bus bulbs.
- **Street Lighting:** As with all bus stops, bus bulbs should be well lit and proximate to safe pedestrian crossings and bicycle parking.
- **Bicycle Share:** Bus bulbs are typically only applied on higher volume routes and thus benefit from co-location with bicycle share stations.

# DESIGN & OPERATIONS

## Design Requirements

**A** **Length:** The length of bus bulbs depends on the type and volume of buses using the stop. Bus bulbs will typically only need to accommodate a single, standard 40-foot bus. Bus bulbs shall extend from the front of the vehicle to beyond the back door, at least 30-feet in length.

**B** **Width:** The width of a bus bulb will depend on the typical curbside use of the street and outside travel lane. A bus bulb shall extend from the curb edge out to within 1.5- to 2-feet of the outside of the travel lane.

**C** **Height and Elevations:** Bus bulbs shall be designed at a curb height consistent with the rest of the street and level with the adjacent sidewalk.

» Bus bulbs may also be designed at a greater height to facilitate level bus boarding. In this case, railings may be required at the back of the bus bulb and ADA accessible ramps must be provided for access to and from the adjacent sidewalk.

- **Bus Stop Design Requirements:** Bus bulbs are typically utilized with near-side or mid-block bus stops. Bus bulbs shall follow other design guidance required of typical bus stops.

**D** **Bicycle Lanes Routing:** Bicycle lanes should be routed behind the bus bulb so that bicycle traffic can be maintained and separated from the roadway.

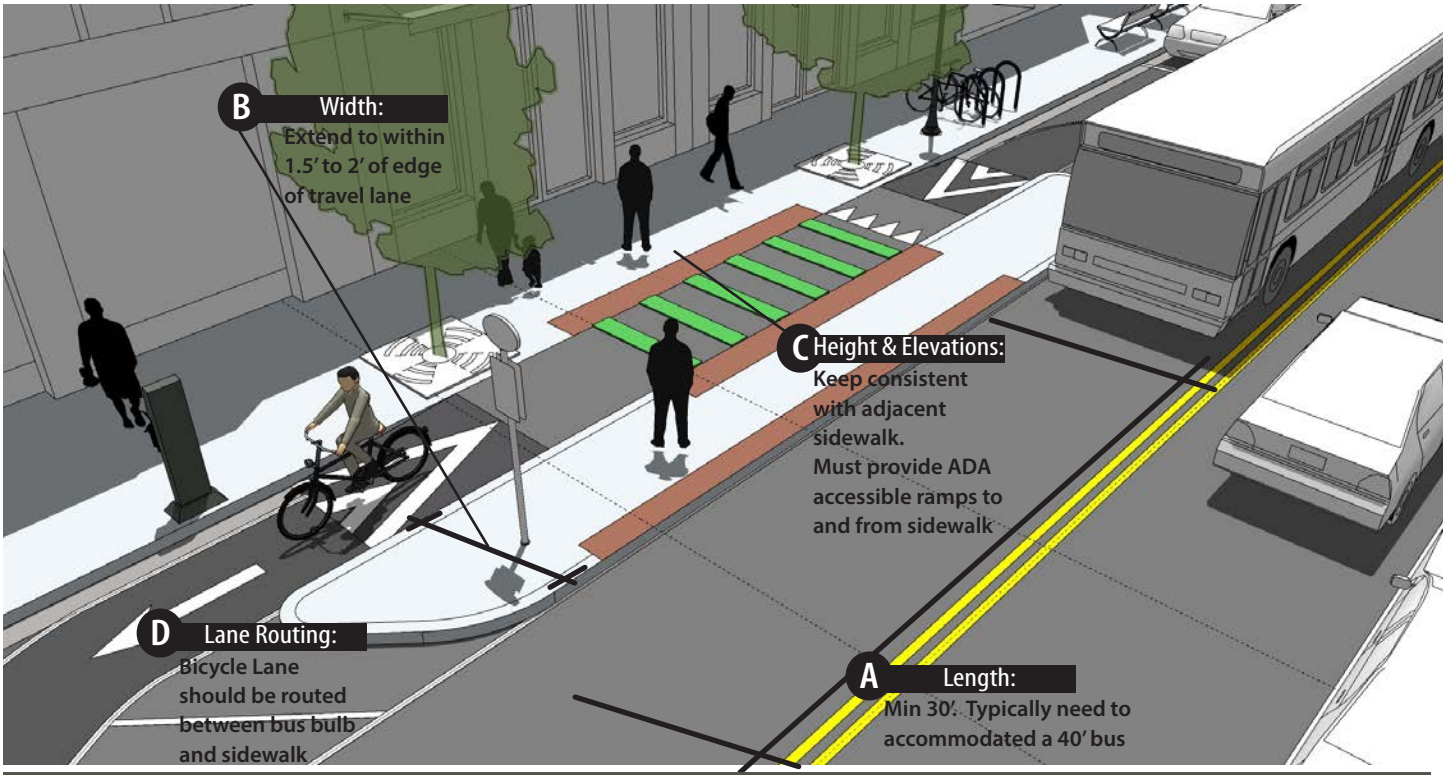
» Bicycle lanes should be raised and ramped up ahead of the bus bulb to provide a level surface for pedestrians. The ramps will help slow bicycle speeds as they enter a pedestrian area.

» Use color pavement markings throughout the length of the bicycle and pedestrian mixing area (green bars or checkered patterns).

» Use "BIKES YIELD TO PEDS" and yield markings on the bicycle lane to give pedestrians the priority.

## Additional Design Considerations

- **Amenities:** Because bus bulbs provide additional pedestrian space, bus shelters, and other passenger amenities should generally be provided. Bus bulbs may include bicycle racks, provided they do not conflict with clear landing zone requirements.
- **Curb Cuts:** Bus bulbs may be located adjacent to driveways, alleys, and other curb cuts provided that adequate space and return angle is provided for their access and egress.
- **Flexible Platforms:** Consider constructing bus bulbs using modular platforms which can be moved, modified, or adjusted more easily than permanently installed facilities.



## Utility Considerations

- Bus bulbs should be designed not to impede stormwater drainage from the street. This may require installation of additional drainage inlets or provision of a trench drain along the normal curb line.
- Bus bulbs may introduce utility conflicts and must be carefully coordinated.

## Sustainability Considerations

- Bus bulbs may include pervious pavement and landscaping. Landscaping may include opportunities for stormwater retention and/or filtration provided it does not conflict with transit landing zones.

## Design References

- The NACTO Transit Street Design Guide (2016) provides additional guidance on how to design a bus bulb (see ***Side Boarding Island Stop***).
- The AASHTO Green Book offers guidance on the appropriate placement and configuration of transit bumpouts.
- More information on bus bulbs can be found in the TCRP Report 65 "Evaluation of Bus Bulbs" sponsored by the Federal Transit Administration.

# MAINTENANCE & MANAGEMENT

## Special Maintenance

- Bus bulbs, like other curb extensions, may complicate street repaving and other maintenance activities.

## Seasonal Use and Maintenance

- Like bus stops, bus bulbs will need to be cleared of snow in such a way that maintains clear passenger access to and from bus doors, including providing for the deployment of wheelchair lifts.
- Bus bulbs should be designed with roadway snow removal and storage in mind. Ensure that the design angles do not inhibit plowing or street sweeping.

## Reviews and Approvals

- Bus bulbs, like bus stops will be approved the AAATA and the Ann Arbor Engineering Unit.


*Example of a flexible bus bulb platform with a bicycle lane traversing through. Bicycles must yield to pedestrians. Ramps help slow down bicycles as they approach the bus bulb.*

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# 4.5

## ROADWAY ELEMENTS

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ROADWAY ELEMENTS

# TRAVEL LANES

## DESCRIPTION & INTENT

Travel lanes are the portion of the roadway marked for the movement of vehicles. The width of travel lanes is a critical dimension that affects many aspects of the street including vehicle speed, pedestrian crossing distances, signal cycles, and the amount of roadway impervious surface.

**Travel lanes** may be used by both motorized vehicles and bicycles. Lanes intended for travel are not to be used for loading or parking.

The width of travel lanes has a direct relationship to the speed of vehicles. Research has shown that narrower lane widths reduce traffic speeds without decreasing safety, and that wider lanes are not correlated with safer streets. In general, travel lanes should be as narrow as possible, while still accommodating the roadway's design vehicle, in order to encourage slower speeds and improve safety for all users.

**Turn lanes** provide a space for vehicles to move out of the general flow of traffic into a dedicated space from which to turn. Turn lanes, particularly center-turn lanes, can significantly improve vehicle flow.

## USE & APPLICATION

### Location

- Travel lanes are required on all public streets.

### Related Design Elements

- Travel lanes and turn lanes must be assembled together with other roadway elements such as parking lanes, bicycle facilities, transit lanes, and other curbside uses.
- The assemblage of travel lanes can have a substantial effect on the street experience, especially for pedestrians. Although a "typical section" taken at a mid-block location may result in a relatively narrow cross section, inclusion of right- and/or left turn lanes at intersections can dramatically increase the total roadway width and pedestrian crossing distances.

# DESIGN & OPERATIONS

## Design Requirements

**A** **Marked Travel Lane Width** [1]**:** The default width for all travel lanes on marked roads should be 10-feet wide, with the following exceptions:

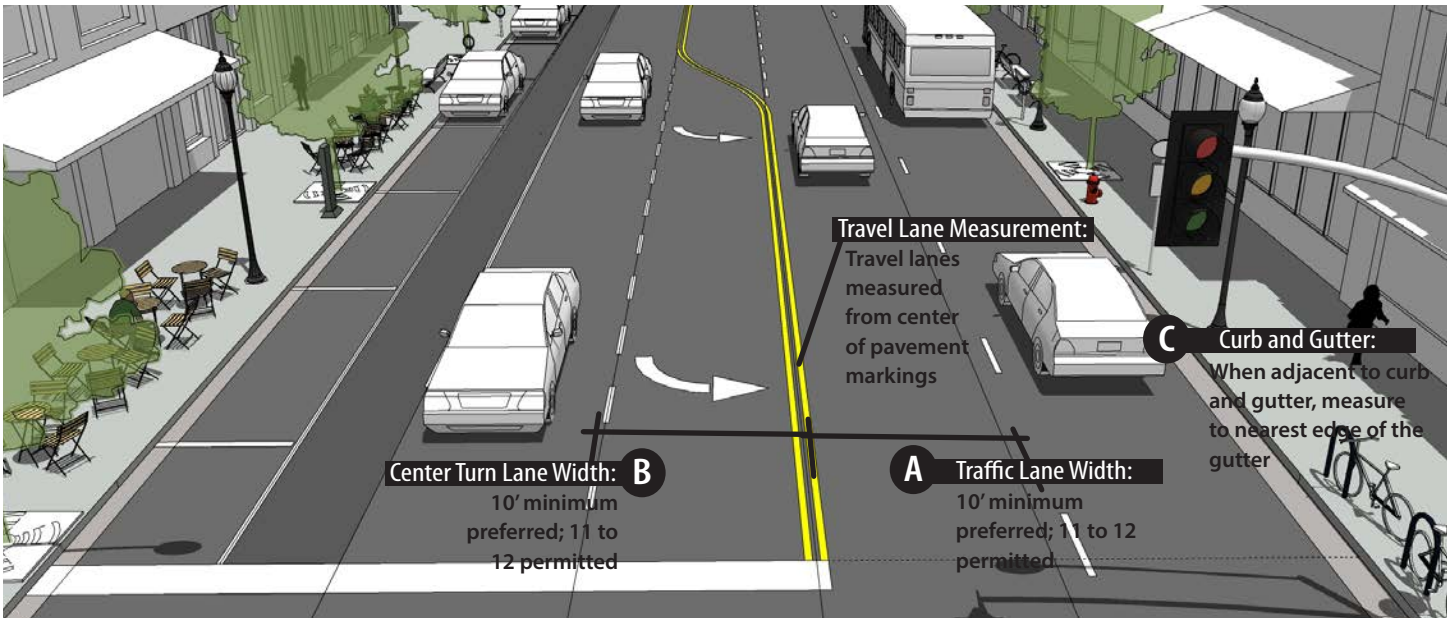
- » On streets with frequent and/or priority transit service, one 11-foot wide lane in each direction may be used where transit vehicles need to be accommodated and need additional room for clearance or operations.
- » On streets with frequent, heavy truck traffic, 11-foot lanes may be used to provide additional maneuvering space.
- » Wider lanes for transit or truck accommodations should be located in the outermost lane.
- » **Centerline Markings:** On streets with lane markings, solid double-yellow (do not pass) lane markings should be used. Dashed yellow lines, which enable passing, are not recommended as it can encourage speeding and unpredictable driver behavior.

**B** **Turn Lane Widths:** Turn lanes (both center and right turn) should be 10-feet wide.

- » Turn lanes used as part of a truck or transit route may be increased up to 11-feet.
- » On lower volume or speed streets, and/or under constrained conditions, travel lanes or turn lanes may be reduced to 9-feet wide.

- **Unmarked Lanes:** Road typologies with unmarked travel lanes (enhanced neighborhood and local neighborhood) typically accommodate two-way traffic in a travel way that is narrower than it would otherwise be with marked lanes. Such roads usually include curbside zones for on-street parking.
  - » For one-way roads, the travel way should be at least 10-feet wide where a curbside zone is present, or 12-feet wide when adjacent to curbing on both sides.
  - » For two-way roads, the travel way should be a minimum of 16-feet wide up to a maximum of 20-feet wide.
  - » Unmarked lanes may require passing cars to yield and slow down when passing each other, particularly in residential areas. Adequate overall roadway width should be present to allow cars to pull partially into parking lanes in order to facilitate passing (see ***Advisory Bicycle Lanes***).
- **Measuring Lane Widths:**
  - » Travel lanes should be measured from the center of lane markings on either side of the travel lane (including where on-street parking is present).

**C** **Curb and Gutter:** When a travel or turn lane is adjacent to a curb and gutter, measure to the nearest edge of the gutter (i.e. "edge of metal"). If no gutter is present, measure to the face of curb, adding 18 inches to required lane width to account for drainage inlets and clearance from the curb.



## Additional Design Considerations

- **Assembly:** The overall roadway cross section (all travel and turn lanes plus in-road bicycle facilities and curbside lanes) should avoid having absolute minimum dimensions for each incorporated street element. For example, narrower travel lanes (e.g. 9-feet) combined with absolute minimum bicycle lane widths (e.g. 4-feet) results in a constrained roadway for all users, and a different design approach should be considered.
- Locations where travel lanes are currently above the desired width should be considered for pavement marking treatments that stripe-off the areas outside of the travel lane and/or establish other street uses to make use of extra space (e.g. a paved shoulder, bicycle lanes, or parking areas). Street reconstruction projects are an opportunity to relocate curb lines and achieve a narrower pavement area.
- Travel lane widths need to be considered within the assemblage of the full street. Narrow travel lanes adjacent to minimally dimensioned bicycle or parking lanes may introduce some friction between uses.
- Wider travel lanes may be necessary approaching existing intersections depending on the design vehicle and curb configuration. Tight turning vehicles require more horizontal space while turning than while traveling straight (see ***Curb Radii***).
- **Road Diets:** Road diets can be used to reduce the number of travel lanes in the roadway and free up space for other uses, while improving safety for all users.
    - » Four lane roads (no center turn lane) typically pose the greatest safety concerns and can often be dieted to three lanes. Roadways with Average Annual Daily Trips (AADT) of 21,000 should be analyzed to assess the feasibility of a road diet.
    - » Vehicle lanes can typically accommodate approximately 1,900 cars per lane per hour. This can be used in consideration of peak hour volumes to understand the number of travel lanes that may be needed.

## Utility Considerations

- Utilities will often be located under travel lanes. Manholes and access portals must be flush with the roadway surface. Utility work in a travel lane should resurface the whole of the travel lane for a smooth travel surface.

## Sustainability Considerations

- Minimizing lane widths minimizes overall paved and impervious surfaces, which contribute to stormwater runoff and water quality.

## Design References

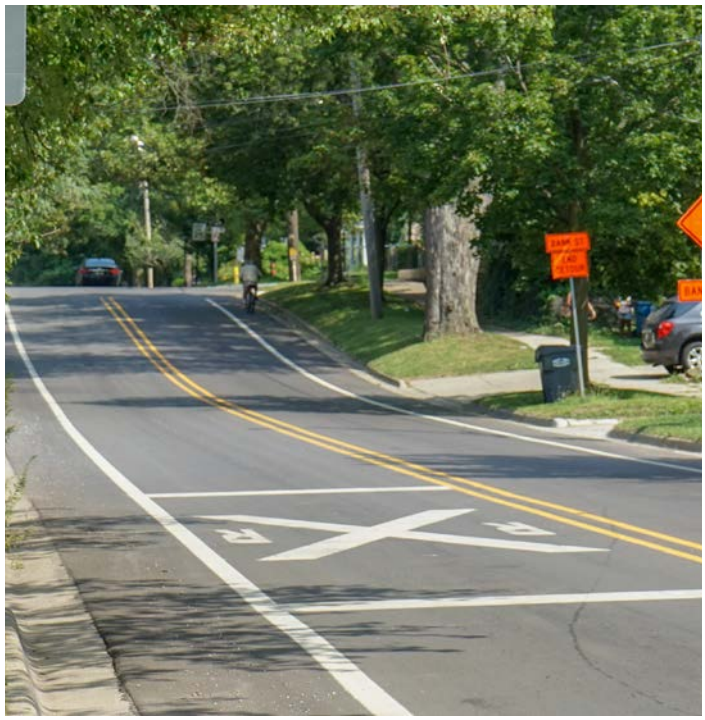
- NACTO Urban Street Design Guide (2013) provides guidance on travel lane widths.
- The AASHTO Green Book recommends 10- to 12-foot travel lanes and 10- to 12-foot turn lanes.
- A number of states have endorsed narrower lanes. The Florida Department of Transportation found that narrower lane widths do not impact street capacity "So long as all other geometric and traffic signalization conditions remain constant, there is no measurable decrease in urban street capacity when through lane widths are narrowed from 12 feet to 10 feet."
- The Institute of Transportation Engineers "Designing Walkable Urban Thoroughfares: A Context Sensitive Approach" recommends a range of 10- to 12-feet for travel lanes on urban arterial and collector streets. Narrower travel lane widths (down to 10-feet) are recommended on lower volume and speed on streets.
- The Michigan MUTCD provides standards and specifications on travel lane signage (Part 2) and markings (Part 3).

# MAINTENANCE & MANAGEMENT

- Travel lanes require periodic sweeping and pavement marking re-striping.

## Seasonal Use and Maintenance

- **Snow Removal:** Efficiently clearing snow and ice from travel lanes is a vital safety operation. Black ice and other dangerous conditions are common in Michigan. Snow should be cleared all the way to the curb, ensuring that drain inlets are able to take in melting snow.
- **Special Events:** Travel lanes may be closed to vehicle traffic and designated as a pedestrian, special event or play street by the city.



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ROADWAY ELEMENTS

# CORNER GEOMETRY & DESIGN VEHICLE

## DESCRIPTION & INTENT

The geometry of corners and turns at roadway intersections is critical for safe and comfortable operations of the street, and has an impact on all street users.

Larger corner radii can accommodate bigger vehicles making turns, but also allow for high speed turns from smaller vehicles, which may not be desired. Larger radii may also cut into pedestrian space at corners and make crossing distances longer, less comfortable, and requiring longer pedestrian crossing signal phases.

Conversely, smaller corner radii may preclude or inhibit larger vehicles from turning, but can promote slower turning speeds for all users while preserving more pedestrian space and narrowing crossing distances.

Two factors play the greatest role in determining the geometry of corner curb radii:

- **Intersection Angle:** Where two streets meet at an angle, the acute angle corners of the intersection commonly have very tight curb radii, while the obtuse angle corners have much larger curb radii. Angled intersections may result in very long pedestrian crossing distances.
- **Vehicle Type:** Larger vehicles make wider turns. Large vehicles include municipal and school buses, tractor trailers, and larger fire trucks.
- There are two measures of curb radius—the actual curb radius and the effective curb radius (see ***Figure*** on next page).

A **Actual Curb Radius:** Refers to the physical radius of the built curb at an intersection.

B **Effective Curb Radius:** Refers to the smallest inside arc that is possible for a vehicle to follow from the departing travel lane to the receiving lane. Because vehicles may begin their arc from a travel lane located outside of a bicycle facility and/or a lane of parking, it is common that the effective curb radius is significantly larger than the actual curb radius.

## USE & APPLICATION

### Location

- Corner geometries exist wherever two streets intersect.

### Related Design Elements

- **Intersections:** Curb radii and corner geometries are critical in the assemblage of intersections. Radii affect pedestrian crossing distances, traffic turning speeds, and overall safety and operation of the intersection.
- **Crosswalks and Curb Ramps:** The size of the actual curb radius directly affect pedestrian crossing distances and visibility relative to the roadway. It also affects the placement of curb ramps. Larger radii make it more difficult to install curb ramps that are in parallel and directly aligned with the crosswalk and approaching sidewalk.

- **Bumpouts:** Although corner bumpouts typically have larger curb radii than the underlying natural curb, they nonetheless help to manage vehicle turning speeds by establishing a tighter effective radius. Actual corner bump out radii are typically equal to the effective curb radii.

# DESIGN & OPERATIONS

## Design Requirements

- **Corner Radius:** Corner curbs shall be designed using the smallest radius possible to accommodate the necessary design vehicle(s) (see ***Design Vehicles*** below).
- On most streets, the effective turn radius should be a minimum of 30-feet in order to accommodate an SU-30 vehicle (which has an inside radius of 28-feet). This may be narrower or larger depending on the selected design vehicle of the roadway (see ***Design Vehicle***).
  - » Actual curb radii should be as small as possible while still achieving the target effective radius. Corner radii may be assembled using a single simple curve, multiple curves, or complex curves.
- **Design Vehicle:** The target design vehicle that needs to be accommodated along the street and must be accommodated for each specific turning movement should be identified early in the design process.
  - » **Target Design Vehicle:** This is the vehicles routinely expected to navigate a corner.
  - » **Accommodation Vehicle:** This is a vehicle that may occasionally be required to navigate the turn, but may require more finessed turning behaviors and/or may result in minor encroachments outside of the normal vehicle path.
  - » **Transit and Trucks:** For transit and truck routes, larger design vehicles may be used at corner locations where these vehicles are regularly making turns as part of the designated routes (i.e. only those corners where trucks or transit vehicles are turning).

| Design Vehicle | Target Design Vehicle | Acommod. Vehicle | Transit Route | Truck Route |
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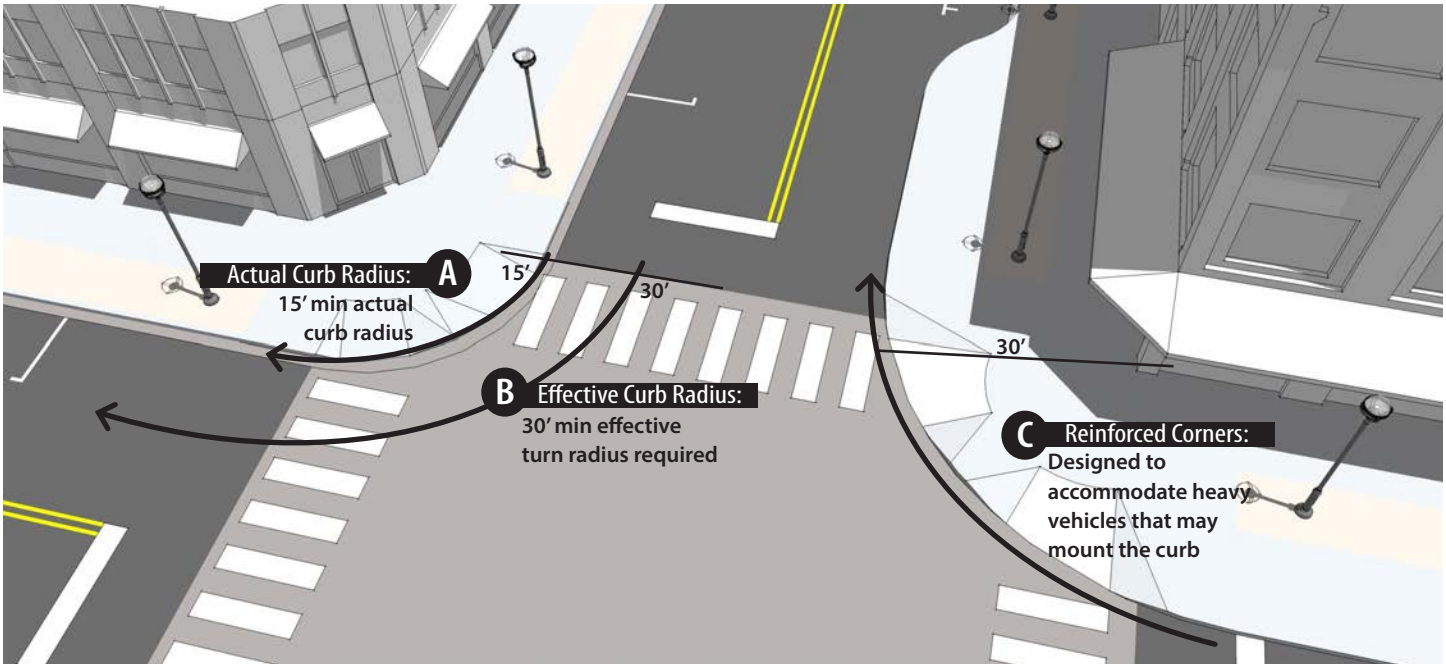
| **Primary Roads** UC, E/F, MS, NB, CB, CC, NN | SU-30 | WB-40 | CITYBUS | WB-50 |
| **Local Roads** EN, LN | DL-23 | SU-30 | CITYBUS | n/a |



- At signalized intersections, larger vehicles may be permitted to use all available receiving lanes to complete their turn. This should be reflected in turn modeling.
- **No-Turn Corners:** Corners where no legal turn is possible, such as from a one-way street onto another one-way street, can have a minimal actual curb radius (5-feet).
- **Parking Lane:** On-street parking permits tighter actual curb radii as no vehicle will be turning directly from curb lane to curb lane along the actual curb radius, vehicles will be turning from outside the parking lane to outside the parking lane. Where permanent on-street parking exists on both streets, bumpouts may be utilized.

C **Reinforced Corners:** Corners can be designed to accommodate heavier vehicle loads where transit vehicles or trucks may occasionally mount the curb.

- "Sneckdowns" are tracks in fresh snow that reveal the actual turn radii and frequency of turning vehicles and may be used to inform locations where tighter curb radii and/or bumpouts are viable.

### Utility Considerations

- Keep utility cabinets, hand holes, and other fixtures off corner curb areas to the extent possible. Where utility cabinets are necessary, they should be in subsurface vaults or in nearby locations clear from the intersection.
- Locate stormwater inlets to effectively drain the street while not precluding curb ramps and corner bumpouts.

### Design References

- The NACTO Urban Street Design Guide provides additional guidance on corner geometries (see ***Corner Radii*** section).

## MAINTENANCE & MANAGEMENT

### Seasonal Use and Maintenance

- Snow should be removed all the way to the vertical curb face of a corner.

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ROADWAY ELEMENTS

# DRIVEWAYS & CURB CUTS

## DESCRIPTION & INTENT

Driveways provide access in and out of adjacent property for vehicles. “Curb cuts” refers specifically to the break in the street curb and associated ramp (also called a driveway apron) that links to the driveway.

While driveways are an important part of the public realm, too many driveways create an unpleasant pedestrian environment and increase conflicts between motorists and other street users. They also take away space that may otherwise support planting, street furniture, and curbside parking. Coordinating the design of driveways together with the sidewalk contributes to a higher-quality pedestrian experience and reduces dangerous conflicts.

## USE & APPLICATION

### Location

- Driveways and curb cuts are generally undesirable in denser pedestrian oriented commercial areas (urban center, event/festival, main streets, neighborhood business). In these areas, building services should be accessed via alleys or side streets whenever possible.
- Driveways and curb cuts in more auto-oriented commercial street types (commercial business, city connector) should be minimized to the extent possible, with property owners sharing curb cuts where feasible.
- Regardless of context, the number of driveways should be minimized. Use of a single common curb cut to provide access to several businesses or properties is preferred. City code allows for one driveway per lot and a second driveway on lots wider than 200-feet.

### Related Design Elements

- **Traffic Calming:** At a location where vehicles frequently enter and exit a street, driveways are excellent opportunities to introduce traffic calming elements to the street (e.g. mid-block bumpouts) to ensure that motorists are aware of their surroundings and do not drive in a way that endangers other road users.
- **Bumpouts:** Driveways can be used in conjunction with bumpouts. Move the driveway apron out to the bumpout and make it flush with the sidewalk level.
- **Intersection Proximity:**
  - » On residential streets, driveways should be restricted within 20-feet of unsignalized intersections, and at least 40-feet from signalized intersections as measured from the leading edge of the crosswalks.
  - » On commercial streets, driveways should always be at least 100-feet from intersections as measured from the leading edge of the crosswalks.
- **Bus stops:** Bus stops and driveways should be positioned relative to each other such that an unbroken curb line can be accessed by the full length of the bus to allow curb height boarding.

# DESIGN & OPERATIONS

## Design Requirements

While driveways are often necessary for building access and loading, their design should indicate to motorists that pedestrians and cyclists, and through vehicle traffic have the right-of-way across a driveway. Driveway entrances and curb cuts are an opportunity to provide traffic calming to reduce the potential for conflicts.

**A Driveway Width:**

- » Single-lane driveways shall be between 8-feet and 12-feet wide at the throat.
- » Bi-directional driveways shall be at least 20-feet wide and no wider than 24-feet. Exceptions may be made for driveways that must accommodate frequent large trucks.

**B Driveway aprons** shall be placed in the amenity zone. The apron should not encroach on the clear sidewalk zone. If there is a bumpout or parking lane planter, the apron should lie within the bumpout. Bumpouts should be used if the sidewalk is too narrow to accommodate a safe driveway intersection.

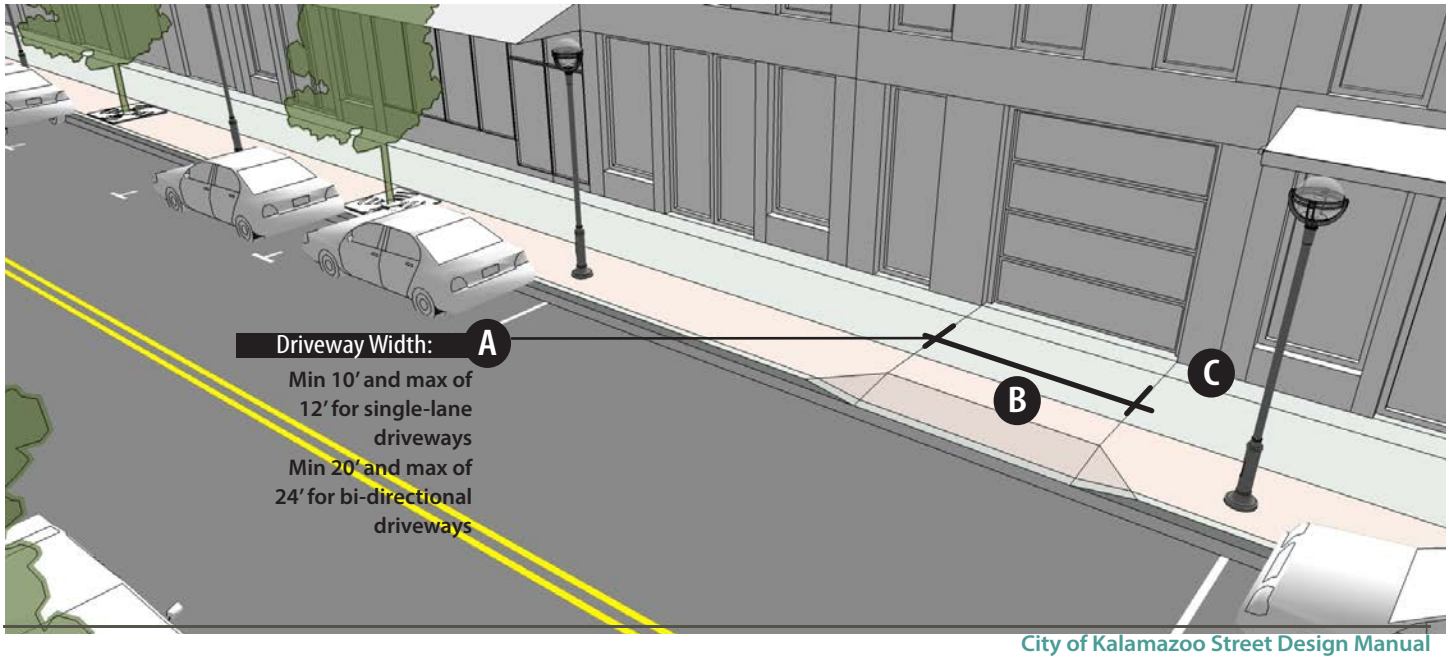
- **Materials:** Driveways shall be of concrete, asphalt, concrete pavers, brick or stone. Curb cuts and associated ramps must be made of concrete.

**C Sidewalk Interface:** Driveways shall be flush with the sidewalk level to maintain a comfortable walking environment and reduce conflicts. Continue sidewalk paving material across the driveway to indicate that pedestrians will be crossing this space.

- **Visibility Sight Lines:** Curb cuts shall provide adequate visibility to and from the sidewalk and street. Ideally, vehicles should not need to block the sidewalk while gaining clear lines of sight, but this may not be unavoidable.
  - » Where sight lines are limited, include appropriate signage indicating where the driver is to stop and wait.
  - » Mirrors, audible signals, or other devices to assist with visibility of pedestrians are encouraged at high volume locations where visibility is limited (e.g. parking garage exits).

## Additional Design Considerations

- **Alley Access:** Curb cuts are not appropriate where alleys can provide rear access to residences and businesses. Where large new development occurs along a significant portion of a block face, provide a central alley to reduce the need for multiple driveways and curb cuts.
- **Bicycle Lane Markings:** Where a driveway crosses a bicycle facility, pavement markings should be dashed across the driveway so that cyclists and drivers are alerted to the potential conflict area.



- **Major Driveways:** Ensure driveways that function as an intersection, such as onto private alleys or circulation drives, contain all of the features of a conventional intersection, including crosswalks, tight corner radii, and a signal (if deemed necessary).

### Utility Considerations

- Design new curb cuts as to not impede drainage from the street. A curb gutter shall be provided where necessary to continue the flow of street drainage across the driveway.

### Sustainability Considerations

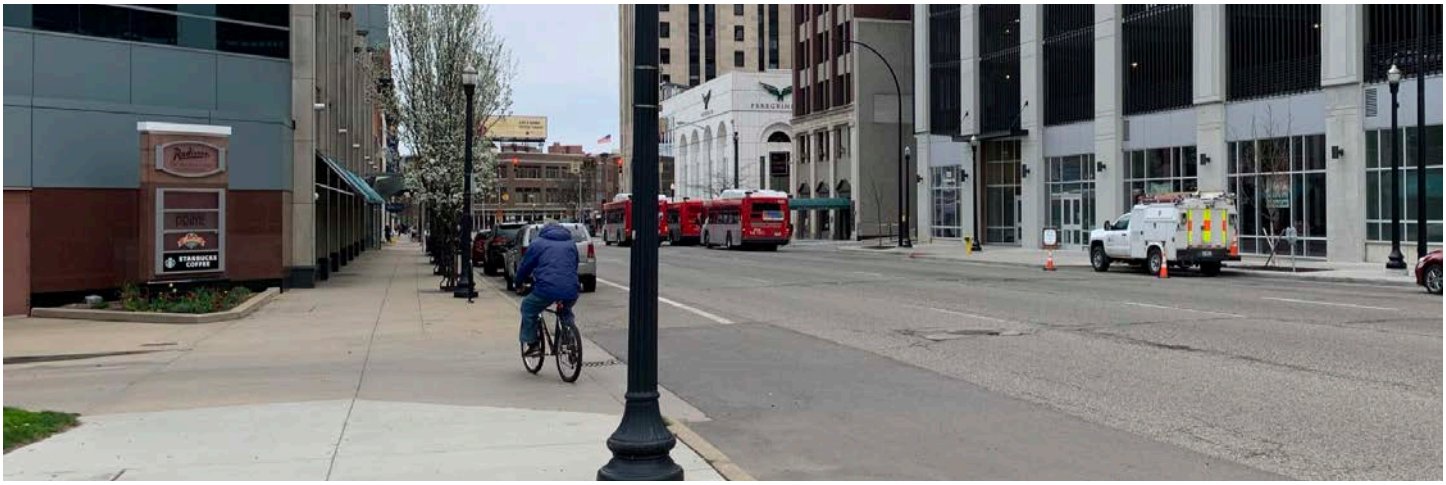
- Consider using pervious materials for driveways, which can reduce stormwater runoff and improve water quality. Double-track driveways are also permitted in areas of low vehicle volume and may reduce imperviousness.

## MAINTENANCE & MANAGEMENT

- Driveway aprons with special paving materials may need additional maintenance from property owners.

### Seasonal Use and Maintenance

- Snow should be removed from the curb line to the back of sidewalk to provide access for vehicles and sidewalk users. Do not clear snow into bicycle lanes.



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ROADWAY ELEMENTS

# MEDIANS

## DESCRIPTION & INTENT

A median divides lanes of traffic. Medians are generally located in the center of the right-of-way and divide opposing directions of travel. They may also be located on the side, separating local access or special purpose lanes such as dedicated travel ways.

Medians increase safety and enhance roadway operations by reducing vehicular movement conflicts, preventing undesired turning movements, and providing a refuge for pedestrians crossing the street. Medians also help visually break down the scale of the street, narrowing the perceived width of the roadway and thereby encouraging slower travel speeds.

Medians take on many forms. They may be flush with the pavement and consist of painted markings, a space protected with bollards, or a raised curb. Striped or painted medians may precede more permanent improvements, providing localities an opportunity to test travel behaviors before making a significant capital investment. Raised medians within the travel zone provide opportunities for landscaping, street trees, and two-stage pedestrian crossings.

## USE & APPLICATION

### Location

- Medians are recommended on larger vehicle oriented streets, especially where there is a center turn lane and/or multiple travel lanes in each direction. Breaks in medians should be provided where essential vehicle turns must be accommodated.
- Medians are an access management tool, providing a means to limit superfluous vehicle turns in a corridor to facilitate traffic flow and safety.
- Medians planted with taller trees and vegetation can impede visibility of businesses, and such landscaping may be less suited to these areas. Medians can make commercial support activities (e.g. deliveries) more challenging.

### Related Design Elements

- **Traffic Calming:** While medians can slow travel speeds on their own, for the purpose of significant speed management, medians are generally used in conjunction with other traffic calming measures, such as bumpouts, lane narrowing, or vertical speed controls (*see **Traffic Calming***).
- **Pedestrian Crossings:** Medians can provide a pedestrian refuge, but add to the overall width of the crossing. For especially large crossings, wider medians can allow pedestrians to comfortably wait and cross the street in two separate movements (*see **Pedestrian Refuge Islands** and **Mid-block Crossings***).
- **Sidewalks and Bicycle Lanes:** Do not remove or narrow sidewalks or bicycle facilities to provide medians or pedestrian refuges.

# DESIGN & OPERATIONS

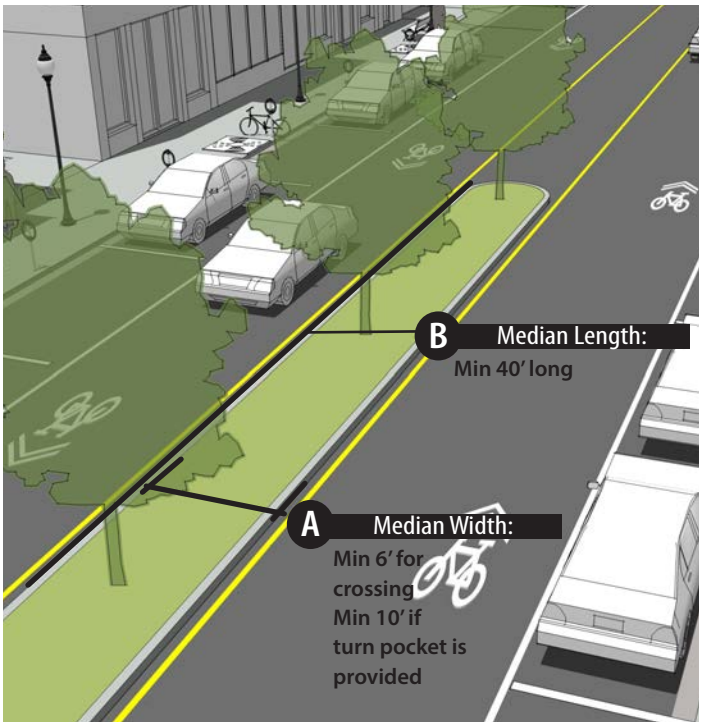
## Design Requirements

**A** **Median Width:** The width of medians can vary depending on site conditions.

- » Narrow medians with a full curb and gutter may be as little as 3-feet wide (two 12-inch gutters and a 12-inch flat surface). Narrower medians can be constructed, but should be at least 2-feet wide for durability and visibility.
- » Medians incorporating a pedestrian refuge island should be a minimum of 6-feet wide to provide a level landing area and detectable warning within the median.
- » Medians should be at least 10-feet wide if they are to provide turn pockets for vehicle turning.

**B** **Median Length:** The length of a median is variable. Medians are more impactful the longer and more unbroken they are, and provide more space for landscape or other site features. However, this must be balanced by providing gaps for turning, crossings, stormwater drainage, and meeting other site needs.

- **Intersection Crosswalks:** Crosswalks should cross medians at street level. The width of the crosswalk opening should be 1-foot wider than the crosswalk width on both sides (see ***Pedestrian Refuge Island***).




- **Median End Cap:** Medians should use a rounded end cap to facilitate snow clearing and better maintain the durability of the median. Angled corners are more prone to damage.
- **Planting:** Plants can help drivers identify medians and also help break down the visual scale of the street, which can have a traffic calming effect. However, plantings should be designed to avoid blocking sight lines for pedestrian, cyclists, and motorists near intersections and crossings.

## Utility Considerations

- Access points to utilities below medians must be maintained. Provide manholes or hand holes as needed. Avoid planting trees in medians if the trees would end up planted above utility lines.

## Sustainability Considerations

- Landscaping medians reduce the impervious surface area in the roadway, allowing stormwater infiltration or retention in the exposed soil. A minimum of 3-feet of width should be provided for planting areas in medians when using perennials and other hardy ground covers.
- Trees planted in medians should have sufficient surface area and soil volume for healthy growth (see ***Street Trees***).

## Design References

- The NACTO Urban Street Design Guide (2016) provides further information on the design of medians and pedestrian crossing islands in urban environments.

# MAINTENANCE & MANAGEMENT

## Seasonal Use and Maintenance

- **Snow Removal:** Medians should be designed with snow removal in mind. Medians can be used for snow storage when necessary, although this may negatively impact planted materials, can block sight lines along the roadway, and can trap pedestrians trying to cross at unmarked locations.
  - » Medians should allow adequate width in the adjacent travel lane to accommodate snow removal vehicles, as well as turn radii that facilitates snow clearing and removal.

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ROADWAY ELEMENTS

# VOLUME & SPEED MANAGEMENT

## DESCRIPTION & INTENT

Volume and speed management are tools used to improve safety and comfort for all street users by creating a calming street environment.

**Speed Management** refers to physical design techniques used to reduce the speeds of vehicles on the roadway and encourage vehicles to operate at or below the posted speed limit. These techniques include the following:

- Speed tables and speed humps
- Lane shifts and chicanes
- Traffic circles and mini-roundabouts
- Medians, bumpouts, and lane narrowing

**Volume Management** refers to techniques used to manage the routing of vehicles. Typically these are used to discourage "cut thru" vehicle trips on quieter streets where lower traffic volumes are desired. Speed management techniques (above) can support volume management, as reduced travel speeds increase travel time and can make such routes relatively less attractive. Additionally, speed management techniques deliberately create navigation obstacles that are less conducive to through trips. Specific volume management techniques include the following:

- Traffic Diverters

This design element section provides general guidance on the use and applicability of specific treatments listed above.

## USE & APPLICATION

### Location

- Speed management techniques should be explored on all street types in order to ensure that roadway design aligns with the desired travel speed of the road. At a minimum, this includes using the narrowest viable travel lanes (see ***Travel Lanes***), bumpouts, medians, and other treatments to manage road speeds.
- More intense speed management techniques (speed tables/humps, lane shifts, etc.) are important to consider on pedestrian focused streets, such as downtown streets, neighborhood business streets, and quieter residential streets where target design speeds can not be achieved through normal treatments and/or where there known cases of regular, excessive speeding.
- Specific volume management techniques (i.e. traffic diverters) should typically only be used as part of a comprehensive strategy for managing traffic flows in the city, and is often associated with the creation of bicycle boulevards or neighborhood greenways (see ***Bicycle Facility Selection***).

## DESIGN GUIDANCE

- FHWA Traffic Calming ePrimer- Module 3: Toolbox of Individual Traffic Calming Measures.
- NACTO Urban Bikeway: Volume Management & Speed Management Sections.

# SPEED TABLES

Speed tables are raised areas of the roadway surface, typically the length of a passenger vehicle that passing vehicles must traverse over. Gradual ramps are located on both approaches to the table. The raised area creates a vertical shift in the road, inciting drivers to slow down.

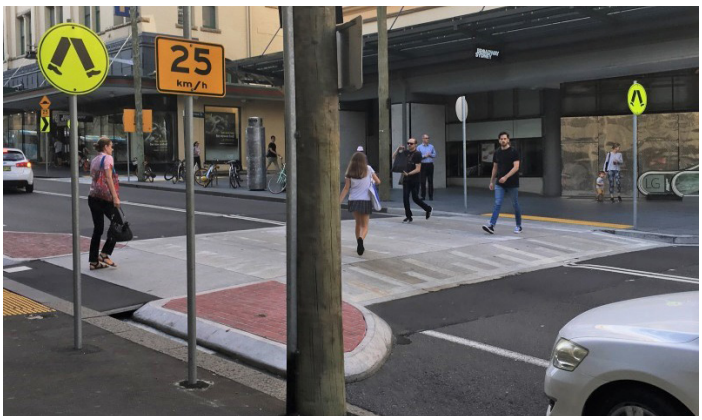
## Applicability

- Speed tables should be considered on lower volume roads where there are concerns about speeding traffic and where there are relatively large gaps between stop or signal controlled intersections.
- Speed tables are often built in conjunction with a mid-block crossing, creating a raised crossing. This can be beneficial near schools or other high pedestrian crossing areas.
- Speed tables provide less jarring and abrupt experience compared to speed humps, and can be more suitable than humps in locations where transit service occurs.
- Speed tables cannot be placed in a manner that blocks driveway or alley access.

## Design and Operations

- **Height:** Speed tables are typically a minimum of 3 inches high up to the height of the curb.
- **Width:** The flat tabletop surface should be 10- to 20-feet long.
- **Ramps:** The approach ramps should be sloped no more than 1:10 and no less than 1:25.
- **Signage:** Signage must be installed warning drivers of the presence of the speed table.
- **Markings:** Pavement arrow markings may be used on the ramps to increase their visibility and guide the vehicle.
- **Materials:** Speed tables and ramps should be constructed of concrete. Special concrete finishes may be used on the flat tabletop surface. Asphalt may be used as a lower cost substitute and/or for rapid deployment.
- **Utilities:** Understanding roadway drainage and providing additional inlets or other drainage structures around the speed table is essential.

**Speed Table (in asphalt) with Mid-block crossing**
*Source: FHWA / R. Goldberg*




**Speed Table (concrete) with Mid-block crossing and gutter trench drain**
*Source: Web*

**Speed Table with Cushions:** *Source: FHWA / Jeff Gulden*

### Cushions

Speed tables or speed humps can be designed with “cut outs” that match the track of wider vehicles to allow emergency vehicles and/or transit vehicles to pass through the speed table more easily. .

# SPEED HUMPS

Speed humps are a curving raised area of the roadway designed to slow traffic on lower volume and lower speed roadways. Speed humps typically reduce speeds to 15 to 20 MPH and are a lower cost treatment than speed tables.

## Applicability

- Speed humps should be considered on lower volume roads where there are concerns about speeding traffic and where there are relatively large gaps between stop or signal controlled intersections.
- Speed humps provide a more pronounced vertical obstacle compared to speed tables, and are less suitable than speed tables for use along transit routes.
- Speed humps cannot be placed in a manner that blocks driveway or alley access.

## Design and Operations

- **Height:** The the highpoint (crown) of a speed hump should be 3 to 4 inches above the roadway.
- **Width and Ramps:** The overall dimension of the speed hump should be 12- to 14-feet wide. Curving slopes should be no steeper than 1:10.
- **Signage:** Signage must be installed warning drivers of the presence of the speed hump.
- **Markings:** Pavement arrow markings may be used on the ramps to increase their visibility and guide the vehicle.
- **Materials:** Speed humps are constructed from asphalt.


**Speed Hump (in asphalt)** *Source: FHWA / Lucy Gibson*

# LANE SHIFTS & CHICANES

Lane shifts, also known as chicanes, is a treatment where the travel lanes of the road is deliberately shifted left or right. These shifts incite drivers to slow down as they navigate the transition. Multiple chicanes can be strung together in order to manage the speed of the roadway along the length of the block.

## Applicability

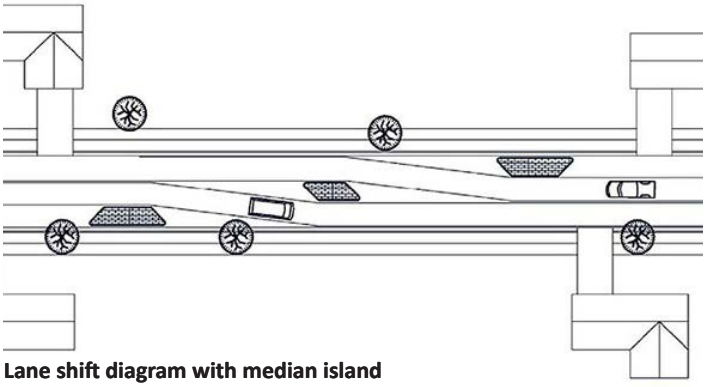
- Chicanes can be used on most street types where speed management is desired. They can be especially beneficial on main streets (in the downtown area) and neighborhood business streets where speed tables or humps could interfere with curbside zones and other vehicle operations.
- Chicanes should be used and designed alongside a comprehensive street design that considers the arrangement of curbside zones (parking, loading, etc.), streetscape, mid-block crossings, and medians.

## Design and Operations

- **Shift Length:** The horizontal shift of the travel lane should be at least 4-feet. Shifts less than 4-feet may be less visible or may not produce the desired speed reduction.
- **Deflection Angle and Taper Length:** The angle of the lane shift and taper length approaching the shifted area will depend on the design speed of the roadway. The taper length can be determined using the following formula for roadways under 45 MPH:
  - » ***$L = WS^2 / 60$***. L is the taper length, W is the width of the lane shift, S is the speed (MPH).
  - » For example, the taper length for a 6-foot lane shift designed for 20 MPH equals 40-feet.
  - » Chicanes can be designed with more abrupt angled tapers or curbing/parabolic lines.
- **Median Island:** Offsetting the opposing flows of traffic as their respective lanes shift can allow the creation of smaller medians within the roadway that can further reinforce slower traffic.

**Lane shift (angled)** *Source: FHWA / Google Street Capture*

**Lane shift (curving)** *Source: NACTO*



**Lane shift diagram with median island**
*Source: Delaware Department of Transportation*

# TRAFFIC CIRCLES

Traffic circles are small circular areas of raised paving, curbing, and/or landscape placed at the center of an intersection. Traffic circles manage the speed of vehicles in the intersection by requiring through and left turning traffic to maneuver around them carefully, typically reducing speeds through the intersection to 5 to 15 MPH.

**Traffic Circle.** *Source: FHWA / Scott Batson*

**Traffic Circle.** *Source: FHWA / Dan Burden*

## Applicability

- Traffic circles are typically used at minor intersections on residential and local streets to slow traffic and address speeding concerns.
- Traffic circles can be used at uncontrolled intersections and/or where stop sign controls are present.
- Traffic circles are generally used in locations where reconstruction of intersection corners and approaches is not required, i.e. the traffic circle can be installed with little modification of the existing intersection.
- Treatment is more effective when multiple sequential intersections utilize traffic circles.

## Design and Operations

- Traffic circles should be designed such that the desired distance at each corner radius from the point closest to the intersection center to the edge of the traffic circle is 15-feet.
- Traffic circles should be curbed and raised at least 3 inches above the roadway.
- The surface of the traffic circle can be hardscape (concrete, decorative brick, pavers, etc.) or landscaped. Landscape should not impede visibility through the traffic circle, and should be kept to 36 inches or less in height above the roadway.
- To accommodate larger vehicles, the traffic circle can be reduced in size with a flared mountable collar added around the traffic circle that allow larger vehicles to pass over it.


**Traffic Circle.** *Source: NACTO*

### Mini-Roundabouts

Mini-roundabouts can also be used as a traffic management and speed control device, while allowing for a free-flow of traffic. Mini-roundabouts typically require more substantial intersection design and should only be considered as part of a larger project (see ***Intersections***).

# TRAFFIC DIVERTERS

Traffic diverters are treatments used within a roadway or intersection that prevent motor vehicles from traveling in certain directions but allow cyclists and other smaller vehicles to pass through them. Diverters are used to discourage and limit through vehicle movements in order to create a lower traffic and calmer street environment for non-motorized travel.

## Applicability

- Diverters should be used as part of a comprehensive neighborhood greenway or bicycle boulevard treatments intended to provide an all ages and abilities accessible route for cyclists. Broader traffic patterns and where diversions will relocate traffic are important to consider.
- Preferred to be used on roadways with less than 1,500 AADT, but may be used on roadways with up to 3,000 AADT if feasibility can be verified through a more extensive analysis effort.
- Understanding local residential needs and obtaining public support for the project from local residents is important for success.

## Design and Operations

- Traffic diverters can be utilized in the following way:
  - » Within an intersection to prevent certain movements. Typically diverters are setup up force right turn only operations for vehicles.
  - » Mid-block to prevent through vehicle movement. Typically must provide turn around space for vehicles and appropriate signage at the start of the block indicating no thru-traffic.
  - » At the receiving lane of an intersection to prevent vehicles from traveling down the road in certain directions.
- Openings in the diverters should be 5- to 6-feet wide to provide room for bicycles to pass but prevent motor vehicles.
- Appropriate signage (e.g. DO NOT ENTER- EXCEPT BIKES) should be used to inform drivers of safe operations and allowed turning movements.


**T-Intersection Diverter.** *Source: NACTO / Richard Drdul*

**Intersection Right Only Diverter.** *Source: NACTO*

**Full Roadway Diverter.** *Source: NACTO*

**T-Intersection Diverter.** *Source: NACTO*


| STREET TYPOLOGY | | | | | | | | |
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ROADWAY ELEMENTS

# INTERSECTION STRATEGIES & TRAFFIC SIGNALS

## DESCRIPTION & INTENT

Intersections occur wherever two or more roads intersect. Sometimes a driveway with significant vehicle volumes may also be treated as an intersecting road, such as at an entrance to a large shopping area, parking lot, or alley. Intersections come in all sizes and shapes, from simple T-intersections to complex multi-leg intersections and traffic circles.

Intersections are one of the most important components of roadway design. They are where all the modes intersect – pedestrians, bicyclists, transit and vehicles. Add to this turning movements, signals, crosswalks, sight lines considerations, lighting , and accessibility and intersections design quickly becomes a complex problem to solve. Not surprisingly, intersections are also where accidents are most likely to occur, especially for pedestrians and cyclists.

Intersections, and corners in particular, are also where people like to hang out. When William H. Whyte did his groundbreaking studies of public life in New York he found that when he mapped where people stopped to have a conversation of two minutes or more, over 50% of the time it was at the corner. People often like to sit near a corner too, as they can be great places to people watch, be seen, or wait for a friend. Intersections can function as gateways, welcoming people into a section of town, district, or corridor.

## USE AND APPLICATIONS

The design and operations of intersections must be considered on all street types and street projects with the City.

At all intersections, it is important to prioritize the most vulnerable users, usually pedestrians and bicyclists, while maintaining a reasonable level of service for vehicles. In urban areas a level of service D or E should generally be acceptable in order to provide design flexibility in meeting the safety needs of all users.

### Related Design Elements

- **Crosswalks:** Crosswalks allow pedestrians to traverse intersections, and their design and placement are critical to pedestrian safety. Whenever possible they should be perpendicular to the direction of vehicle travel (see ***Crosswalks***).
- **Pedestrian Refuge Islands:** Pedestrian refuge islands can greatly improve pedestrian safety at intersections but need to be coordinated carefully with left hand turning movements (see ***Refuge Islands***).
- **Bumpouts:** Bumpouts should be used whenever possible at intersections to shorten crossing distances and improve sight lines. They can also prevent parked vehicles and loading from creeping to close to the intersection and blocking crosswalks and sight lines, making them 40’ near side and 30’ far side at a minimum. They do require careful coordination with bus stops, protected bike lanes, and right turn lanes (see ***Bumpouts***).

- **Bicycle Boxes:** Bicycle boxes provide a place for bicyclists to wait at the intersection where they can be in front of traffic, and therefore more visible. They also can help cyclists safely make a left turn. Coordinating bike boxes with signals, crosswalks, stop bars and sight lines is important to ensure safety and visibility (see ***Bicycle Boxes***).
- **Two-stage Turn Queues:** Two-stage turn queues, much like bicycle boxes, can help bicyclists make left turns through intersections, and similarly, need to be coordinated with crosswalks, turning movements and signals. It is important to align these spaces to minimize conflicts with turning movements and use protected intersections where feasible (see ***Two-Stage Turn Queues***).
- **Protected Intersections:** Protected intersections greatly increase safety for pedestrians and cyclists at intersections, but they also require space and careful coordination with bus stops and turn lanes, and clear markings so that all users understand when they are to stop or yield to others (see ***Protected Intersections***).
- **Bus stops & Shelters:** Bus stops and their accompanying shelters, are often located at intersections. The general rule is that intersections function better when bus stops are far side, but this is not always feasible. When near side, they can be combined with right turn lanes. Ensuring the buses have enough clearance to prevent them from blocking crosswalks is also very important. Ideally bus stops are 100 foot in length to ensure buses can pull to the curb and that multiple buses can be accommodated if need be (see ***Bus Stops & Shelters***)
- **Bus Bulbs:** Bus bulbs can speed up boarding and alighting at bus stops which can help with traffic flow through intersections, but they usually mean that the bus will be stopping in the through lane, which can also back up traffic, so location and traffic patterns must be carefully considered. Also it is important that pedestrians can safely access them and that they do not compromise crosswalk sight lines (see ***Bus Bulbs***).
- **Corner Geometry & Design Vehicles:** Many of the elements listed above impact corner geometry and therefore what design vehicle can be accommodated. If large vehicle turning movements need to be accommodated this will need to be carefully coordinated, with a focus on protecting the most vulnerable users, pedestrians and cyclists (see C***orner Geometry and Design Vehicles***).

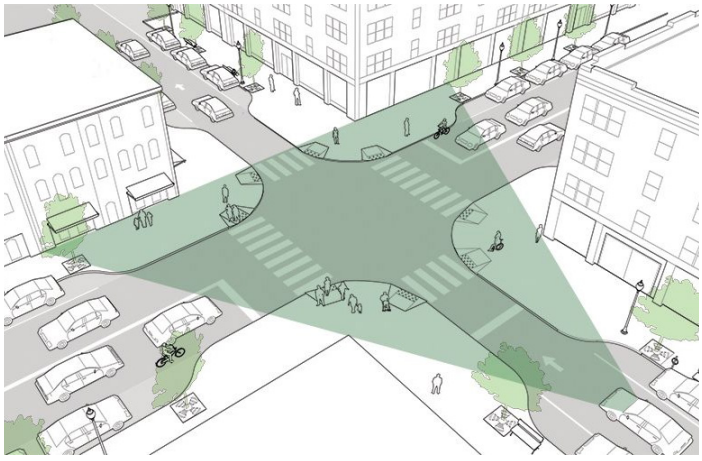
### Design Guidance

- NACTO Urban Street Design Guide (2016)
- NACTO Don't Give Up at the Intersection Design Guide (2019)
- Signalized Intersection Informational Guide, Second Edition, Federal Highways Administration

## INTERSECTION STRATEGIES

### Overall Approaches:

- Be predictable and intuitive.
- Maximize visibility, especially of vulnerable users.
- Promote eye contact between all users.
- Be as compact as possible.
- Use signalization timing to minimize delay and queue lengths, modulate speed, and accommodate different use patterns during different times of the day and days of the week.
- Design intersections to function as part of the overall transportation network.



**Sight Lines.** *Source: NACTO*

## Specific Strategies:

- **Traffic Control Warrants:** All established traffic signal warrants should be considered to determine whether a stop-controlled or signalized intersection is appropriate. Warrants may also be used to justify removal of signals and converting intersections back to stop control.
- **Corners:** Corner radii should be as tight as possible to allow for the design vehicle while safely accommodating pedestrians, reducing vehicle speeds should be prioritized over turning movements
- **Crossing distances** should be minimized and good sight lines should be maximized.
- **Waiting Space:** Corners should have plenty of space to wait and be fully accessible, with well-marked crosswalks.
- **Throat widening:** A widening of the roadway pavement at intersections to accommodate extra lanes (usually turn lanes), should be avoided when possible as this usually increases the pedestrian crossing distance and reduces the width of the sidewalks where it is needed most. However, if throat widening is determined to be beneficial so that mid-block roadway pavement widths can be minimized, reduce their impact with curb extensions that shadow right turn lanes, and/or pedestrian refuge islands where left turns are forbidden or when intersecting a one-way street whenever possible.
- **Intersection Size:** Extra-large intersections should be avoided. If they cannot consider using round abouts and traffic circles, and medians and pedestrian refuge islands. It is critical to ensure pedestrians have at least 3.5'/second to cross the road, and if that is not possible, proper refuge space to create a two-stage crossing should be present.
- **Parking & Driveways**: On-street parking and driveways should be setback from the intersection (30-feet and 100-feet respectively) to not conflict with intersection operations.
- Intersections should be well lit (see ***Street Lighting***)
- **Pork chop** islands and slip lanes should generally be avoided and only allowed in unique circumstances and where they can prioritize safety for vulnerable users.
- **Utilities:** Avoid crowding intersections with poles, signage, signal boxes and controllers.

# NO TURN ON RED

## Description and Intent

"Right on Red" permit vehicles to complete a right-hand turn even when the signal governing their leg is displaying red.

Right on Red operations are generally used to aid in progressing vehicle traffic, but can create conflicts between turning vehicles and pedestrian movements. Vehicles wishing to turn on red are inclined to "inch forward" over crosswalks, often blocking pedestrians wishing to cross.

## Use and Application

- No Right on Red is typically employed at locations with relatively high pedestrian volumes, such as downtown street typologies and neighborhood commercial areas. It is also used when sight lines are poor for cross traffic or intersection geometry is complex, such as with 6 legged intersections.

## Design Guidance

- No Turn on Red must be used at locations where turning movements cross separated bikeways and/or where two-stage turn queue boxes for bicycle are present.
- Right on Red can be temporal, prohibiting right turns only during peak hours of pedestrian activity (for example 7AM to 7PM). Right on Red may be further qualified with signage that indicates "No Right on Red When Pedestrians Present."

# SIGNAL TIMING

Traffic signals are an integral part of maintaining safe and efficient roadway operations on public streets. There are a number of specific signalization strategies described below that should be considered wherever signalized intersections are currently operating or proposed.

Signal timing should:

- Be designed to achieve the desired speed, not the existing travel speeds.
- Be adjusted for different times of the day and days of the week.
- Minimize signal phases
- Shorten signal cycle lengths to increase turnover balanced with providing ample signal time for pedestrians and bicyclists to safely navigate the intersection.
- Transit priority should be considered when transit is present.
- Provide fixed timing verses activated signals

## Related Design Elements

- **Pedestrian Signals:** Pedestrian signalization and associated strategies must be considered alongside traffic signals. Leading Pedestrian Intervals (LPIs), recall, and other treatments must integrate with the overall signalization.
- **Bicycle Signals:** Bicycle signalization must be considered alongside traffic signals, and coordinated with left and right turn signalization similar to pedestrian signals.

## Design Guidance

- The MMUTCD is the definitive guide for all signal operations and design.

# LAGGING VS. LEADING LEFTS

## Description and Intent

Designated signal phases for left turns are common in many locations. Left turns may be accommodated through an exclusive signal phase, where only opposing left turns are permitted, or as an early or elongated period for the through green time for one approach of the intersection. These left turns are known as “leading lefts” if they occur at the beginning of the through vehicle phase or “lagging lefts” if they occur at the end of the phase.

Leading lefts tend to be less intuitive to pedestrians accustomed to being given a walk phase at the conclusion of the red phase for opposing traffic. Pedestrians may jump the signal and find themselves in direct conflicts with left turning vehicles. Pedestrian/vehicle conflict have been found to be almost six times higher with leading lefts as compared to lagging left signal operations.

## Use and Application

- Lagging lefts are preferred (over leading-lefts) and should be used as the default signal phasing, as they prioritize for pedestrian progression, allowing waiting pedestrians to clear the intersection before left turning vehicles make their turns.
- Leading or lagging lefts allow time for turning vehicles to clear the intersection with less conflicts. They should be used in locations that have a high volume of pedestrians or through traffic that inhibit the completion of the left turn.

## Design and Operations

- Intersections with leading left phases should provide more generous sidewalk space to accommodate pedestrian queuing. Pedestrians are generally at their greatest concentration at the beginning of any signal cycle. Lagging lefts permit the majority of pedestrians to clear the intersection before left turns proceed.
- Leading Pedestrian Intervals (LPI) may not be used in conjunction with leading left signal operations, but may be combined with lagging left signals.

PNC BANK

# 4.6

## STREETSCAPE & INFRASTRUCTURE


| STREET TYPOLOGY | | | | | | | | |
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STREETSCAPE & INFRASTRUCTURE

# STREET LIGHTING

## DESCRIPTION & INTENT

Lighting is an essential element of street design, safety, and security. Street lighting is used to illuminate the street, sidewalks, and bicycle facilities. Street lighting is critically important at intersections and crosswalks.

Lighting levels are important. Lighting should be sufficient for people to see comfortably and correctly distinguish persons and objects in the street, but lighting should not be so great as to create deep shadows or pronounced areas of light and dark.

Street lighting should be efficient in both energy use and direction of light. Street lights are important elements of street character during daytime hours as well. The light poles helps to distinguish the curb line of the street and establishes a particular rhythm to the street edge. The spacing of light poles often dictates the spacing of other street elements as well, notably street trees.

There are two broad categories of street lights used:

- **Roadway lighting** is mounted higher (typically 30-to 40-feet above the roadway) and poles may have an arm that extends the street light over the roadway.
- **Pedestrian-scale lighting** is typically mounted lower (12- to 16-feet above the sidewalk) and primarily used to illuminate the pedestrian area.

## USE & APPLICATION

### Location

Street lighting must be considered on all streets as part of providing a safe street environment. The specific approach and needs vary by street, but the following should be considered:

- On downtown street types (Urban center, event/ festival, main street) and neighborhood business streets, providing consistent pedestrian and roadway lighting should be provided on all streets.
- Commercial business and civic center streets typically emphasize roadway lighting, especially at intersections and major driveway approaches. Uniform roadway lighting is important to achieve.
- On neighborhood streets types (network neighborhood, enhanced neighborhood, and local neighborhood) it is important for intersections and crosswalks areas to be properly lit. Mid-block areas are less critical to light.

### Related Design Elements

- **Crosswalks:** All crosswalks, especially mid-block crossings at major streets, must be adequately lit.
- **Bus stops:** Bus stops should be well lit to provide a safe and comfortable atmosphere and ensure that pedestrians are visible to bus drivers.
- **Street Trees:** Trees should be placed and managed to minimize conflicts and impacts to street lights and lighting performance.

# DESIGN & OPERATIONS

## Design Requirements

**A** **Light Levels:** Street lighting shall be used to provide sufficient illumination, particularly at crosswalks and intersections. Lighting shall be placed to provide consistent lighting levels with appropriate contrast. The chart below describes target light levels based on street typology.

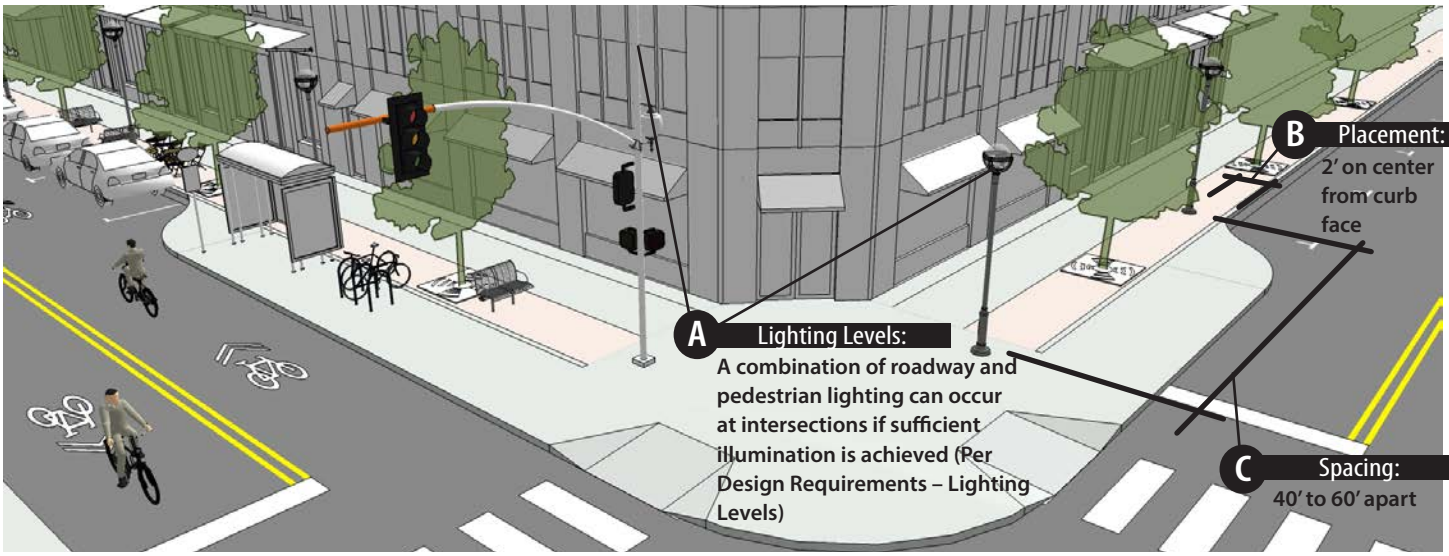
- Higher levels of lighting may be desired at bus stops, bicycle share stations, or other areas of concentrated pedestrian activity. Supplemental lighting may be provided by sources other than street lights, such as from lit bollards, building-mounted lighting, or other accent lighting.
- Mounting height for pedestrian lighting should be 12'-20' high, while the mounting height for roadway lighting should be 20'-40' high.
- **Positive Contrast Lighting:** Positive contrast lighting should be utilized at mid-block crossings. This is usually achieved by placing lights in advance of the crosswalk from both directions to provide vertical illumination of pedestrians at the crosswalk.

**B** **Placement:** Light poles should ideally be placed in the amenity zone of the street. The nearest face of the light pole should be at least 24 inches back from the face of road curb.

- Where bumpouts are present, light placement should typically be consistent with the curb line outside of the bumpouts.

| TABLE<br>Street Typology | Roadway Luminance ($cd/m^2$) | Target Light Level (foot candle / uniformity ratio) | | | |
|---|---|---|---|---|---|
| | | Signalized Intersections | Unsignalized Intersections | Pedestrian Area / Sidewalk | Mid-Block Crossings |
| Urban Center (UC) | 1.2 | 3.2 | 3.2 | 1.5 | 3.2 |
| Event/Festival (E/F) | 1.2 | 3.2 | 3.2 | 1.5 | 2.0 |
| Downtown Main (MS) | 1.2 | 3.2 | 3.2 | 1.5 | 2.5 |
| Neighborhood Business (NB) | 0.8 | 2.2 | 2.2 | 1.5 | 2.0 |
| Commercial Business (CB) | 0.6 | 2.0 | 1.5 | 1.0 | 2.0 |
| City Connector (CC) | 0.4 | 1.7 | 1.1 | 0.5 | 2.0 |
| Neighborhood Network (NN) | 0.6 | 1.7 | 1.5 | 0.7 | 1.7 |
| Enhanced Neighborhood (EN) | 0.5 | 1.3 | 0.7 | 0.7 | 1.2 |
| Local Neighborhood (LN) | 0.3 | n/a | 0.7 | 0.5 | 1.2 |

Source: Adapted from City & County of Denver Street Lighting Design Guidelines & Details (2019) (1)



C **Spacing:** Lighting should be spaced to achieve the target light levels in the chart below. Typically, roadway lights are placed every 150- to 250-feet, and pedestrian scale lights every 40- to 60-feet, but this will vary based on the selected fixtures.

- **Energy Efficiency:** Lighting fixtures should use LED lighting and/or best available energy efficient technology to reduce energy consumption to the extent possible.
- **Dark Skies Compliance and Up lighting:** Fixtures should meet Dark Skies requirements intended to prevent light pollution. This means that fixtures must limit or prevent up lighting using visors, shades, cutoffs, or ore directional lighting.
- **Glare:** Fixtures should be selected that minimize glare (light exiting the fixture at 60- to 90-degree angles).
- **Back light:** Back light is glare exiting the rear of the fixture and directed towards adjacent properties. In residential areas, fixtures that minimize back lighting should be used to prevent rear light spillage into residential dwellings.
- **Materials and Finishes:** Light poles and fixtures should use durable metal material (with galvanized and powder-coated steel, aluminum or stainless steel finishes).

## Additional Design Considerations

- **Light Fixture Style:** A variety of light fixtures are found throughout the city:
  - » Consistent light fixtures within a character district will reinforce the image of the place and facilitate maintenance.
- **Arrangement:** The type and arrangement of light fixtures can reflect the character and hierarchy of the street. Light poles may be arranged in an "alternate" or "opposite" configuration. Opposite configurations are typically associated with a more formal, higher order streetscape, although such a configuration may result in uneven lighting levels and more lights and light poles than are necessary to meet target lighting standards.
- **Banner Poles:** Brackets for banners, hanging baskets, or other ornamentation may be affixed or integrated into the light pole.
- **Electrical Outlets:** Light poles may provide electrical outlets to support activities or seasonal displays. Access to electrical outlets should be secure behind a panel or located at a higher elevation to access control.
  - » Electrified street lighting may also be an opportunity to incorporate public Wi-Fi, speaker systems, and traffic cameras/detection.
- **Signage:** Street signage, bicycle parking and/or single space parking meters should be attached onto light poles (wherever feasible) to reduce sidewalk clutter.

## Sustainability Considerations

- Solar-powered or other emerging technology lights offer additional alternatives to consider.
- Lighter street surfaces and/or higher levels of reflectivity may lower lighting requirements and associated costs.

## Design References

- City & County of Denver Street Lighting Design Guidelines & Details (2019) provides extensive guidance on street lighting practices.
- The Illuminating Engineering Society of North America (IES) authors the nationally recognized "Recommended Practice for Roadway Lighting" – the standard for roadway, pedestrian and bicycle facilities approved by the American National Standards Institute (ANSI).[2]
- FHWA Lighting Design for Mid-block Crosswalks (2008) provides guidance on lighting and visibility considerations at crosswalks to improve pedestrian safety.
- ANSI/iES LP-2-20 Lighting Practice: Designing Quality Lighting for People in Outdoor Environments
- IES G-1-16 Guide for Security Lighting for People, Property, and Critical Infrastructure

# MAINTENANCE & MANAGEMENT

## General Maintenance

- Maintenance responsibilities for street lighting depends on the installer of the lighting.
  - » Standard street lighting is installed and maintained by Consumers Energy.
  - » Special street lighting installed as part of a development project or private entity is the responsibility of that entity to maintain.
  - » Special street lighting may be provided by other city departments or public entities, such as in the downtown or designated commercial districts. Maintenance of such lighting becomes the responsibility of that entity.

| STREET TYPOLOGY | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
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STREETSCAPE & INFRASTRUCTURE

# STREET TREES

## DESCRIPTION & INTENT

Street trees are critical component of the City's overall green infrastructure system. Street trees provide a broad range of benefits, such as managing stormwater volumes, providing shade for pedestrians, making streets safer and more appealing, enhancing the aesthetic character of the street, and reducing the urban heat island effect. Street trees also have a positive impact on adjacent property values.

Maintaining healthy street trees is a challenge in dense urbanized environments, where trees may only last 40-60 years. Proper consideration of the growing environment that yields large and healthy street trees that provide maximum benefit is crucial. Equally important is planning for the eventual replacement of street trees and proactive re-planting to maintain canopy cover

## USE & APPLICATION

### Location

- Trees are especially important to locate near seating, bus stops, and other locations where pedestrians may be sitting, resting, or waiting and can take advantage of the shade trees provide.
- Limited space at the curbside on urban streets may not allow for street trees in all desired locations. Streets need to balance space for trees with a bus stop, on-street parking, seating, and other uses.

Street trees can be planted in one of three different conditions:

- **Trees in Open Landscape Planters:** Landscape planters are curbed or raised planting beds with exposed soil/ mulch within the amenity zone.
  - » Open landscape planters are the preferred method for accommodating trees in commercial areas as they provide more soil surface for water and air to access the tree roots.
- **Trees in a Tree Trench:** Tree trenches use a combination of grates and covered soil areas within the amenity zone to provide an area for root growth beneath a hardscape surface.
  - » Covered Tree Trenches are best-used in locations where significant foot traffic—such as high on-street parking turnover, loading/unloading zones, bus stops, taxi stands, and other intense uses compete for limited space.
- **Trees in a Curb Lawn:** Trees are located within a lawn area in the amenity zone, typically in non-commercial areas.

## Tree Species Selection and Planting Criteria

- **Street Character:** Selecting the right tree for a given street type is important and must consider the specific conditions, space, and growing environment for the planting itself. Trees play a critical role in defining the street character, as such congruency with the street use is critical.
- **Tree Placement:** Proper selection of tree species for a given site shall consider:
  - » Size of available growing areas and growing medium.
  - » Width and height of the tree relative to the distance between trees (tree spacing) and adjacent building faces.
  - » Presence of other street elements that would adversely impact trees or be adversely impacted by trees, such as signs, light posts, and overhead or underground utilities.
  - » Sight line visibility at intersections and proximity to crosswalks.
- **Soil Volumes:** Trees typically need 2-cubic feet of growing soil for every square foot of canopy area for healthy growth based on the anticipated canopy area of the tree at maturity.
  - » Ideally, the soil volumes listed below are accommodated within open landscape areas (planters, lawn, or under tree grates). Practically, this can be challenging to achieve. The following approximate soil volumes by tree size are desired targets.
    - » Small Trees = ~10-foot diameter canopy (approximately 150-cubic feet of soil)
    - » Medium Trees = ~15- to 20-foot diameter canopy (approximately 350-cubic feet of soil)
    - » Large Trees = 20+ foot diameter canopy (approximately 600-cubic feet of soil)
- **Planting Layout and Spacing:** Trees should be planted in a sequence of two to three of the same species in a row to provide a consistent character for a given segment of the street. Typical tree spacing uses the following distances:
  - » Small Trees = 25-foot spacing typical
  - » Medium Trees = 35-foot spacing typical
  - » Large Trees = 45-foot spacing typical
- **Tree Height:** Height requirements based on tree size for the City of Kalamazoo include the following:
  - » Small Tree: Less than 30-feet at maturity
  - » Medium Tree: 30- to 40-feet at maturity
  - » Large Trees: 40-feet or more at maturity
- **Clearance:** The minimum clearance of any overhanging portion should be 8-feet over sidewalks and 16-feet over all streets.
- **Drainage:** Provide subsurface drain lines connected to the stormwater system in areas with poorly drained surrounding soils.

# DESIGN & OPERATIONS

## Permitted Tree Types

- The City's zoning code (Chapter 42- Tree Ordinance) provides a list approved and/or prohibited street tree species that may be used.
- The list in the box below indicates some additional street trees species to consider. The exact installation location should be considered closely to understand the needed salt-tolerance, drought-tolerance, and wet-root tolerance that is needed.

## Design Requirements - Tree Installation

- **Soil Mix:** Street trees must be installed with an approved planting soil mix.
- Planted street trees must include a 3-year maintenance agreement from the installer to ensure that planted trees are property watered and survive long enough to become established.
- Trees should be planted so that the top of the root ball is level with the finished soil surface.
- Avoid placing mulch directly against the bark of trees. Keep mulch 6 inches back.
- The sides of landscape planters and covered tree trenches should be open to existing sub-grade wherever possible to provide for additional root space.

## Utility Considerations

- Do not plant trees directly on top of major utilities, utility leads, vaults, access panels, or other utility infrastructure that are within the soil growth zone.
- No large trees may be planted under or within 10-lateral feet of any overhead primary electric wire. Selection of small or medium size trees should carefully consider wire height. The height of lower hanging non-electric wires (cable, telephone, etc.) should also be considered when selecting tree species.
- Trees should be placed within 5-feet of fire hydrants in order to provide clear space for accessing hydrants.

### Street Tree Species for Consideration

Trees marked with a asterisk (*) typically have Michigan native cultivars available.

- **Small Trees (includes but is not limited to):**
  - » Striped Maple*, Serviceberry* (single stem), Eastern Redbud*, Chinese or White* Fringetree (single stem), Kousa Dogwood (single stem), Cornelian Cherry, Crabapple, Flowering Cherry, Sargent Cherry, Kwanzan Cheery, Japanese Tree Lilac
- **Medium Trees (includes but is not limited to):**
  - » River Birch (single stem), European or American* Hornbeam, American Yellowwood, Carolina Silverbell, American Hophornbeam*, English Oak
- **Large Trees (includes but is not limited to):**
  - » Red & Sugar Maples*, Hackberry*, Ginko (male variety only), Honeylocust*, Kentucky Coffeetree*, Sweetgum, Tuliptree*, Blackgum*, American Sycamore*, London Planetree, Oaks (Swamp White*, Shingle*, Burr*, Chestnut*, Chinkapin*, Northern Red*), American* or Big Leaf Linden, American Elm* (Dutch Elm disease resistant varieties), Zelkova

*List adapted from the City of Ann Arbor*

## Trees in Curbed Landscape Planters

Open landscape planters are curbed areas containing open soil and mulch for accommodating trees and landscape. See ***Curbed Landscape Planters*** for additional planter details.

**A** **Minimum Soil Surface Area:** Minimum of 30 square feet for trees in landscape planters (eg. 6-feet x 5-feet).

- **Width of Planting Area:** Planting areas should provide at least 1-foot of clearance around the tree root ball in all dimensions at a minimum for trees 3 inches in caliper or less, and 18 inches of surrounding soil for trees over 3-inch in caliper.

**B** **Soil Volume:** Strive to have as much soil area as can be accommodated in the planter. Achieving at least 50% of the target volume within the planter curbing is desired, provided the planter is open to surrounding soil areas to absorb future growth.

- **Planter Curbing:** Curbing for planters should be 4 to 6 inches in height and 6- to 10-feet wide. Precast curbing may be used or curbs may be poured in place and/or integral to the surrounding sidewalk. For cast-in-place curbing, ensure that the back (interior) or the curbing is finished.
- **Landscape Surface Elevation:** The soil surface should be 3 to 4 inches below the top of the curb, allowing for 2 to 3 inches of mulch cover and a remaining 1-inch of free board to contain materials during rain events.

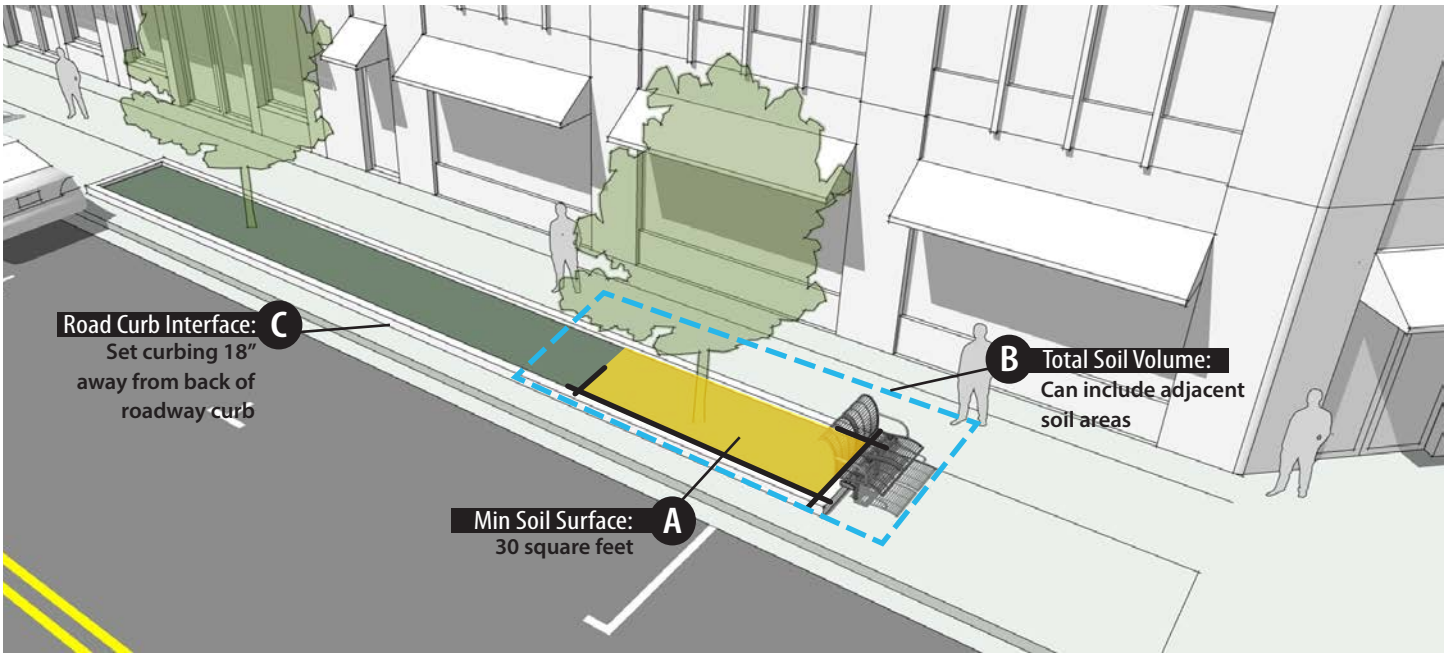
## Additional Design Considerations

- **Curbless Planters:** Curbless planters should be avoided on downtown street types, neighborhood commercial streets, and other areas with heavier pedestrian traffic. Curbless planters do not effectively discourage foot track through the landscape beds, are prone to having mulch or soil materials washout, and allow for deicing agents (salt, etc.) to flow into the planters more readily.

**C** **Interface with Road Curbs:** Landscape planters should be set back at least 18 inches (24 inches is preferred where space allows) from the back of roadway curbs to accommodate curbside access or vehicle clearances near the curb.

## Sustainability Considerations

- Explore opportunities for using structural soils below existing paved sidewalk and amenity zone areas when they can be connected to the growing zone of tree roots. Structural soils utilize larger coarse aggregates to provide load bearing for sidewalks, with the voids between them filled with looser, less compacted soil mixes.
- Use permeable pavements in the amenity zone to encourage infiltration of stormwater into the root zone around trees.
- Landscape planters can be designed as biorention facilities (see ***Stormwater Management*** section).



## Trees in a Tree Trench

*Tree trenches are used in more constrained planting areas (e.g. downtown commercial areas) and utilize tree grates and other structural treatments to provide space for trees to grow while maximizing the area around the tree for flexible, pedestrian uses.*

A **Minimum Tree Grate Area:** The minimum width of tree grates is 4-feet. Tree grates should be as long as possible in order to achieve at least 24-square feet of area. Additional tree grate panels are encouraged to provide a larger open soil area.

- **Width of Planting Area:** Trees should be sized and selected based on the size of the tree grate available, such that the root ball is as least 6 inches (preferably 12 inches) away from the edges of the tree grate/sides of the trench.

B **Soil Volume:** Achieving at least 50% of the target volume within the tree grate area is desired, provided the planter is open to surrounding soil areas to absorb future growth.

  - » Additional soil volume can be achieved by using structural soils or geoengineered solutions underground to provide an expanded and uncompacted soil area.

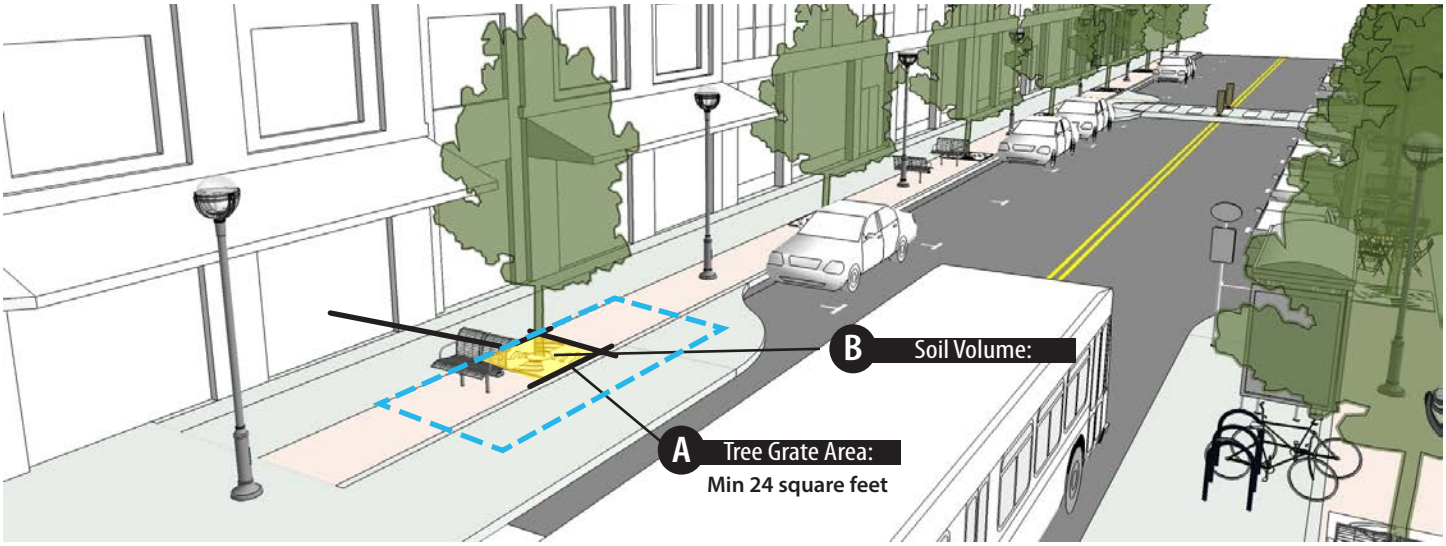
- **Tree Grate Materials:**

  - » Tree grates shall be constructed out of solid steel or cast iron and able to meet the load bearing capacity and requirements of the surrounding sidewalk area.
  - » Tree grates shall be able to be locked in place or bolted down to prevent vandalism, but still removable in order to provide maintenance access below the tree grate.
  - » Tree grates shall provide a 18-inch diameter opening around the tree truck to allow for tree growth. The grate system shall be able to be removed and replaced with a larger opening grate in the event the tree trunk grows too large for the opening.
  - » Tree grates shall provide openings within the tree grate to allow air and water to enter the planting soil. These other openings should not allow an object greater than 0.5-inch in diameter to pass through (e.g. a chair leg).

- **Landscape Surface Elevation:** The distance between the finished soil grade and the top of the tree grate may not be more than 6 inches in height.

## Additional Design Considerations

- **Interface with Road Curbs:** Tree grates should be at 12 inches or more away from the back of the roadway curbs, allowing for a stable paving area to install tree grates.
- **Permeable/Flexible Surfacing Alternative**: Where tree grates or other planting approaches are infeasible, use of permeable and flexible surface materials may be used. This material is preferred over mulch in areas where the mulch cannot be contained and/or periodic foot traffic is expected.



### Sustainability Considerations

- Use permeable pavements in the amenity zone to encourage infiltration of stormwater into the root zone around trees (see ***Stormwater Management***).

## Trees in a Curb Lawn

*Trees planting in a lawn extension (typically between the road curb and sidewalk edge) can provide ample space for tree plantings.*

- **Width of Planting Area:** Trees should only be planted in a lawn extension areas where at least 1-foot of planting space beyond the root ball can be achieved (e.g., a 3-foot diameter root ball requires minimally a 5-foot wide planting area).
- **Tree Planting Area:** A 2- to 3-inch thick mulch ring should surrounded the disturbed area for newly planted trees. Keep mulch 6 inch" away from the edge of the trunk.
- **Lawn and Landscape Planting:** See ***Curb Lawn*** design element.

### Additional Design Considerations

- **Interface with Road Curbs:** Tree trunks should not be closer than 30 inches to the back of curb at maturity.

# MAINTENANCE & MANAGEMENT

- All maintenance performed on trees located in public places, amenity zones, and street rights-of-way will be performed by the City or its agent, unless an exemption is made.
  - » Weeding, trash removal, and mulching must be maintained to keep the tree area free from weeds, trash, and other debris.
  - » Street tree pruning in downtown and neighborhood commercial areas for storefront and signage visibility is important.

### Seasonal Use and Maintenance

- **Snow Removal:** Snow should be cleared from landscape planters and grated tree areas as soon as possible to minimize salt and other pollutant loading from entering exposed soil areas. Snow should not be stored on top of landscape planters and grated tree areas.

| STREET TYPOLOGY | | | | | | | | |
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STREETSCAPE & INFRASTRUCTURE

# STORMWATER MANAGEMENT

## DESCRIPTION & INTENT

Managing stormwater in the urban environment is critical for protecting water quality and reducing the volume of stormwater entering rivers and other water bodies.

Stormwater management techniques, often referred to as Green Stormwater Infrastructure (GSI) at the City of Kalamazoo, include facilities designed to divert, infiltrate, store, and/or filter stormwater runoff prior to entering the city's wastewater system. A variety of stormwater management techniques may be applied in order to achieve management targets. Typically, these techniques will include infiltration planters and underground infiltration and/or storage systems.

## USE & APPLICATION

### Location

- All public street construction and re-construction projects require stormwater management and should explore opportunities to include GSI.
- Stormwater management facilities can be located in various places of the public right-of-way from within the roadway (pervious pavement and subsurface infiltration) to within the amenity zone (infiltration planters and plantings).

# DESIGN & OPERATIONS

## Design Requirements - Bioretention Systems (Infiltration Planters and Rain Gardens)

Infiltration planters are open landscaped areas typically in the amenity zone of the street. They may also be located in other zones depending on the overall design of the street. Infiltration planters are designed to capture runoff from the roadway and other impervious areas of the street. Captured water is filtered through plants and soil and infiltrated completely through the planter or into an overflow underdrain and can be treated in a secondary stormwater system.

- **Management Volume:** Infiltration planters shall be designed, in conjunction with other stormwater systems, to infiltrate the required stormwater quantities per the city's guidelines (50 year, 24 hour design storm for depressed storage).

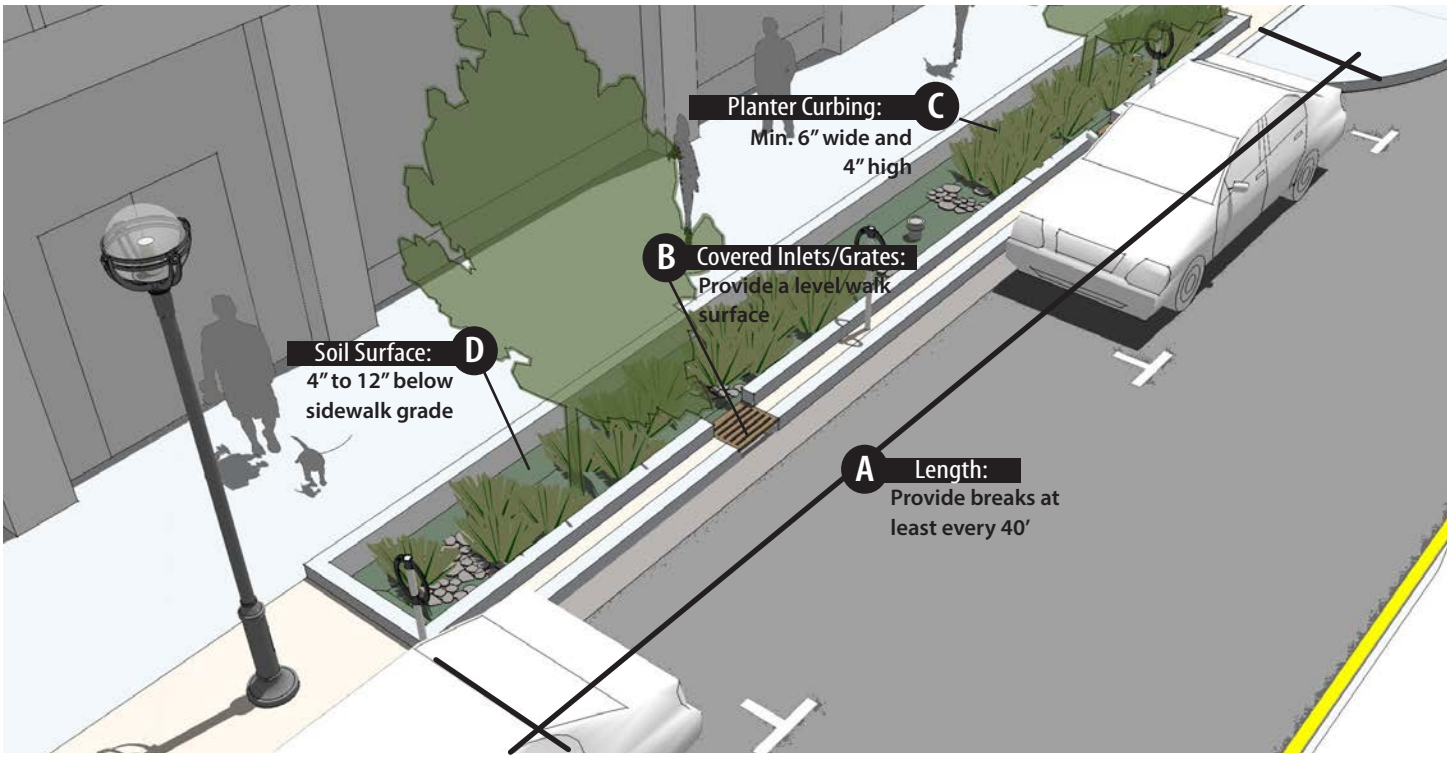
A **Length:** Stormwater planters may line the entire street length, however where on-street parking is provided, breaks shall be provided at least every 40-feet (approximately two car lengths) to allow access from parked cars to the sidewalk.

B **Inlets:** When water runoff is captured from the street, it must be brought into the infiltration planter through a covered flow inlet structure or a curb cut with adequate scour protection.

C **Curbing:** Infiltration planters must be curbed with a minimum of 6 inches wide and 4 inches high curb when adjacent to sidewalk and amenity zone areas. When adjacent to the road curb, this additional curbing is not required along that side of the infiltration planter.

D **Soil Surface:** The finished soil height must be recessed at least 4 inches but not more than 12 inches below the grade of the surrounding sidewalk and amenity zone areas.

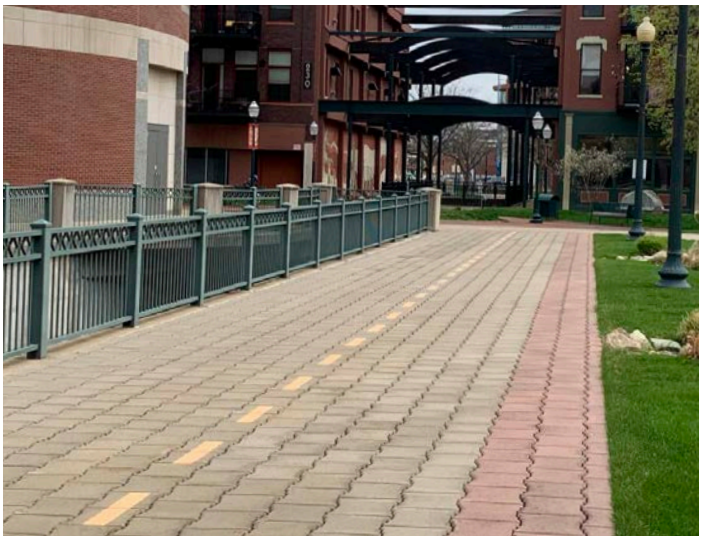
- **Soil Mix:** Soil mix must be specified to infiltrate stormwater and have sufficient depth to store and infiltrate the targeted water volume.
- **Drainage:** Infiltration planters must include a positive overflow drain to divert water accumulation in excess of the infiltration rate of the planter to another treatment system such that areas adjacent to the landscape planter do not get flooded or eroded.
  - » For infiltration planters unable to drain collected water within 12 hours of the end of the rain event, under-drains must be provided to drain excess water into the storm sewers.
- **Plant Materials:** Plant materials must be tolerant of salt and other common runoff pollutants.



## Design Requirements - Subsurface Infiltration

Subsurface infiltration can take a number of forms, including underground infiltration systems, infiltration trenches, and dry wells. These systems can be used to provide stormwater infiltration and constrained urban areas with limited surface area available for landscape planters and/or in conjunction with surface treatments to add additional storage and infiltration capacity.

- **Management Volume:** Subsurface infiltration systems must be designed, in conjunction with other stormwater systems to infiltrate the required stormwater quantities per the city's guidelines.
  - » At a minimum, stormwater infrastructure with enclosed drainage must be designed to drain the 10-year storm event without surface accumulation. Open ditches or depressed drainage must accommodate the 50-year storm event.
- **Load Bearing:** Subsurface infiltration systems must be designed to accommodate the load bearing requirements of the roadway, constructions or other accessible surfaces above the infiltration system.
- **Conveyance:** Water shall be conveyed to the subsurface infiltration systems through piping and conventional curb and gutters and/or through an inlet.
- **Pre-treatment:** Water being conveyed into a subsurface infiltration system shall be pre-treated through a sump, stormwater flow-through planter, or comparable facility to remove large debris and materials.
- **Subsoils:** Geotechnical evaluations including infiltration tests are critical to understanding the underlying soils and an infiltration system.



Green infrastructure in Syracuse, New York

## Design Requirements - Pervious Pavement (Pavers, Concrete, Asphalt)

Pervious pavements can be located within the roadway or in the sidewalk zone in areas where traditional impervious pavements have been used. In pervious pavements, stormwater runoff infiltrates through the pavement section, then is stored in the aggregate base, and infiltrates into native soils.

- **Load Bearing:** The pavement section must be designed to accommodate the load bearing requirements of the roadway, constructions or other accessible surfaces above the infiltration system. Pervious pavement is typically located in areas of lower traffic volumes including parking lots, sidewalks, and plazas.
- **Conveyance:** Water shall be conveyed to the subsurface infiltration systems by permeating through the open graded pavement section into an aggregate base and infiltrating into native soils, or discharging to the city's wastewater system via an underdrain
- **Pre-treatment:** Pervious pavements are susceptible to clogging. Runoff from erodible areas like lawn and landscape should be avoided. Concentrate flows from gutters and downspouts should be allowed to disperse with level spreaders.
- **Subsoils:** Geotechnical evaluations including infiltration tests are critical to understanding the underlying soils and an infiltration system.

## Additional Design Considerations

- Locate pre-treatment material, such as cobble and stone, to capture debris just inside the inlet point and provide easily access to clean out.
- Incorporate appropriate trees into the infiltration planter to enhance the stormwater benefits.
- Incorporate stormwater planters with traditional landscape planters, and integrate seat-walls and other vegetation into the design.
- Consider locating special signage along the street at key locations to tell people there is an underground stormwater management facility present and educate them about their operation and benefits.

## Utility Considerations

- Consider the location and condition of existing utility infrastructure and access points.
- Ensure overflows into existing stormwater pipe infrastructure do not result in additional flooding or bottlenecking.
- Install waterproof vault covers or other utility access points if located within an infiltration planter.

## Design References

- SEMCOG Low Impact Development Manual for Michigan (2008).

# MAINTENANCE & MANAGEMENT

- Regularly (quarterly, at a minimum) remove excess sediment, litter, and debris, particularly within any pre-treatment facilities, to maintain a clean appearance and preserve effective functioning.
- Quarterly Inspection of inlets, sumps and outlet points to ensure there are no blockages or impediments to designed water flows (including sediment buildup and excess debris).
- Sumps or pre-treatment areas should be cleaned out at least once per year unless excess debris and sediment build up occurs requiring more frequent service.
- Regular landscape maintenance, such as deadheading, weeding, and leaf removal is important to maintaining the health and attractiveness of infiltration planters.
- Bioretention systems are susceptible to compaction of the soils. Snow storage should be restricted from the footprint of these systems.
- Pervious pavement systems require periodic maintenance to prevent surface clogging. Maintenance can include periodic vacuuming to remove debris from the surface and minimal use of de-icing salts and sand.

## Seasonal Use and Maintenance

- **Winter Conditions:** Inspect inlet and outlet points more frequently in winter to ensure they are clear of excess snow and ice and remain open, particularly positive overflow drains.

| STREET TYPOLOGY | | | | | | | | |
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| Lim. | Lim. | Lim. | Opt. | Opt. | Rec. | Rec. | Rec. | Rec. |

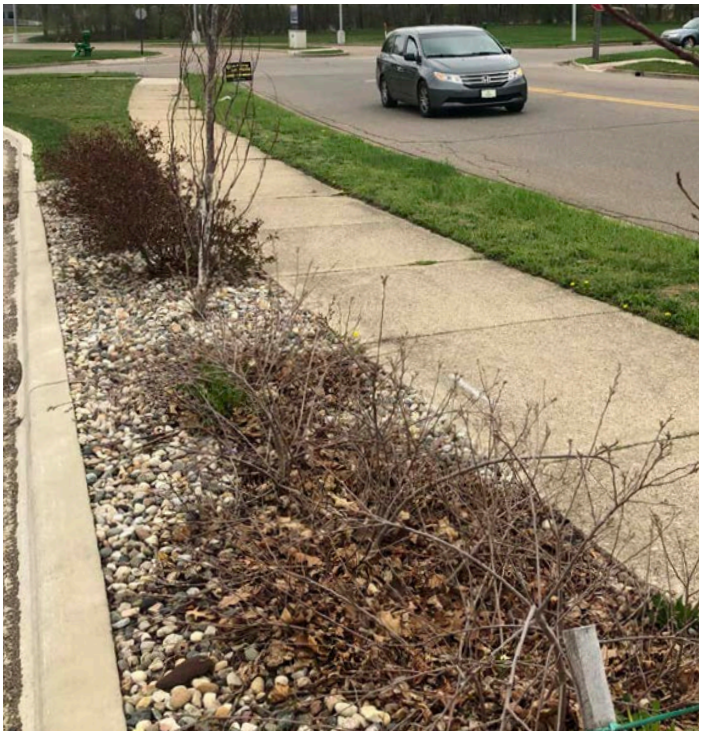
STREETSCAPE & INFRASTRUCTURE

# LANDSCAPE & CURB LAWNS

## DESCRIPTION & INTENT

Curb lawns are areas in the amenity zone between the sidewalk and street curb where plantings are used to provide buffers between the sidewalk and the roadway.

Curb lawns are typically found in more neighborhood contexts where more intense commercial uses and foot traffic over the lawn area is less frequent. While lawn areas require maintenance (watering, mowing, and weed control) to stay healthy, they add flexible greenery to neighborhood environments.



## USE & APPLICATION

### Location

- Curb lawns should not be used in downtown street types (urban center, event/festival, and main streets).
- Curb lawns may be used in neighborhood business or commercial business streets in locations where frequent foot traffic is not anticipated. Where frequent foot traffic is present (e.g. due to presence of on-street parking or loading areas), hard surfacing treatments should be used instead (concrete or pavers).
- Curb lawns should occur along the majority of the block side where they are being used to provide a cleaner and more consistent look for that portion of the street.

### Related Design Elements

- **Bus stops:** Gaps in lawn/landscape panels should be provided at bus stops, with areas of the amenity zone paved in order to provide an ADA accessible pathway for transit access.

# DESIGN & OPERATIONS

## Design Requirements

- **Width:** Curb lawns shall be a minimum width of 3-feet between the back of the street curb and edge of the sidewalk.
  - » If this width cannot be achieved, the area between the curb and sidewalk should be paved with a hard surface (concrete or pavers).
- **Lawn Seeding:** Lawn areas shall be seeded or sodded with a species mix suitable for Kalamazoo's climate region and consistent with the sun/shade availability of the specific planting site.
  - » When installing lawn extensions with seeding, a straw cover shall be used to minimize soil runoff and discourage pedestrian traffic while the lawn is established
- **Soil:** Lawn areas shall contain at least 4 inches of topsoil and the topsoil or soil surface for sod applications must be flush to the edge of the sidewalk and the back of curb.
  - » Curb lawns shall be smooth and not result in water pooling or ponding on their surface or on the surface of adjacent sidewalk areas.

## Additional Design Considerations

- **Landscape Plantings:** Curb lawns may be planted with perennials beds or ground covers as an alternative to or complimenting lawn areas. These plantings should grow to a height in excess of 36 inches above the adjacent sidewalk road surface. Shrubs or other low woody plants may not be used. Vegetation should not grow into or otherwise obstruct the sidewalk area.
  - » Where perennials and ground covers are used, periodic clear zones or pathways connecting from the street edge to the sidewalk are important where on-street parking occurs to provide ADA accessible pathways and minimize foot traffic impacts on ornamental plantings. Gaps should typically be provided at least every 40-feet (i.e. car lengths)
  - » Where perennials and ground covers are used, at least 1-inch of mulch should be applied to cover and protect exposed soil areas. Stone, cobble, pea gravels, and other hard mulches should not be used as mulching materials.
- **Street Trees:** Larger lawn extensions are ideal locations for planting street trees. Street trees are required on all streets (see ***Street Trees***).

## Utility Considerations

- Lawn extensions may be located on top of most utilities. Identify and avoid covering access to water valves or other utility access panels that may be found in the amenity zone.

## Sustainability Considerations

- Consider using lawn substitutes, such as "no mow" plant species or creeping ground covers as an alternative to traditional lawn turf species. Such alternatives should be selected based on their ability to withstand foot traffic when used as a lawn substitute.
- Consider using xeriscaping practices or other low water need plants to conserve water compared to typical lawn plantings.
- Avoid the use of synthetic fertilizers and herbicides to avoid impact on water quality and pollutant exposure to people touching lawn areas.
- Phosphorous fertilizer should not be used, due to its impacts on water (can cause unhealthy nutrient loading into local waterways).

# MAINTENANCE & MANAGEMENT

- **Plant Care:** Lawn extensions and any plantings within that zone must be maintained by the fronting property owners. Regular maintenance includes mowing to maintain lawn areas, watering, weeding, trash removal, trimming, and maintaining mulch.
  - » Lawn extensions covered in turf grass must be maintained with an average height not in excess of 9 inches.

| STREET TYPOLOGY | | | | | | | | |
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STREETSCAPE & INFRASTRUCTURE

# CURBED LANDSCAPE PLANTERS

## DESCRIPTION & INTENT

Curbed landscape planters (referred to in this document simple as landscape planters) are fixed, curbed or raised soil areas designed to accommodate decorative plantings in a clean and clearly maintained fashion within the streetscape. Landscape planters soften the urban environment and provide foliage and flowers to make the street environment more appealing and engaging for all types of users.

Landscape planters typically contain a variety of suitable and tolerant perennial plant species and may be used to accommodate street tree plantings. Annual plants can be suitable for landscape planters provided that arrangements for their maintenance and replacement have been made.

Landscape planters are either curbed or raised in order to deter pedestrian traffic from moving through the landscaped area and harming or impacting plant materials. Curbing landscape planters provides a strong edge for the planter, improves soil and mulch containment, and discourages pedestrians from cutting through the planting beds. Raised planter designs provide an opportunity to incorporate informal seating areas into the streetscape design.

The use and abundance of landscape planters within the amenity zone must be carefully considered alongside other competing uses.

## USE & APPLICATION

### Location

- Landscape planters are well suited to the downtown street types and neighborhood business areas. They can be used in other street types where lawn/landscape panels are less appropriate (e.g. limited space, foot traffic, etc.).
- Landscape planters occur primarily within the amenity zone between the sidewalk and the curb. Where buildings are setback from the sidewalk, landscape planters are also appropriate in the frontage zone, and can be incorporated into building facades.

### Related Design Elements

- **Amenity Zone Uses:** Locate landscape planters in coordination with street lighting, signs, parking meters, and other elements within the amenity zone.
- **Public Seating:** In areas with higher pedestrian volumes, planters can incorporate seatwalls to provide flexible seating for people.
    - » Seatwalls are especially beneficial at intersections and when used in conjunction with bulb outs at the corner or in a mid-block location to provide a seating zone close to intersections where people may have to wait for a signal.

# DESIGN & OPERATIONS

## Design Requirements

- **Planter Type:** Design landscape planters as either a curbed planting bed, a raised planter, or a hybrid design.

  **A** **Curbed Landscape Planters:** For a curbed planting bed, edge the planter box with a 6- to 10 inch wide and 4- to 6 inch high concrete curb with chamfered edges following the grade of the sidewalk and amenity zones.

  **B** **Raised Landscape Planters:** For a raised planter, surround the planter box by a 12- to 16-inch wide and 15- to 22-inch (18 inches preferred) tall concrete seatwall with chamfered edges. Design seatwalls to provide a level surface for seating.

  » **Hybrid Landscape Planters:** Design hybrid planters as a curbed planter except with one, two, or three sides of the landscape planter designed with seatwalls.

**C** **Width:** The width of landscape planters must provide at least a 2.5-feet wide zone for soil and plantings, not accounting for the width of curbing or seatwalls.

**D** **Curb Strip:** Provide at least 18 inches (24 inches preferred) of paved surface between the back of the street curb and the nearest face of the landscape planters. This paved zone provides a place for people to walk around the planter and/or for parking meters and other signage to be installed outside of the planting bed itself.

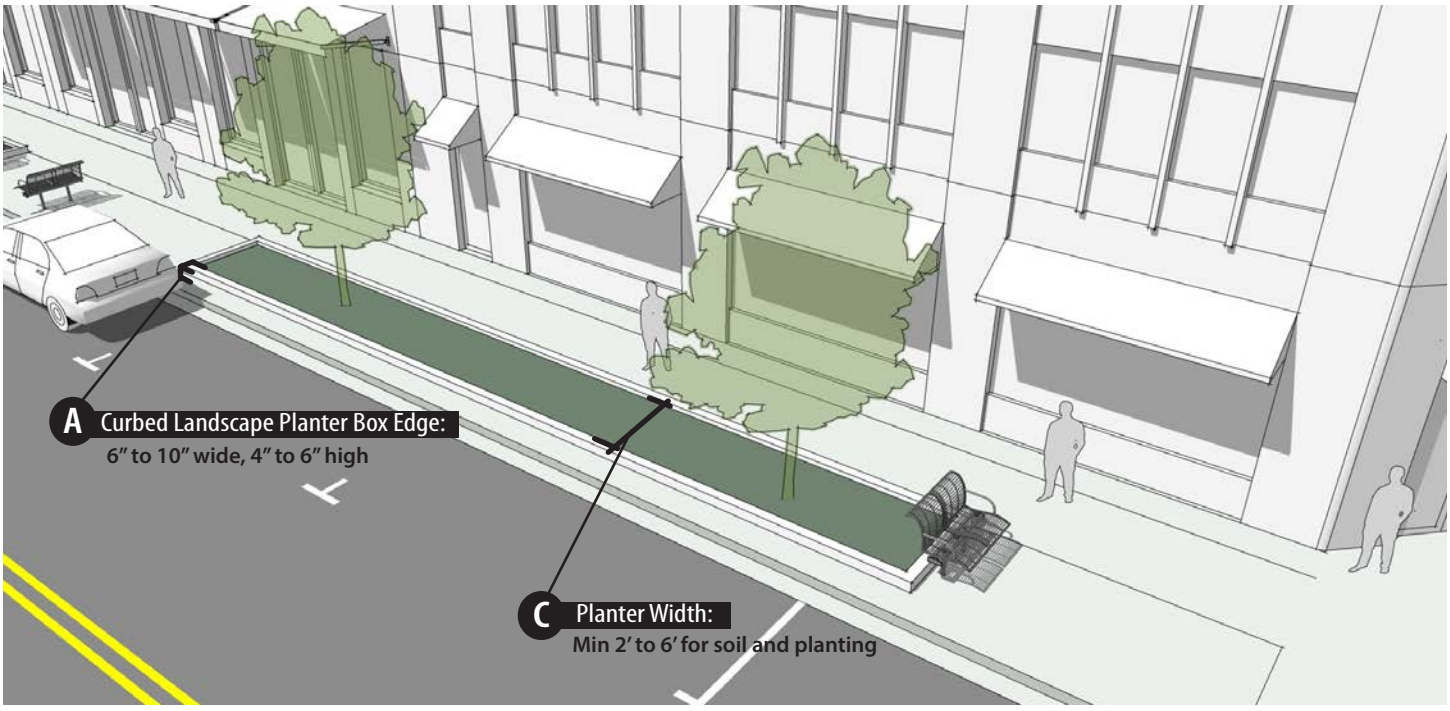
- **Planting Mulch:** Provide a 2- to 3-inch thick mulch surface for all exposed planting soils.

  » Keep mulch surfaces for planting between 2 to 3 inches below the edge of curbs or seatwalls to prevent mulches from spilling outside of the landscape planter.

- **Plantings:** Planters use a combination of herbaceous plants and street trees.

  » Select perennial species suited to specific site conditions, including sun/shade, water availability, and salt tolerance for plantings within landscape planters.

  » Suitable herbaceous annuals may be planted by private entities but only with a maintenance agreement and approval.



## Additional Design Considerations

E **Seatwalls:** Raised landscape planters with seatwalls, if space is available, should be setback at least 1-foot from the through sidewalk areas so that people sitting on the seat-wall minimize impacts to the flow of pedestrian traffic.

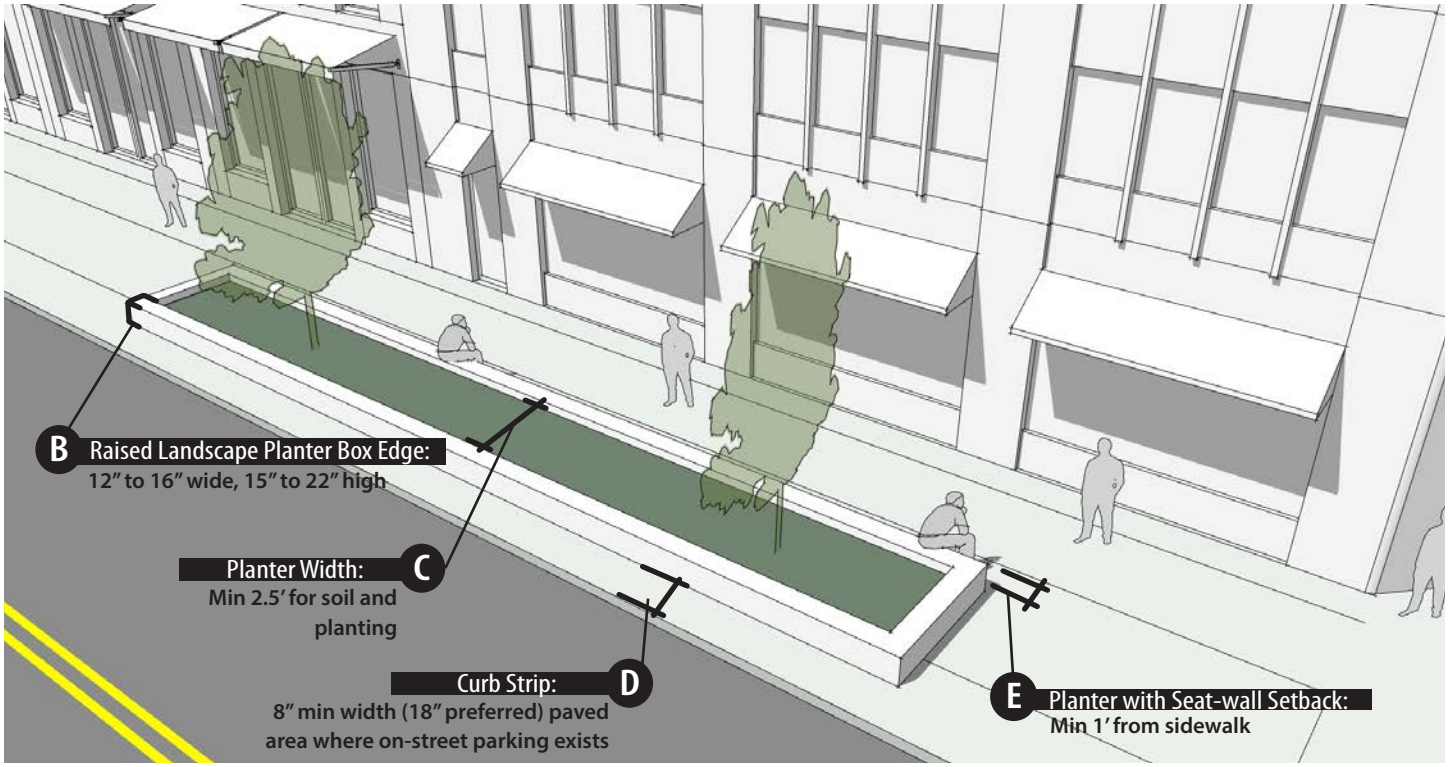
- **Street Trees:** Consider locating street trees in landscape planters.

## Utility Considerations

- Landscape planters should not be located in areas where utility access panels, vaults, or other regular utility maintenance and access occurs.
- Street lights may be set within curbed landscape planters when the width of the landscape planter is at least three times the needed width of the street light base and footing to still provide sufficient soil volume and planter width.

## Sustainability Considerations

- Consider drought tolerant plant materials that do not require extensive watering outside of their establishment period (typically two years).
- Design landscape planters into stormwater infiltration planters. Lower the soil surface elevation to below the sidewalk and/or street grade and provide a break in the curb or seat-wall with an inlet structure to divert stormwater into the planter. Design the planter to handle anticipated rainfall and water quantity volumes.



# MAINTENANCE & MANAGEMENT

- **Plant Care:** Plant materials shall be maintained in accordance with a maintenance agreement established as part of the planter design and construction process. As with curb lawns, plantings in adjacent landscape planters (except for street trees) should be maintained and cared for by the adjacent property owner or other designated entity.
  - » Maintain at least a 2-inch mulch cover over the landscape planter.
  - » Weed, remove litter, and maintain plants (deadheading, cutting, etc.).
  - » Clear, sweep, and remove mulch and other materials that spill outside of the landscape planter.
  - » Regularly water, especially during dry periods.
  - » Replace dead or missing plant material.
- **Establishment Period:** Following new landscape planter construction, water new plant materials regularly during the growing season for the first 3-years during plant establishment.



| STREET TYPOLOGY | | | | | | | | |
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STREETSCAPE & INFRASTRUCTURE

# UTILITIES

## DESCRIPTION & INTENT

The public right-of-way is home to the utilities that serve the buildings and uses of the city, and their presence is typically unremarkable to the average visitor. The intent of this section is to provide guidance for locating private and public utility services, particularly as they relate to the pedestrian environment.

## USE & APPLICATION

### Location

Almost all public streets projects impact utility mains and services in some way. A few examples include:

- Sidewalk reconstruction and streetscape improvements which impact utility service lines, hand holes, valves, and storm inlets.
- Utility main replacement and subsequent service line adjustments.
- Utility repairs to mains and service lines.
- Street resurfacing, which may impact manholes and catch basin inlets.

### Private Development

Private development projects that impact the street right-of-way or require reconstruction of portions of the public right-of-way will typically impact public and private utilities in the following ways:

- Installation of new water and sanitary service leads from existing mains.
- Connection to the stormwater system.
- Replacement or up-sizing utility mains to provide for the new development's needs.
- Streetscape reconstruction, which may include new lighting.
- Electrical and communication service connections.
- **Repair Standard:** Private projects must repair the public right-of-way to the design standards consistent with this design manual. The physical design and layout of repaired areas should match the prior condition's design intent and layout.

# DESIGN & OPERATIONS

## Design Requirements - Manholes/ Vaults, Valves, and Hand Holes

Access to utility service junctions through manholes, hand holes, and valves are critical to the maintenance, emergency management, and safety of the utility systems. The cover for these access points are typically flush with adjacent pavement, or slightly raised when located in unpaved areas.

- Hand holes are used for electrical and communications cable junctions and have specific design requirements based on the utility service provider.
- Locate hand holes as follows:
  - » Locate within landscape beds if used in design. Conduits should sweep into the hand holes such that they are located at least 12 inches from the planting soils of the beds and trees.
  - » In streetscapes without planting beds, locate sidewalks to limit conflicts with conduits running through the urban street tree soil treatment.
  - » Avoid placing hand holes on barrier-free ramps or at grade breaks in the sidewalks, as the long rectangular shape of most hand holes makes it difficult to pour the concrete in these situations without grade issues.
  - » Place the top of the conduits at least 12 inches below the base of the subgrade.
- Where electrical junctions occur in vehicular traffic areas use precast concrete structures and cast iron frames and lids designed to carry heavy traffic loads, in lieu of hand holes.
- Avoid locating manholes and water main valves within the road curb or within the clear zone of the sidewalk. Locating these within the roadway zone or amenity zone of the street is preferred.
- Locate utility manholes and building vaults a minimum of 10-feet from water mains and services.

## Design Requirements - Fire Hydrants

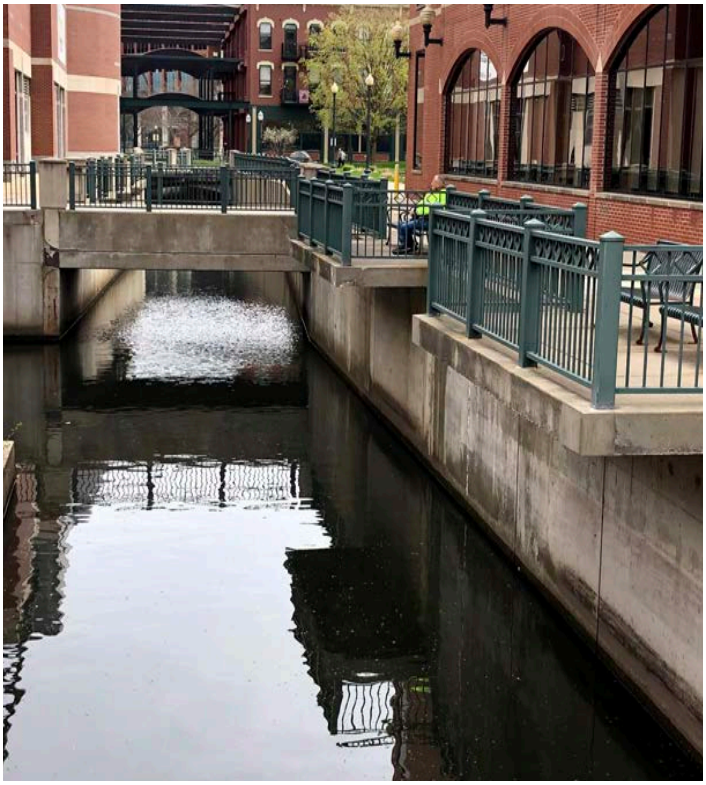
Providing for fire safety is critical to protecting historic architectural resources and providing for new development and growth. Providing adequate number and spacing of fire hydrants is an important element in ensuring for adequate fire protection.

- Hydrants shall be typically spaced at 300-feet along the roadway or as required by the City of Kalamazoo Code and the fire code official.
  - » Hydrant placement should also consider necessary proximity to building Fire Department Connections (FDCs). This is typically a 100-feet maximum from FDC to hydrants, or per the Fire Marshall's requirements.
- Hydrants should be located a minimum of 4- to 6-feet and maximum of 7-feet from the face of the curb or edge of a paved area. Setting the hydrant closer to the shorter end of the range will allow more flexibility in the design and use of the intersection, and will typically place the hydrants outside of the sidewalk zone, and in the amenity zone.
- A 3-foot clear zone or distance required by the fire code official around the hydrant is required to maintain access. Curb use around a hydrant is restricted. No parking, loading, standing, or pick-up will be allowed at the curb in front of a hydrant. Provide a clear path between the curb and the hydrant. No site furnishings will be allowed between a hydrant and the curb.
- Hydrant barrels shall be painted safety yellow and hydrant caps and operating nut shall be painted John Deere green per the City of Kalamazoo Standard Specifications for Water Main and Services Installation.

## Design Requirements - Storm Inlets

The placement of stormwater inlets/catch basins at crosswalks and intersections is important for efficient storm drainage, as well as providing an accessible street environment. Of particular concern is ensuring universal access, avoiding the puddling of water at the base of curb ramps and on sidewalks during the snow season and providing for maintenance of the drains, inlets, and catch basins.

- Storm sewer systems shall be designed for the minimum 10-year, 24 hour design storm.
- Typically, place Inlets/catch basins at the point of curvature (spring point) of each intersection, thus requiring two inlets/catch basins for each corner.
- Adjust the location of inlets/catch basins so that they are:
  - » Not within the travel lane of curb ramps.
  - » Placed on the higher elevation side and directly adjacent to curb ramps so that ice and snow are less likely to block drainage to the inlets and catch water before crossing a curb ramp.
- Locate inlets/catch basins directly adjacent to mid-block crossing curb ramps on the higher elevation side of the curb line from the curb ramp.
- If inlets/catch basins must be placed in the travel lane of curb ramps, design the cast grate of the structure to accommodate universal access.
- Use bicycle safe grates in bicycle lanes.
- Valley grates that meet City of Kalamazoo minimum standards are permitted.
- **Trench Drains:** The use of trench drains is discouraged and they should not be used unless there is no adequate storm drainage alternative. While the use of trench drains and sidewalk inlets should be avoided, where they are deemed necessary they should meet the following design requirements:
  - » The accessible body of all trench drains and sidewalk drains must be a minimum of 8 inches wide for maintenance purposes.
  - » Trench drains and sidewalk drains must be rated for light duty traffic. Non-metal drain grates are not allowed.
  - » The grate of the structures must accommodate universal access.
  - » Lateral pipes draining the trench drains and sidewalk inlets must be a minimum of 8 inches in diameter, and be no longer than 40-feet before tapping into a city standard inlet/catch basin or manhole.



## Design Requirements - Above Ground Utilities

New building construction and electrical and communications services often require above grade utility boxes, panels, and transformers.

While these appurtenances provide for important private utility service, they can hamper the pedestrian use of streets and sidewalks.

- Where such appurtenances are required for a specific private development, they should be located on private property.
- If appurtenances are serving public amenities and/or multiple properties and private buildings, they should still be located on private land, alleys, or parking lots. Co-locate surface mounted utilities and share boxes or pedestals wherever possible.

### Additional Design Considerations

- Overhead electrical and communication lines provide maintenance issues and can be unsightly. Underground lines are strongly preferred.
- Utility poles shall be located at regular intervals within the amenity zone, typically 3-feet from the face of the curb.

# MAINTENANCE & MANAGEMENT

- Complete inspection of the condition of hand hole and valve covers annually, particularly after the winter snow removal season, to assess any damage or impact to the walkability of the sidewalk surfaces.

### Design References

- City of Kalamazoo Department of Public Services, Standard Specifications for Water Main and Service Installation, 2021.
- Federal Highway Administration Hydraulic Design Series 2
- AASHTO Highway Drainage Guidelines

### Sustainability Considerations

- Coordination of utility main upgrade and the need for street or streetscape reconstruction is itself a technique of sustainability as it minimizes the use (and expenditure for) construction materials and the energy and resources used to install them.

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