Active Transportation Plan

Adopted June 5th, 2025

CORINTH
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Prepared by | Freese and Nichols, Inc.

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1 Introduction

About the Plan

Plan Purpose

The 2025 Active Transportation Plan ("the Plan") presents a shared vision for the development of a safe and highly functional active transportation network of pedestrian and bicycle facilities and amenities within the City of Corinth, Texas ("Corinth" or "the City").

The Active Transportation Plan provides a comprehensive assessment of current mobility issues, needs, trends and priorities and serves as a framework for Corinth to make informed decisions regarding active transportation infrastructure, policies and investments. The Plan outlines goals and objectives (Exhibit 1 on page 3) that guide the network development, recommendations and implementation strategy that integrate the concepts of Complete Streets and micromobility.

Plan Background

In 2020, the City adopted its Envision 2040 Comprehensive Plan and Park, Recreation & Open Space Plan. The Park, Recreation & Open Space Master Plan provided an Active Transportation Network which was refined in the 2025 Active Transportation Plan. In addition to the updated network, the Plan will build upon these previous efforts to create goals and objectives related to active transportation, updated design standards, review of best practices and guidance for planning for micromobility and Complete Streets.

This Plan serves as a guide for developing active transportation within Corinth and establishes standards for the City's future network.

What's in the Plan

The Active Transportation Plan includes an inventory of existing and planned active transportation facilities, an analysis of existing data and policies, a summary of public engagement, guidance and recommendations on facility design and policy (the Complete Streets Design Manual and Ordinance in Appendix B), recommended priority network, and an implementation plan with project priorities.

Existing pedestrian crossing along the Denton Katy Trail in Corinth.

Vision, Goals and Objectives

A vision statement outlines the overarching aspirations and desired future outcomes upon which goals and objectives are built. It provides high-level guidance on the pragmatic balance between aspirations and current realities. The vision sets the tone and direction for strategic initiatives, fostering alignment and clarity in organizational purpose.

The Envision 2040 Comprehensive Plan contains Guiding Principles, which provide the structural support and the guidance for the vision described in the Plan. These are:

- A Dynamic and Aesthetically Pleasing Community
- Complete, Connected, and Safe Neighborhoods
- Future Infill Development

The vision statement in the Park, Recreation & Open Space Master Plan is also directly related to active transportation. It reads:

> "To support a thriving and connected City through non-motorized transportation infrastructure that enhances overall quality of life and provides an elevated level of functionality by maintaining connections for expansion and surge of development across the City."

Goals serve as outcome-based, broad statements that encapsulate longer-term aspirations. They are concise, straightforward and relatable, guiding efforts toward tangible achievements. Aligned with local and regional objectives, goals provide a clear direction for strategic planning and action, ensuring coherence and synergy across various initiatives.

Objectives outline specific, measurable targets that break down larger goals into manageable components, providing a clear roadmap for implementation and progress tracking. They are characterized by their clarity, specificity and relevance to a plan's overarching goals. Objectives are often designed using the SMART criteria — specific, measurable, attainable, relevant and timely — to ensure they are realistic and actionable. The goals and objectives of this Active Transportation Plan are outlined in Exhibit 1 on page 3.

Exhibit 1. *Goals and Objectives*

Goal: Safety

Eliminate fatalities and reduce serious injuries for active transportation users

Objectives

A. By 2050, eliminate all traffic fatalities and reduce severe injuries by 50% compared to the 2023 baseline.

B. By 2028, secure an increasing proportion of safety funding for active transportation.

C. By 2028, ensure utilization of the National Association of City Transportation Officials (NACTO) Urban Street Design Guide and the Complete Streets Design Manual for all local project designs to support bike/ped projects that create a low-stress network for bike/ped users and use context-sensitive design.

D. By 2028, complete an inventory and conditions assessment of the existing active transportation network, prioritize noted deficiencies, and establish procedures for monitoring conditions and updating the assessed inventory.

Performance Measures

» Fatal and serious injury crashes within the City of Corinth
» Annual funding for safety projects related to active transportation
» Local adoption of Active Transportation Plan and its design guidance elements
» Inventory of active transportation network and conditions, with priorities for improvements

Goal: System Performance

Improve active transportation connectivity and mobility

Objectives

A. Annually create 5 miles of new on-street protected bicycle facilities or off-street bike/ped facilities within the City of Corinth.

B. Annually construct or repair 5 miles of Americans with Disabilities Act (ADA)-compliant sidewalks within the City of Corinth.

C. Increase active transportation activity within the City by implementing improved or new bike/ped connections to residential areas, community facilities, shopping areas, tourist attractions, employment concentrations, greenways and regional parks. Enhance the user experience by providing amenities (physical and visual) and wayfinding along the route.

Performance Measures

» Miles of on- and off-street bicycle facilities/trails
» Miles of ADA-compliant sidewalks
» Active Transportation mode share data (U.S. Census American Community Survey (ACS) dataset)

Goal: Promote Activity

Promote use of active transportation for healthy lifestyle

Objectives

A. Annually promote and actively participate in nationally recognized active transportation events, such as Bike to Work Week and Walk to School Day.

B. Annually promote and actively participate in local events focusing on active transportation such as Bike the Bay.

C. Annually promote the benefits of active transportation.

D. Annually promote driver education and awareness of bicyclists and pedestrians using our roadways.

Performance Measures

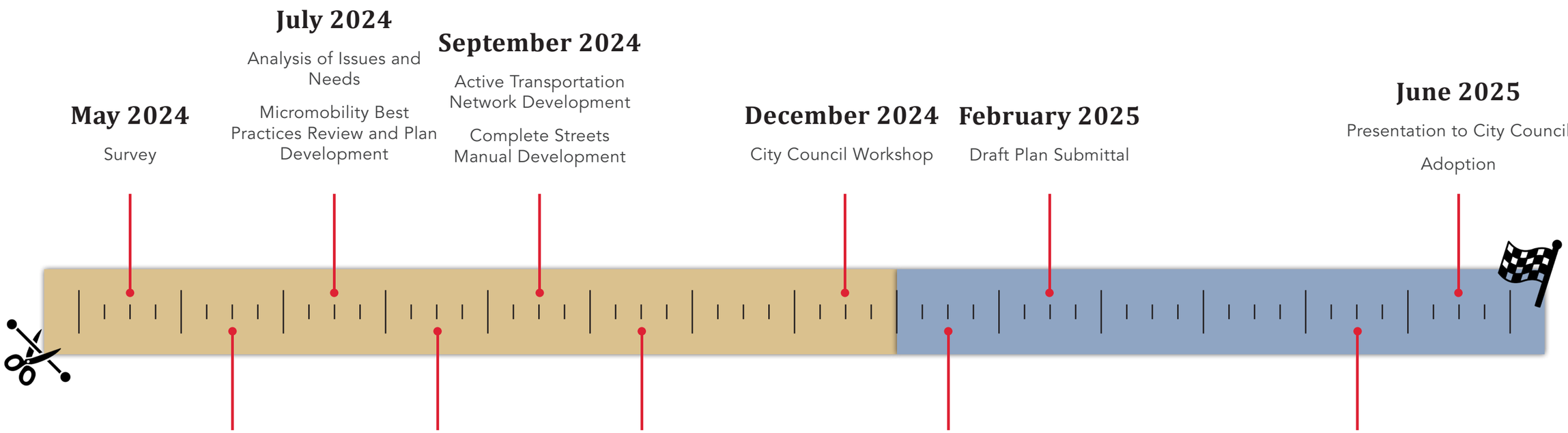
» Number of occasions or events promoted by MPO or member cities
» Number of participants in bike/ped events
» Number of promotional or instructional events regarding bike/ped benefits or safety

Planning Process and Timeline

The development of the Active Transportation Plan was a six-month process involving public and stakeholder involvement to obtain the project's vision, goals and objectives, data collection, analysis and review. Outlining the sequence of activities and key milestones illustrates the thoughtful and systematic approach to ensure the project's success.

The project's timeline ran from June 2024 until December 2024 and served as a roadmap for guiding the project through its various stages and ensuring that all objectives were met within the set time frame. Exhibit 2 outlines each phase in the planning process and its place on the project timeline.

Exhibit 2. *Plan Development Timeline*



2 Existing Conditions and Plans

This section provides a general overview of the area's population, employment and current utilization of its transportation network. As part of the assessment of existing conditions, the City of Corinth collected available data on existing and planned trails, bike lanes, separated bike lanes, shoulders and sidewalks.

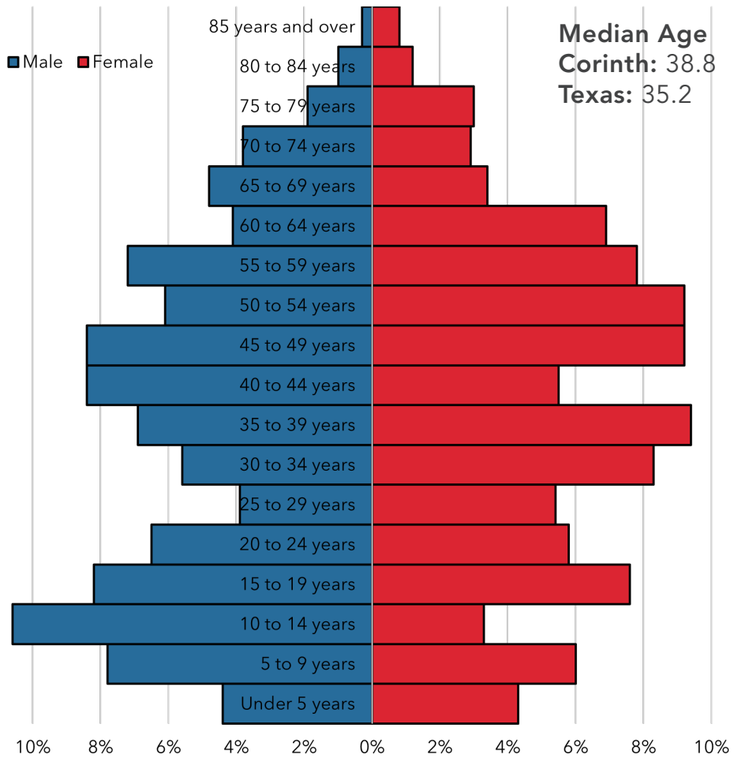
Community Snapshot

Data presented in the Community Snapshot section was sourced from the 2022 American Community Survey (ACS) 5-Year Estimates unless indicated otherwise.

Population and Employment in Corinth

Corinth's population as of 2022 is 22,502. The Texas Water Development Board's demographic forecasts show that Corinth's population will grow to 29,174 by 2030.

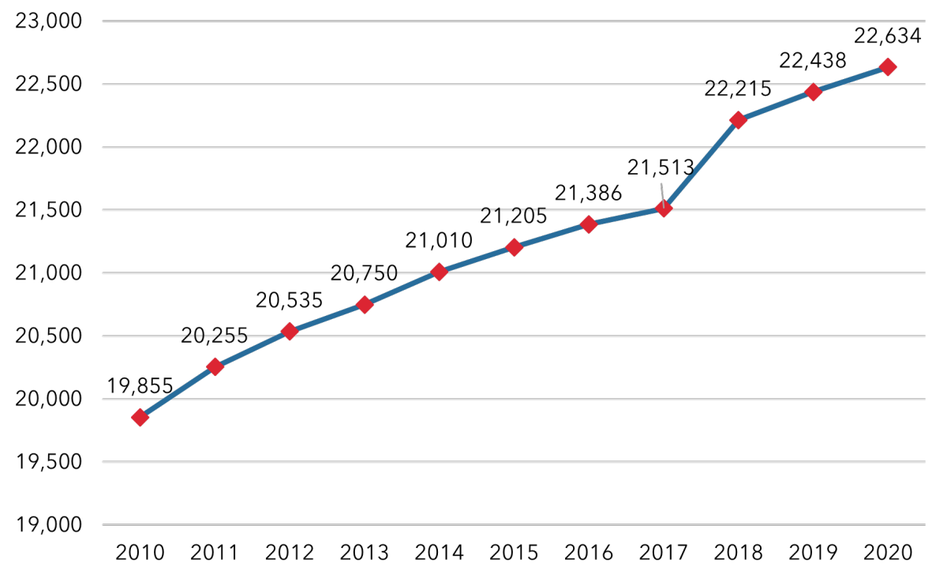
Exhibit 3. *Age Profile in 5-Year Increments*



(ACS Table S0101)

The 2022 ACS indicates that Corinth has a slightly higher median age (Exhibit 3) than the state of Texas. The City's population pyramid indicates a heavy working-age population of people aged 30-59, with a skew toward working-age females and adolescent males.

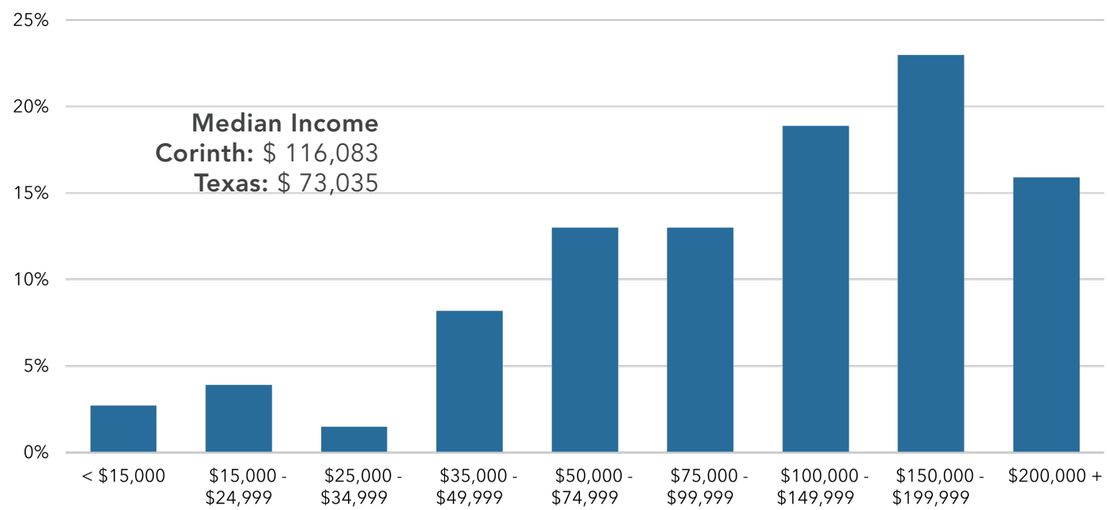
Exhibit 4. *Historical Population Growth*



(Texas Demographic Center, 2010-2020 Intercensal Population Estimates)

According to the Texas Demographic Center, the population in the City of Corinth has been steadily increasing each year, with a significant jump from 2017 to 2018 (Exhibit 4). The increasing population presents opportunities that the project team considered when developing the active transportation network.

Exhibit 5. *Household Income*



(ACS Table S1901)

Compared to the state of Texas, the City of Corinth has a significantly higher median household income (Exhibit 5), a lower concentration of service and blue-collar workers, and fewer households without vehicles and households in poverty (Exhibit 6 on page 7).

Exhibit 6. *Community Overview*

	Total Population (ACS Table S0101)	Zero Car Households (ACS Table S2504)	Households in Poverty (ACS Table S1701)
Corinth	22,502	0.9%	4.8%
Texas	*29,243,342*	*5.3%*	*13.9%*

	Population 65+ (ACS Table S0101)	Language Other than English at Home (ACS Table S1601)
Corinth	11.7%	13.1%
Texas	*12.9%*	*35.1%*

	Services (ACS Table S2401)	Blue Collar (ACS Table S2401)	White Collar (ACS Table S2401)
Corinth	12.0%	17.8%	70.2%
Texas	*16.4%*	*23.3%*	*60.3%*

Inflow and Outflow of Workers

The analysis performed by the 2021 LEHD Origin-Destination Employment Statistics (LODES) dataset in Exhibit 7 reveals that a large number of people (12,496) who live in Corinth travel out of the City for work. A smaller number of workers (3,970) live outside of Corinth and work in the City, and few (395) live and work within Corinth. This indicates that Corinth has a high concentration of commuters to nearby towns.

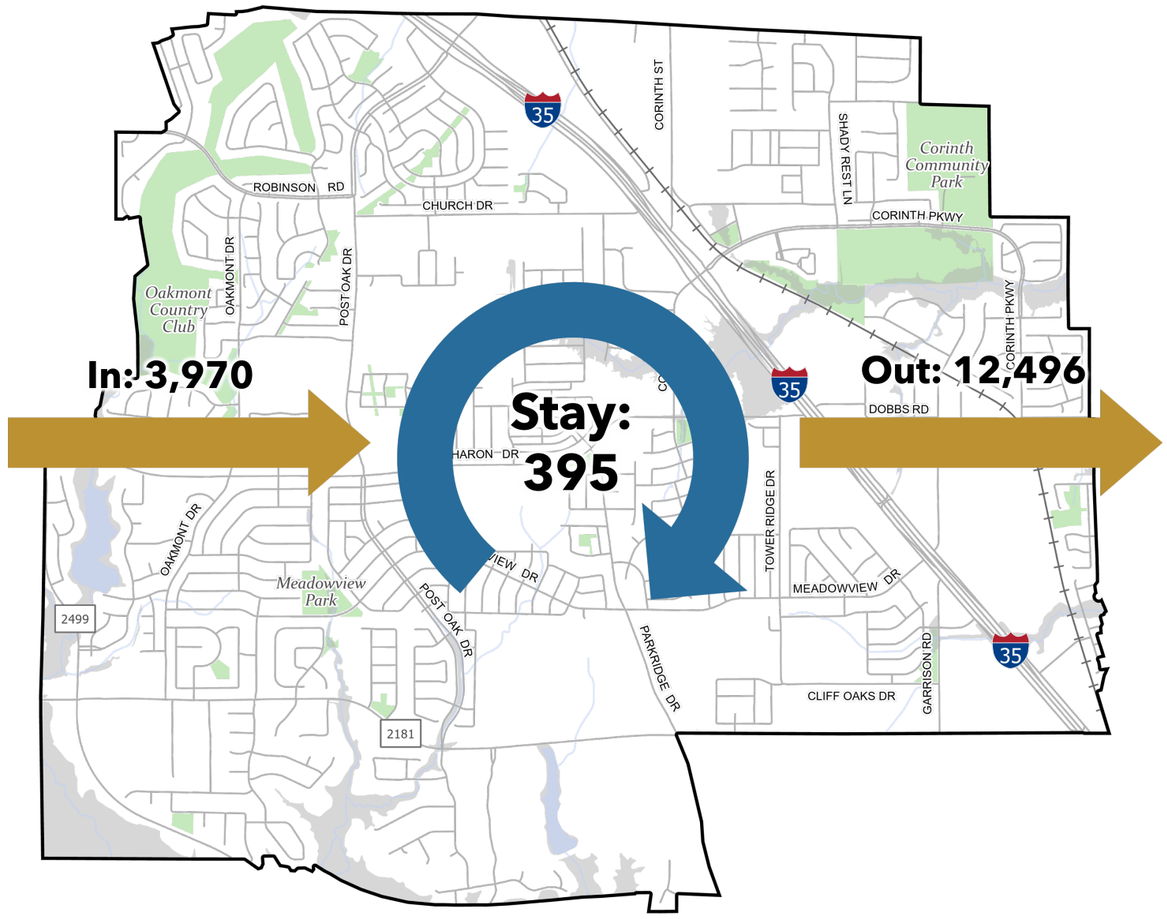
Exhibit 8 lists the top home locations of these 4,365 people employed in Corinth. The City of Denton is the top home city for Corinth workers.

Exhibit 8. *Top Home Cities of Corinth Workers*

Home City	Percent of Workers
Denton	18.6%
Corinth	9.0%
Dallas	5.1%
Fort Worth	4.1%
Lewisville	3.8%
Frisco	2.6%
All Other Locations	56.6%

Source: U.S. Census Bureau, OnTheMap Application and LEHD Origin-Destination Employment Statistics (Beginning of Quarter Employment, 2nd Quarter of 2002-2021).

Exhibit 7. *Inflow & Outflow Analysis*



Source: U.S. Census Bureau, OnTheMap Application and LEHD Origin-Destination Employment Statistics (Beginning of Quarter Employment, 2nd Quarter of 2002-2021).

Commuting

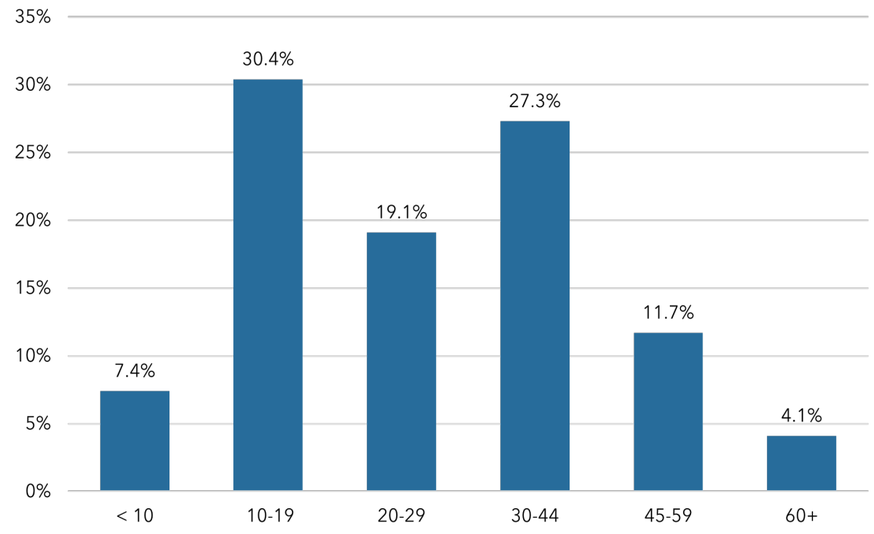
The majority of workers who live in Corinth (56.9%) have a commute of less than 30 minutes.

The most common hour of the day that people leave for work is between 7 a.m. and 8 a.m, as shown in Exhibit 9. Almost 20% of people also leave for work after 9 a.m.

Exhibit 11 reveals that over 85% of people drive alone or carpool to work, and only a small percentage of workers walk, bike, or use transit, following the statewide trend. According to ACS data, 0% of workers in Corinth commute by bike. This could indicate a lack of bicycle infrastructure in and around the City that provides safe and comfortable routes to work. However, this does not indicate that no one in Corinth rides a bicycle for recreation or travels to other destinations like community centers, shopping centers, etc.

Almost 12% of employed people in Corinth work from home and do not have a commute.

Exhibit 10. *Commute Time to Work in Minutes*



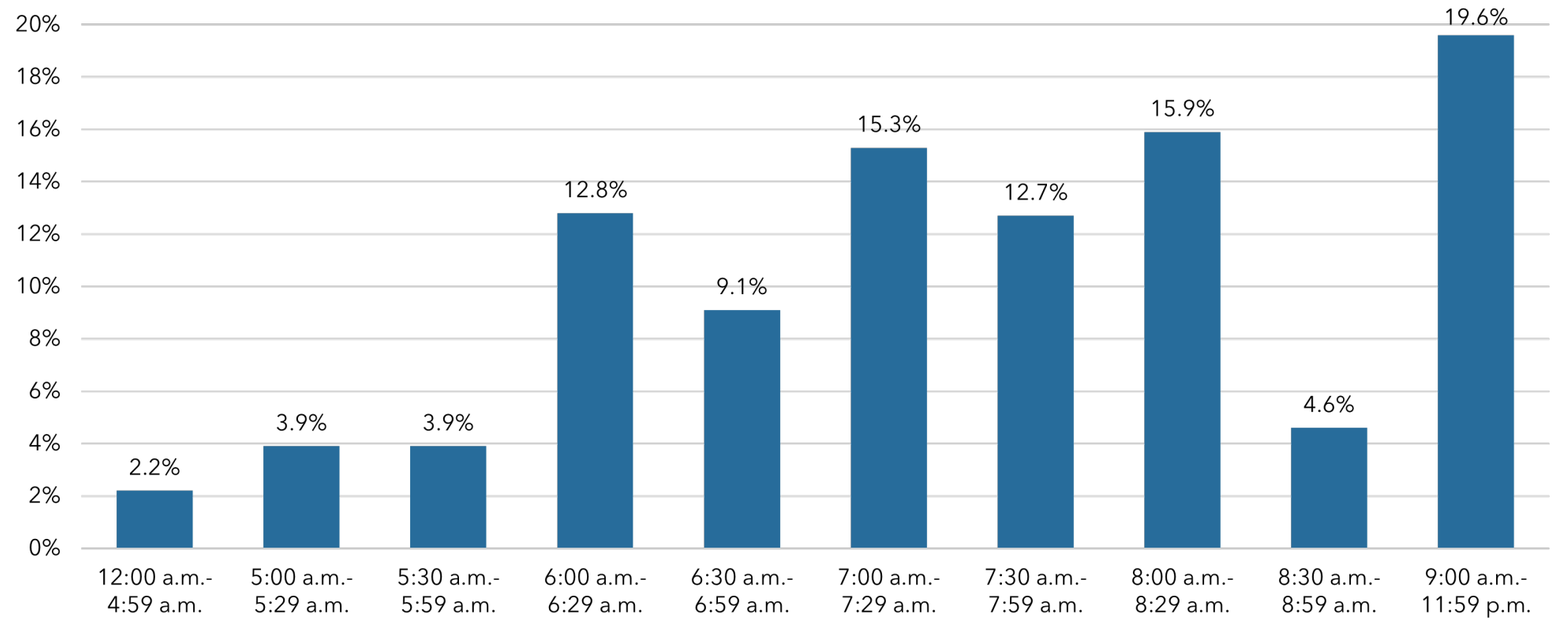
(ACS Table S0802)

Exhibit 11. *Means of Transportation to Work*

	Drive Alone	Carpool	Walk	Bike	Public Transportation	Work from Home
Corinth	78.2%	7.5%	0.7%	0.0%	0.1%	11.8%
Texas	*75.1%*	*9.7%*	*1.5%*	*0.2%*	*1.0%*	*11%*

(ACS Table S0801)

Exhibit 9. *Time of Departure to Go to Work*



(ACS Table S0802)

Review of Existing Plans

Current and previous plans were reviewed to determine existing conditions, document existing efforts, identify opportunities and ensure that proposed recommendations support broader objectives. This integration helps to create a more connected and accessible network.

City of Corinth Plans

Envision Corinth 2040 Comprehensive Plan (2020)

The Envision Corinth 2040 Comprehensive Plan was adopted in 2020 and sets the long-term vision for the City of Corinth. Guiding principles include a dynamic and aesthetically pleasing community; complete, connected, and safe neighborhoods; and future infill development.

The plan notes gaps in the non-motorized transportation system within the City, particularly the lack of on-street bike infrastructure. It is recommended that bike infrastructure be installed in dense and mixed-use areas, starting with Corinth's planned Transit-Oriented Development (TOD) in the northeast (Exhibit 12).

The Comprehensive Plan envisions Corinth as a "Smart City," with Smart Mobility as a key indicator. This aligns with the 2025 Active Transportation Plan's goals of connectivity and efficiency within the multi-modal transportation system. Additionally, sustainability is a part of Corinth's vision for the future.

The Comprehensive Plan also introduces Corinth's New City Center, a transit-oriented development intended as a "cultural, commercial and civic center." Site-specific recommendations accompany strategic focus areas identified in the plan that can guide decision-making concerning the development or rezoning of the areas.

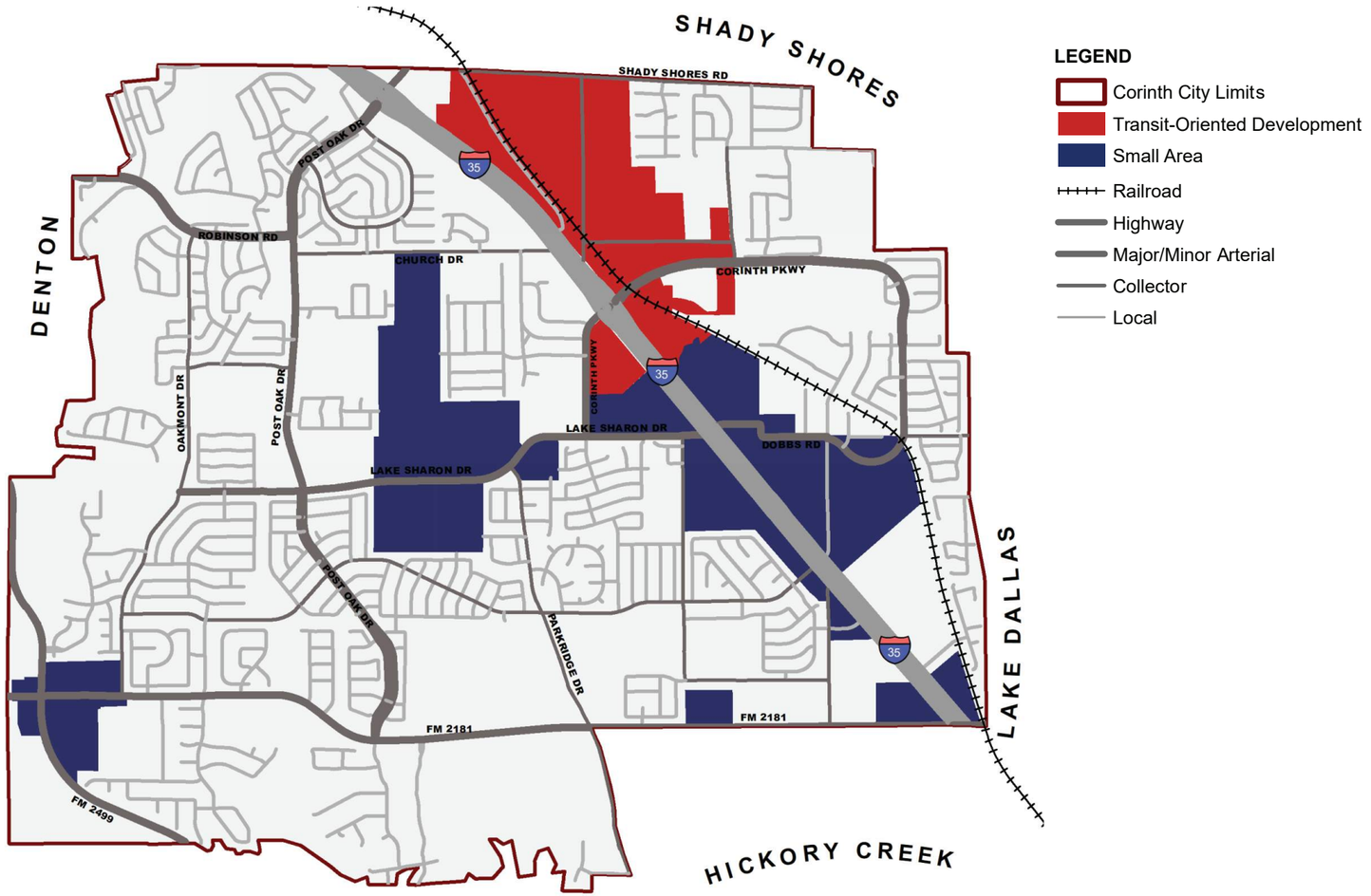
This TOD is being planned in coordination with the Denton County Transit Authority (DCTA). The goal is to have an additional transit stop on the A-train commuter rail line, which currently passes through Corinth.

The Mobility Strategy outlined in the plan is to "Maintain and improve a safe and context-sensitive transportation network that:

- Expands upon Corinth's existing non-motorized transportation network
- Provides a complete network of roads to support Corinth's new residential and economic developments
- Connects the east and west sides of Interstate 35E (I-35E) for all modes of transportation
- Creates a safe bicycle and pedestrian network for all ages and abilities. Improves the street space for these multi-modal uses. Creates an opportunity to connect neighborhoods to public amenities"

The Master Thoroughfare Plan (Exhibit 13 on page 10) is introduced in this plan along with proposed typical cross sections for Future Collector, Future Local, and Future Minor Arterial roadways.

Exhibit 12. *Strategic Focus Areas in Envision Corinth 2040 Comprehensive Plan*



Source: Envision Corinth 2040 Comprehensive Plan

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Master Thoroughfare Plan

SHADY SHORES RD
CORINTH ST
SHADY REST LN
CORINTH PKWY
Corinth Community Park
ROBINSON RD
CHURCH DR
OAKMONT DR
POST OAK DR
Oakmont Country Club
LAKE SHARON DR
DOBBS RD
TOWER RIDGE DR
MEADOWVIEW DR
Meadowview Park
PARKRIDGE DR
CLIFF OAKS DR
GARRISON RD
2499
2181
35

- Highway
- Major Arterial
- Major Arterial - Widening
- Minor Arterial
- Minor Arterial - Widening
- New Collector
- Collector
- Collector - Widening
- Roundabouts
- Parks
- Lakes
- Streams
- City Limits
- Railroads
- Flood Zone
- Streets

N

0 0.25 0.5 Miles

Exhibit 13. *Corinth Master Thoroughfare Plan*

Source: Envision Corinth 2040 Comprehensive Plan

Envision Corinth Park, Recreation & Open Space Master Plan (2020)

Corinth's 2020 Park, Recreation & Open Space Master Plan is meant to be seamlessly integrated with its Comprehensive Plan. The plan is also foundational to this 2025 Active Transportation Plan. The Park, Recreation & Open Space Master Plan's vision statement reads:

> "To support a thriving and connected City through non-motorized transportation infrastructure that enhances overall quality of life and provides an elevated level of functionality by maintaining connections for expansion and surge of development across the City."

This vision statement supports the establishment and expansion of active transportation within Corinth. Goals concerning active transportation include:

- Enhance and connect existing trails and sidewalks throughout the City
- Increase wayfinding and signage for trail users
- Increase shade by capitalizing on natural shade provided by existing or proposed trees, or by constructing new shade such as pavilions or rest areas
- Provide safer routes for citizens on foot or bike, focusing around I-35E area
- Recommend trail design guidelines
- Prioritize recommendations for future park development and trails

The plan contains a full inventory of the parks and trails in the City of Corinth, noting the surface type, use, presence of wayfinding and more (Exhibit 14).

Several public engagement efforts were conducted as part of the plan development process. The results of this engagement informed the 2025 Active Transportation Plan and are discussed further in Public Engagement Summary on page 28.

A significant contribution of the Park, Recreation & Open Space Master Plan is the Active Transportation Plan which served as the basis for the 2025 Active Transportation Plan. The plan shows a network of on-street bicycle lanes, sidepaths and trails which "identifies areas where infrastructure improvements can be created to generate a safe environment for non-motorized transportation modes throughout Corinth." The network is shown in Exhibit 15 on the following page. The prioritization of needs within the plan lists the adoption and implementation of the Active Transportation Plan in coordination with Capital Improvement Plans as the number one priority.

Exhibit 14. *Trails Inventory from the Park, Recreation & Open Space Master Plan*

	ACCESS POINT ADDRESS	TRAIL SURFACE TYPE	MODES ALLOWED	RECREATIONAL USE	UTILITARIAN USE	SIGNAGE/ WAYFINDING	TRAIL MONUMENTS	PARKING	BENCHES	SHADE STRUCTURE	RESTROOMS
1 KNOLL PARK TRAIL	Post Oak Drive at Church Drive	Concrete	Walking, Biking	✓	✓				✓		
2 HAWK ELEMENTARY AND CROWNOVER MIDDLE SCHOOL TRAILS	Robinson Road at Vintage Drive	Concrete	Walking, Biking	✓	✓				✓		
3 LAKE SHARON TRAILS	Indian Lake Trail at Pottery Trail	Concrete, Dirt or Gravel	Hiking, Biking	✓							
4 ELM FORK AND PILOT KNOLL TRAILS	218 A Orchard Hill Lane, Argyle	Dirt or Gravel	Walking, Equestrian	✓		✓		✓	✓		✓
5 DCTA A-LINE RAIL TRAIL	Many Regional Access Points	Concrete	Walking, Biking	✓	✓	✓		✓			
6 CORINTH COMMUNITY PARK TRAILS	3700 Corinth Parkway	Concrete, Dirt, or Gravel	Walking	✓		✓	✓	✓	✓	✓	✓
7 MOUNTAIN BIKING AREA	3700 Corinth Parkway	Dirt or Gravel	Biking, Equestrian	✓		✓		✓	✓		
8 CORINTH FARMS TRAIL (HOA)	Corinth Farms Trail at Grassy Glenn Drive	Concrete	Walking, Biking, Equestrian	✓	✓						

Source: Envision Corinth Park, Recreation & Open Space Master Plan

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2020 Active Transportation Plan

- Future On-Street Collector
- Future Sidepath
- Existing Trail
- Planned Trail
- Mountain Bicycling Area
- Parks
- Lakes
- Streams
- City Limits
- Railroads
- Streets

N

0 0.25 0.5 Miles

Exhibit 15. *Active Transportation Plan from the Park, Recreation & Open Space Master Plan*
Source: Envision Corinth Park, Recreation & Open Space Master Plan

Corinth Downtown Plan

The City of Corinth is currently in the process of developing a Downtown Plan. The downtown area is a key focus area for future growth within Corinth; the Envision Corinth 2040 Comprehensive Plan identifies it as a future TOD with mixed-use land use and activated streets that are built for all users. A Downtown Visioning Workshop held in February of 2024 included visioning exercises and discussions which yielded ideas for the future downtown.

At a 2024 joint workshop, existing plans for Corinth's Downtown were reviewed, including the Corinth Village Center Concept included in the Envision Corinth 2040 Comprehensive Plan. Key recommendations concerning street design from this workshop are listed on the right.

Corinth Parkway (Exhibit 16)

- Road diet (4 to 2 lane)
- Add on-street parking, bike lanes
- Enhance pedestrian comfort with wide sidewalks, street trees

N. Corinth Street (Exhibit 17)

- Road diet (3 to 2 lane)
- Add on-street parking, shared street markings on traffic lanes
- Enhance pedestrian comfort with wide sidewalks, street trees

Old Highway 77

- Construct a 2-lane street
- Add on-street parking
- Enhance pedestrian comfort with wide sidewalks, street trees

General

- Incorporate on-street and trail connectivity in bicycle study
- Explore opportunities for Katy Trail enhancements
- Work with TxDOT on design/funding options to enhance the I-35 underpass to increase pedestrian access/safety/comfort between the east/west sides of I-35

Exhibit 16. *Vision for Corinth Parkway*

Source: Downtown Corinth Joint Workshop Presentation

Exhibit 17. *Vision for N. Corinth Street*

Source: Downtown Corinth Joint Workshop Presentation

Regional Plans

DCTA Long Range Service Plan (2012)

The Denton County Transit Authority (DCTA) is the regional transit agency in Denton County.

The agency currently has one rail line that travels through Corinth but does not stop in Corinth: the A-train, a 21-mile regional rail system connecting Denton and Dallas Counties. The existing A-train service is shown in Exhibit 18. The planned TOD in northeast Corinth is tied to a proposed A-train station in the area which DCTA and Corinth have discussed.

DCTA uses North Central Texas Council of Government's (NCTCOG) Mobility 2045, along with its 2012 Long Range Service Plan, as the basis for its planning efforts. Mobility 2045 identifies transit and bike/ped facilities as solutions to existing mobility issues like congestion.

NCTCOG 2045 Regional Veloweb

In 2022, the regional planning association, NCTCOG, adopted its Mobility 2045 Update. As a part of this plan update, the Regional Veloweb was adopted. This 2,165-mile network of off-street shared-use paths (trails) is meant to serve as the regional network of active transportation facilities. Corinth's active transportation network can be expanded by connecting into this network to reach NCTCOG's 10-county planning area.

In Corinth, the Regional Veloweb network includes the existing Denton Katy Trail as well as a planned off-street shared-use path (trail) near FM 2499 (Exhibit 19).

TxDOT Bicycle Tourism Trails Study

In response to the 2005 Texas Bicycle Tourism Trails Act, TxDOT collaborated with its Bicycle Advisory Committee to investigate the development of a statewide bicycle tourism trail network. The products resulting from this study serve as an initial high-level network analysis for statewide bicycle tourism and considerations for system implementation and long-term development.

Developing a bicycle tourism network in Texas is envisioned to be a long-term collaborative process built incrementally over many years in partnership with multiple public, private and nonprofit partners.

The example network shows a regional route through Corinth on the Denton Katy Trail but no other proposed facilities in the City.

Exhibit 18. *DCTA A-Train Current Service Map*

Source: DCTA

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2045 Regional Veloweb

Status
- Existing
- Funded
- Planned
- Lakes
- Streams
- City Limits
- Railroads

N

0 0.5 1 2 Miles

Exhibit 19. *2045 Regional Veloweb*
Source: NCTCOG

Accessibility Planning

Public Right-of-Way Accessibility Guidelines (PROWAG)

In August 2023, the U.S. Department of Justice collaborated with the U.S. Department of Transportation (USDOT) and Federal Highway Administration (FHWA) to develop PROWAG to ensure that pedestrian facilities in the public rights-of-way are accessible by people with disabilities at all times - during business as usual, maintenance, or alterations done to the pedestrian facilities as defined by the final rule.

The key features discussed in the guideline included pedestrian access routes and alternate routes, accessible pedestrian signals, crosswalks, transit stops and on-street parking.

PROWAG requires the provision of curb ramps on street-level pedestrian walkways whenever streets, roadways, or highways are altered. Resurfacing, rehabilitation, reconstruction, historic restoration, or changes or rearrangement of structural parts or elements of a facility, among other things, constitute an alteration under the ADA. This means that where resurfacing a street "involves work on a street or roadway spanning from one intersection to another, and includes overlays of additional material to the road surface, with or without milling," the accessibility and usability of the pedestrian walkway for persons with disabilities must be ensured. These standards are enforceable by law, and TxDOT now uses PROWAG as its de facto "standards."

TxDOT ADA Self-Evaluation and Transition Plan

TxDOT updated its 2004 ADA Transition Plan in February 2022. Since 2004, TxDOT has authorized over $280 million in funding to remove identified barriers and plans to spend $500 million between fiscal years 2022 and 2025.

The 2022 update identified barriers to TxDOT's physical assets, services and means of communication. A total of 4,419 miles of sidewalk, 131,920 curb ramps, 4,582 island curb cuts, 6,156 bus stops, and 52,179 pedestrian signal pushbuttons were evaluated, as well as 157 facilities, including TxDOT administrative facilities and safety rest areas.

The plan proposes to construct pedestrian infrastructure on various streets; the majority of the projects focus on improving traffic signals.

The plan included an implementation schedule to eliminate these barriers systematically over continuous four-year planning cycles.

The process, led by the individual district or division, involves using an online tool called the TxDOT Comprehensive Accessibility Program (TCAP) WebApp, which "references an ArcGIS system housing Pedestrian Access Inventory (PAI) data, facility data, notations of locations for grievances, and reporting."

To ensure comprehensive ADA compliance in transportation projects, all planned projects are first reviewed using the TCAP WebApp to validate and incorporate any necessary remediation. TxDOT staff is trained to understand the DOJ/DOT interpretation of "alteration versus maintenance" for ADA compliance inclusion.

Corinth Sidewalk Gap Analysis

Sidewalks are an integral part of an accessible pedestrian network. Existing and planned developments in Corinth were reviewed to inventory planned roads and active transportation facilities. This revealed gaps in the sidewalk network that are not currently planned to be filled. This inventory of Corinth's sidewalk network is shown in Exhibit 20.

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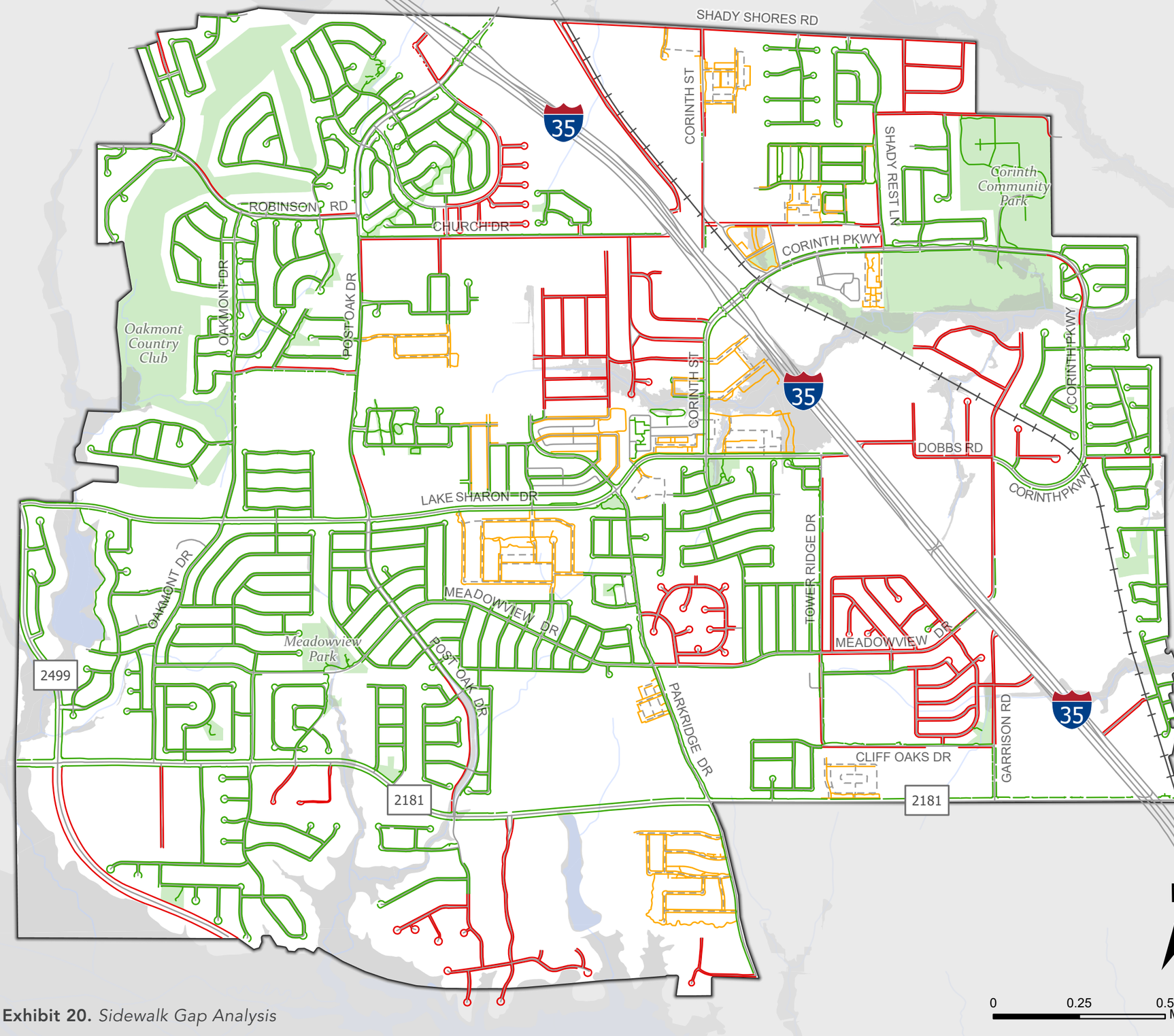
Sidewalk Gap Analysis



- Existing Street
- Planned Street
- Existing Sidewalk
- Planned Sidewalk
- Missing Sidewalk
- Parks
- Lakes
- Streams
- City Limits
- Railroads
- Flood Zone

Exhibit 20. *Sidewalk Gap Analysis*

Review of Current and Planned Capital Improvement (CIP) Projects

The project team also reviewed all current and planned CIP projects in the City of Corinth. All reviewed projects related to active transportation facilities were incorporated into the proposed active transportation network. These projects are shown in Exhibit 21 and Exhibit 22.

Exhibit 21. *List of CIP Projects in Corinth with Active Transportation Elements*

Proj. No.	Title	Description	Type	Status	Target Completion	Potential Active Transportation Element
1	Lake Sharon/Dobbs Realignment	The proposed extension and realignment will connect with the TxDOT proposed underpass at I-35E.	Street	Under Design	January 2027	Buffered bike lane & wide sidewalk connection between east and west of I-35E and continuing through Corinth Parkway
2	NCTC Way	Install new 60' wide collector road connecting I-35E frontage to N. Corinth Street and close RR crossings at N. Corinth Street & Walton Drive.	Street	Under Design	100% Design December 2023, DART Approval Fall 2023 Construction 2025.	Shared-use path(s) to connect into the future downtown area
3	Quail Run Realignment	Working with CoServ and TxDOT it was determined that for the best future use of the land along I-35E Quail Run would need to be re-aligned to meet the Interstate at more of a 90˚ angle	Street	Under Review	TBD	Shared-use path(s)
4	Shady Shores Road and Drainage County Project	Culvert capacity improvement project between Meadows Drive and the eastern City Limits.	Drainage	Under Design	100% design June 2025, Construction Complete Late 2026	Shared-use path(s)
5	Walton Drive Rehabilitation	Reconstruct 2-lane asphalt street to 37' wide collector.	Street	Under Design	Unknown	Shared-use path(s); bike lanes to contribute to pedestrian-friendly environment in future downtown area
6	Lake Sharon at FM 2499 Traffic Signal	Coordinate with TxDOT and City of Denton on installation of a traffic signal.	Street	Under Review	TBD - awaiting funding and coordination with City of Denton	Increased pedestrian protections at signal
7	TxDOT Overpass at I-35/ Lake Sharon	Relocate utilities for widening of I-35E.	Street	Under Design	2026	Buffered bike lane & wide sidewalk connection between east and west of I-35E

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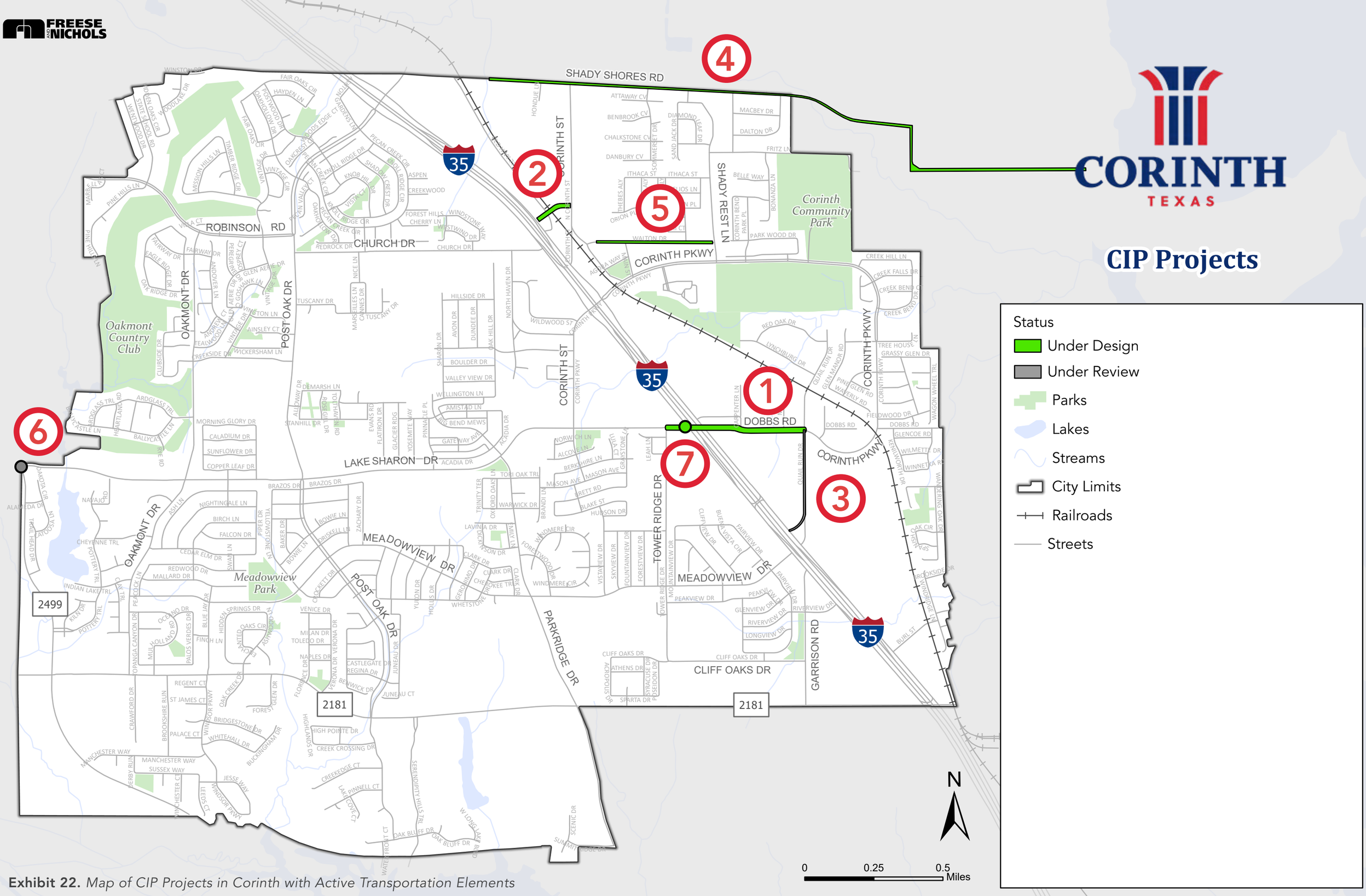
CIP Projects



Status
- Under Design
- Under Review
- Parks
- Lakes
- Streams
- City Limits
- Railroads
- Streets

N

0 0.25 0.5 Miles

Exhibit 22. *Map of CIP Projects in Corinth with Active Transportation Elements*

Existing Active Transportation Network

The City of Corinth's existing network of sidewalks and trails is shown in Exhibit 27. Corinth's active transportation network currently includes 10.8 miles of paved and unpaved trails, including the Denton Katy Trail. Trails that have the primary use of recreation, like most of those near the City of Corinth Fishing Pond, are not included. Corinth is home to 143.6 miles of sidewalks and 0.3 miles of shared-use paths, available for pedestrians and cyclists. There are currently no dedicated bike facilities in the City. Please see Bikeway Typologies section for more information on the different facility types.

More important than the quantity of facilities is the appropriateness of each facility and the connections made to destinations and the rest of the broader network. Exhibit 24 through Exhibit 27 show examples of active transportation facilities currently provided in the City of Corinth.

Exhibit 23. *Total Length of Each Bicycle Facility Type in Corinth*

Facility Type	Total Length (miles)	Percent of Total
Regional Trail	3.39	30.5%
Shared-use Sidepath (one side)	0.27	2.4%
Local Trail, paved	3.95	35.5%
Local Trail, unpaved	3.50	31.5%
Total Length (Miles)	**11.10**	**100%**

Regional Trail

Exhibit 24. *Regional Trail, also known as the Denton Katy Trail, in eastern Corinth*

Local Trail, Paved

Exhibit 25. *Local paved trail around Sharon Lake in Corinth*

Local Trail, Unpaved

Exhibit 26. *Local unpaved trail in the mountain biking area south of Corinth Parkway*

Shared-Use Path (one side)

Exhibit 27. *Shared-use path in the Corinth Community Park*

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Existing Active Transportation Network

Facility Type
- Shared-Use Path, one side
- Regional Trail
- Local Trail, Paved
- Local Trail, Unpaved
- Sidewalks
- Crosswalks
- Parks
- Lakes
- Streams
- City Limits
- Railroads
- Flood Zone
- Streets

N

0 0.25 0.5 Miles

Exhibit 28. *Existing Active Transportation Network*

Typical Active Transportation User Profile

According to FHWA's 2019 Bikeway Selection Guide, there are three types of general bikeway users:

- Interested but concerned
- Somewhat confident
- Highly confident

Exhibit 29 illustrates and further describes these bikeway user types.

The three types of general bikeway users can be expanded to encompass the following existing and potential active transportation users in Corinth (Exhibit 30 on page 23). This plan is designed to accommodate the specific needs of these and other users.

Exhibit 29. *Bicyclist Design User Types*

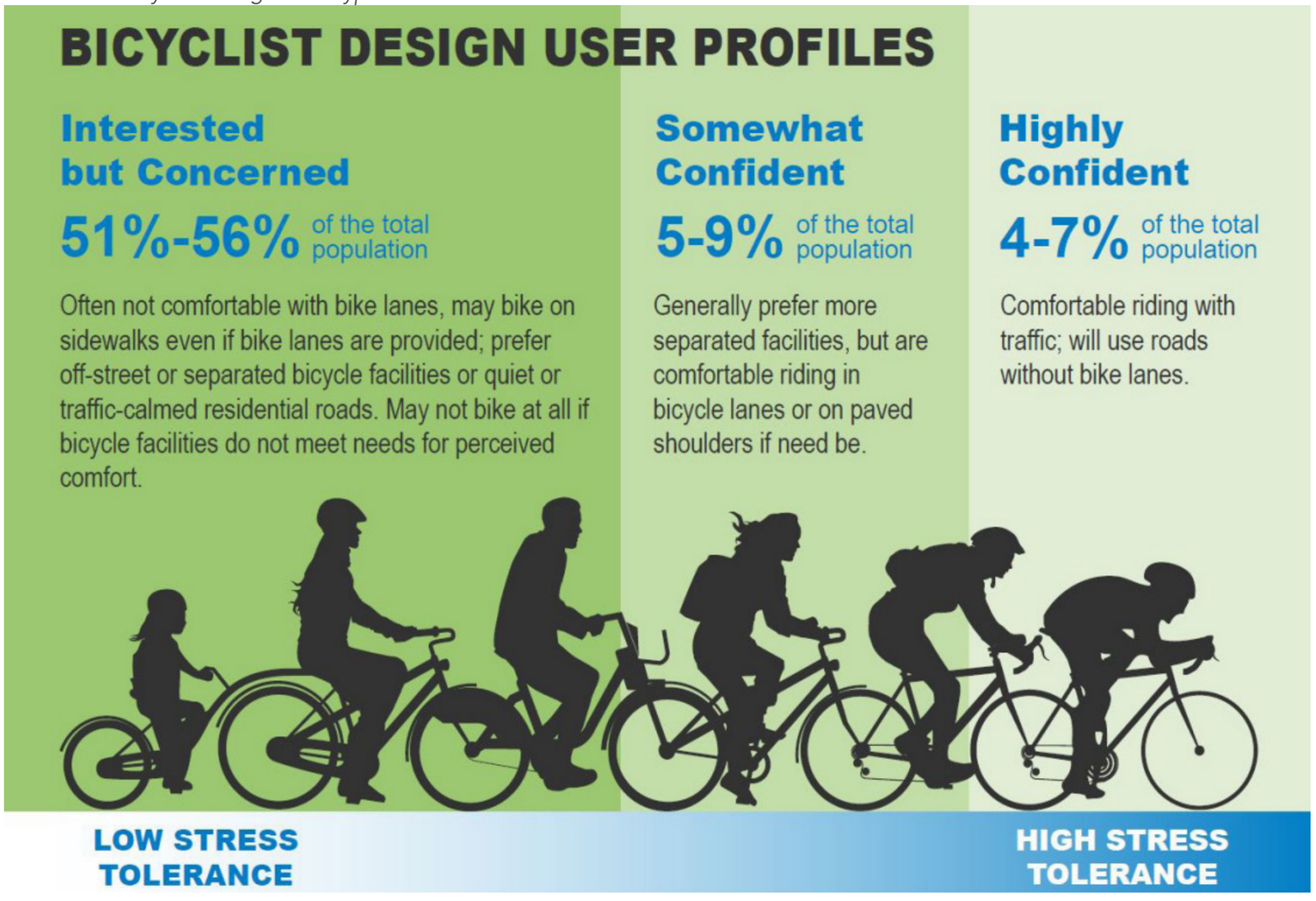


Exhibit 30. *Bicyclist Design User Profiles*

Jose is a retiree living in Denton County. Once a week he needs to run errands and appointments in Corinth. Jose would love it if he could walk to all his destinations on well-maintained and shaded sidewalks.

Ashley and Jake live in Corinth with their two kids. They like going out to walk and bike but have found limited opportunities to take the kids out in places that are safe for them.

Mike is a father of two living in Denton County. His parents live down the street. He doesn't feel safe allowing the kids to walk or bike to their grandparents' house, but wants to keep the family active. Mike would love to see expansion of the existing mountain biking trails and better connectivity and maintenance for sidewalks in the area.

Gabriel is an unhoused person in Denton County. He has limited support and relies on walking to access his daily needs. Occasionally he uses public transit when given a bus pass.

Karen lives in Corinth and uses a wheelchair for getting around. She needs to get across town to work and attend medical appointments. She does not drive or bike, and she relies on public transportation. She hopes there are better sidewalks so she can commute more easily.

Bryan is a serious cyclist living in Corinth who loves to bike for exercise and entertainment. He often rides with a group of cyclists on city streets and trails after work and on weekends.

Elizabeth is a sophomore at the North Central Texas College Corinth Campus. She loves the convenience of biking to class and to run errands, but her bike was stolen last year and she has been nervous parking her bike around town ever since.

Sarah is a fifth grader whose school is a few streets away from her house. This is the first year Sarah has been allowed to walk to school by herself.

Chris is a senior citizen living in Corinth. He does not drive and lives far from public transportation. He's still very active in his community and regularly walks to visit family and friends who live nearby.

Luciana and Alejandro are a young couple living in Corinth. They enjoy riding their bikes on city streets after work and on weekends.

Bike and Pedestrian Crashes

Crash data from the TxDOT Crash Records Information System (CRIS) can reveal patterns of safety issues. In the 5 years of 2019 to 2023, there were a total of 17 crashes that involved cyclists or pedestrians in the City of Corinth. Annually, the number of crashes in the City showed slight fluctuations from year to year, with 2020 having the lowest number of crashes. This might be explained due to the impact of the COVID-19 pandemic that resulted in lower traffic volumes across the country.

Exhibit 31 shows the distribution of the severity of injury among bike/ped crashes. The graph reveals that most crashes involving cyclists or pedestrians resulted in possible or minor injury, which is consistent with the statewide trends (Exhibit 32).

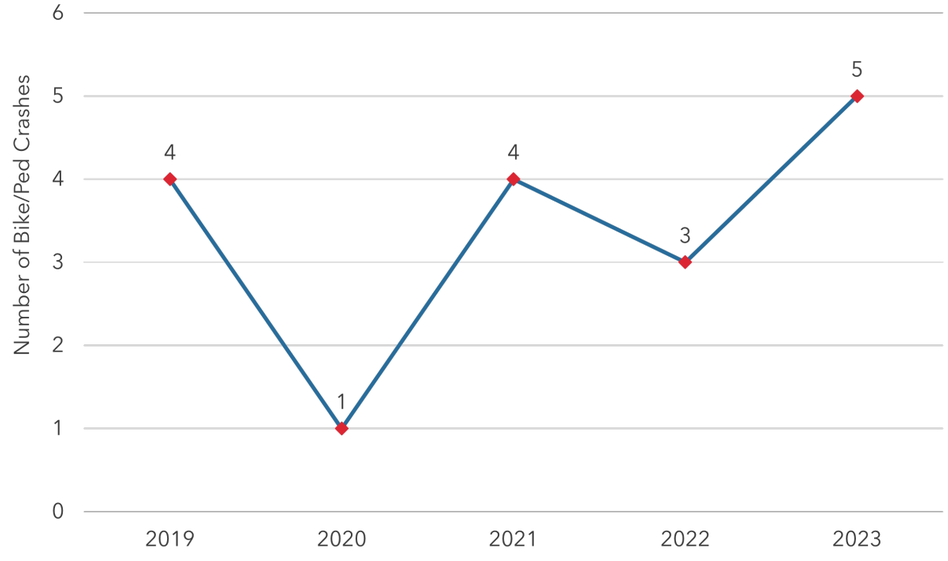
As shown in Exhibit 34, crashes involving cyclists and pedestrians occur disproportionately on FM 2181. Of the seven crashes on FM 2181, five had the primary contributing factor of failure to yield right-of-way to pedestrians, and the primary contributing factor of the one fatal crash on FM 2181 was failure to control speed.

The primary contributing factor of more than half of the bike/ped crashes in Corinth during these 5 years was a failure to yield the right-of-way to pedestrians (Exhibit 35). This trend points to the need for increased awareness of cyclists and pedestrians as transportation network users.

Exhibit 36 on page 26 reveals where bike and pedestrian crashes have occurred between 2019 and 2023. The concentration of all crashes is also shown; IH 35E is the most common location of crashes in Corinth, followed by FM 2181. Note that crashes whose records do not include coordinates are not shown on the map.

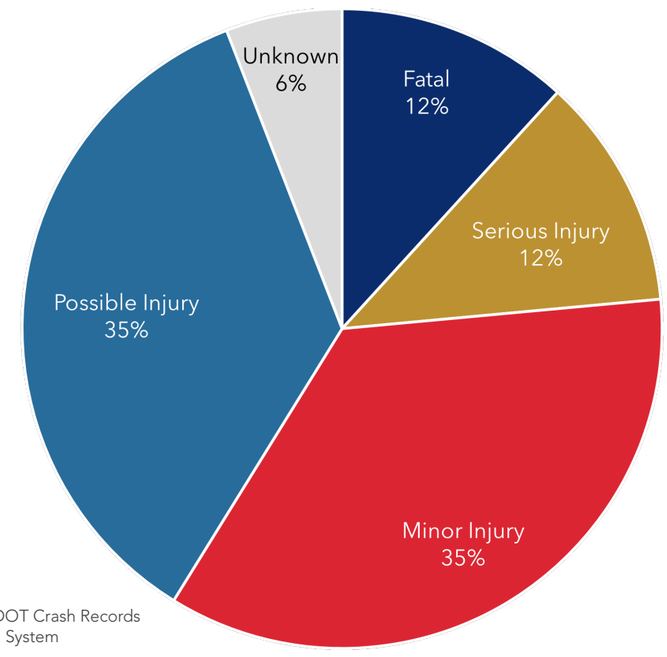
The number of total vehicle crashes is important because it provides a real-life illustration of the impacts of operational and congestion issues in a city. Between 2019 and 2023, there were 2,093 crashes in Corinth, and eight of those crashes (0.4%) resulted in fatalities.

Exhibit 33. *Bike and Pedestrian Crashes in Corinth by Year, 2019-2023*



Source: TxDOT Crash Records Information System

Exhibit 31. *Bike and Pedestrian Crashes in Corinth by Severity, 2019-2023*



Source: TxDOT Crash Records Information System

Exhibit 32. *Statewide Bike and Pedestrian Crashes by Severity, 2019-2023*

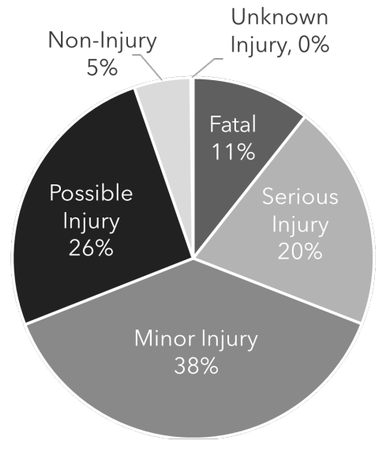
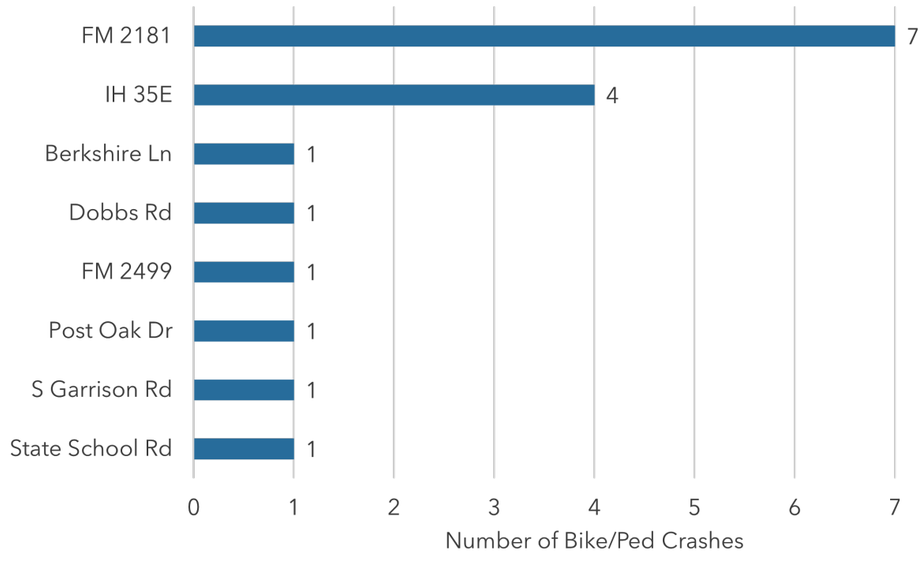


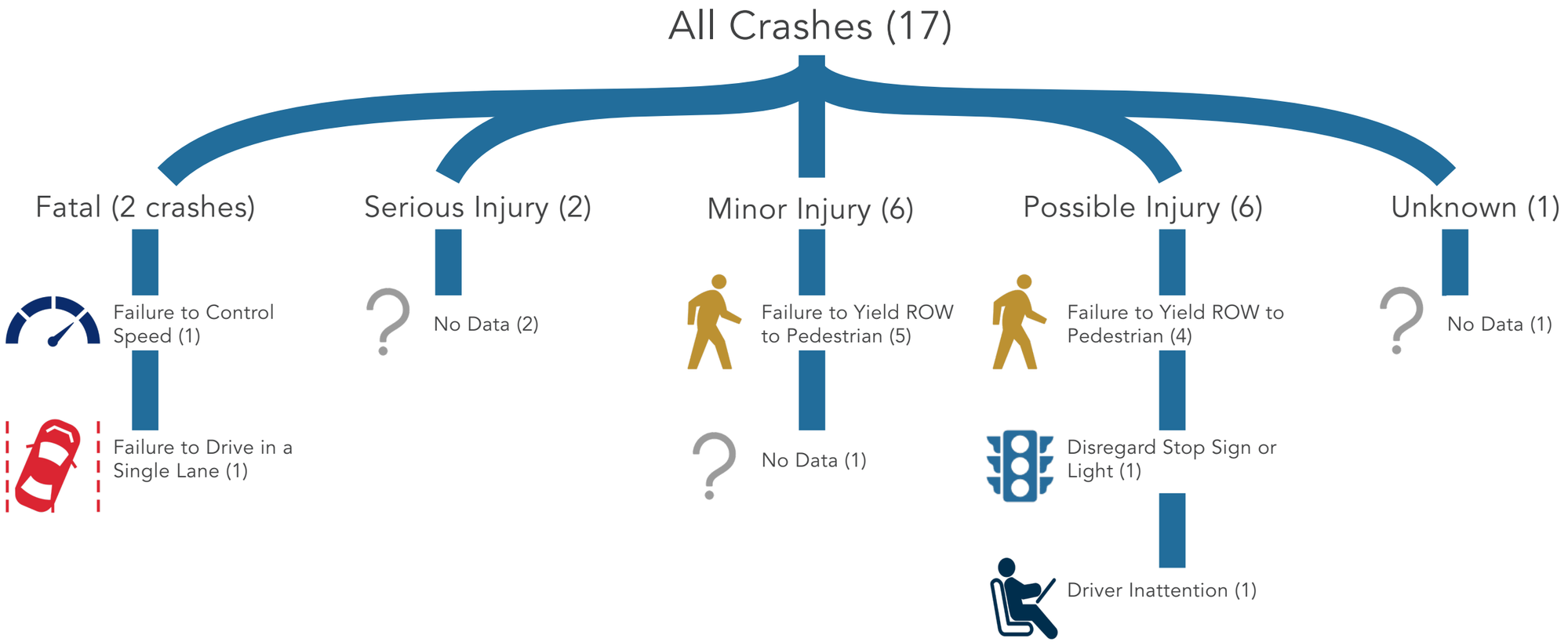
Exhibit 34. *Bike and Pedestrian Crashes in Corinth by Road, 2019-2023*



Source: TxDOT Crash Records Information System

Exhibit 35. *Primary Contributing Factors in Bike and Pedestrian Crashes in Corinth, 2019-2023*

Source: TxDOT Crash Records Information System



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Bike and Pedestrian Crashes in Corinth 2019-2023

Crash Severity (bike/ped crashes)
- Fatal
- Serious Injury
- Minor Injury
- All Other Crashes

Crash Density (all crashes)
- Sparse
- Dense

- Lakes
- Streams
- City Limits
- Railroads
- Streets

N

0 0.25 0.5 Miles

Exhibit 36. *Bike and Pedestrian Crashes in Corinth, 2019-2023*

Source: TxDOT Crash Records Information System

3 Issues, Needs and Opportunities

Public Engagement Summary

The City of Corinth coordinated with the consultant team and developed an online survey to gather input from Corinth's residents on active transportation-related issues, needs and opportunities.

Online Survey

The online survey was open from May 3 to June 11, 2024, and received 375 responses. The entire survey with results and open-ended responses can be viewed in Appendix D. The key takeaways from this survey were the following:

- 64% of respondents travel on a bike for exercise or recreation (Exhibit 39)
- Recurring driver behavior, lack of bicycle facilities and inadequate sidewalks/poor pavement condition were the top four safety concerns for respondents (Exhibit 37)
- 54.4% of respondents will prioritize construction of bike facilities if it means redirecting funds from other transportation needs (Exhibit 39)
- In the open-ended responses, residents indicated:
  - Unsafe crossings on Swisher Road, Corinth Parkway, Post Oak Road and Church Road
  - Lack of sidewalks along Pecan Creek Circle, Fritz Lane and NCTC campus
  - Driver behavior issues on Corinth Parkway, Shady Shores Road and Shady Rest Lane

Park, Recreation and Open Space Master Plan Engagement Summary

The Active Transportation Plan also considered and built on the input received from the extensive public and stakeholder engagement efforts conducted by the City for the 2020 Park, Recreation and Open Space Master Plan.

The key takeaways related to active transportation included:

- Trails need better signage and wayfinding, shade structures, landscaping and paving
- Existing trails should be enhanced and expanded upon
- Corinth Community Park trails and Rail Trail are the two most used trail locations in the City

Exhibit 37. *What are top 3 safety concerns when you travel on a bike?*

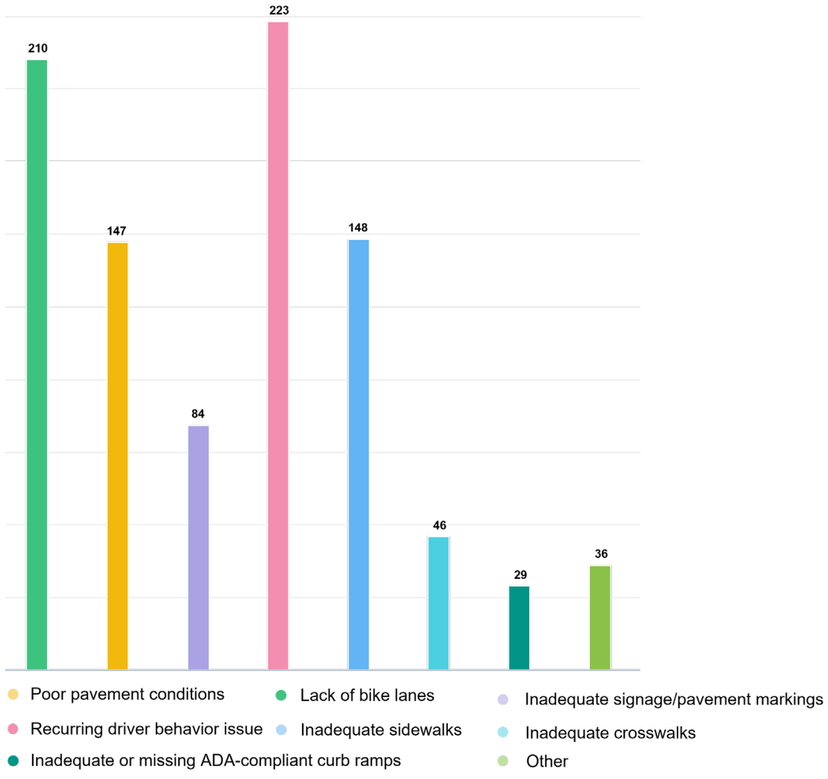


Exhibit 39. *Where do you travel to on a bike?*

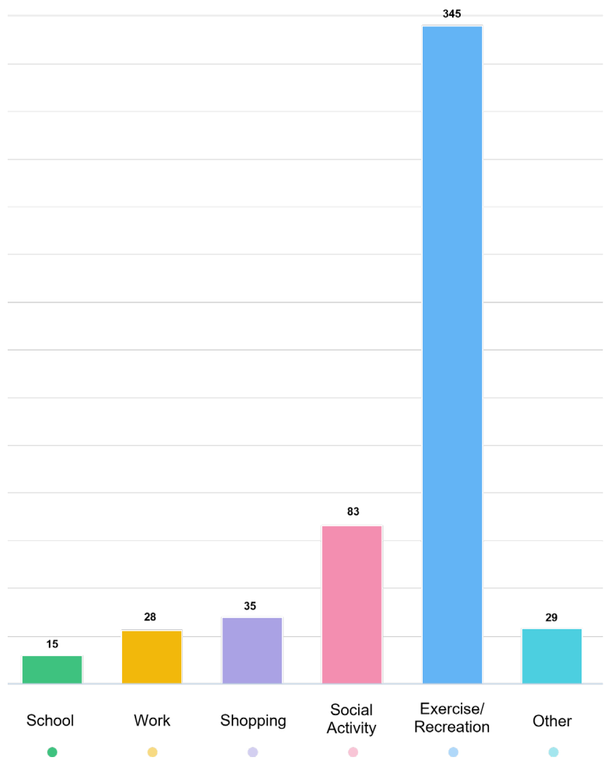
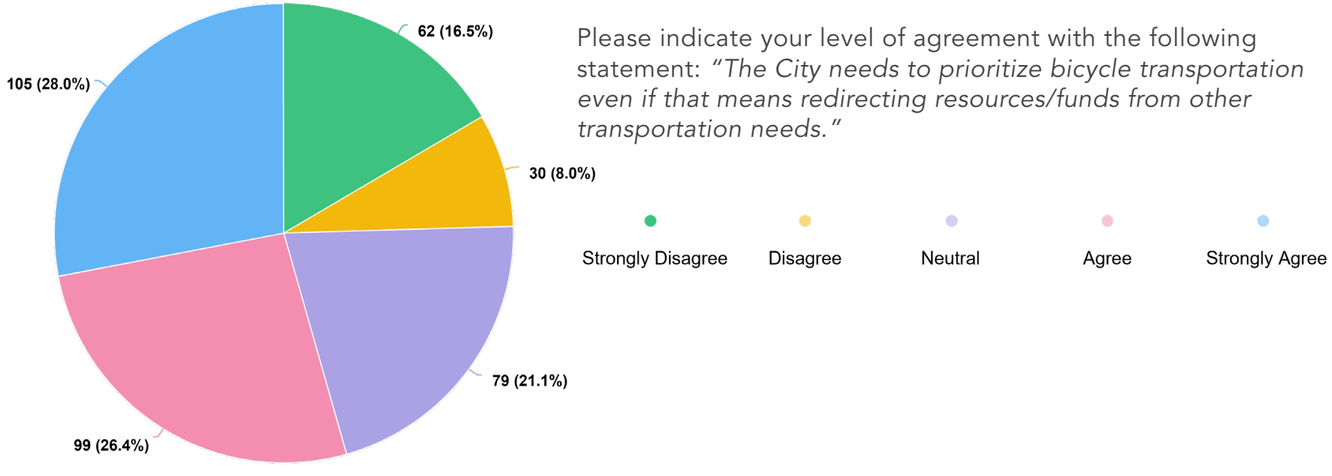


Exhibit 38. *Resource Prioritization Preference*



Identified Issues, Needs and Opportunities Summary

During Plan development, input from the general public, City staff, and Parks, Recreation and Open Space Master Plan identified several key issues regarding active transportation within the City of Corinth. As seen in Exhibit 40 on page 30, common themes were unsafe routes for bike/ped users along major east-west corridors, unsafe railroad crossings and expansion of bike/ped facilities to connect local destinations.

1. Mobility

The Issue:

The City of Corinth currently does not have a comprehensive bicycle network with designated bicycle facilities. Some neighborhoods and areas of the City also lack sidewalks and crosswalks for pedestrian access.

The Need:

Expanding on the existing trail system and constructing new bike/ped connections would encourage more residents to choose cycling and walking as safe and convenient modes of transportation. Additionally, providing safe pathways and bike lanes would enable better access for vulnerable populations, including children, older adults and those with disabilities.

Addressing this infrastructure gap is crucial for promoting healthier lifestyles, reducing congestion, enhancing community connectivity and fostering a more resilient urban environment.

Railroad crossing at Swisher Road was identified as one of the problematic crossings for bike/ped users.

2. Connectivity

The Issue:

The lack of connectivity within Corinth's existing network presents another challenge. Currently, the bicycle and/or trail facilities are scattered in small, isolated pockets throughout the City, and there is no designated bicycle facility connecting the east and west portions of the City across IH 35E. Public input also revealed an issue with pedestrian connectivity across the railroad and IH 35E due to a lack of safe crossing options.

The Opportunity:

Improving the current network by connecting trails between parks and recreation areas and ensuring that sidewalks are connected with crosswalks and are ADA-compliant will close gaps in the existing network. A continuous and well-connected network is essential for providing direct, uninterrupted routes to key destinations, enhancing overall accessibility and mobility for all residents, and making walking and cycling more practical and appealing transportation options.

Inadequate crossing and sidewalk connection at the intersection of Meadowview Drive and Vistaview Drive.

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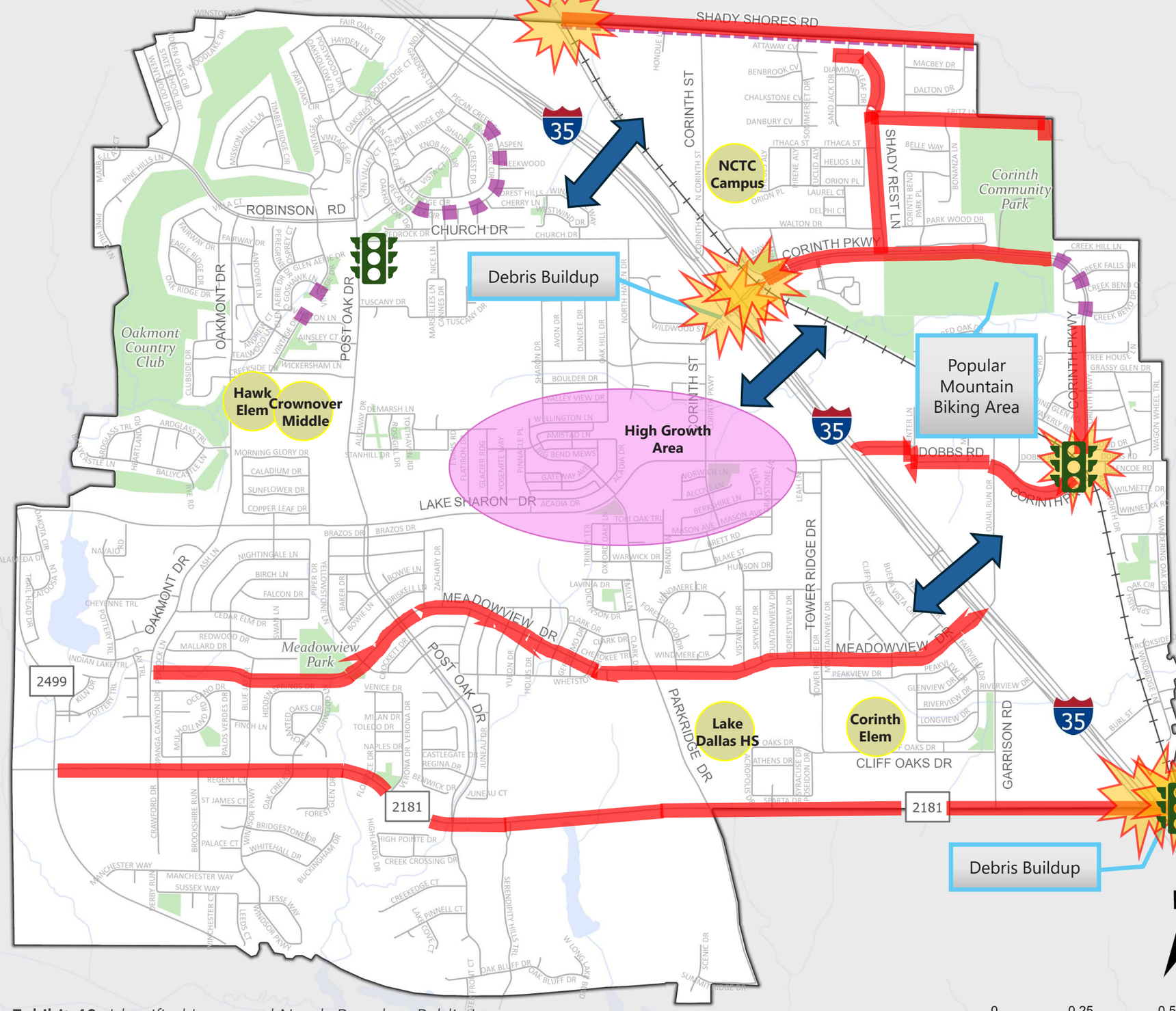
Issues and Needs



Parks
Lakes
Streams
City Limits
Railroads
Streets
Unsafe Crossing
Trail/Sidewalk Needed
Unsafe Route
Connectivity Issue
Lights/Signs Needed

Exhibit 40. *Identified Issues and Needs Based on Public Input*

3. Safety

The Issue:

Speed is the main factor in a majority of pedestrian and bicyclist deaths. As vulnerable road users, bicyclists and pedestrians are very sensitive to the relative safety of their journey along and crossing roadways. Providing some degree of separation for the user groups and managing traffic speeds should be considered in the planning and design of the active transportation network. It is still common for agencies to establish design speeds 10 mph higher than the anticipated posted speed as a "safety factor". This practice leads to roadways operating at speeds that degrade safety performance.

The failure to yield the right-of-way to a pedestrian or cyclist was the most common contributing factor in minor or no-injury bike/ped crashes.

The Need:

In addition to providing safer bike/ped facilities, educating drivers about the rights and vulnerabilities of cyclists and pedestrians helps promote safer driving behaviors, such as yielding at crosswalks, maintaining safe distances, and being vigilant in areas with heavy foot and bike traffic. This will ultimately create a safer environment for all street users.

4. Continued Growth

The Issue:

According to the NCTCOG 2045 Population Projections, the City of Corinth's permanent population is estimated to grow from 23,815 in 2024 to 26,978 in 2045, a growth rate of 0.6% annually. This number is likely underestimated, considering that more than 500 single-family units were built in 2024, and more than 1,000 additional residential units are currently underway.

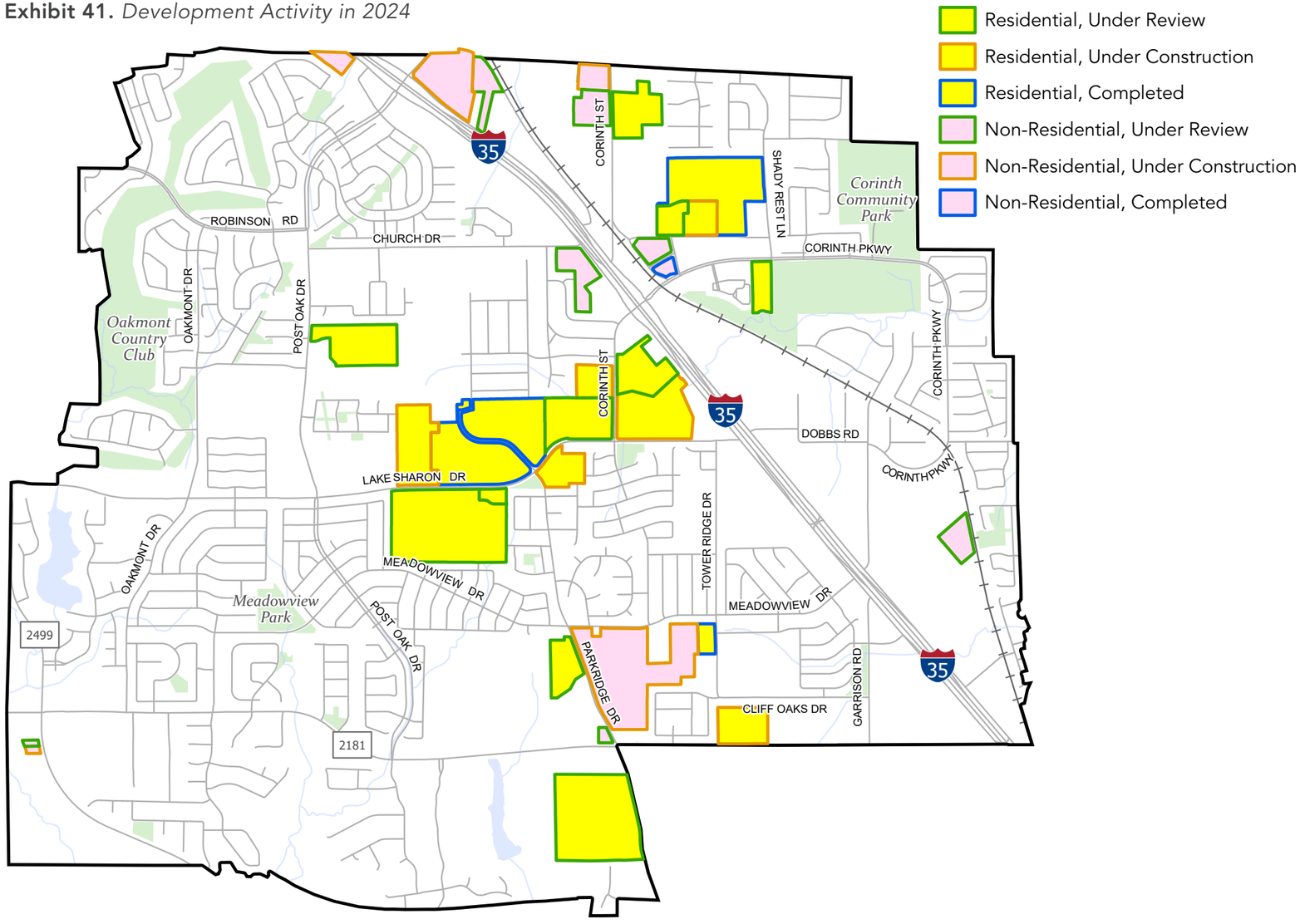
The City is also reviewing potential developments that could add over 600 single-family units, 160 townhome units, 80 duplexes and 1,200 multifamily units. If approved,this would result in higher population growth by 2045 than initially estimated. Exhibit 41 illustrates all the developments under construction or review, and developments completed in 2024.

With increasing population comes greater traffic volumes and congestion rates, highlighting the need to provide adequate infrastructure for alternative modes of transportation.

The Opportunity:

New residential developments present a unique opportunity to enhance the City's bike/ped infrastructure by integrating these amenities into their design from the planning stage. The City should have established clear guidelines and requirements for developers, emphasizing the importance of incorporating bicycle lanes, sidewalks, shared-use paths and multi-use trails.

Exhibit 41. *Development Activity in 2024*



5. Promotion of Cycling and Walking

The Issue:

The residents of Corinth currently use biking and walking only for recreational and exercise purposes but not for their daily transportation needs. The majority of the residents do not walk or bike at all in the City. Promoting regular cycling and walking in the City is important because it enhances public health through increased physical activity and reduces traffic congestion, among other benefits.

The Opportunity:

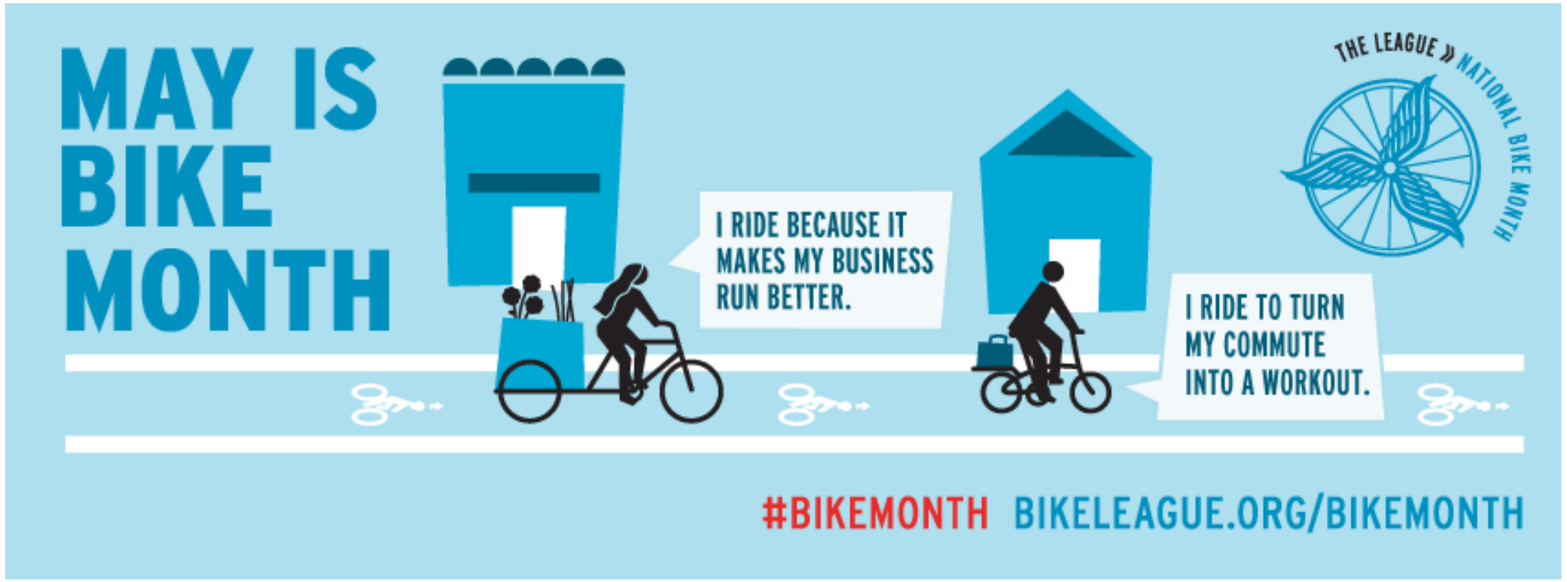
Concurrently with expanding the bike/ped network, the City can partner with local schools, bike groups (e.g., Corinth Cycling and Denton County Cycling), running groups (e.g., Lake Cities Run Walk Group), and local activists to promote bike/ped initiatives such as:

- Participation in Safe Routes to School programs
- Hosting outreach events to promote bike/ped transportation such as Bike to Work/School/Park and other citywide celebrations and modal promotions, including, but not limited to:
  - National Night Out
  - Earth Day activities
  - National Walk/Bike Week, Month or Day
- Supplemental support to City staff on grant writing, identification of maintenance issues, and monitoring of bicycle and pedestrian facility conditions
- Participation in the formal and informal review of facility development or decommissioning
- Increasing awareness of and accommodation for the needs of the mobility-challenged populations

(Source: Valley Transportation Authority)

DCTA offers free rides to riders with bikes on board on National Bike to Work Day.

(Source: DCTA)



NCTCOG encourages residents to commute to work on bike or other sustainable transportation modes, in support of the national event initiated by the League of American Bicyclist.
(Source: NCTCOG)

4 Network Development

Network Development Process

Several factors were considered in the development of the active transportation network. These included consideration of the intended outcomes for an Active Transportation Plan as outlined in the City's Comprehensive Plan (Exhibit 42), expansion of existing facilities, inclusion of development site plans, and other identified needs to create a citywide network and to propose active transportation projects.

Exhibit 42. *Envision Corinth Mobility Intended Outcomes*

- Expands upon Corinth's existing non-motorized transportation network.
- Provides a complete network of roads to support Corinth's new residential and economic developments.
- Connects the east and west sides of Interstate 35E for all modes of transportation.
- Creates a safe bicycle and pedestrian network for all ages and abilities.
- Improves the street space for these multi-modal uses. Creates an opportunity to connect neighborhoods to public amenities.

The Active Transportation Network

An active transportation network is a seamless interconnected system of sidewalks, hike and bike trails, shared-use paths and bikeways. The purpose and quality of the network depends on the assumptions, goals and decisions made during the planning process. Networks should be thoughtfully planned to provide necessary and desired connections and access. The most successful bike/ped networks enable people of all ages and abilities to safely and conveniently get where they want to go.

Network Formulation

The active transportation network development process for Corinth considered the following steps:

- Expanding upon what works – extend existing trails, add more on- and off-road SUPs, and protected bikeways
- Enhancing what exists – transitions, ADA-compliance
- Adding local connections – parks, schools, local site plans
- Accommodating multiple user groups - local trips as well as longer-distance travel

The active transportation network can be viewed in Exhibit 44 on page 35.

Network Principles

Effective bike/ped networks lead to more people bicycling and walking by creating active transportation facilities that are efficient, safe, seamless and easy to use. Seven key principles for network design, shown in Exhibit 43, are described in the Bikeway Selection Guide published by FHWA in 2019. Of these seven principles, three have particular importance in guiding bike/ped facility selection:

Safety: Bike/ped facility designs should be selected to reduce the frequency and severity of crashes and minimize conflicts between users.

Comfort: Bike/ped facilities should be selected to minimize stress, anxiety and safety concerns for the target design user. Comfort and safety are closely related.

Connectivity: Trips within a bicycle network should be direct and convenient and offer access to all destinations served by the roadway network. Transitions between active transportation facilities should be seamless and clear.

Exhibit 43. *Seven Principles of Bike/Ped Network Design*

Source: FHWA 2019 Bicycle Selection Guide

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2025 Active Transportation Plan

Facility Status
- Existing
- Planned

Facility Type
- Shared-Use Path, both sides
- Shared-Use Path, one side
- Shared Street/Parking Lanes + Sidewalks
- Buffered Bike Lanes + Sidewalks
- Bike Lanes + Sidewalks
- Parking-Protected Bike Lane + Sidewalks
- Regional Trail
- Local Trail, Paved
- Local Trail, Unpaved
- Buffered Bike Lanes + Shared-Use Path
- Bike Lanes + Shared-Use Path
- Shared Street

- Existing Signal
- Proposed Signal
- Proposed Pedestrian Hybrid Beacon
- Proposed Trail Grade Separation
- Existing Street
- Planned Street
- City Limits
- Railroads
- Lakes
- Streams
- Parks

N

0 0.25 0.5 Miles

Exhibit 44. *2025 Active Transportation Plan*

Facility Typologies

There are some general principles that should guide the applications of active transportation facility types. For instance, as traffic volumes and speeds increase, greater separation of a bikeway from motor vehicle traffic is desirable. Other factors to consider are users, adjacent land uses, available right-of-way and costs.

Exhibit 45 to Exhibit 52 on the following pages describe the active transportation facility typologies that currently exist in Corinth, and additional typologies that are being proposed to accommodate cyclists of different comfort levels and in different contexts. The proposed typologies in the Active Transportation Plan include:

- Shared-Use Path on both sides
- Shared-Use Path on one side, sidewalk on other side
- Buffered Bike Lane with Wide Sidewalks
- Buffered Bike Lane/Parking Lane with Wide Sidewalks
- Regional Trail
- Local Paved Trail
- Local Unpaved Trail
- Shared Street

Shared-Use Path on Both Sides

A shared-use path is a designated, off-street pathway designed to accommodate multiple non-motorized users, such as pedestrians, cyclists, skaters, eScooter, eBike or wheelchair users. They are usually 8-12 feet wide. In this typology, the shared-use path is provided on both sides of the street.

Exhibit 45. *Shared-Use Path on Both Sides*

Shared-use path on both sides of Williams Drive in Corpus Christi, Texas

Pros

- Serves multiple types of users – cyclists, pedestrians, inline skaters, wheelchair users, joggers, and other non-motorized users
- Adjacent and parallel to a street
- Accommodates two-way traffic on one side of the street

Cons

- Can experience user conflicts due to the two-way traffic with users at different speeds
- Finding sufficient right-of-way for a shared-use path can be challenging

Shared-Use Path on One Side

When the right-of-way is not wide enough and does not allow shared-use path on both sides, it will be provided on only one side.

Exhibit 46. *Shared-Use Path on One Side*

Shared-use path on one side of E. Park Street in Cedar Park, Texas

Pros

- Serves multiple types of users – cyclists, pedestrians, inline skaters, wheelchair users, joggers, and other non-motorized users
- Adjacent and parallel to a street
- Accommodates two-way traffic on one side of the street
- Easier to implement with limited right-of-way

Cons

- Can experience user conflicts due to the two-way traffic with users at different speeds
- May increase crossings as users on the opposite side must cross the road to access the path

Buffered Bike Lane (with Wide Sidewalks)

A buffered bike lane is a dedicated on-street cycling lane separated from vehicle traffic by painted buffer zones in a form of white lines, with or without a diagonal cross hatching. With available right-of-way, the buffered bike lane can be accompanied by a wide sidewalk of minimum of 8 feet.

Exhibit 47. *Buffered Bike Lane*

Buffered bike lane on Doddridge Street in Corpus Christi, Texas

Pros

- Provides extra space between cyclists and motor vehicles, reducing the risk of collisions and creating a safer environment for cyclists
- Allows cyclists more room without appearing as a car travel/parking lane
- Using paint to create separation makes them less expensive to implement than physically separated bike lanes

Cons

- The painted buffer offers no physical barrier, so vehicles can still encroach on the bike lane

Shared Buffered Bike Lane and Parking Lane (with Wide Sidewalks)

A buffered bike shared with a parking lane uses edge lines to provide curbside space for bikers and on-street parking. It is appropriate on streets with lower volumes and on-street parking needs. With available right-of-way, the buffered bike lane can be accompanied by a wide sidewalk of minimum of 8 feet.

Exhibit 48. *Shared Buffered Bike Lane and Parking Lane*

Shared bike lane and parking lane on Mescalero Road in Roswell, New Mexico

Pros

- Maximizes existing pavement width, making it easier to incorporate bike lanes on narrow streets
- Using paint to create separation makes them less expensive to implement than physically separated bike lanes
- Integrating buffered bike lanes with parking allows cities can to promote active transportation without fully removing car parking, which may be important in mixed-use, commercial and/or residential areas

Cons

- The painted buffer offers no physical barrier, so traveling and parking vehicles can still encroach on the bike lane/ parking lane
- Bicyclists may have to encroach on the buffer zone to avoid a parked vehicle

Regional Trail

A regional trail is an off-street, long-distance, multi-use pathway that connects multiple communities or regions, providing continuous routes for recreation and active transportation across broader areas. It usually takes a form of a shared-use path.

Exhibit 49. *Regional Trail*

Denton Katy Trail in Corinth

Pros

- Allows users to travel between communities and access a broader network of destinations, parks, and recreational sites
- Accommodates two-way traffic on one side of the street

Cons

- Can experience user conflicts due to the two-way traffic with users at different speeds
- Long, sometimes remote stretches of trails may lack sufficient lighting or surveillance

Local Paved Trail

A local paved trail, sometimes also referred to as "Hike and Bike" trail, is a designated, off-street pathway designed to accommodate multiple non-motorized users. It usually passes through a greenway, park or an open space and provides a connection within communities or short-distance recreational activities. It usually takes the form of a shared-use path.

Exhibit 50. *Local Paved Trail*

Local paved trail along Sharon Lake in Corinth

Pros

- It is completely separated from traffic
- Paved surface provides a smooth, stable path for users of all ages and abilities
- Paved surface is more durable and will stay usable during adverse weather conditions

Cons

- Can experience user conflicts due to the two-way traffic with users at different speeds
- Higher initial construction cost
- May disrupt local ecosystems and wildlife habitats during construction, particularly in natural or undeveloped areas

Local Unpaved Trail

A local unpaved trail is a natural pathway designed for recreational activities such as hiking, biking, or horseback riding, typically made of dirt, gravel, or other natural materials, and located within a specific community, park or open space.

Exhibit 51. *Local Unpaved Trail*

Local unpaved trail in the Corinth Community Park

Pros

- It is completely separated from traffic
- Lower initial construction cost
- Preserves natural terrain and drainage patterns, promoting better water management and reducing soil erosion
- Provide a more immersive experience in nature, scenic landscapes, wildlife, and diverse ecosystems

Cons

- Requires more frequent maintenance to address issues such as erosion, overgrowth, and trail damage caused by weather or heavy use
- Can be less accessible for individuals with mobility challenges or those using strollers or bikes with narrow tires
- Limited usability during or right after adverse weather events

Shared Street

Shared street refers to a designated roadway segment marked with shared lane symbols or "Share the Road" signage that indicates a shared space for both cyclists and motor vehicles. It is appropriate on streets with low volumes and low speed limits.

Exhibit 52. *Shared Street*

Proposed shared street on Vistaview Drive in Corinth

Pros

- Provides basic bicycle access on roads where no space for a designated bicycle facility is available
- Helps to maintain connectivity between destinations and streets with designated bicycle facilities
- Is low cost and requires minimal changes to infrastructure

Cons

- Does not provide any physical separation from motor vehicle traffic
- Can experience user conflicts due to the shared lane with users of different sizes and at different speeds

Proposed Street Cross-Sections

Carpenter Lane

Existing Cross-Section

Carpenter Lane has 28 feet of right-of-way. The current configuration of Carpenter Lane, as shown in Exhibit 53, includes no median, one 10-foot-wide travel lane, no sidewalks, and green spaces of varying widths on each side of the street.

Proposed Cross-Section

The proposed reconfiguration of Carpenter Lane would incorporate expanding the right-of-way to 50 feet. Using the wider right-of-way, the roadway will be expanded to include two 11-foot-wide travel lanes in each direction. 8-foot-wide shared-use paths and 6-foot-wide parkways will be added on both sides of the street.

Benefits of the Proposed Improvement

- The street's right-of-way will be used to a greater potential
- 8-foot-wide shared-use path on each side accommodates more user types, such as cyclists, pedestrians, wheelchair users and joggers, enhancing connectivity for nonmotorized users
- The 6-foot-wide parkway on both sides acts as a buffer between the road and sidewalk, improving pedestrian safety while adding green space to enhance aesthetic and environmental appeal
- The multimodal design balances connectivity for vehicles, cyclists and pedestrians, and creates a safer, more attractive corridor for community use

Exhibit 53. *Typical Existing Cross-Section on Carpenter Lane (18' ROW)*

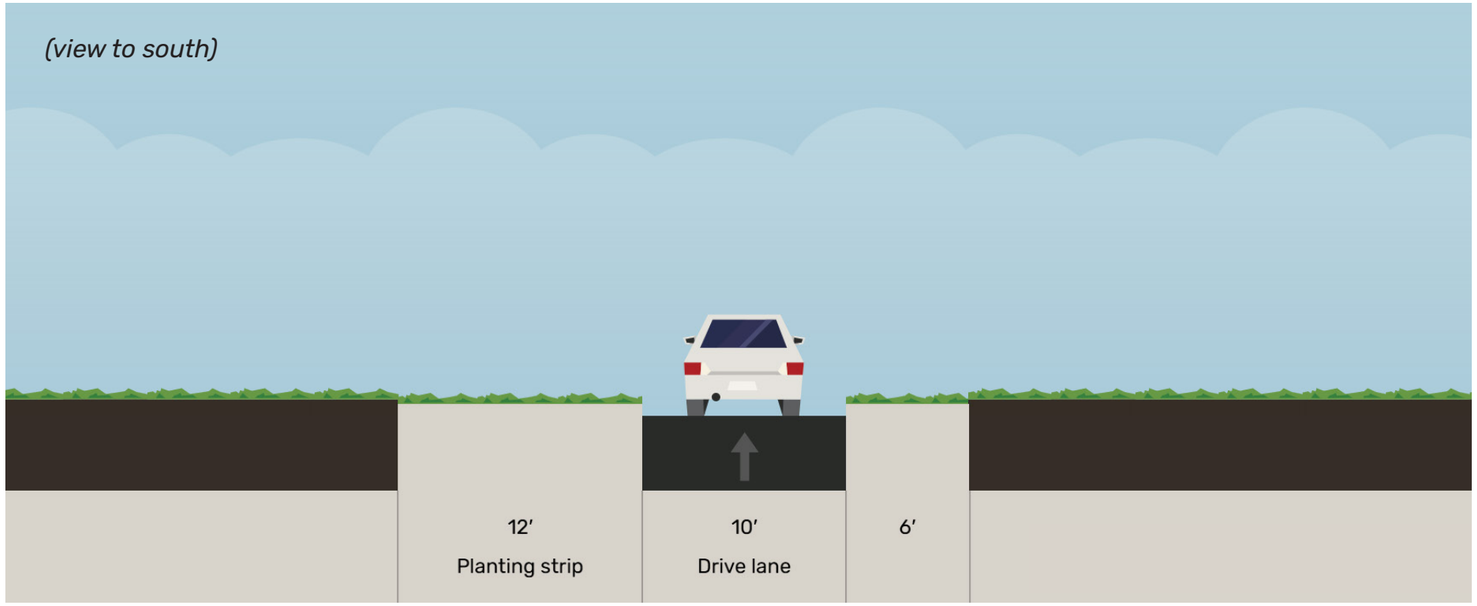
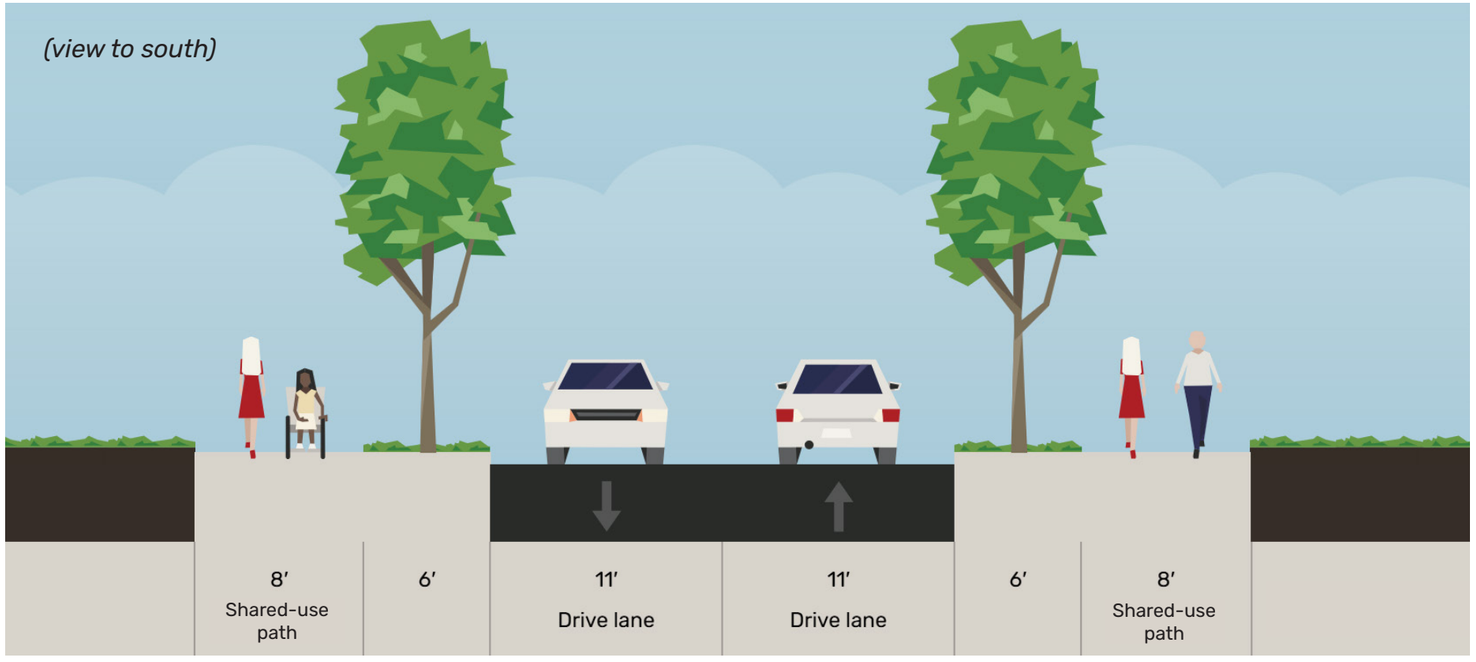


Exhibit 54. *Proposed Typical Cross-Section on Carpenter Lane (50' ROW)*



Church Drive

Existing Cross-Section

Church Drive's right-of-way ranges from 50 to 55 feet. The current configuration of Church Drive, as shown in Exhibit 55, includes two 12-foot-wide travel lanes, a 12-foot-wide center turn lane, 5-foot-wide sidewalk on the street's northern side, and planting strips of different widths.

Proposed Cross-Section

The proposed reconfiguration of Church Drive would restripe the three-lane road to two 12-foot-wide travel lanes and 6-foot-wide bike lanes on each side. A 5-foot sidewalk would be added on the southern side of the street.

Benefits of the Proposed Improvement

- Lane reduction from three to two lanes helps to calm traffic and lowers vehicle speeds, and reduces the likelihood and severity of a collision
- Dedicated bike lanes, even without a buffer, provide a safer space for cyclists, separate from vehicle traffic, and serve as the active transportation element on this corridor with limited right-of-way
- Standard sidewalk on both sides provide a safe space and accessibility for pedestrians along the corridor

Exhibit 55. *Typical Existing Cross-Section on Church Drive (50'-55' ROW)*

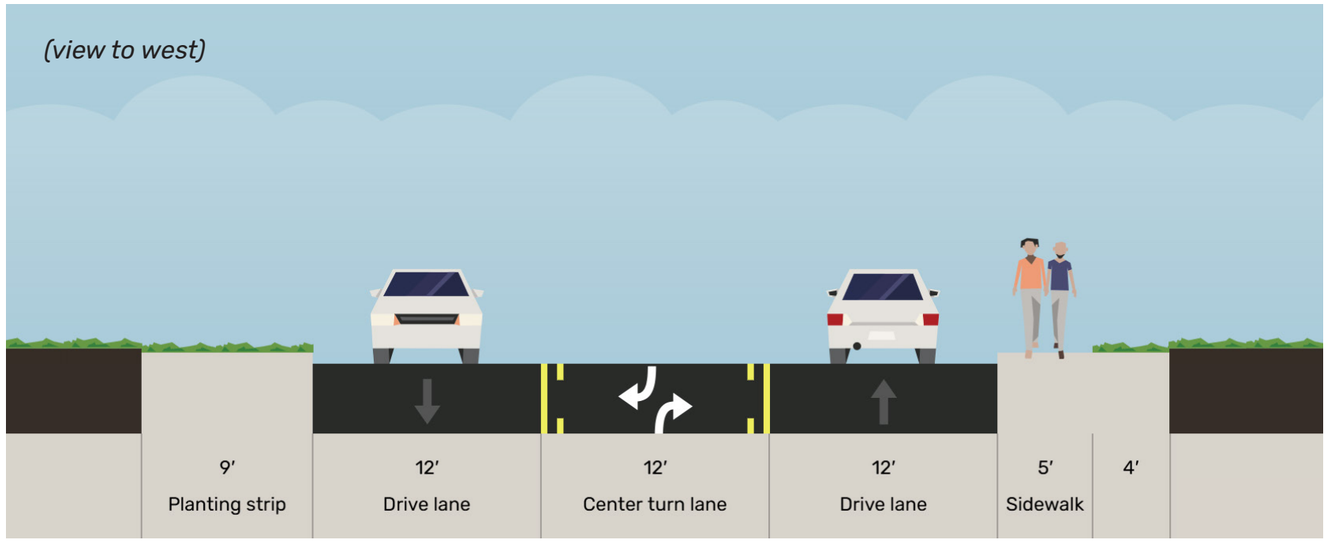
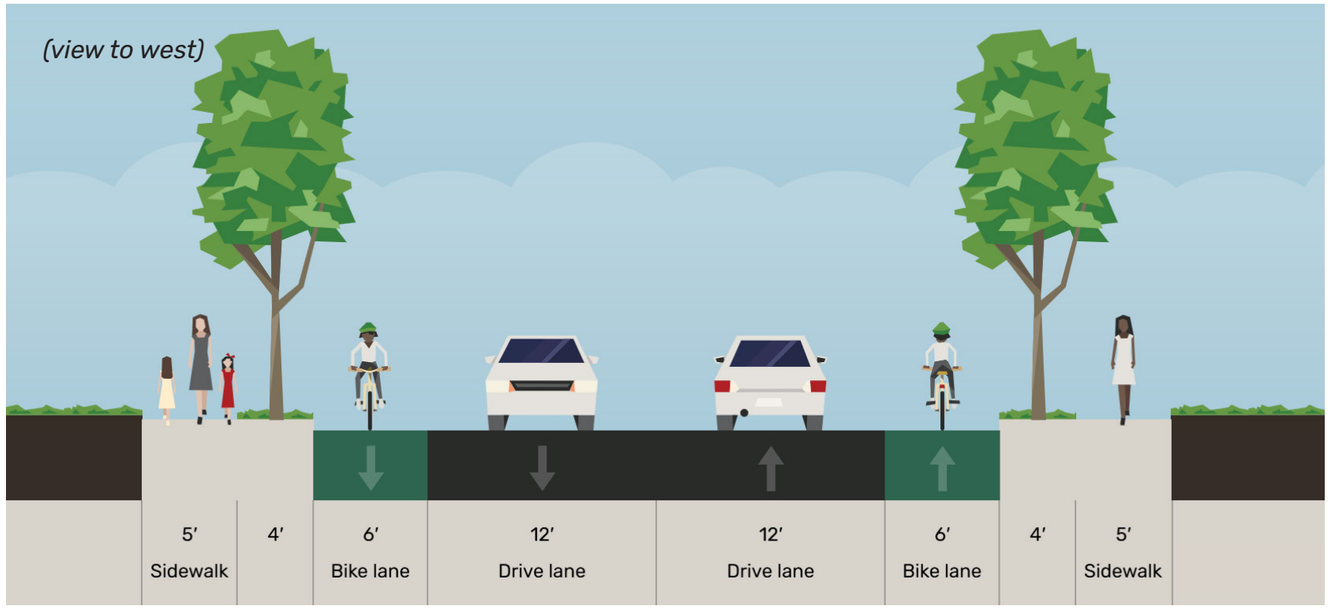


Exhibit 56. *Proposed Typical Cross-Section on Church Drive (50'-55' ROW)*



Cliff Oaks Drive

Existing Cross-Section

Cliff Oaks Drive has approximately 57 feet of right-of-way available. The current configuration of Cliff Oaks Drive, as shown in Exhibit 57, includes two 11.5-foot-wide travel lanes, a 13-foot-wide green space on the street's southern side, and an 11-foot-wide parkway, a 6-foot-wide sidewalk and a 4-foot-wide green space on the street's northern side.

Proposed Cross-Section

The proposed reconfiguration of Cliff Oaks Drive would incorporate replacing the green spaces with a 10-foot-wide shared-use path on the street's south side and an 8-foot-wide shared-use path on the north side. The pavement and travel lanes would remain the same width.

Benefits of the Proposed Improvement

» Shared-use paths on both sides support higher pedestrian traffic and other modes of transportation serving as the active transportation element in this corridor
  - Shared-use paths on both sides are especially appropriate considering the presence of the Corinth Elementary School and high-density land use adjacent to the corridor, and with another multifamily development underway

» The multimodal design balances connectivity for vehicles, cyclists and pedestrians, and creates a safer, more attractive corridor for community use

» A parkway buffer separates the roadway from the path, enhancing pedestrian safety, and provides space for landscaping, improving aesthetic and environmental appeal

Exhibit 57. *Typical Existing Cross-Section on Cliff Oaks Drive (57' ROW)*

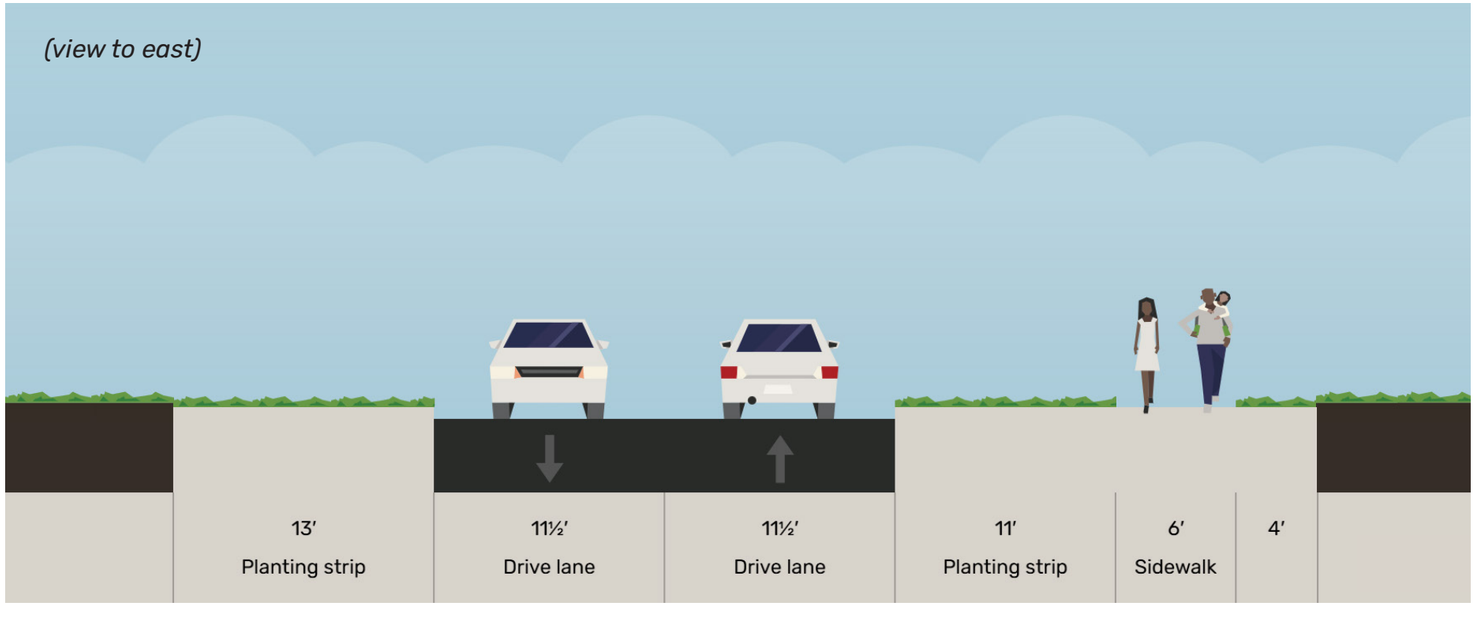
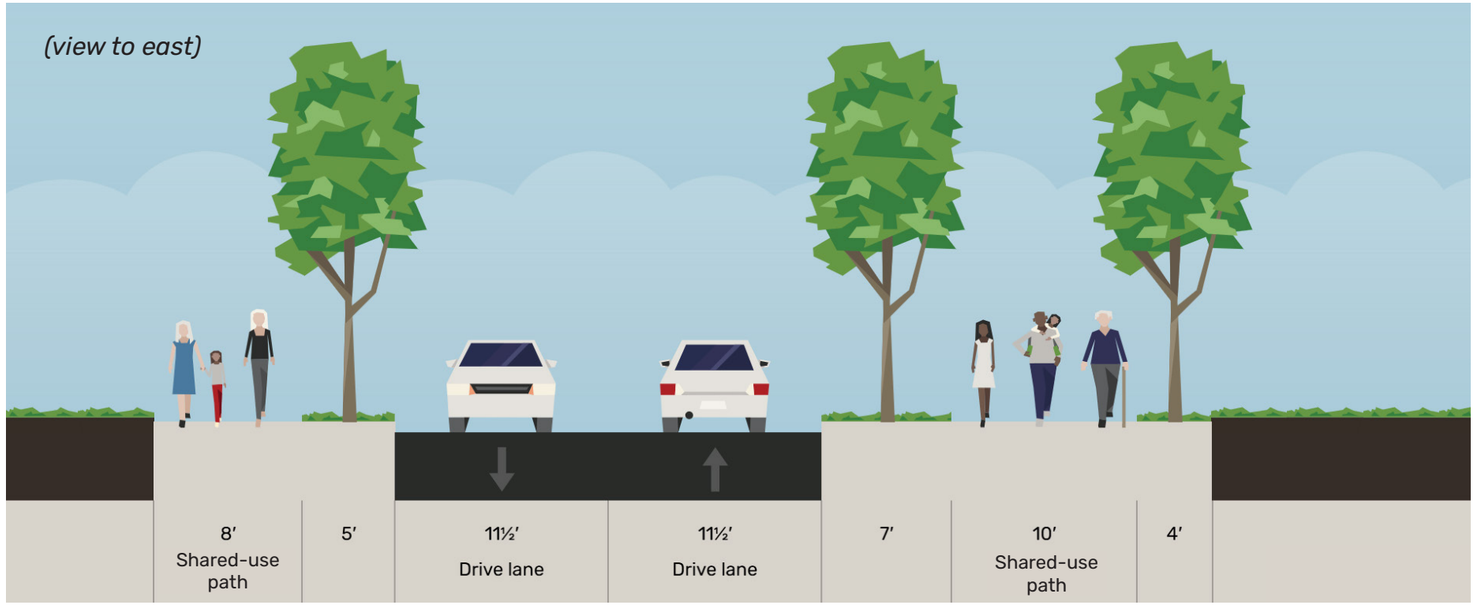


Exhibit 58. *Proposed Typical Cross-Section on Cliff Oaks Drive (57' ROW)*



Corinth Parkway (West of IH 35)

Existing Cross-Section

Corinth Parkway has 84 feet or more of right-of-way available. The current configuration, as shown in Exhibit 59, includes a 16.5-foot-wide median, four 12-foot-wide travel lanes, parkways of minimum of 5 feet and sidewalks on each side of a minimum of 4 feet.

Proposed Cross-Section

The proposed reconfiguration would reduce the number of lanes from four to two and add 7-foot bike lanes with 5-foot buffers. The existing sidewalks would be widened to 5 feet at minimum.

Benefits of the Proposed Improvement

- Lane reduction from four to two lanes helps to calm traffic and lowers vehicle speeds, and reduces the likelihood and severity of a collision
- Dedicated bike lanes with buffers provide a safer space for cyclists and encourage cycling by providing a designated area separate from vehicle traffic
- 5-foot-wide sidewalks increase pedestrian safety and accessibility while supporting walkability and foot traffic in the area
- Parkway separates the roadway from the sidewalk, enhancing pedestrian safety, and provides space for landscaping, improving aesthetic and environmental appeal

Exhibit 59. *Typical Existing Cross-Section on Corinth Parkway (West of IH 35) (84' ROW)*

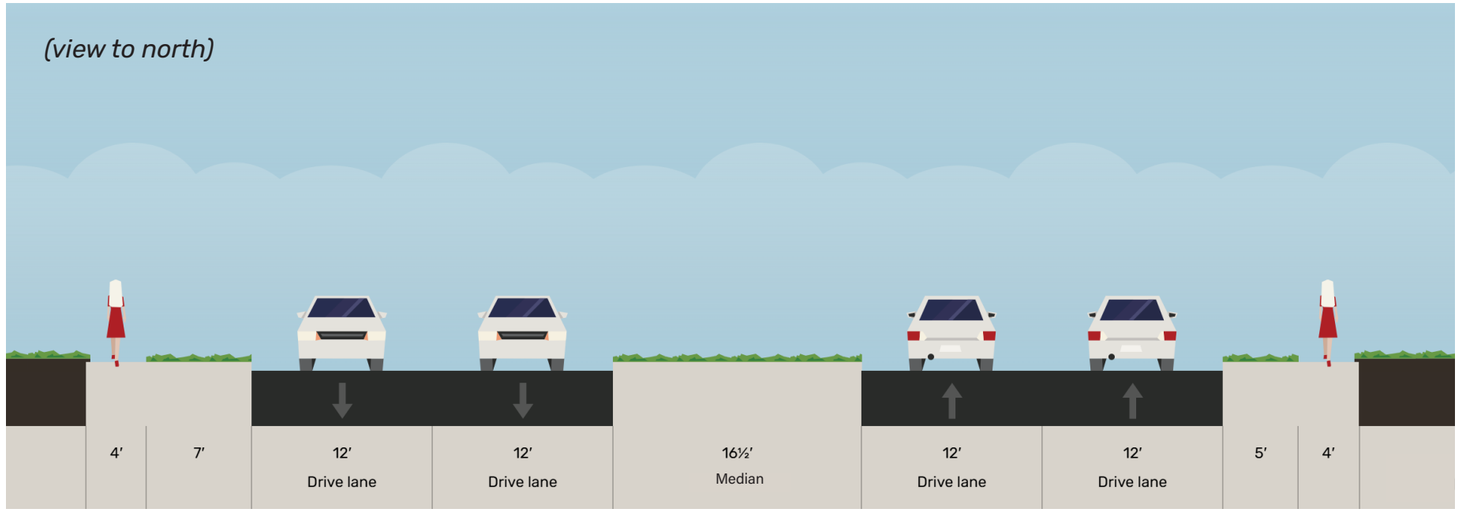
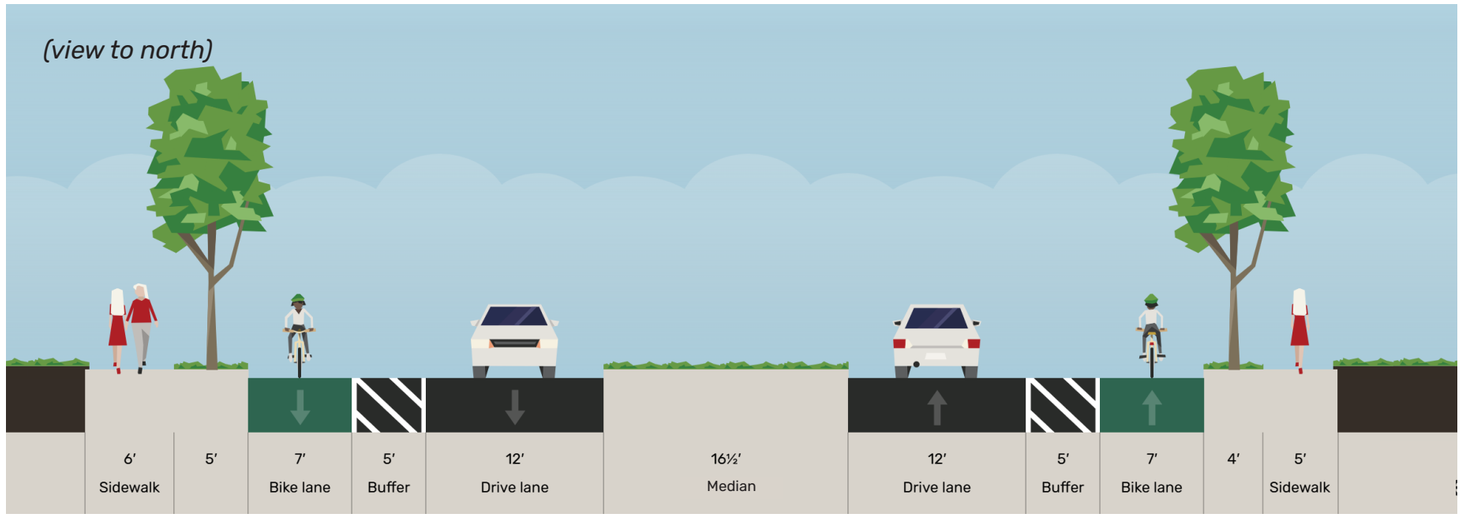


Exhibit 60. *Proposed Typical Cross-Section on Corinth Parkway (West of IH 35) (84' ROW)*



Corinth Parkway (IH 35 to Creek Bend Drive)

Existing Cross-Section

Corinth Parkway from IH 35 to Creek Bend Drive typically has 84 feet or more of right-of-way. The current configuration of Corinth Parkway in this segment, as shown in Exhibit 61, is a four-lane divided roadway that includes a 15-foot landscaped median, 12-foot-wide travel lanes in each direction, sidewalks on each side of the street with a minimum of 4 feet, and a landscaped buffer between the sidewalk and roadway.

Proposed Cross-Section

The proposed reconfiguration of Corinth Parkway in this segment would involve restriping the existing two lanes in each direction to one 11-foot-wide travel lane with an on-street parking lane, 5-foot-wide bike lane and 6-foot-wide sidewalk on each side of the street.

Benefits of the Proposed Improvement

- Lane reduction from four to two lanes helps to calm traffic and lowers vehicle speeds, and reduces the likelihood and severity of a collision
- Dedicated 5-foot bike lanes buffered by a parking lane provide a safer space for cyclists, separate from vehicle traffic, and encourage cycling by providing a designated, physically-protected area
- 6-foot-wide sidewalks increase pedestrian safety and accessibility, and support walkability and foot traffic
- On-street parking lane provides direct access to local destinations and increases foot traffic, boosting local economy while contributing to calmer traffic
- Enhanced connectivity supports a more balanced, multimodal corridor while increasing accessibility for drivers, cyclists, and pedestrians

Traffic Volume Analysis

Traffic data collected between September 24 and October 2, 2024, show weekday AM and PM peak volumes of 400-850 vehicles per direction per hour, with Tuesday and Wednesday being the highest. The peak hourly volumes reach 857 vehicles eastbound and 602 westbound.

Exhibit 61. *Typical Existing Cross-Section on Corinth Parkway (IH 35 to Creek Bend Drive) (84' ROW)*

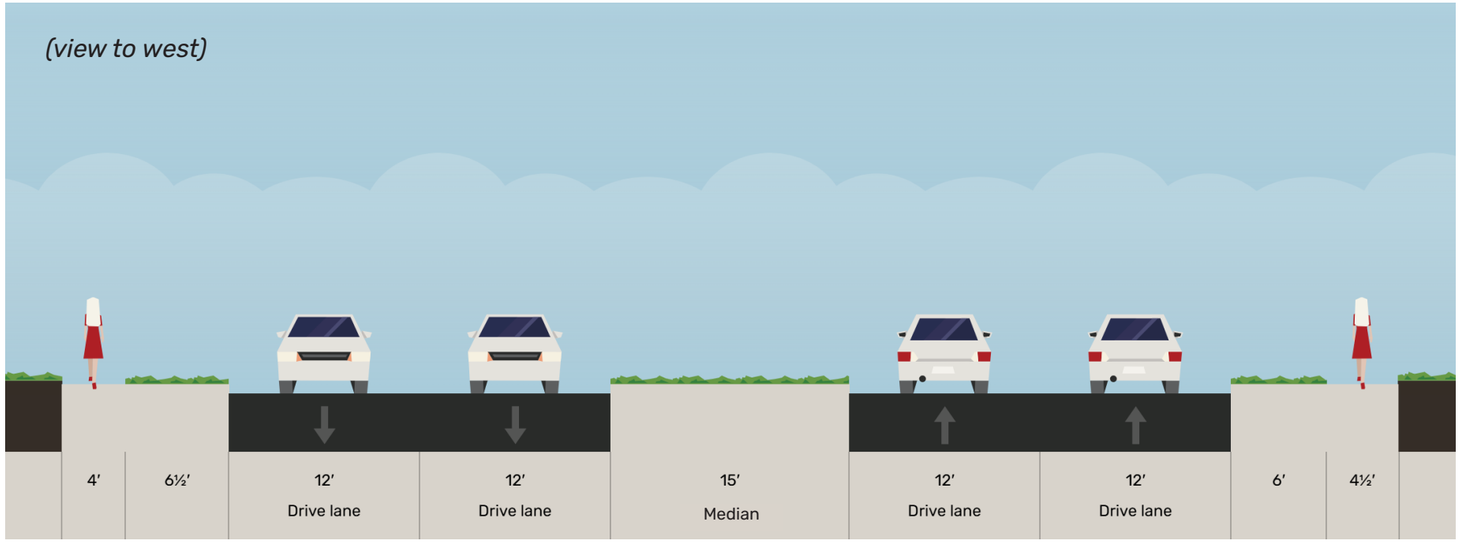
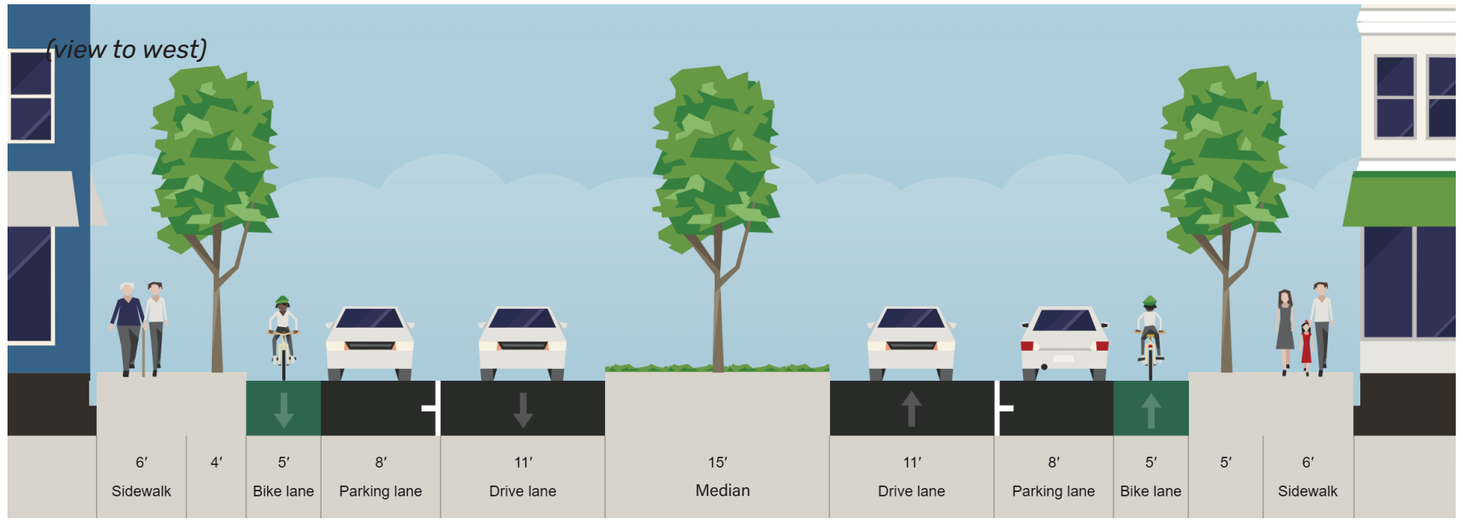


Exhibit 62. *Proposed Typical Cross-Section on Corinth Parkway (IH 35 to Creek Bend Drive) (84' ROW)*



The proposed road diet, reducing the street from four lanes to two, can accommodate off-peak and weekend traffic but will reach capacity during peak periods, especially the PM peak hour.

Corinth Parkway (Creek Bend Drive to IH 35 @ Lake Sharon Drive)

Existing Cross-Section

Corinth Parkway south of Creek Bend Drive typically has around 84 feet of right-of-way. The current configuration of this segment of Corinth Parkway, as shown in Exhibit 63, includes a 16.5-foot median, two travel lanes in each direction, a landscaped buffer of 3.5 to 4 feet, and 4-foot-wide sidewalks on each side of the street.

Between Quail Run Drive and IH 35, the existing 2-lane roadway (Dobbs Road) will be replaced with a 4-lane divided roadway.

Proposed Cross-Section

The proposed reconfiguration of this segment of Corinth Parkway would involve restriping the existing four lanes to two 12-foot-wide travel lanes with 5-foot-wide buffers, 7-foot-wide bike lanes and sidewalks that are at least 5 feet wide on each side of the street.

This typical section would continue all the way to IH 35 and the new interchange with service roads at Lake Sharon Road.

Benefits of the Proposed Improvement

- Lane reduction from four to two lanes helps to calm traffic and lowers vehicle speeds, and reduces the likelihood and severity of a collision
- Dedicated bike lanes with buffers provide a safer space for cyclists and encourage cycling by providing a designated area separate from vehicle traffic
- Sidewalks increase pedestrian safety and accessibility while supporting walkability and foot traffic in the area
- Parkway separates the roadway from the sidewalk, enhancing pedestrian safety, and provides space for landscaping, improving aesthetic and environmental appeal

Traffic Growth Consideration

The planned creation of the underpass of Corinth Parkway/ Lake Sharon Drive at IH 35 will attract additional traffic to this roadway. That tendency, coupled with anticipated new development along the new segment of Corinth Parkway between Quail Run Drive and IH 35 service road will increase the need for traffic capacity near the IH 35 interchange. Design of the new segment of Corinth Parkway between Quail Run Drive and IH 35 should consider transition of the buffered bike lane into 10- to 12-foot-wide shared-use paths along both sides of Corinth Parkway. See page 74 for further information.

Exhibit 63. *Typical Existing Cross-Section on Corinth Parkway (Creek Bend Drive to IH 35 @ Lake Sharon Drive) (84' ROW)*

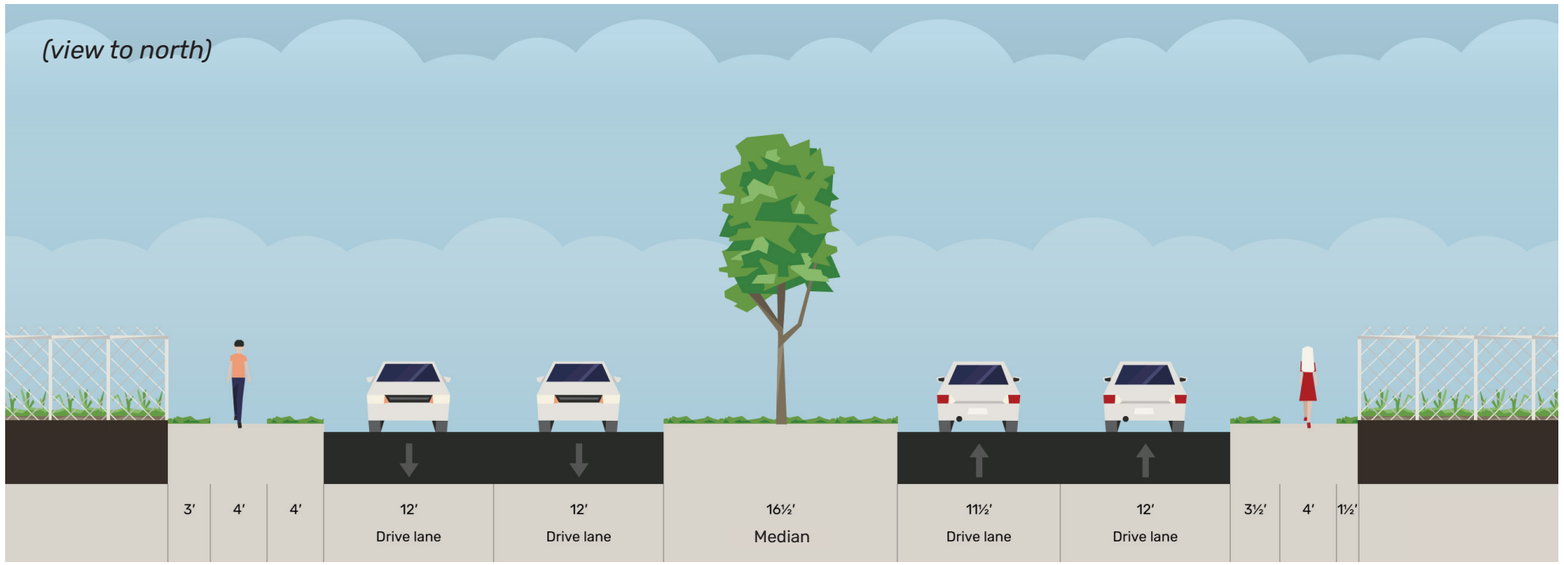
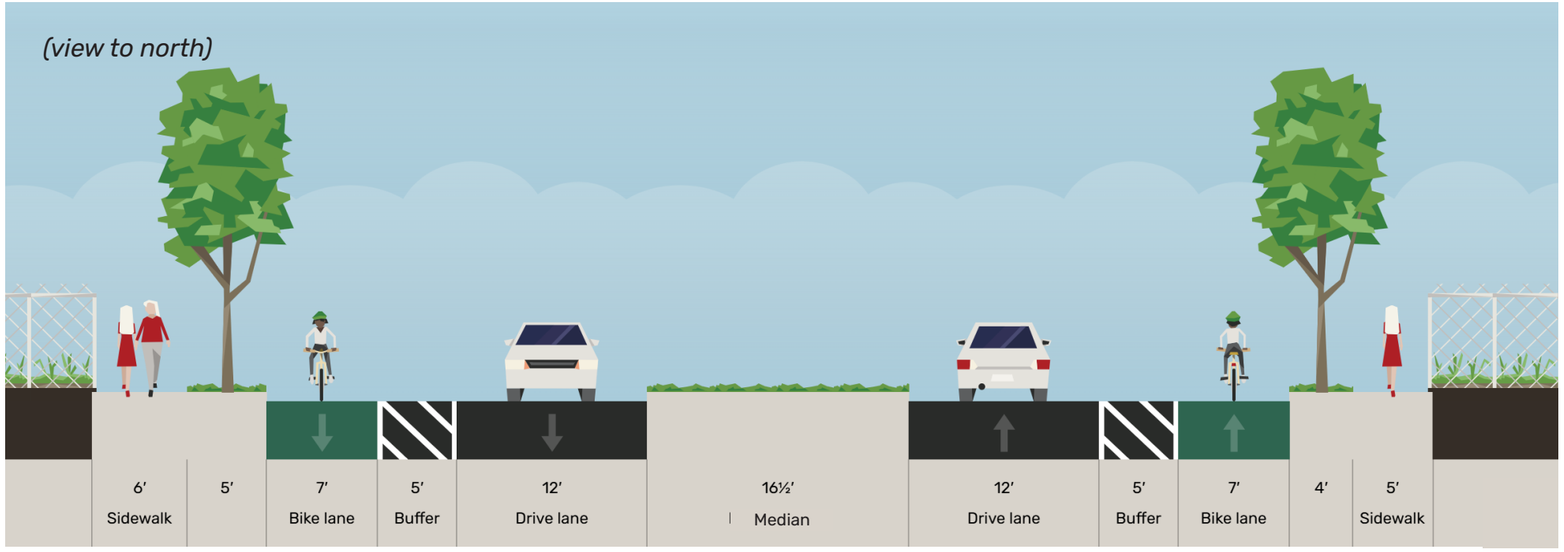


Exhibit 64. *Proposed Typical Cross-Section on Corinth Parkway (Creek Bend Drive to IH 35 @ Lake Sharon Drive) (84' ROW)*



Creekside Drive

Existing Cross-Section

Creekside Drive has around 65 feet of right-of-way available. The current configuration of Creekside Drive, as shown in Exhibit 65, includes two 19.5-foot-wide travel lanes, a 4-foot-wide sidewalk on the street's southern side, parkway and green space of different widths.

Proposed Cross-Section

The proposed reconfiguration of Creekside Drive would incorporate widening the existing sidewalk to 6 feet on the street's north side and adding a 10-foot shared-use path on the south side, with parkways on both side. The existing 19.5-foot-wide travel lanes would be narrowed to 11 feet while adding an 8.5-foot-wide parking lane in both directions.

Benefits of the Proposed Improvement

- A shared-use path can support higher pedestrian traffic and other modes of transportation serving as the active transportation element in this corridor
- A shared-use path can safely accommodate students walking and biking to school
- The multimodal design balances connectivity for vehicles, cyclists and pedestrians, and creates a safer, more attractive corridor for community use
- Designated curbside parking is provided near the adjacent school

Exhibit 65. *Typical Existing Cross-Section on Creekside Drive (65' ROW)*

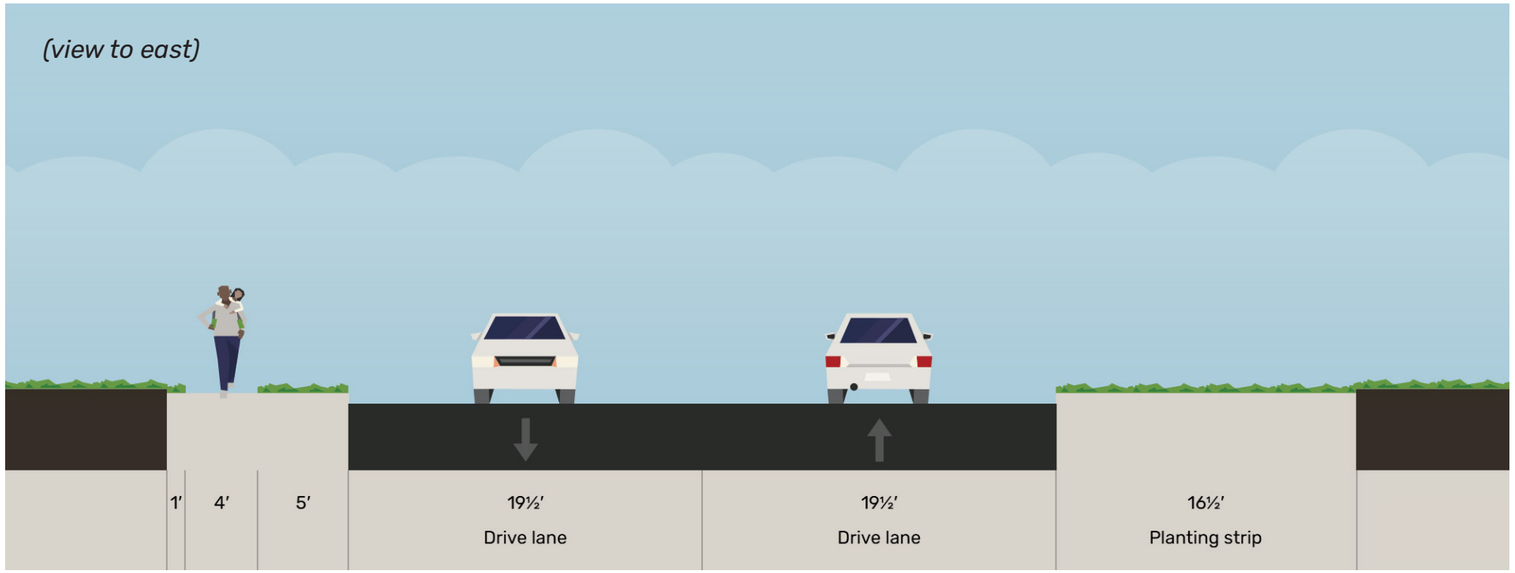
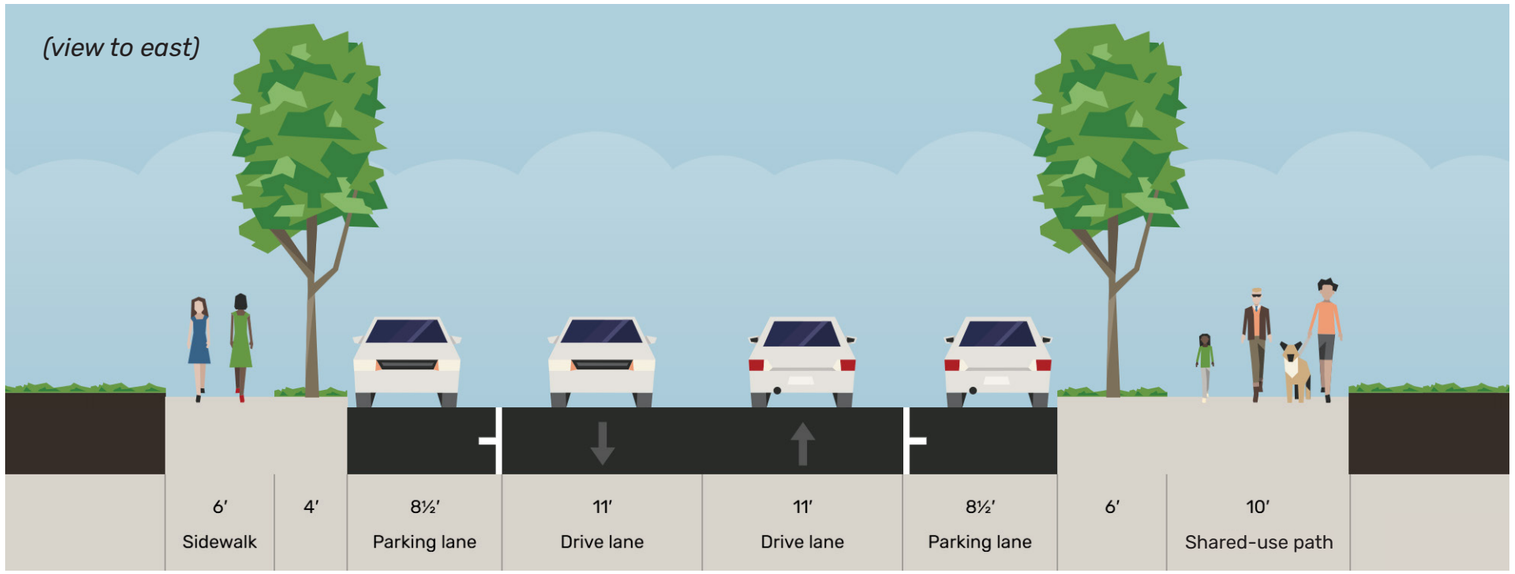


Exhibit 66. *Proposed Typical Cross-Section on Creekside Drive (65' ROW)*



FM 2181/Teasley Drive

Existing Cross-Section

FM 2181/Teasley Drive has 118 feet of right-of-way. The current configuration of FM 2181, as shown in Exhibit 67, includes a 16.5-foot-wide median, six 11-foot-wide travel lanes, 2-foot-wide inside and outside shoulders, sidewalks on each side of the street with at minimum of 5 feet wide, and green spaces of different widths.

Proposed Cross-Section

The proposed reconfiguration of FM 2181/Teasley Drive would incorporate increasing the width of the sidewalks to create 8- and 10-foot-wide shared-use paths on the north and south side of the street, respectively.

Benefits of the Proposed Improvement

- The street's right-of-way will be utilized to its fullest potential
- Shared-use paths on each side provide ample space for both pedestrians and cyclists, promoting active transportation and enhancing safety by offering a dedicated, wide path separate from vehicle lanes
- The multimodal design balances connectivity for vehicles, cyclists and pedestrians, and creates a safer, more attractive corridor for community use

Exhibit 67. *Typical Existing Cross-Section on FM 2181/Teasley Drive (118' ROW)*

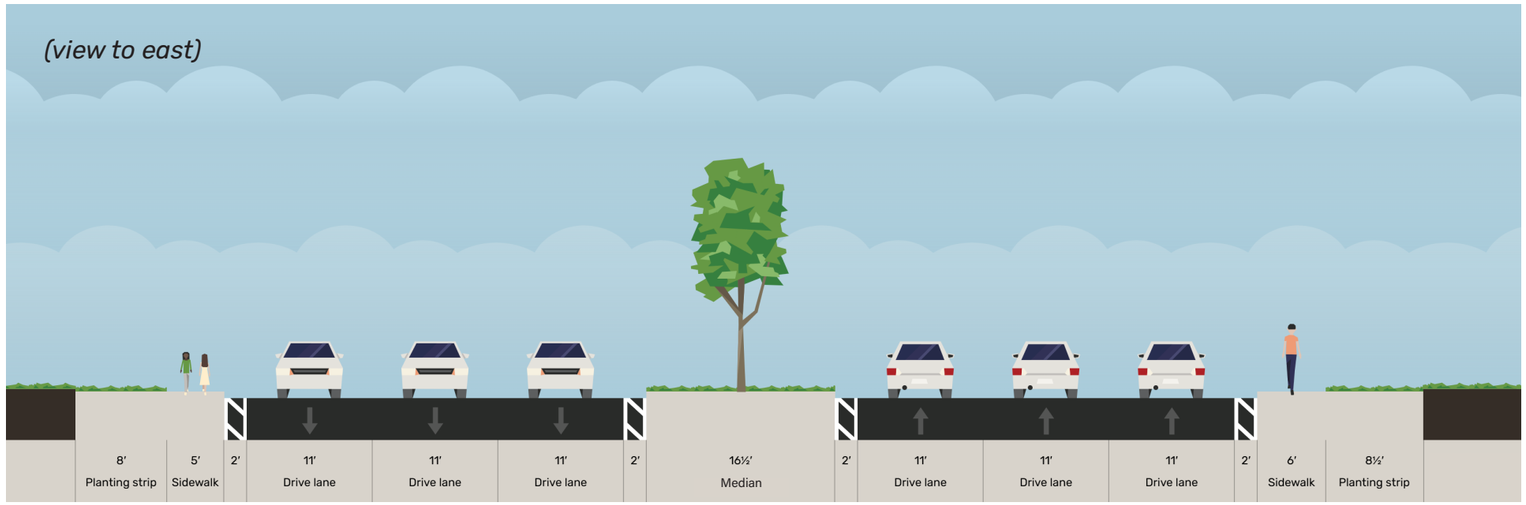
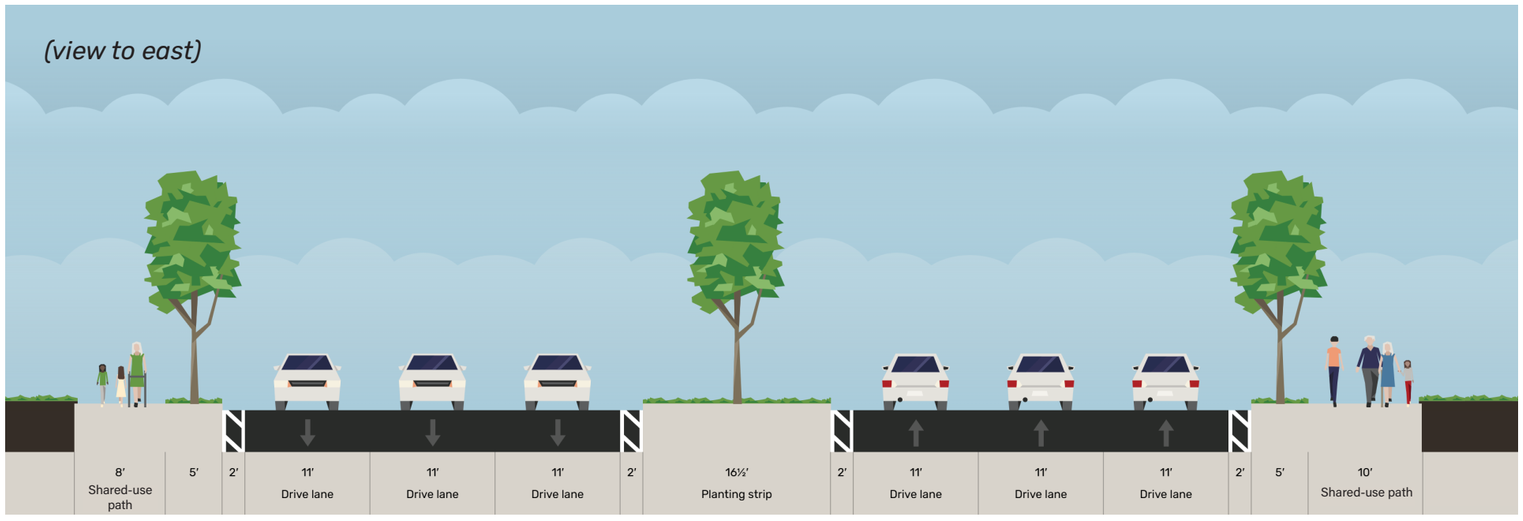


Exhibit 68. *Proposed Typical Cross-Section on FM 2181/Teasley Drive (118' ROW)*



FM 2499/Barrel Strap Road (North of FM 2181)

Existing Cross-Section

FM 2499/Barrel Strap Road north of FM 2181/Teasley Drive has around 120 feet of right-of-way. The current configuration of FM 2499, as shown in Exhibit 69, includes a 16-foot-wide median, six travel lanes, with 14-foot-wide outer lanes and 12-foot-wide center lanes, 6-foot-wide sidewalks on each side of the street, and 6-foot-wide green spaces on each side of the street.

Proposed Cross-Section

The proposed reconfiguration of FM 2499/Barrel Strap Road would incorporate increasing the width of the sidewalks to create 8-foot-wide shared-use paths on the north and south side of the street. Additionally, 4 feet of parkway will be added on both sides of the street.

Benefits of the Proposed Improvement

- 8-foot-wide shared-use path on each side accommodates more user types, such as cyclists, pedestrians, wheelchair users, and joggers, enhancing connectivity for nonmotorized users
- The 4-foot-wide parkway acts as a buffer between the road and shared-use path, improving pedestrian safety while adding green space to enhance aesthetic and environmental appeal
- The multimodal design balances connectivity for vehicles, cyclists and pedestrians, and creates a safer, more attractive corridor for community use

Exhibit 69. *Typical Existing Cross-Section on FM 2499 (North of FM 2181) (120' ROW)*

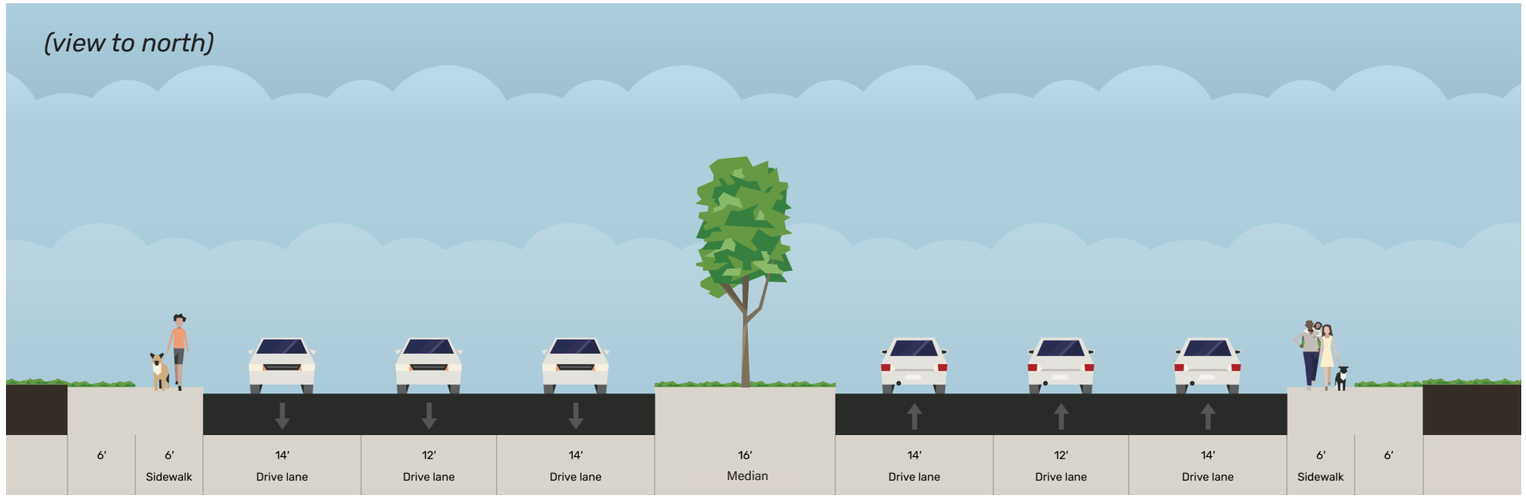
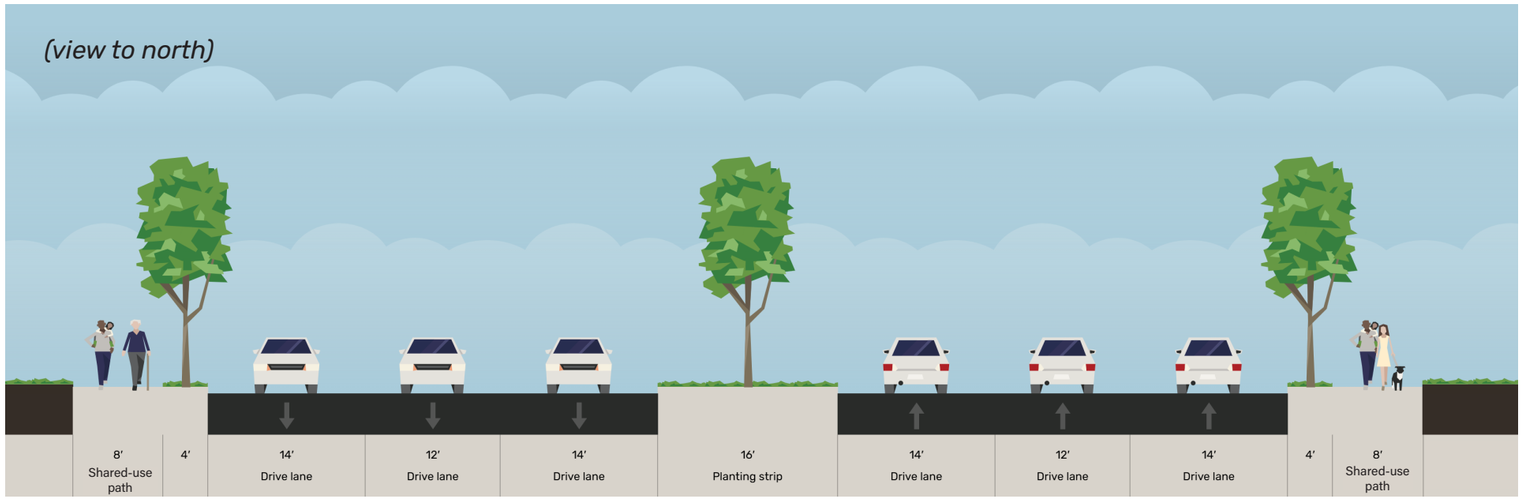


Exhibit 70. *Proposed Typical Cross-Section on FM 2499 (North of FM 2181) (120' ROW)*



FM 2499/Village Parkway (South of FM 2181)

Existing Cross-Section

FM 2499/Village Parkway south of FM 2181/Teasley Drive has 140 feet of right-of-way. The current configuration of FM 2499/Village Parkway, as shown in Exhibit 71, includes a 44-foot-wide median, four 14.5-foot-wide travel lanes, no sidewalks, and green spaces of varying widths on each side of the street.

Proposed Cross-Section

The proposed reconfiguration of FM 2499/Village Parkway would incorporate using the existing wide green spaces to create 8-foot-wide shared use paths on both sides of the road. Implementing this design also adds parkway space between the sidewalk and the road, with a minimum width of 8.5 feet.

Benefits of the Proposed Improvement

- 8-foot-wide shared-use path on each side accommodates more user types, such as cyclists, pedestrians, wheelchair users, and joggers, enhancing connectivity for nonmotorized users
- The minimum 8.5-foot-wide parkway on both sides acts as a buffer between the road and sidewalk, improving pedestrian safety while adding green space to enhance aesthetic and environmental appeal
- The multimodal design balances connectivity for vehicles, cyclists and pedestrians, and creates a safer, more attractive corridor for community use

Exhibit 71. *Typical Existing Cross-Section on FM 2499 (South of FM 2181) (140' ROW)*

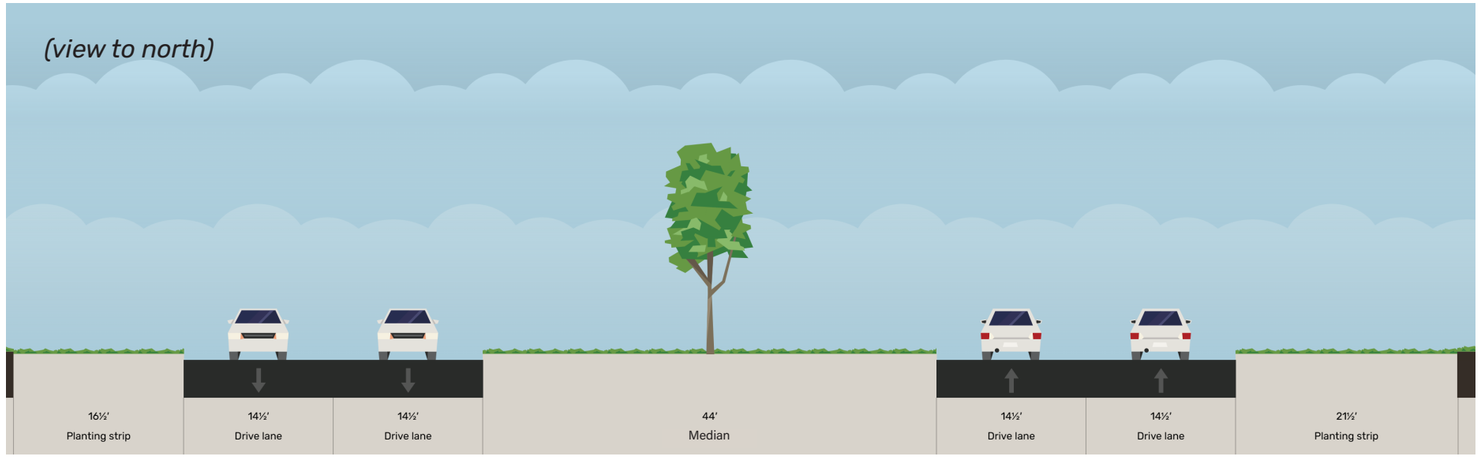
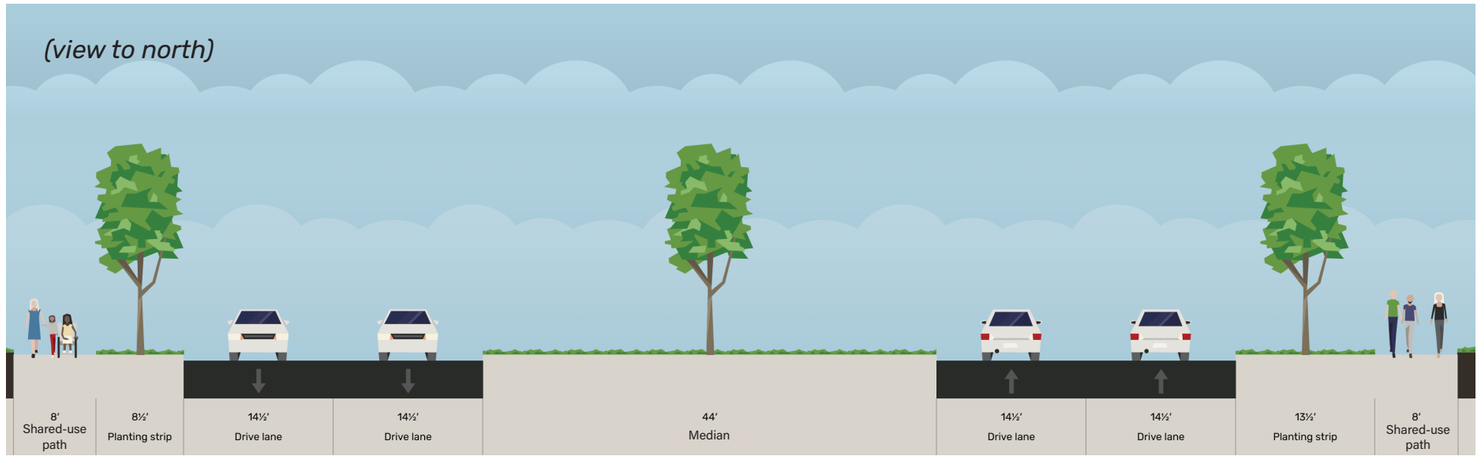


Exhibit 72. *Proposed Typical Cross-Section on FM 2499 (South of FM 2181) (140' ROW)*



Fritz Lane

Existing Cross-Section

Fritz Lane has 48 feet of right-of-way available. The current configuration, as shown in Exhibit 73, includes two 10-foot-wide travel lanes, and at least 12-foot-wide green space on each side of the street.

Proposed Cross-Section

The proposed reconfiguration would incorporate a 10-foot-wide shared-use path on the street's south side, a 6-foot-wide sidewalk on the north side and 6-foot-wide parkways on both sides.

Benefits of the Proposed Improvement

- Shared-use path will support higher pedestrian traffic and other modes of transportation serving as the active transportation element in this corridor
- The multimodal design balances connectivity for vehicles, cyclists and pedestrians, and creates a safer, more attractive corridor for community use
- Parkway buffer separate the roadway from the path, enhancing pedestrian safety, and provide space for landscaping, improving aesthetic and environmental appeal

Exhibit 73. *Typical Existing Cross-Section on Fritz Lane (48' ROW)*

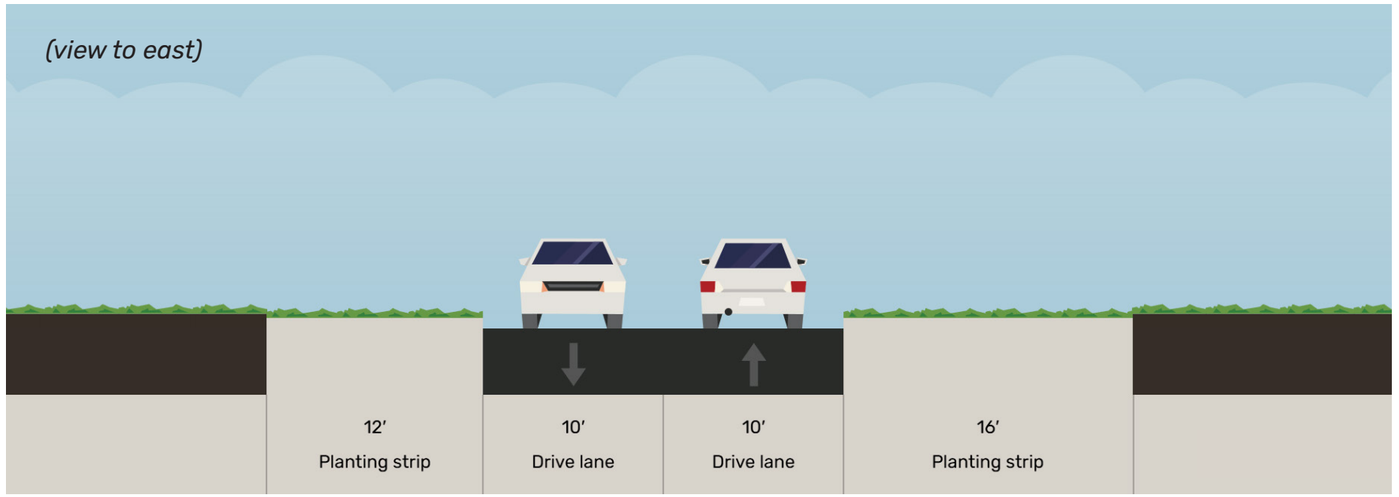
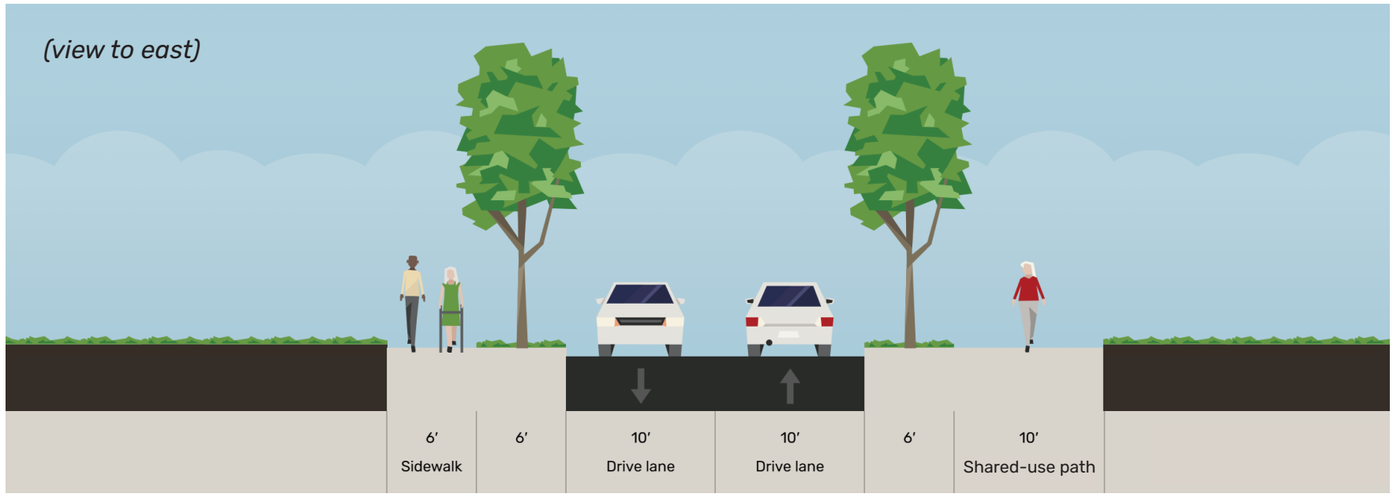


Exhibit 74. *Proposed Typical Cross-Section on Fritz Lane (48' ROW)*



Garrison Road (North of Cliff Oaks Drive)

Existing Cross-Section

Garrison Road (north of Cliff Oaks Drive) has approximately 60 feet to over 100 feet of right-of-way available. The current configuration, as shown in Exhibit 75, includes two 11-foot-wide travel lanes and green space on each side of the street with a minimum of 13 feet. A 5-foot-wide sidewalk has been installed along the west side of Garrison Road, ending just before the IH 35 service road.

Proposed Cross-Section

The proposed treatment transforms the existing sidewalk on the western side into an 8-foot-wide shared-use path and adds a new 8-foot-wide shared-use path along the eastern side while keeping the pavement and travel lane width consistent.

Benefits of the Proposed Improvement

- Shared-use path on the both sides supports both pedestrian and bike traffic, serving as the active transportation element in this corridor
- The multimodal design balances connectivity for vehicles, cyclists and pedestrians, and creates a safer, more attractive corridor for community use

Exhibit 75. *Typical Existing Cross-Section on Garrison Road (North of Cliff Oaks Drive) (60' ROW min)*

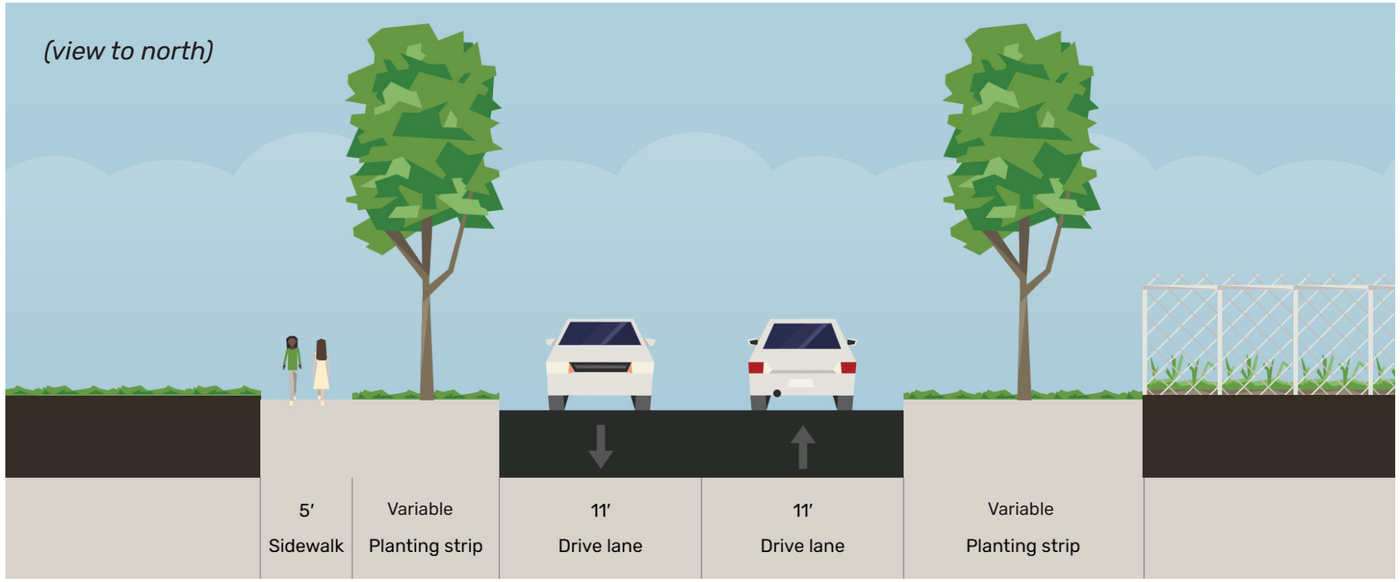
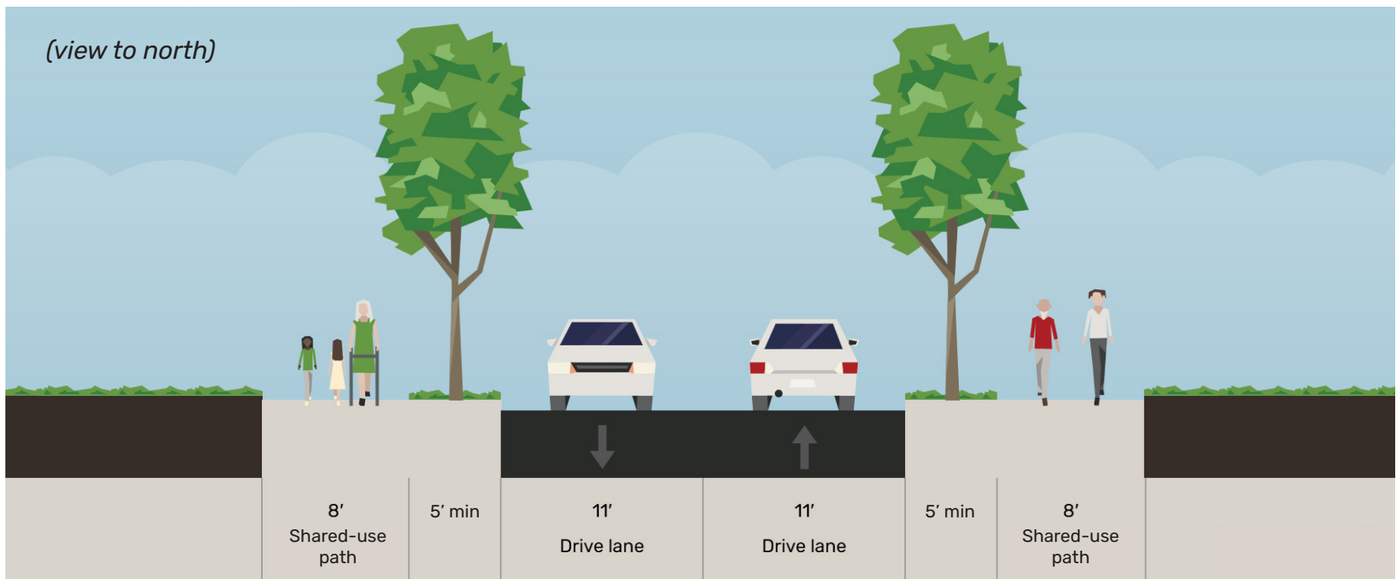


Exhibit 76. *Proposed Typical Cross-Section on Garrison Road (North of Cliff Oaks Drive) (60' ROW min)*



Garrison Road (South of Cliff Oaks Drive)

Existing Cross-Section

Garrison Road (south of Cliff Oaks Drive) has approximately 60 feet of right-of-way available. The current configuration, as shown in Exhibit 77, includes two 19.5-foot-wide travel lanes, 4-foot-wide sidewalks, 5-foot-wide parkways and green space on each side of the street.

Proposed Cross-Section

The proposed reconfiguration would transform one lane in each direction to a 5-foot-wide bike lane with a 3-foot-wide buffer on each side of the street. The remaining travel lanes would be narrowed to 11.5 feet, and the sidewalks would be expanded from 4 to 6 feet.

Benefits of the Proposed Improvement

- Lane narrowing from 19.5 to 11.5 feet helps to calm traffic and lowers vehicle speeds, and reduces the likelihood and severity of a collision
- Dedicated buffered bike lanes provide a safer space for cyclists, separate from vehicle traffic, and encourage cycling by providing a comfortable riding area
- Sidewalks increase pedestrian safety and accessibility
- The multimodal design balances connectivity for vehicles, cyclists and pedestrians, and creates a safer, more attractive corridor for community use
- Parkway buffer separate the roadway from the path, enhancing pedestrian safety, and provide space for landscaping, improving aesthetic and environmental appeal

Exhibit 77. *Typical Existing Cross-Section on Garrison Road (South of Cliff Oaks Drive) (60' ROW)*

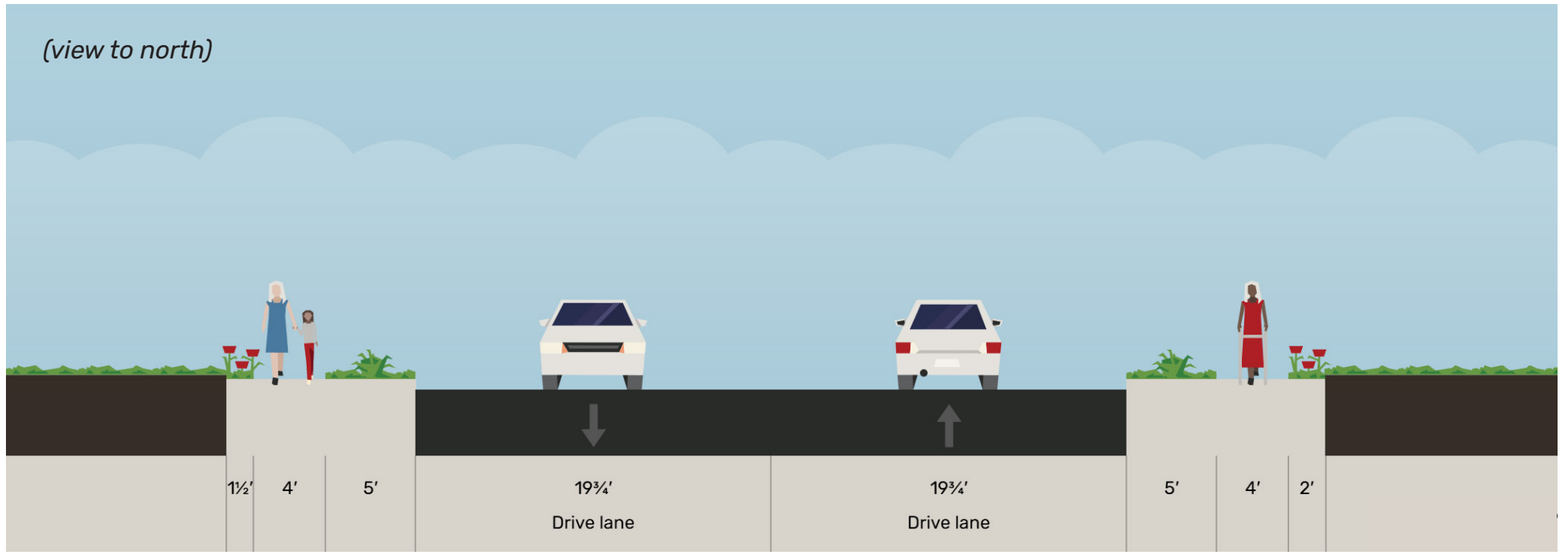
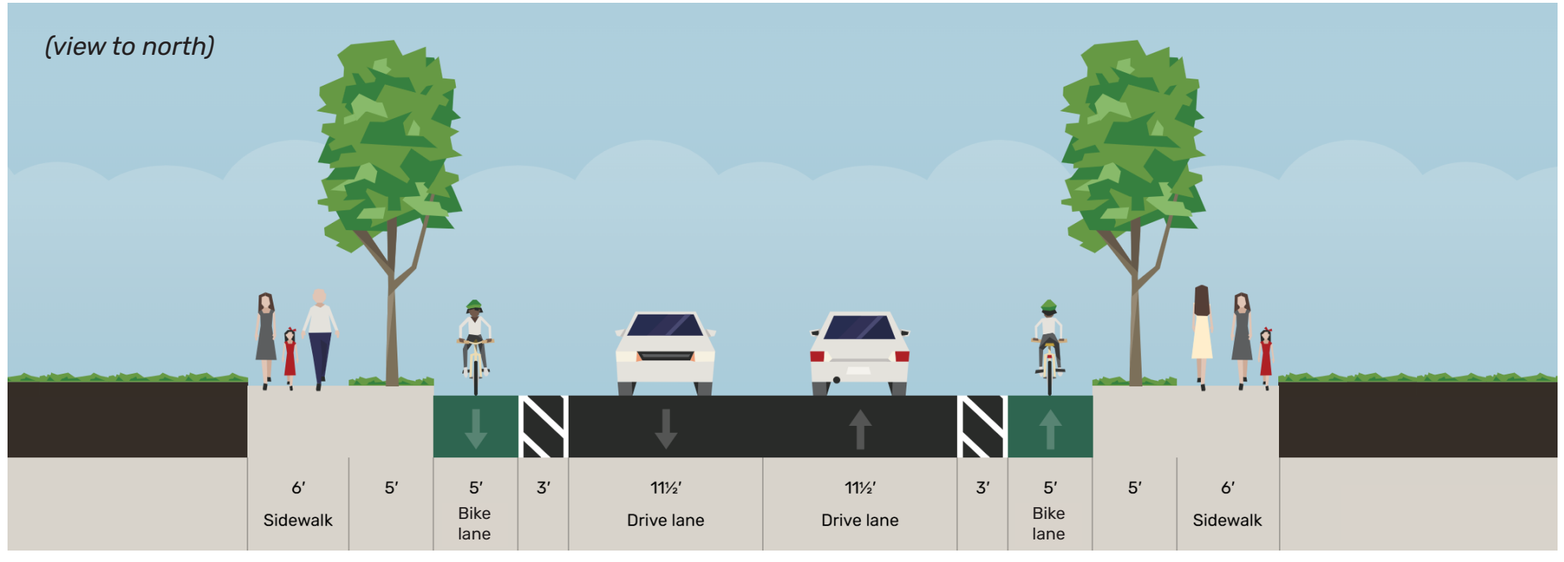


Exhibit 78. *Proposed Typical Cross-Section on Garrison Road (South of Cliff Oaks Drive) (60' ROW)*



Lake Sharon Drive

Existing Cross-Section

Lake Sharon Drive typically has 84 feet of right-of-way. The current configuration of Lake Sharon Drive, as shown in Exhibit 79, includes a median, four 12-foot-wide travel lanes, parkways, and sidewalks on each side of the street with a minimum width of 4 feet.

Proposed Cross-Section

The proposed reconfiguration of Lake Sharon Drive would reduce the four existing travel lanes to two 12-foot-wide travel lanes. A 7-foot-wide bike lane with a 5-foot-wide buffer and parkway would be featured on each side, with a 10-foot-wide shared-use path on the north side and 6-foot-wide sidewalk on the south side.

Benefits of the Proposed Improvement

- Lane reduction from four to two lanes helps to calm traffic and lowers vehicle speeds, and reduces the likelihood and severity of a collision
- Wide dedicated buffered bike lanes provide a safer space for cyclists separate from vehicle traffic, and encourage cycling by providing a comfortable riding area
- Wide sidewalks increase pedestrian safety and accessibility, and support higher foot traffic than standard sidewalks
- A shared-use path supports two-way traffic and accommodates multiple user types
- The multimodal design balances connectivity for vehicles, cyclists and pedestrians, and creates a safer, more attractive corridor for community use

Traffic Volume Analysis

Traffic data collected between January 2 and January 17, 2024, show weekday AM and PM peak volumes ranging from 300 to 500 vehicles per direction per hour, with Tuesday and Wednesday exhibiting the highest traffic volumes. The peak hourly volume recorded was 633 vehicles eastbound and 382 vehicles westbound.

The proposed road diet, which reduces the roadway from four lanes to two lanes, is capable of accommodating the daily traffic demand. However, there may be instances where peak hour volumes approach capacity during peak periods.

Exhibit 79. *Typical Existing Cross-Section on Lake Sharon Drive (84' ROW)*

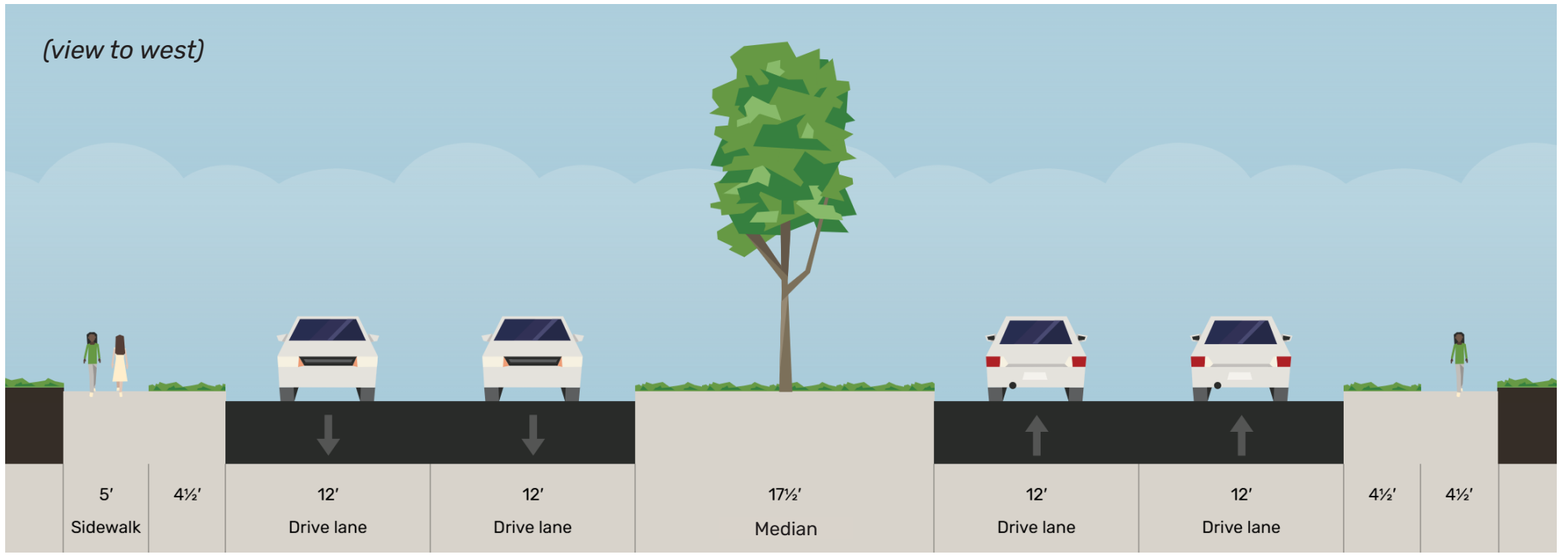
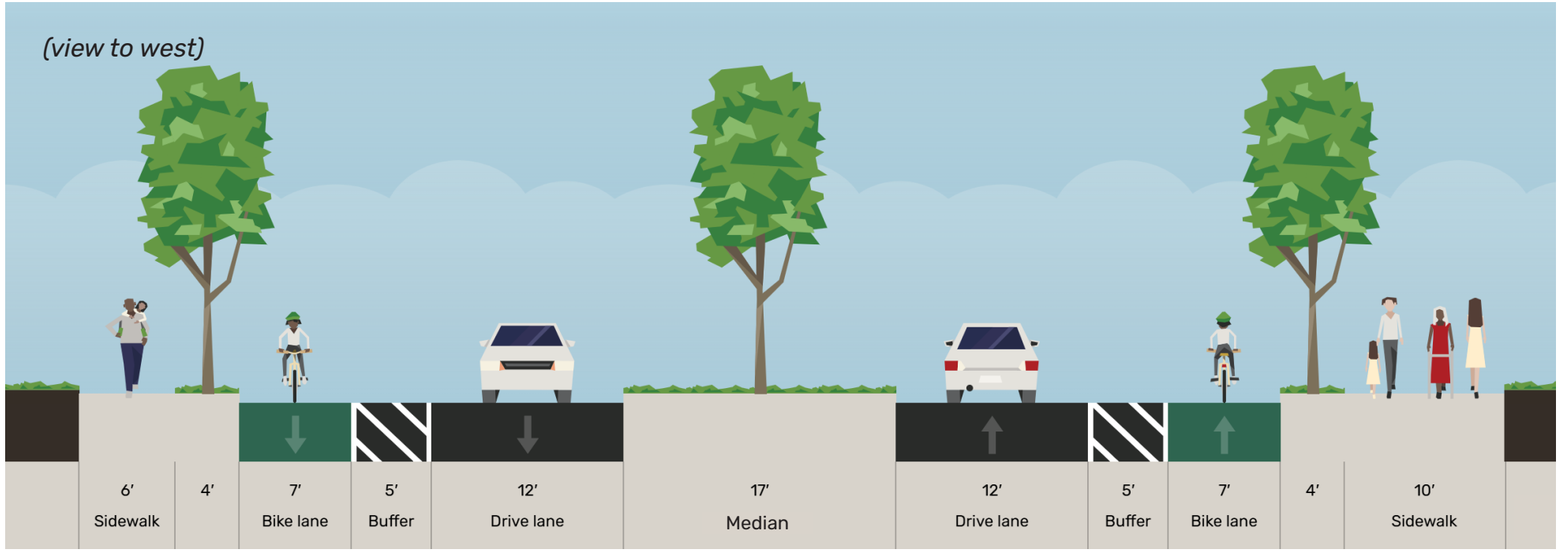


Exhibit 80. *Proposed Typical Cross-Section on Lake Sharon Drive (89' ROW)*



Future Conditions

The planned extension of Lake Sharon Drive/Corinth Parkway will create a concentration of new development and added traffic volumes on the approaches to the new IH 35 interchange. When that interchange is created, the segment of Lake Sharon Drive and Corinth Parkway on either side of the interchange will need to have the buffered bike lanes merge into a 12-foot-wide shared-use path along each side of the roadway for a distance of about 1,000 feet or more to accommodate the increased traffic demand on the approaches and the conflicts with right-turning traffic.

Meadows Drive

Existing Cross-Section

Meadows Drive has around 50 feet of right-of-way available. The current configuration, as shown in Exhibit 81, includes two 13-foot-wide travel lanes, and at least 10.5-foot-wide green space on each side of the street.

Proposed Cross-Section

The proposed reconfiguration would add an 8-foot-wide shared-use path on the east side and a 5-foot-wide sidewalk on the west side with 5.5-foot landscaped buffers on each side. This corridor, along with Fritz Lane and Shady Rest Lane, would provide bike and pedestrian connections to Corinth Parkway and Shady Shores Road.

Benefits of the Proposed Improvement

- Shared-use path will support higher pedestrian traffic and other modes of transportation serving as the active transportation element in this corridor
- The multimodal design balances connectivity for vehicles, cyclists and pedestrians, and creates a safer, more attractive corridor for community use
- Parkway buffer separate the roadway from the path, enhancing pedestrian safety, and provide space for landscaping, improving aesthetic and environmental appeal

Exhibit 81. *Typical Existing Cross-Section on Meadows Drive (50' ROW)*

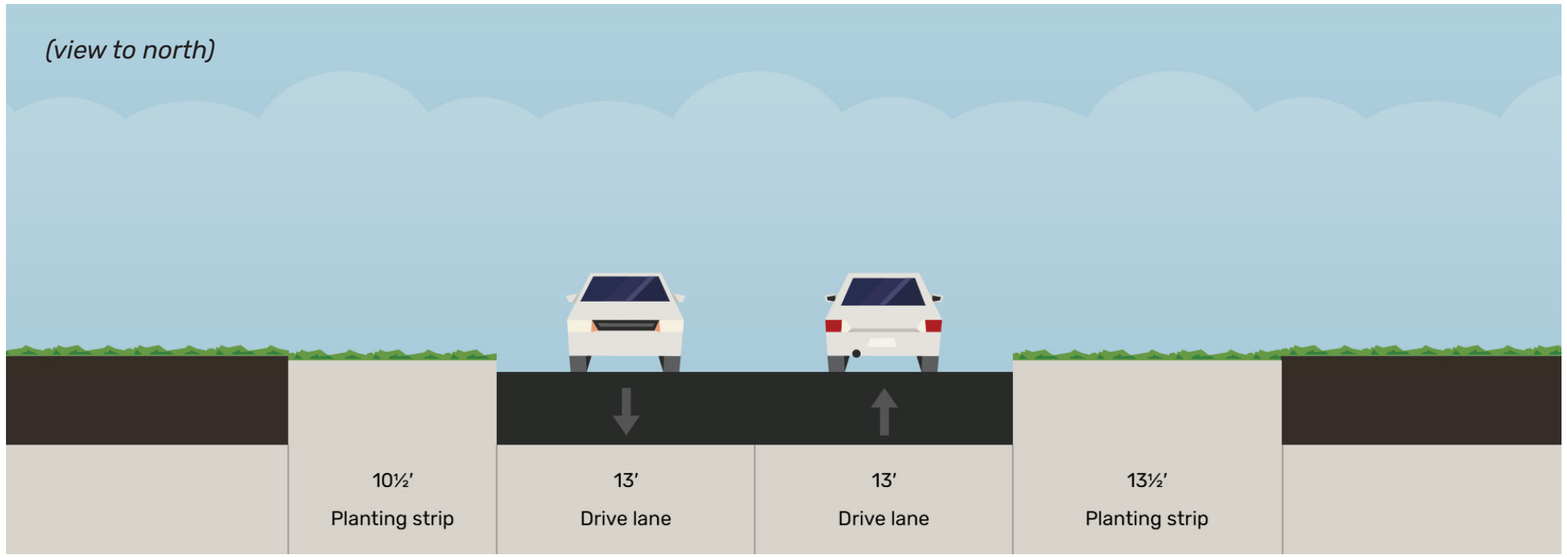
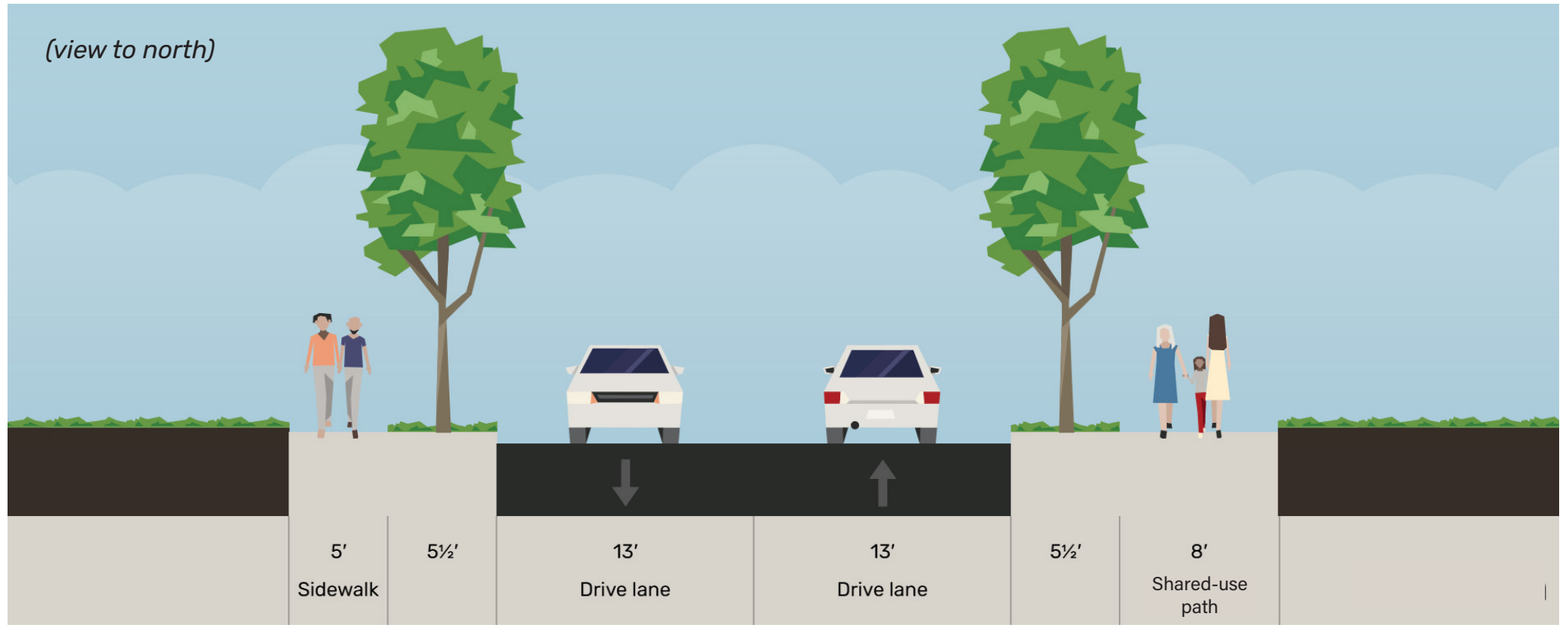


Exhibit 82. *Proposed Typical Cross-Section on Meadows Drive (50' ROW)*



Meadowview Drive

Existing Cross-Section

Meadowview Drive has 62 feet of right-of-way available. The current configuration of Meadowview Drive, as shown in Exhibit 83, includes two approximately 11-foot-wide travel lanes, an approximately 9-foot-wide on-street parking lane on each side, 4-foot-wide sidewalks and parkways of different widths.

Proposed Cross-Section

The proposed reconfiguration of Meadowview Drive would maintain the existing 9-foot-wide parking lane and install shared street markings to indicate shared space between vehicles and cyclists. The existing sidewalks would be expanded to 6 feet on the street's southern side and an 8-foot-wide sidewalk on the street's northern side.

Benefits of the Proposed Improvement

- Shared street provides a space for cyclists while maintaining the existing parking and travel lanes; cyclists can utilize the parking lane when it is empty
- Standard sidewalk on southern side increases walkability and accessibility on both sides of the street, and supports higher foot traffic than standard sidewalks
- Sharrows encourage lower vehicle speeds
- The addition of striping for parking lanes designates separate spaces for moving and parked vehicles and narrows travel lanes, encouraging lower speeds
- 4-foot parkway separates the roadway from the sidewalk, enhancing pedestrian safety, and provides space for landscaping, improving aesthetic and environmental appeal

Exhibit 83. *Typical Existing Cross-Section on Meadowview Drive (62' ROW)*

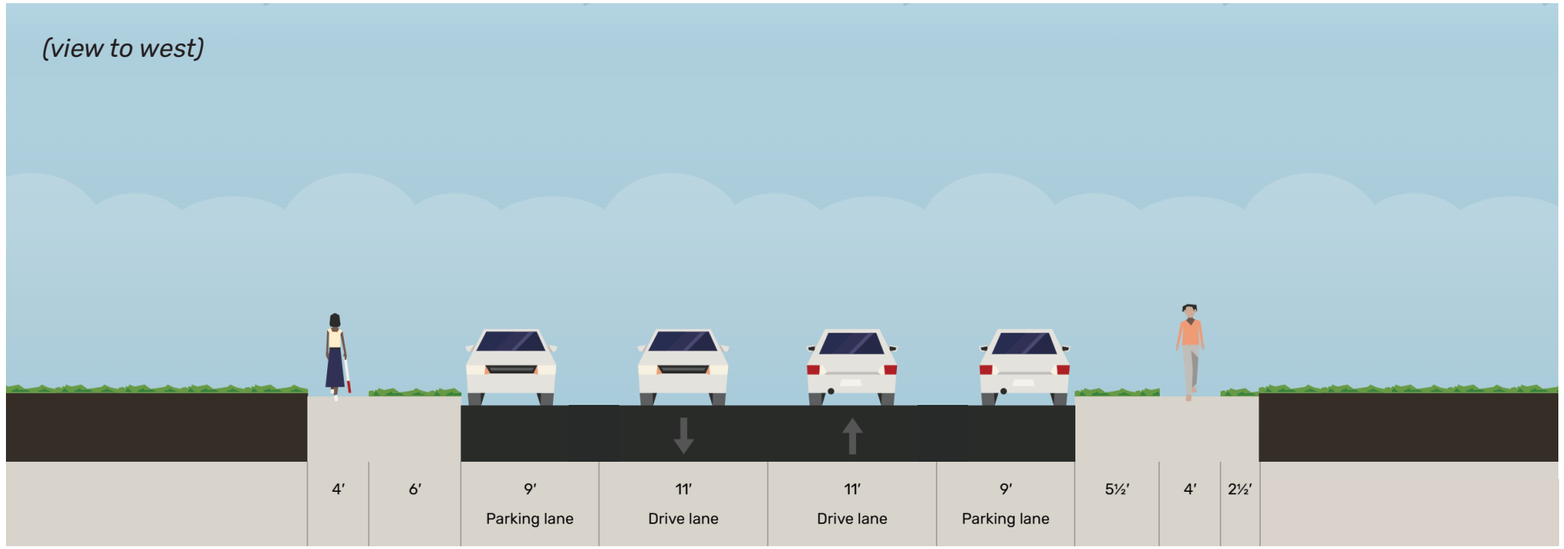
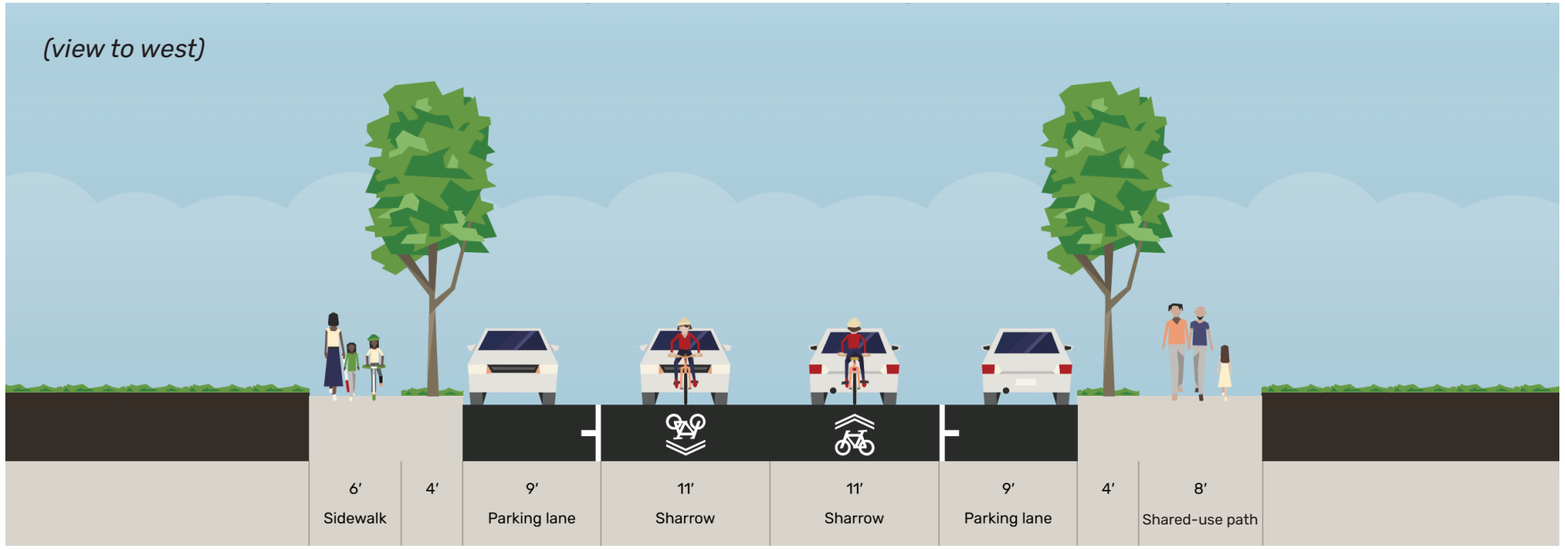


Exhibit 84. *Proposed Typical Cross-Section on Meadowview Drive (62' ROW)*



North Corinth Street

Existing Cross-Section

North Corinth Street has 53 feet of right-of-way available. The current configuration, as shown in Exhibit 85, includes a 12.5-foot-wide center turn lane, two 11.5-foot-wide travel lanes and green space on both sides.

Proposed Cross-Section

The proposed reconfiguration would incorporate reducing three lanes to two 10-foot-wide shared bike and vehicle lanes and two 8-foot parking lanes. Additionally, an 8-foot-wide shared-use path would be provided on each side. This configuration would require the acquisition of additional right-of-way.

Benefits of the Proposed Improvement

- Expanded right-of-way allows for multimodal facilities to serve the surrounding mixed-use land uses
- Lane reduction from three to two lanes helps to calm traffic, lowers vehicle speeds, and reduces the likelihood and severity of a collision
- Shared bike and travel lanes allow for bike travel on the low-speed roadway
- The 8-foot-wide sidewalks provide a safe space and accessibility for pedestrians along the corridor
- Enhanced connectivity supports a more balanced, multimodal corridor as well as increased accessibility for drivers, cyclists, and pedestrians

Exhibit 85. *Typical Existing Cross-Section on North Corinth Street (53′ ROW)*

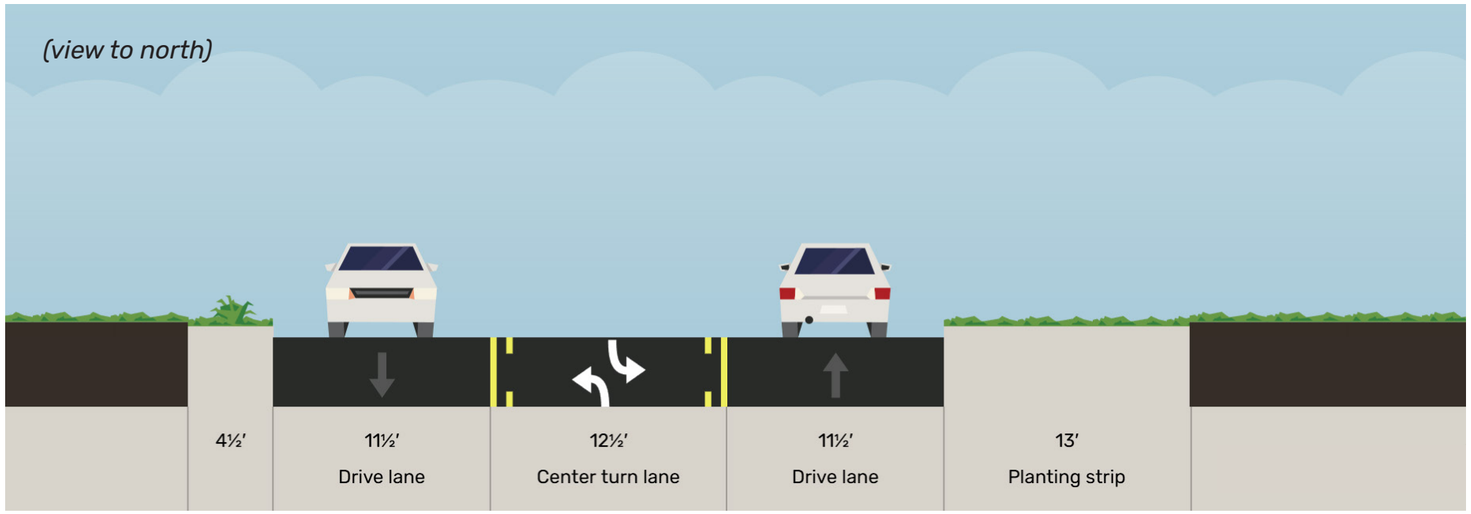
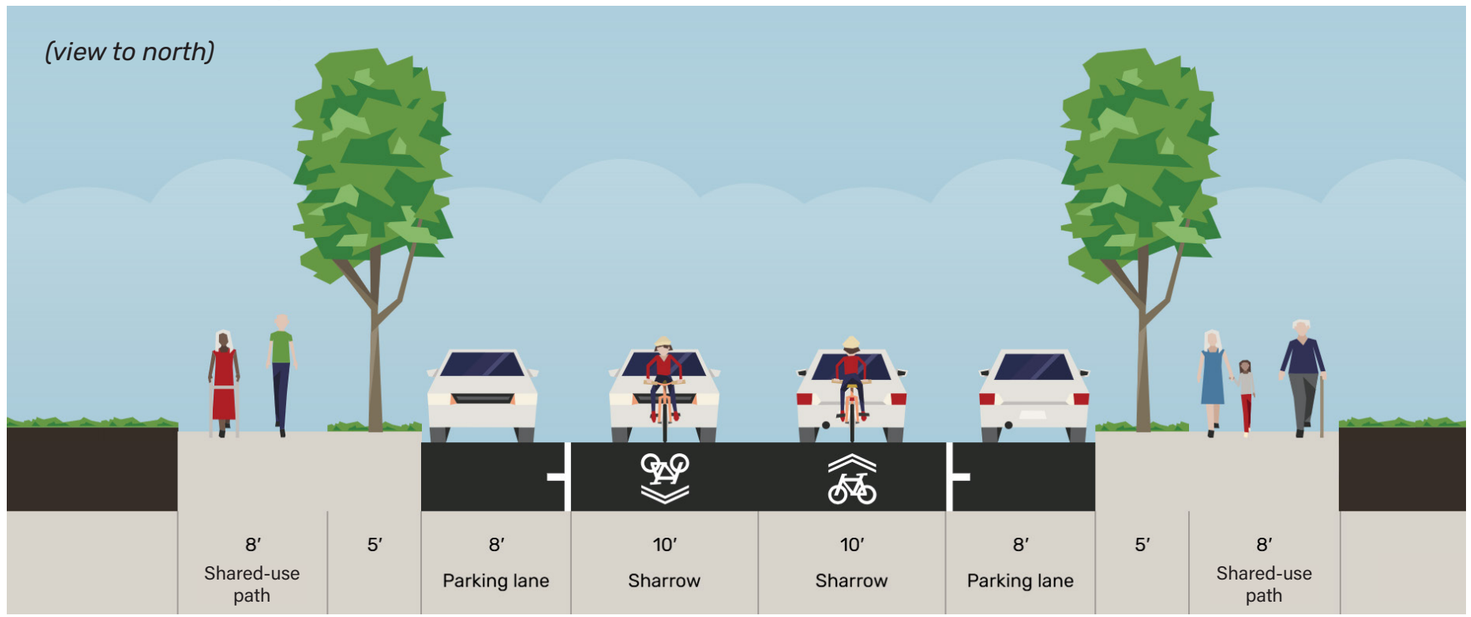


Exhibit 86. *Proposed Typical Cross-Section on North Corinth Street (62′ ROW)*



Oakmont Drive

Existing Cross-Section

Oakmont Drive has around 60 feet of right-of-way. The current configuration of Oakmont Drive, as shown in Exhibit 87 includes two 18-foot-wide travel lanes, 4-foot-wide sidewalks, parkways on each side of the street with a minimum of 4 feet, and green spaces.

Proposed Cross-Section

The proposed reconfiguration of Oakmont Drive would incorporate reducing the two 18-foot-wide travel lanes to 11 feet, adding a 5-foot-wide bike lane with a 2-foot-wide buffer, 5.5-foot-wide parkway and 6-foot-wide sidewalk on each side.

Benefits of the Proposed Improvement

- Lane narrowing from 18 to 11 feet lanes helps to calm traffic and lowers vehicle speeds, and reduces the likelihood and severity of a collision
- Dedicated buffered bike lanes provide a safer space for cyclists, separate from vehicle traffic, and encourage cycling by providing a comfortable riding area
- Wide sidewalks increase walkability and accessibility on both sides of the street
- The multimodal design balances connectivity for vehicles, cyclists and pedestrians, and creates a safer, more attractive corridor for community use

Traffic Volume Analysis

Traffic volumes on Oakmont Drive are relatively low, with peak hourly volumes ranging from 200 to 300 vehicles per direction per hour. A two-lane cross-section will operate smoothly throughout all weekdays and weekends.

Exhibit 87. *Typical Existing Cross-Section on Oakmont Drive (59' ROW)*

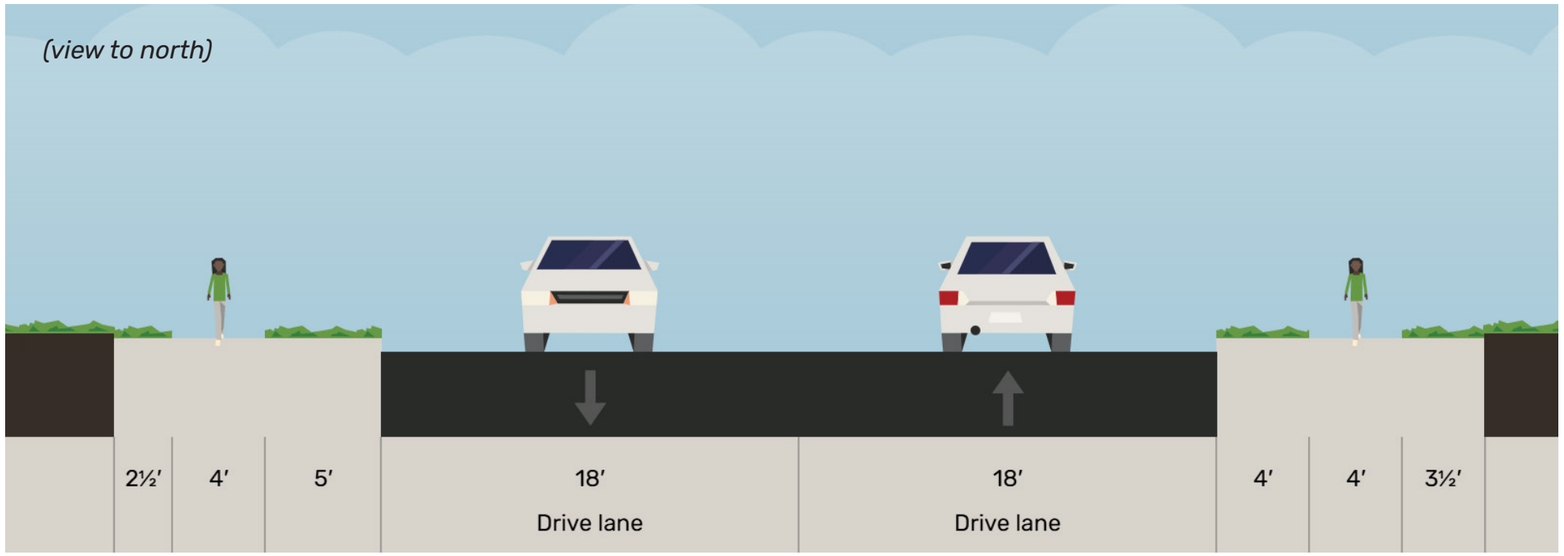
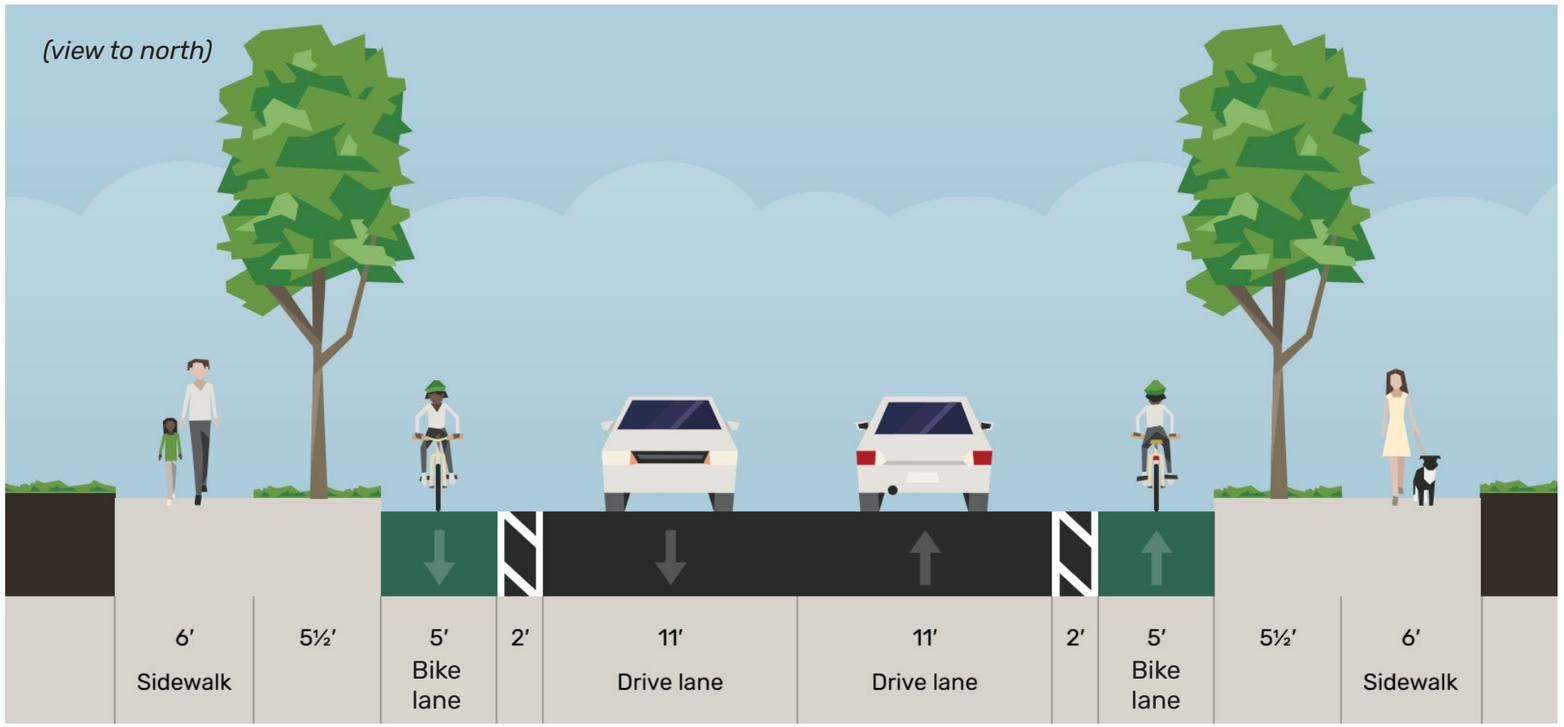


Exhibit 88. *Proposed Typical Cross-Section on Oakmont Drive (59' ROW)*



Old Highway 77

Existing Cross-Section

Old US Highway 77 has approximately 40 feet of right-of-way available. The current configuration of Old US Highway 77, as shown in Exhibit 89, includes two 12-foot-wide travel lanes with no median and a 16-foot-wide parkway on one side with no sidewalks.

Proposed Cross-Section

The proposed reconfiguration of Old US Highway 77 would incorporate expanding the right-of-way to 60 feet. Using the new right-of-way, travel lanes will be reduced to include two 10-foot-wide shared bike and vehicle lanes and 8-foot-wide on-street parking lanes on each side. 8-foot-wide shared-use path on the west side and 6-foot-wide sidewalk on the east side will be added.

Benefits of the Proposed Improvement

- Shared-use path provides space for both pedestrians and cyclists, promoting active transportation and enhancing safety by offering a dedicated, wide path separate from vehicle lanes
- The sidewalk on the opposite side increases pedestrian safety and accessibility in both directions
- The multimodal design balances connectivity for vehicles, cyclists and pedestrians, and creates a safer, more attractive corridor for community use

Exhibit 89. *Typical Existing Cross-Section on Old Highway 77 (40' ROW)*

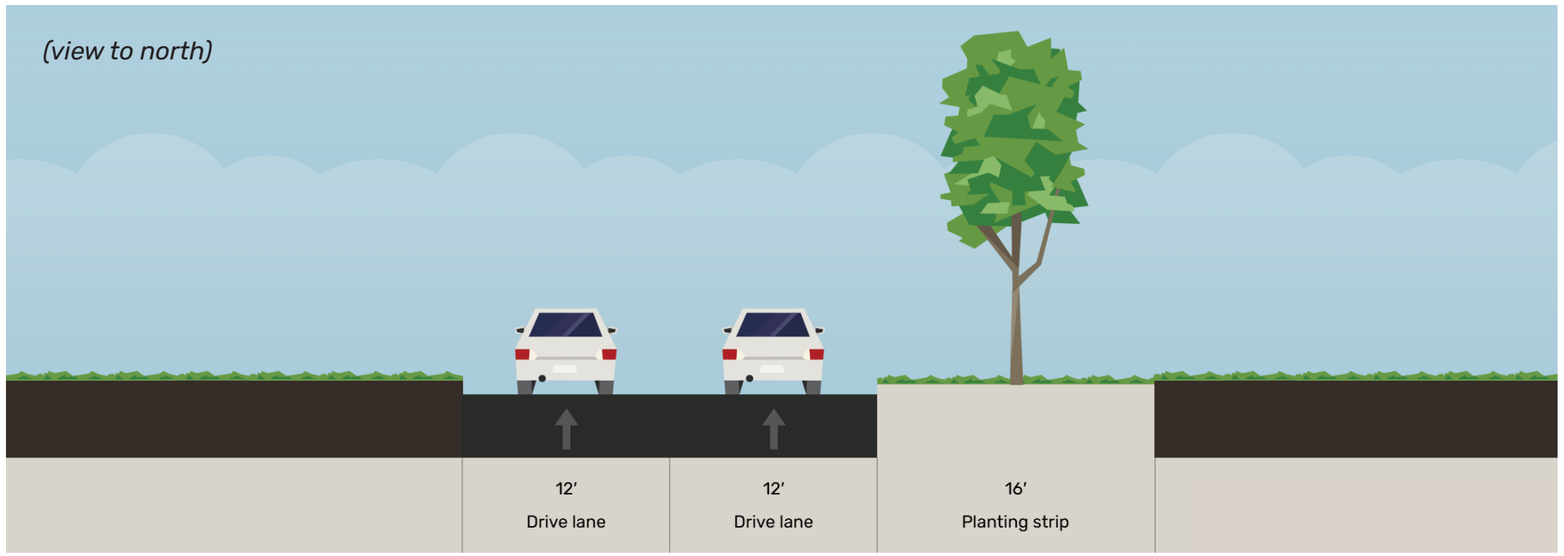
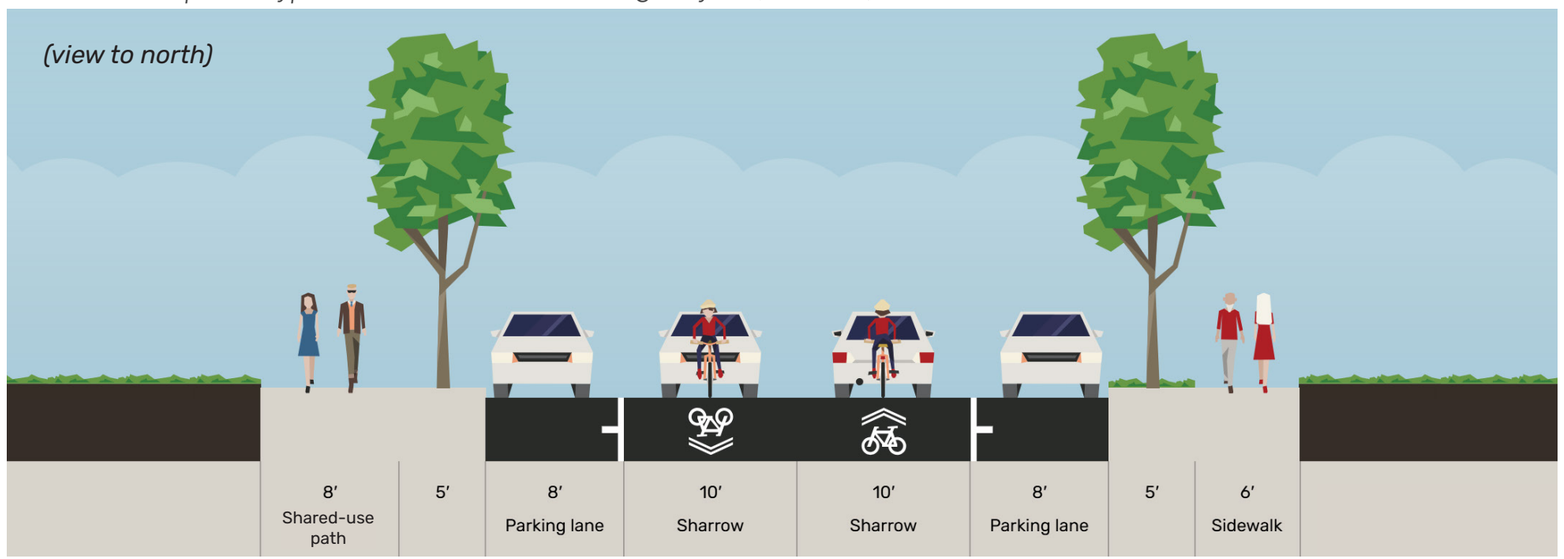


Exhibit 90. *Proposed Typical Cross-Section on Old Highway 77 (60' ROW)*



Parkridge Drive

Existing Cross-Section

Parkridge Drive has approximately 60 feet of right-of-way available. The current configuration of Parkridge Drive, as shown in Exhibit 91, includes two 13-foot-wide travel lanes and a 12-foot-wide center turn lane with sidewalks on each side of the street. Sidewalks vary from 3.5 to 8 feet, and 3- to 5-foot parkways are between the sidewalks and the street.

Proposed Cross-Section

The proposed reconfiguration of Parkridge Drive would incorporate an 8-foot-wide shared-use path on the east side of the road. The center turn lane would be removed, and instead, 22 feet of roadway remains for two 11-foot-wide travel lanes and 6-foot-wide bike lanes in each direction.

Benefits of the Proposed Improvement

- Shared-use path provides space for both pedestrians and cyclists, promoting active transportation and enhancing safety by offering a dedicated, wide path separate from vehicle lanes
- The sidewalk on the opposite side increases pedestrian safety and accessibility in both directions
- Dedicated buffered bike lanes provide a safer space for cyclists, separate from vehicle traffic, and encourage cycling by providing a comfortable riding area
- The multimodal design balances connectivity for vehicles, cyclists and pedestrians, and creates a safer, more attractive corridor for community use

Exhibit 91. *Typical Existing Cross-Section on Parkridge Drive (60' ROW)*

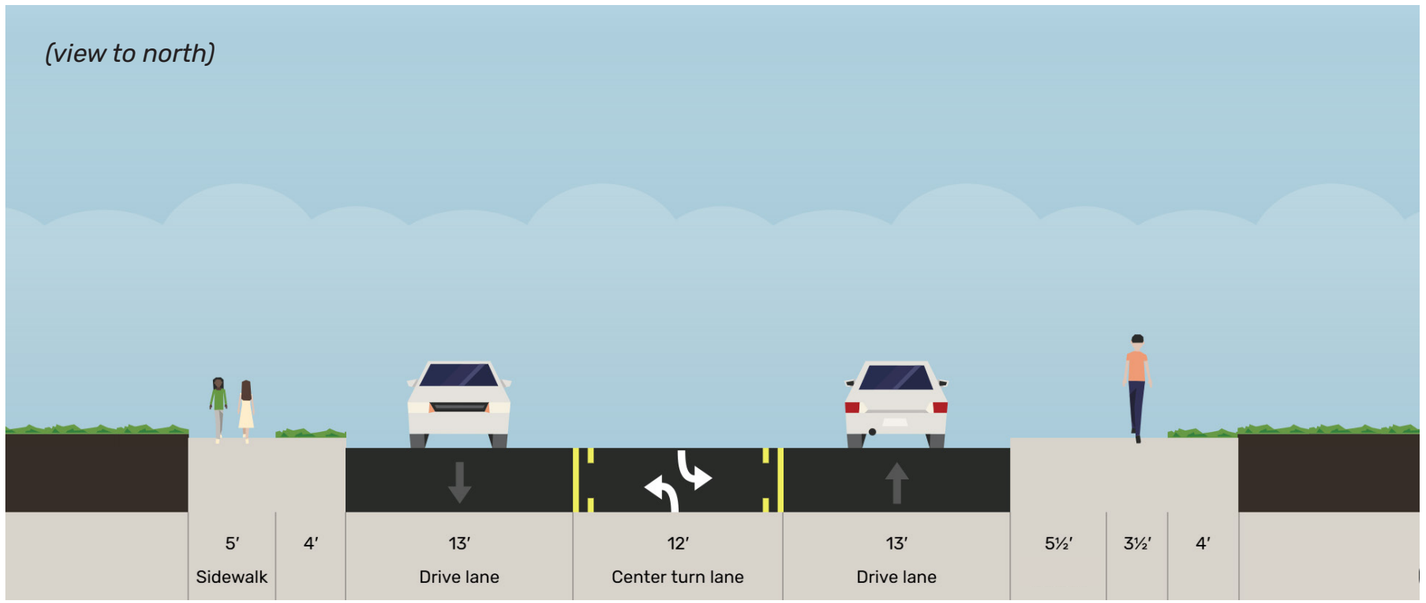
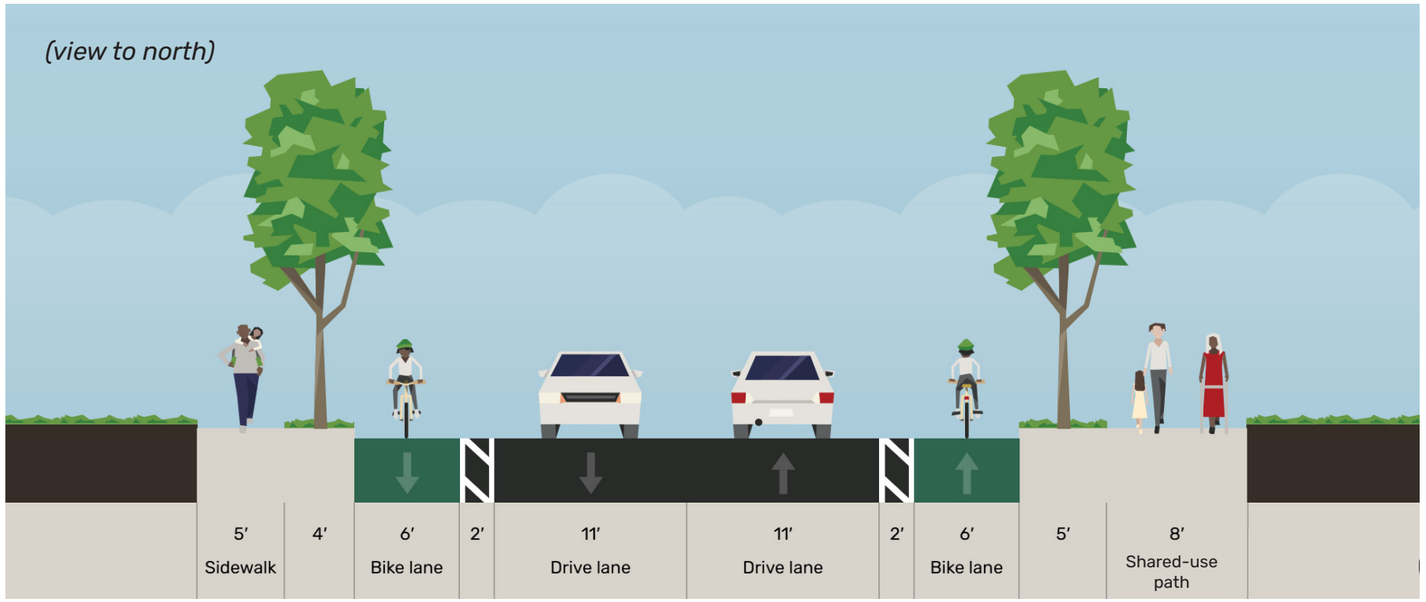


Exhibit 92. *Proposed Typical Cross-Section on Parkridge Drive (60' ROW)*



Post Oak Drive (IH 35 to Robinson Road)

Existing Cross-Section

Post Oak Drive between IH 35 and Robinson Road has around 100 feet of right-of-way available. The current configuration of the corridor, as shown in Exhibit 93, includes two 11.5-foot-wide travel lanes each way, parkways, and a 36-foot-wide median. 4- and 5-foot sidewalks are featured on both sides.

Proposed Cross-Section

The proposed treatment of this corridor involves converting one travel lane each way into a 6.5-foot-wide bike lane with a 5-foot-wide buffer. The sidewalk on the west side would be expanded to be a minimum of 5 feet wide.

Benefits of the Proposed Improvement

- Lane reduction from three to two lanes helps to calm traffic, lowers vehicle speeds, and reduces the likelihood and severity of a collision
- Wide dedicated buffered bike lanes provide a safer space for cyclists, separate from vehicle traffic, and encourage cycling by providing a comfortable riding area
- The multimodal design balances connectivity for vehicles, cyclists and pedestrians, and creates a safer, more attractive corridor for community use

Exhibit 93. *Typical Existing Cross-Section on Post Oak Drive (IH 35 to Robinson Road) (100' ROW)*

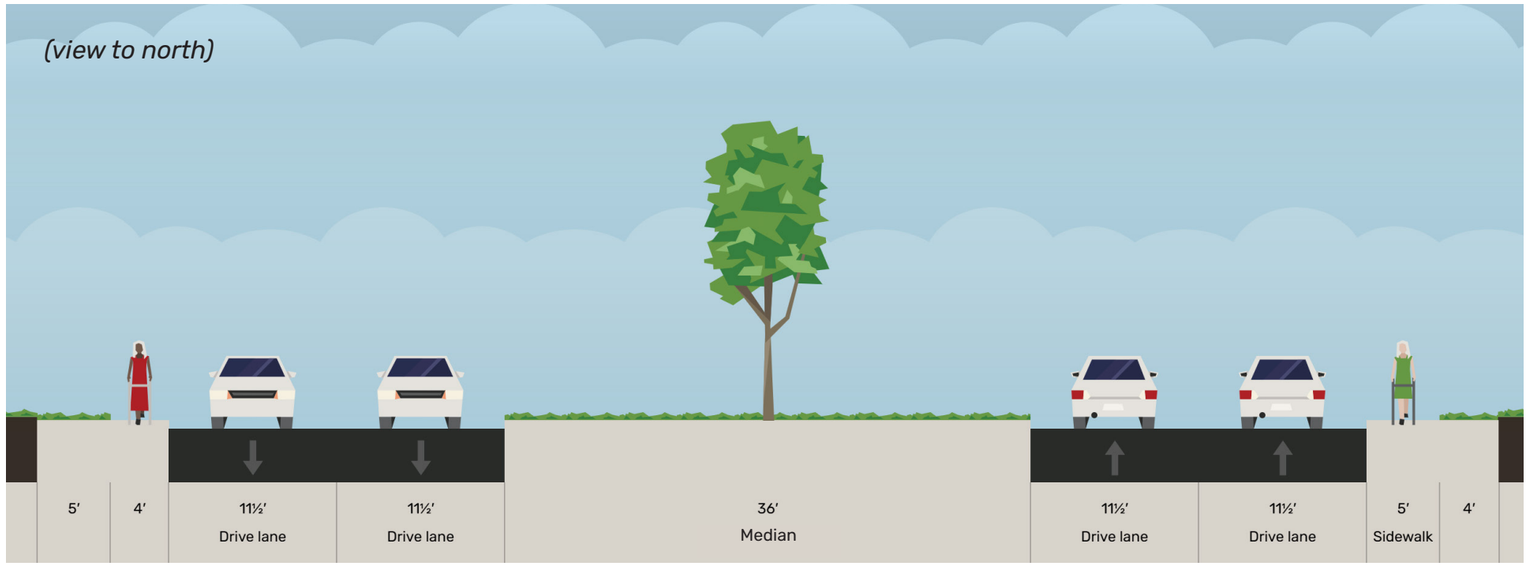
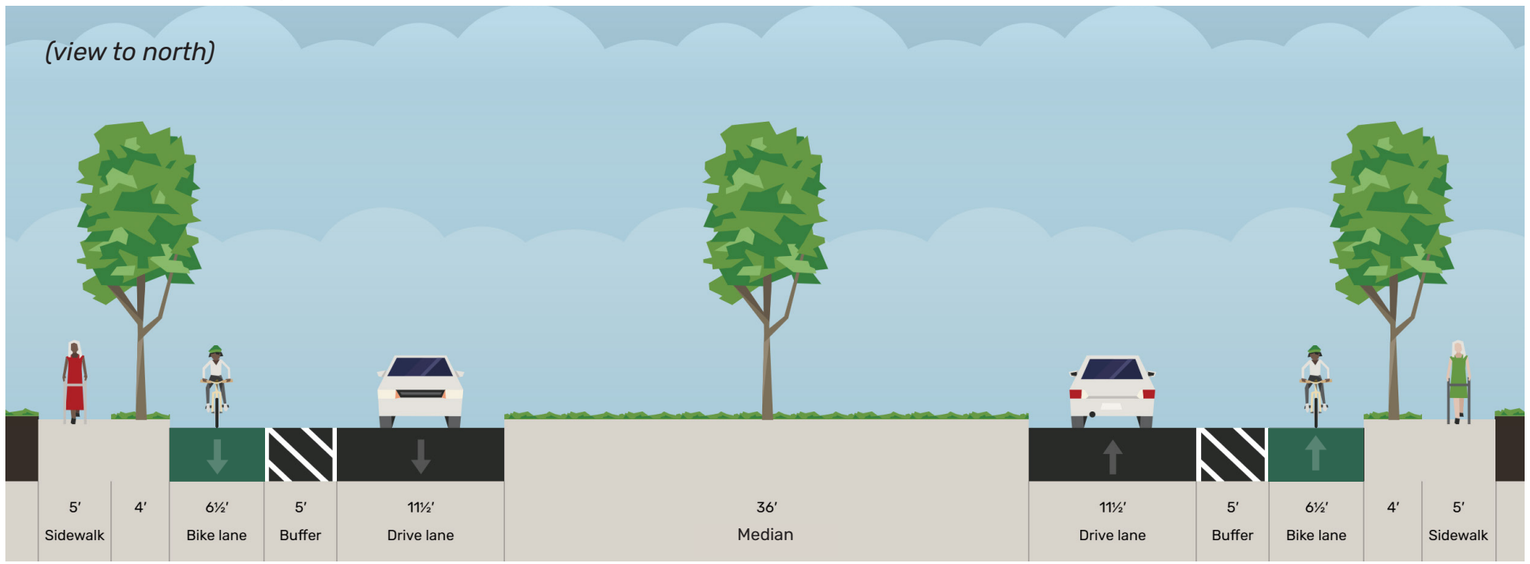


Exhibit 94. *Proposed Typical Cross-Section on Post Oak Drive (IH 35 to Robinson Road) (100' ROW)*



Post Oak Drive (Robinson Road to Lake Sharon Drive)

Existing Cross-Section

Post Oak Drive (north of Lake Sharon Drive) has up to 80 feet of right-of-way available. The current configuration of the corridor, as shown in Exhibit 93, includes two 11-foot-wide travel lanes, parkways, and intermittent sidewalks on each side of the street of 4 to 5 feet in width. Green spaces are of different widths, but are at least 5 feet.

Proposed Cross-Section

The proposed reconfiguration of this corridor segment would incorporate a 10-foot-wide shared-use path on the east side and a 6-foot-wide sidewalk on the west side of the street and retain the two 11-foot-wide travel lanes with parkways on both sides.

Benefits of the Proposed Improvement

- The street's right-of-way will be utilized to a fuller potential
- A shared-use path can support higher pedestrian traffic and other modes of transportation serving as the active transportation element in this corridor
- The multimodal design balances connectivity for vehicles, cyclists and pedestrians, and creates a safer, more attractive corridor for community use
- Parkways separate the roadway from the sidewalk, enhancing pedestrian safety, and provide space for landscaping, improving aesthetic and environmental appeal

Special Considerations

Along the east side of the roadway, the back of curb conditions vary and need to consider such factors as drainage swales, terrain, trees, and other elements that may constrain the width of the shared-use paths that can be provided. On either side of the roadway, preservation of existing specimen trees would require design exceptions from the typical.

Exhibit 95. *Typical Existing Cross-Section on Post Oak Drive (Robinson Road to Lake Sharon Drive) (up to 80' ROW)*

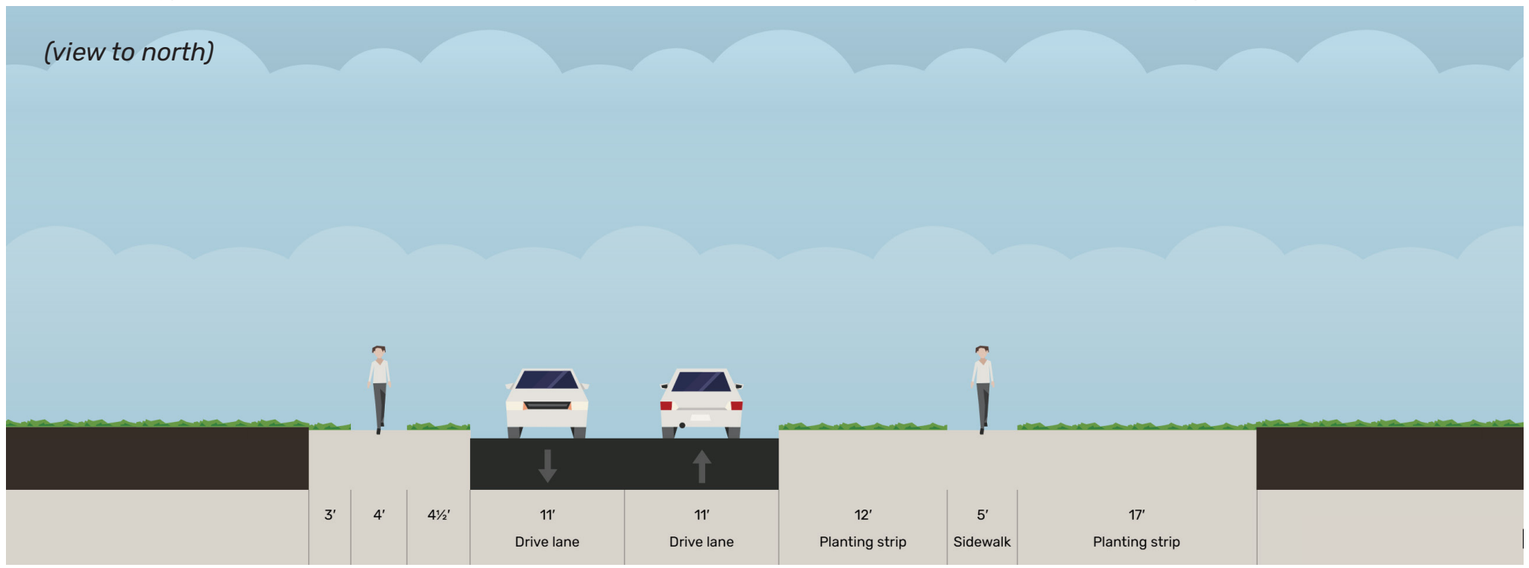
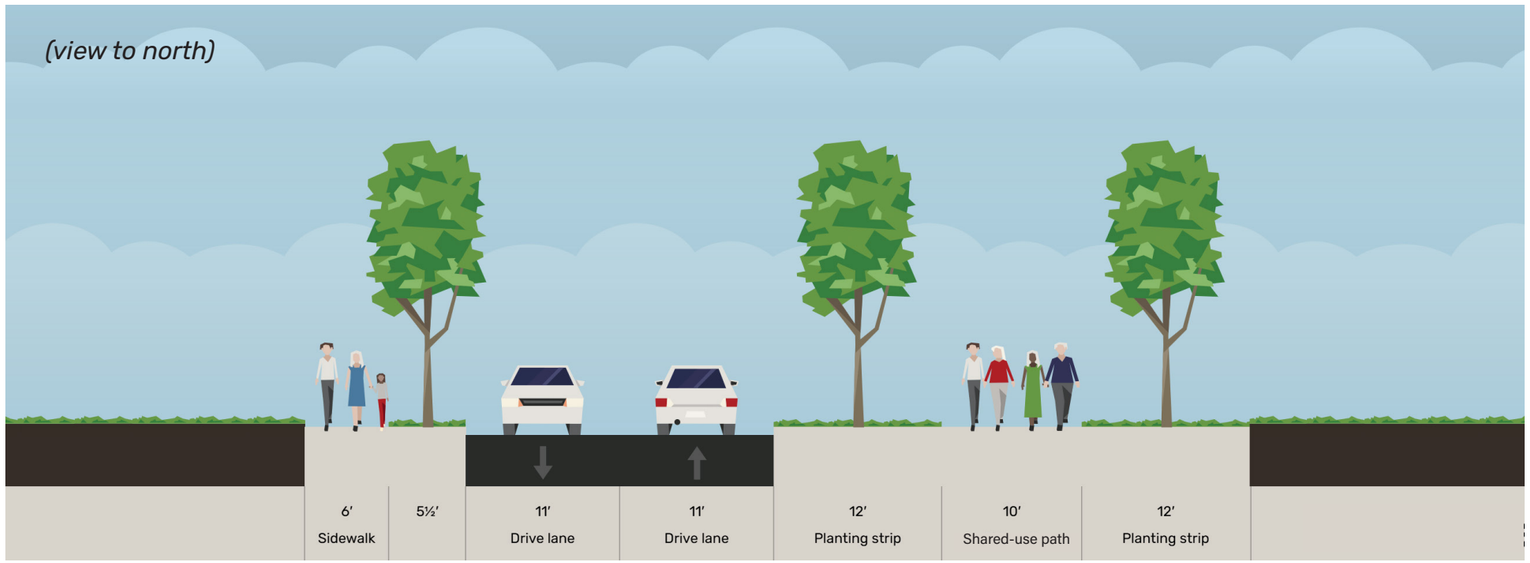


Exhibit 96. *Proposed Typical Cross-Section on Post Oak Drive (Robinson Road to Lake Sharon Drive) (up to 80' ROW)*



Post Oak Drive (Lake Sharon Drive to FM 2181)

Existing Cross-Section

Post Oak Drive (south of Lake Sharon Drive) has around 107 feet of right-of-way. The current configuration, as shown in Exhibit 97, includes a 37-foot-wide median, four 11-foot-wide travel lanes, 4-foot-wide sidewalks, parkways on each side of the street with minimum of 4.5-feet and green spaces.

Proposed Cross-Section

The proposed reconfiguration of this segment of Post Oak Drive would incorporate reducing four lanes to two 11-foot-wide travel lanes, restriping the road to a 6-foot-wide bike lane with a 5-foot-wide buffer, and adding a 5-foot-wide parkway and 8-foot-wide shared-use path on each side of the street.

Benefits of the Proposed Improvement

- Lane reduction from four to two lanes helps to calm traffic and lowers vehicle speeds, and reduces the likelihood and severity of a collision
- Wide dedicated buffered bike lanes provide a safer space for cyclists, separate from vehicle traffic, and encourage cycling by providing a comfortable riding area
- 8-foot-wide shared-use paths increase pedestrian safety and accessibility, and support walkability and foot traffic in the area
- 5-foot-wide parkways separate the roadway from the sidewalk, enhancing pedestrian safety, and provides space for landscaping, improving aesthetic and environmental appeal
- Enhanced connectivity supports a more balanced, multimodal corridor, and accessibility for drivers, cyclists, and pedestrians

Exhibit 97. *Typical Existing Cross-Section on Post Oak Drive (Lake Sharon Drive to FM 2181) (107' ROW)*

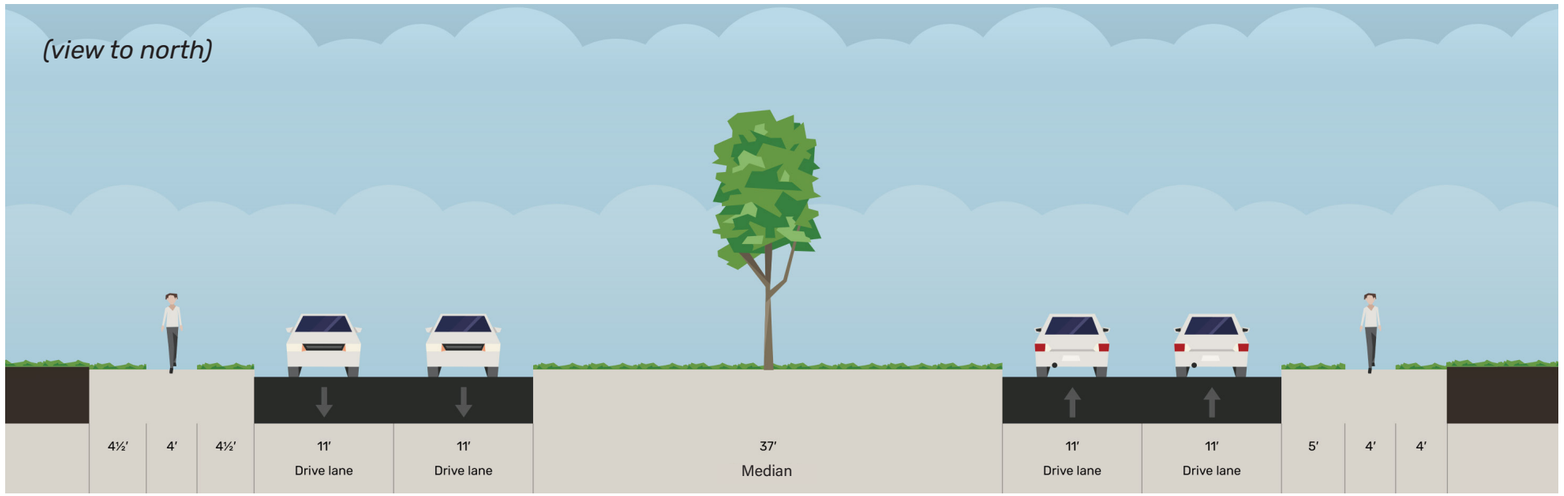
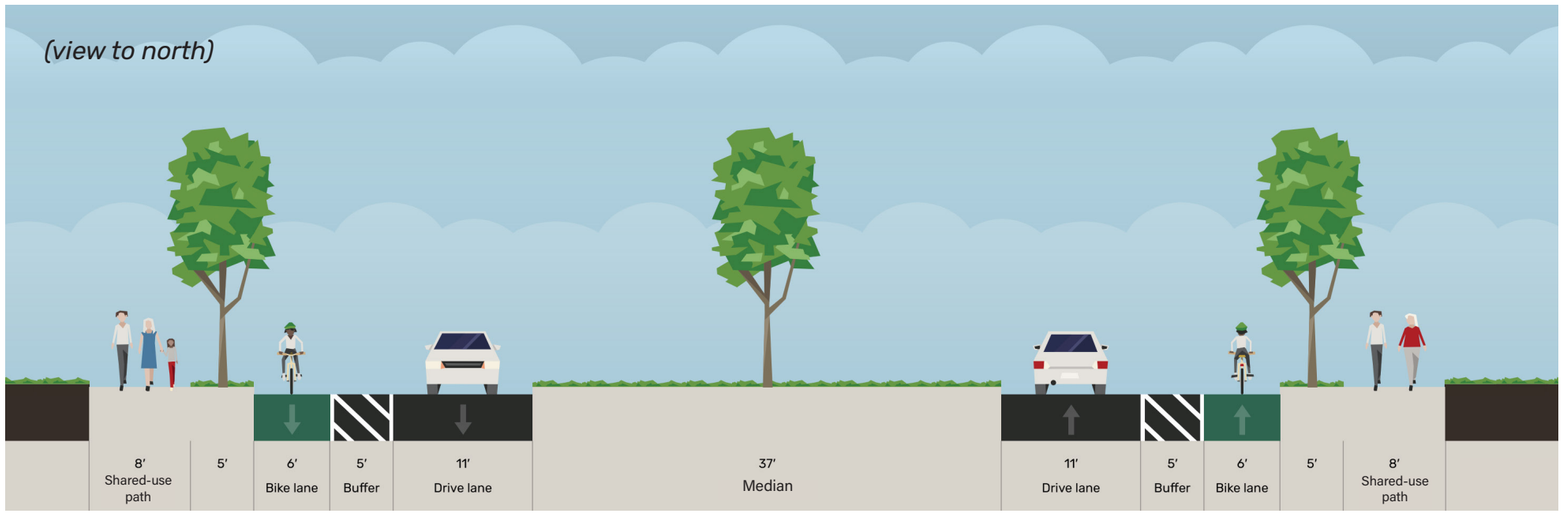


Exhibit 98. *Proposed Typical Cross-Section on Post Oak Drive (Lake Sharon Drive to FM 2181) (107' ROW)*



Quail Run Drive (South of Corinth Parkway)

Existing Cross-Section

Quail Run Drive (south of Corinth Parkway) has 50 feet of right-of-way. The current configuration of Quail Run Drive, as shown in Exhibit 99, includes no median, two 11-foot-wide travel lanes, no sidewalks, and 14-foot-wide green spaces on each side of the street.

Proposed Cross-Section

The proposed reconfiguration of Quail Run Drive would incorporate using the existing wide green spaces to create 8-foot-wide shared-use paths on both sides of the road. Implementing this design also adds a 6-foot-wide parkway space between the sidewalk and the road.

Benefits of the Proposed Improvement

- The street's right-of-way will be used to a greater potential
- 8-foot-wide shared-use path on each side accommodates more user types, such as cyclists, pedestrians, wheelchair users, and joggers, enhancing connectivity for nonmotorized users
- The 6-foot-wide parkway on both sides acts as a buffer between the road and sidewalk, improving pedestrian safety while adding green space to enhance aesthetic and environmental appeal
- The multimodal design balances connectivity for vehicles, cyclists and pedestrians, and creates a safer, more attractive corridor for community use

Exhibit 99. *Typical Existing Cross-Section on Quail Run Drive (South of Corinth Parkway) (50' ROW)*

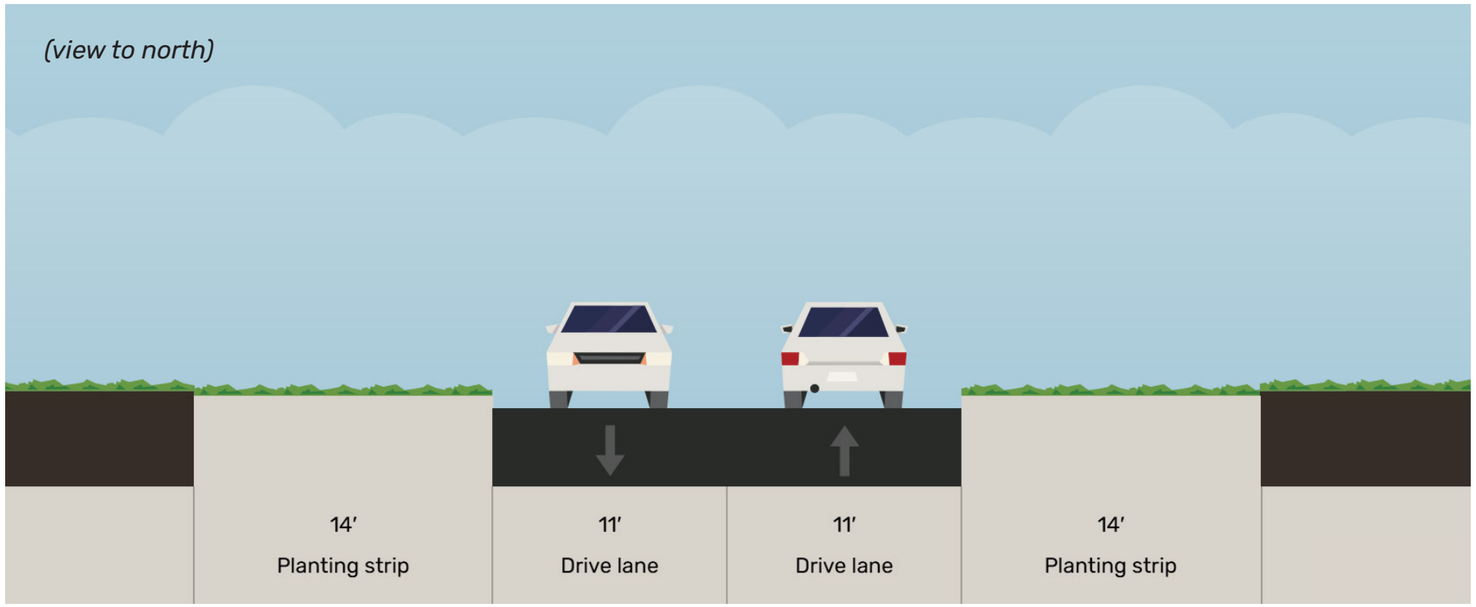
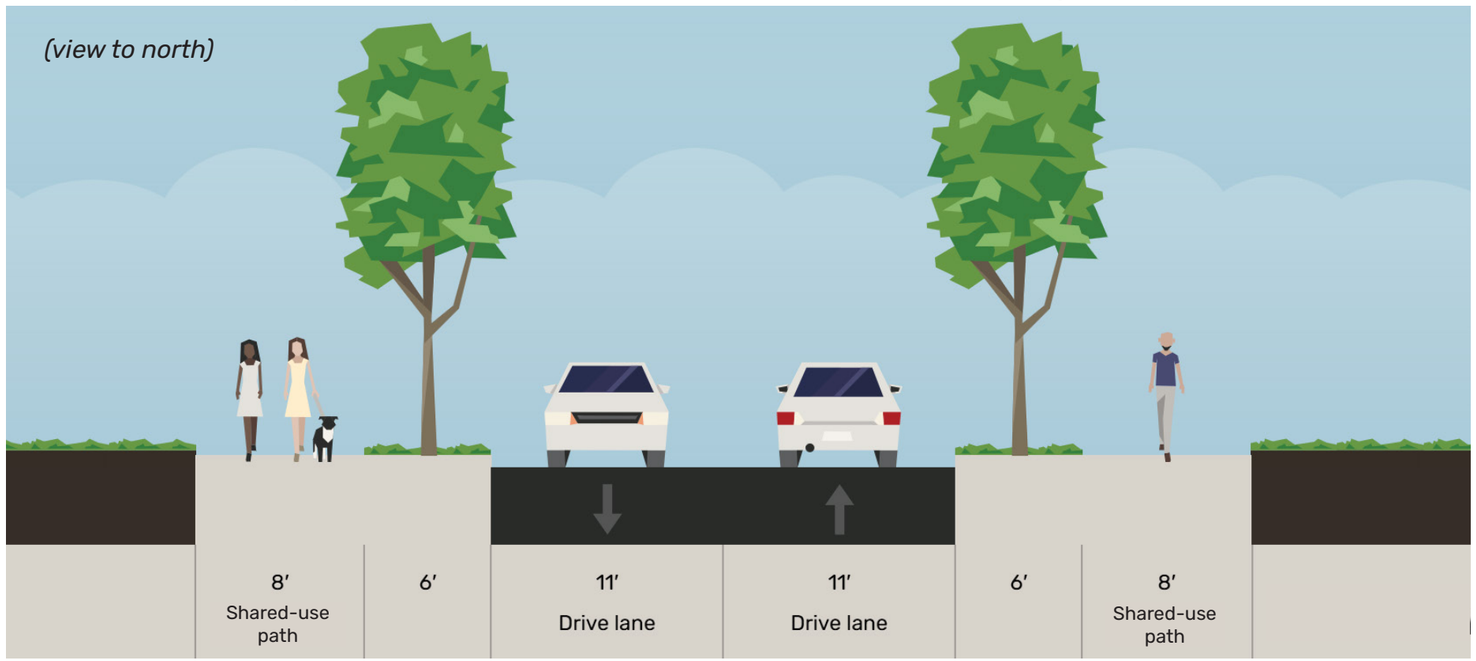


Exhibit 100. *Proposed Typical Cross-Section on Quail Run Drive (South of Corinth Parkway) (50' ROW)*



Robinson Road

Existing Cross-Section

Robinson Road has 84 feet of right-of-way available. The current configuration of Robinson Road, as shown in Exhibit 101, includes four 11-foot-wide travel lanes, a 15-foot-wide median, 4-foot-wide sidewalks, and green spaces on each side of the street.

Proposed Cross-Section

The proposed reconfiguration of Robinson Road would involve replacing the existing 4-foot sidewalks with an 5-foot-wide sidewalk on the south side and a 10-foot-wide shared-use path on the street's north side with parkways on both sides.

Benefits of the Proposed Improvement

- 10-foot-wide shared-use paths increase pedestrian and cyclist safety and accessibility, and support walkability and foot traffic in the area
- The multimodal design balances connectivity for vehicles, cyclists and pedestrians, and creates a safer, more attractive corridor for community use
- Shared-use paths create active transportation connection into Denton

Exhibit 101. *Typical Existing Cross-Section on Robinson Road (84' ROW)*

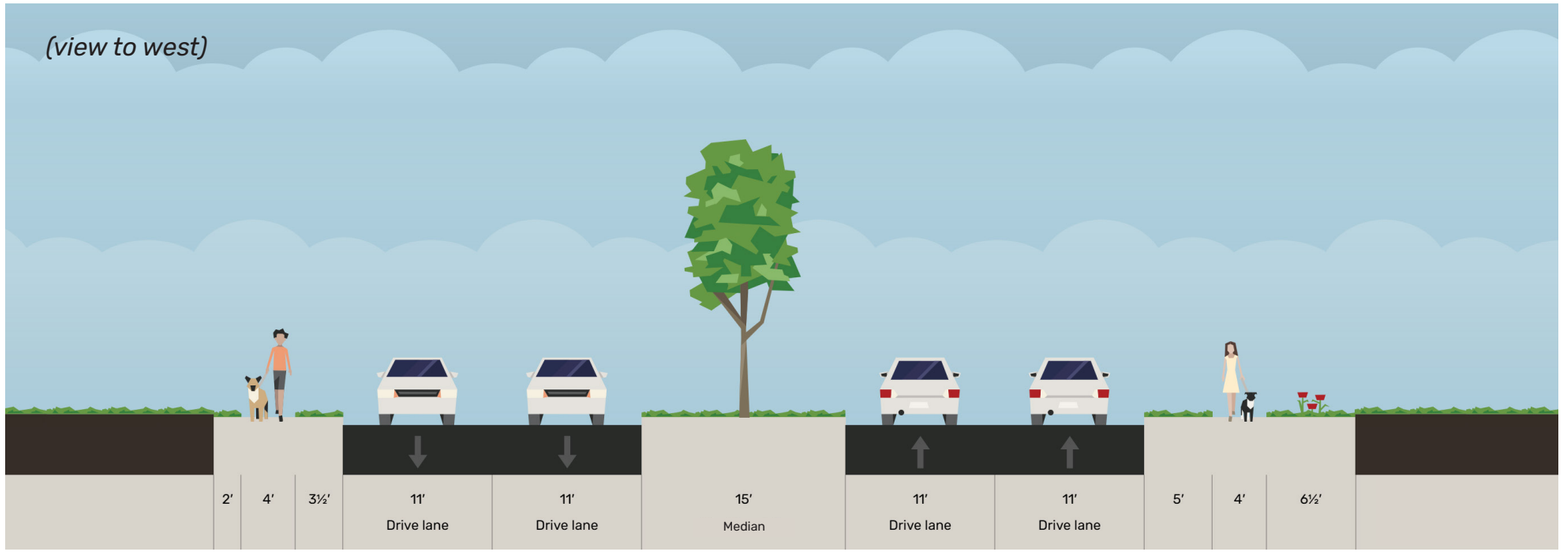
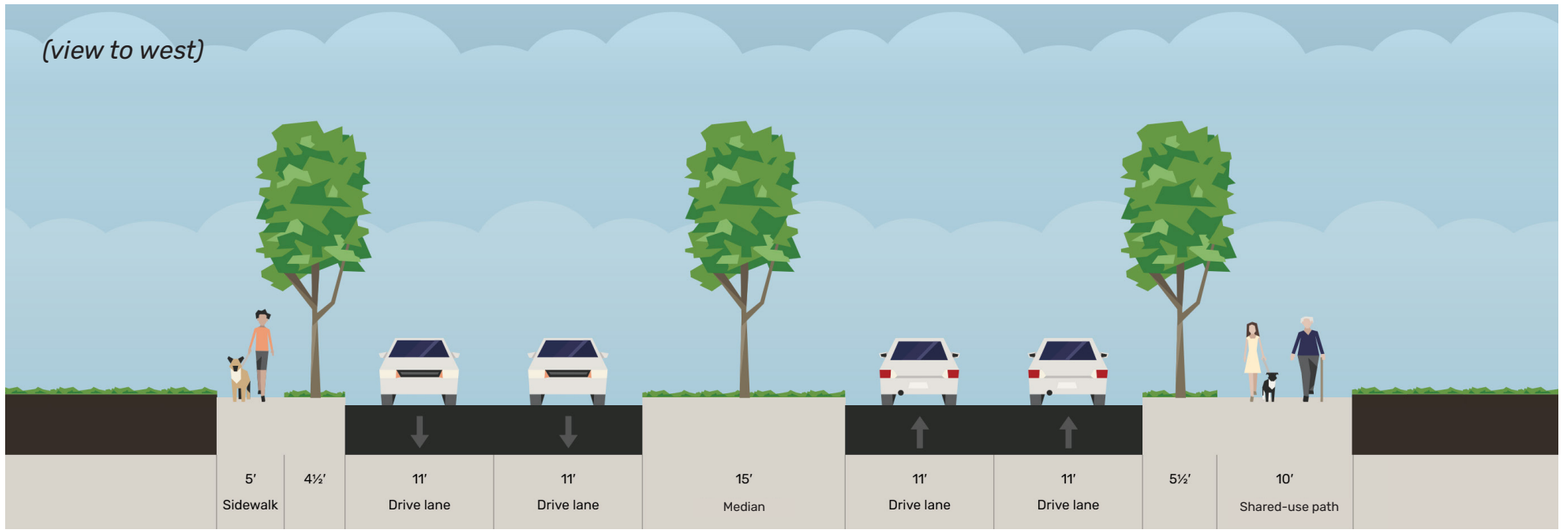


Exhibit 102. *Proposed Typical Cross-Section on Robinson Road (84' ROW)*



Shady Rest Lane (Corinth Parkway to Fritz Lane)

Existing Cross-Section

Shady Rest Lane has a around 55 feet of right-of-way. The configuration shown in Exhibit 103 includes two 15-foot-wide travel lanes, a 5-foot-wide sidewalk on the eastern side, parkways on each side of the street with a minimum of 5.5 feet, and some green space. Shady Rest Lane currently has a short segment with a 10-foot-wide shared-use path on its western side which presents an opportunity for connection.

Proposed Cross-Section

The proposed reconfiguration of Shady Rest Lane would increase the width of the existing sidewalk on the western side to 10 feet, and leaving a 7-foot-wide parkway. The existing travel lanes would be restriped to include 5-foot-wide bike lanes.

Benefits of the Proposed Improvement

- A shared-use path can support higher pedestrian traffic and other modes of transportation serving as the active transportation element in this corridor
- Parkways separate the roadway from the sidewalk, enhancing pedestrian safety, and provide space for landscaping, improving aesthetic and environmental appeal
- Dedicated bike lanes, even without a buffer, provide a safer space for cyclists, separate from vehicle traffic, and serve as the active transportation element on this corridor with limited right-of-way

Exhibit 103. *Typical Existing Cross-Section on Shady Rest Lane (Corinth Parkway to Fritz Lane) (55' ROW)*

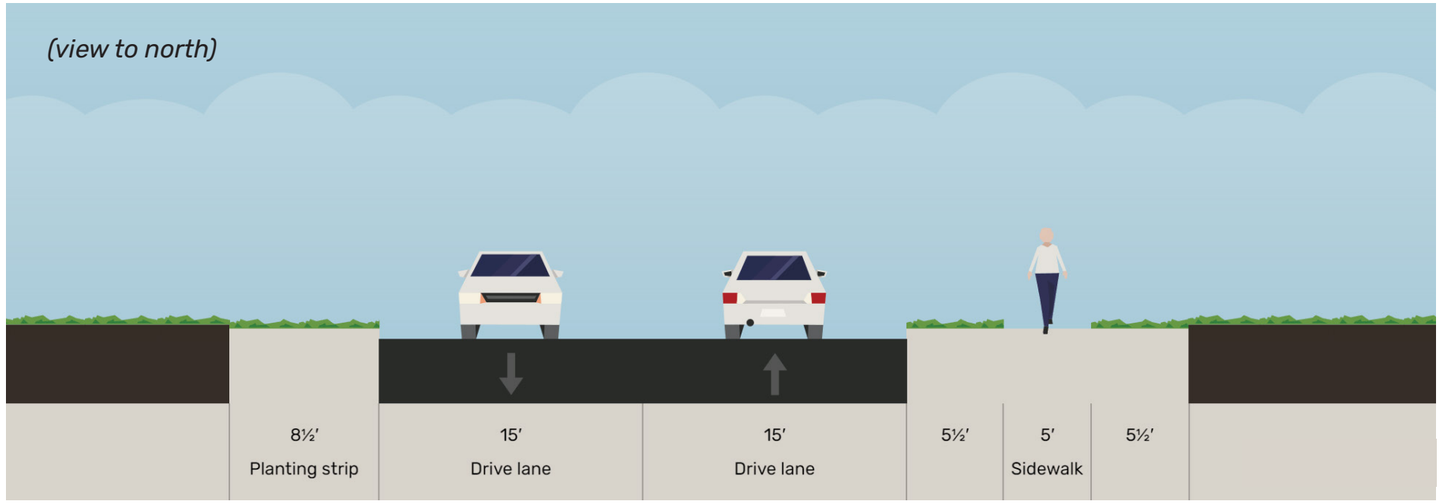
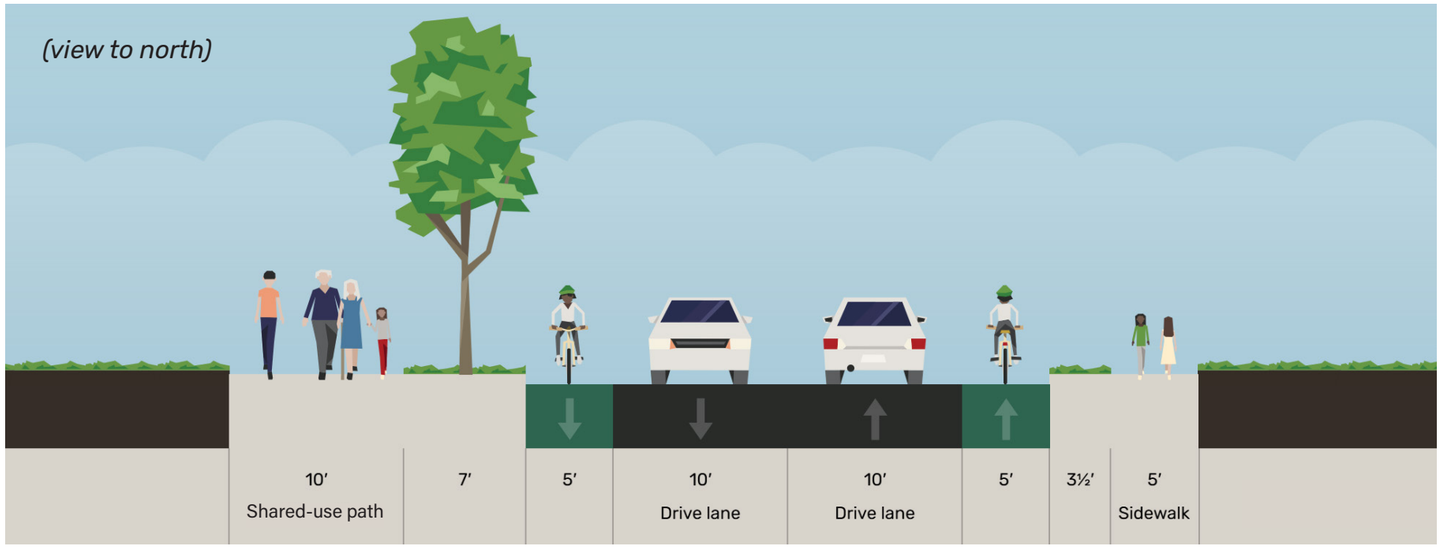


Exhibit 104. *Proposed Typical Cross-Section on Shady Rest Lane (Corinth Parkway to Fritz Lane) (55' ROW)*



Shady Shores Road

Existing Cross-Section

Shady Shores Road has 60 feet of right-of-way available. The current configuration of Shady Shores Road, as shown in Exhibit 105, includes two 10.5-foot-wide travel lanes, a 12.5-foot-wide green space on its northern side and a 25-foot-wide green space on the street's southern side, accommodating open ditch drainage.

Proposed Cross-Section

The proposed reconfiguration of Shady Shores Road would incorporate increasing the two 10.5-foot-wide travel lanes to 12 feet, adding 5-foot-wide parkways, a 10-foot-wide shared-use path on the street's southern part, a 6-foot-wide bike lane with a 4-foot-wide buffer, and a 6-foot-wide sidewalk on the northern side.

Benefits of the Proposed Improvement

- The street's right-of-way will be utilized to its fullest potential
- Lane widening from 10.5 to 12 feet on a street with higher volumes and speed limits than a residential street will improve safety by accommodating larger vehicles more comfortably
- A shared-use path can support higher pedestrian traffic and other modes of transportation serving as the active transportation element in this corridor
- Standard sidewalk on northern side increases walkability and accessibility on both sides of the street
- Dedicated buffered bike lane will provide a safer space for cyclists, separate from vehicle traffic, and encourage cycling by providing a comfortable riding area on the northern side
- 5-foot parkway separates the roadway from the sidewalk, enhancing pedestrian safety, and provides space for landscaping, improving aesthetic and environmental appeal

Traffic Volume Analysis

Traffic data collected from September 24 to October 2, 2024, show weekday AM and PM peak volumes ranging from 600 to 950 vehicles per direction per hour. The peak hourly volume recorded was 974 vehicles eastbound and 891 vehicles westbound.

The proposed cross-section does not suggest lane reduction. The new cross-section with added buffered bike lane and shared-use path can accommodate traffic demand during weekday off-peak and weekend periods. However, during weekday peak hours, the traffic volumes would exceed the roadway's capacity.

Exhibit 105. *Typical Existing Cross-Section on Shady Shores Road (60' ROW)*

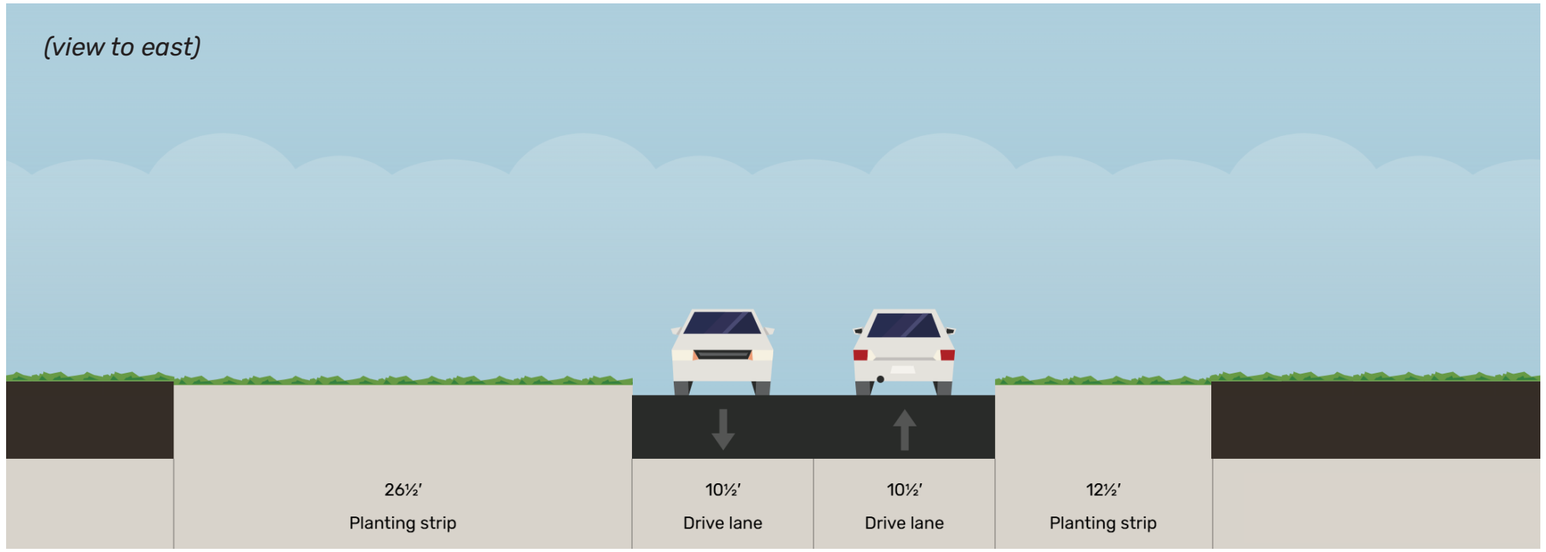
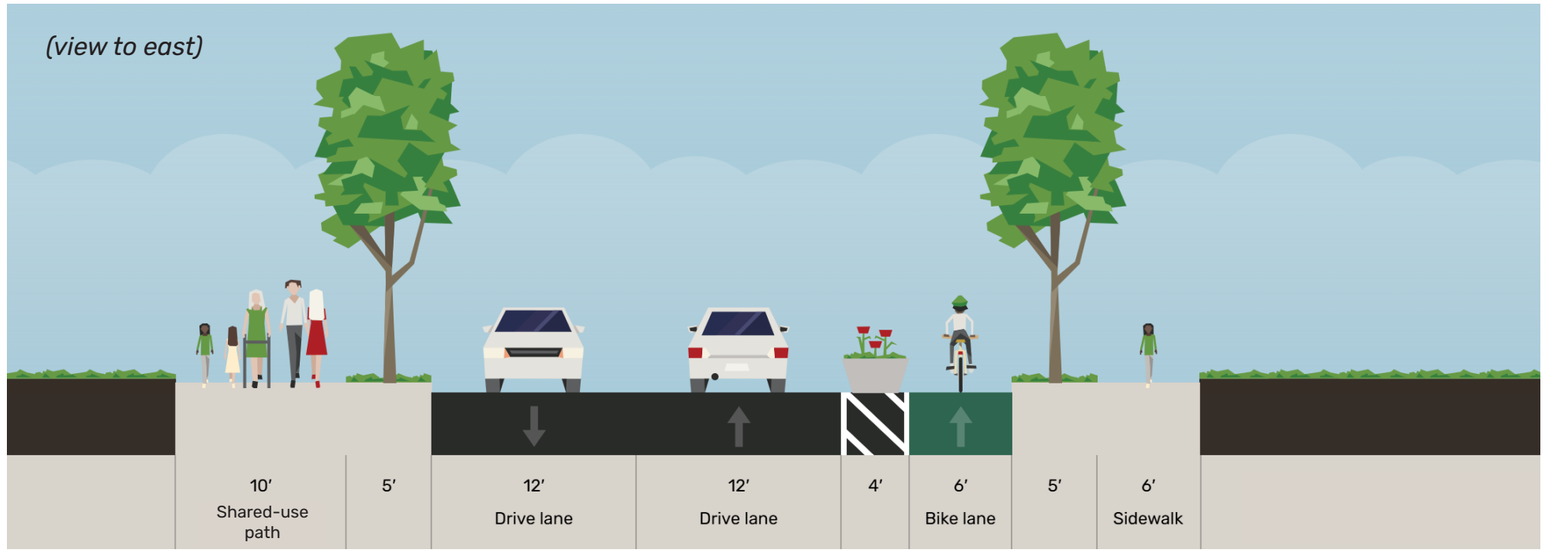


Exhibit 106. *Proposed Typical Cross-Section on Shady Shores Road (60' ROW)*



Silver Meadow Lane

Existing Cross-Section

Silver Meadow Lane has 60 feet of right-of-way available. The current configuration, as shown in Exhibit 107, includes two 9.5-foot-wide travel lanes, and at least 19.5-foot-wide green space on each side.

Proposed Cross-Section

The proposed reconfiguration would expand the street to include two 11-foot travel lanes, 8-foot on-street parking lanes on both sides, and an 8-foot-wide shared-use path on the north side.

Benefits of the Proposed Improvement

- A shared-use path can support higher pedestrian traffic and other modes of transportation serving as the active transportation element in this corridor
- The multimodal design balances connectivity for vehicles, cyclists and pedestrians, and creates a safer, more attractive corridor for community use
- Parking lanes add a buffer between pedestrians and vehicles, creating a safer and more comfortable environment for active transportation. Street parking also contributes to lower vehicle speeds along the corridor

Exhibit 107. *Typical Existing Cross-Section on Silver Meadow Lane (60' ROW)*

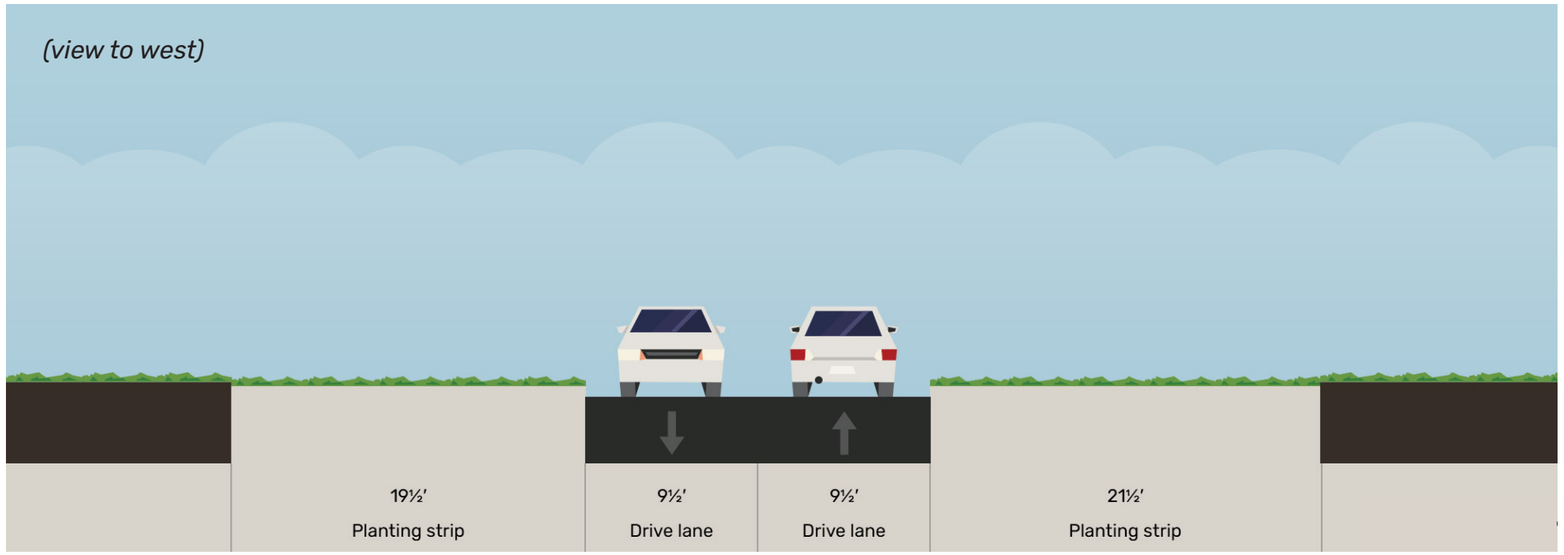
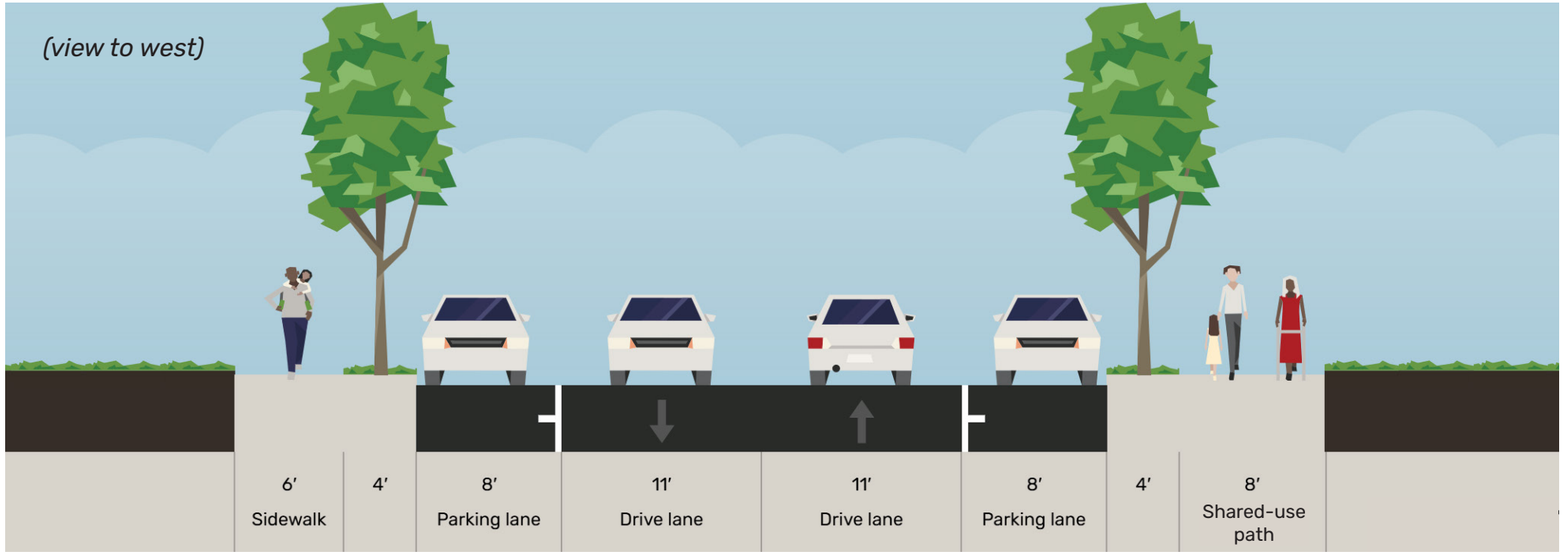


Exhibit 108. *Proposed Typical Cross-Section on Silver Meadow Lane (60' ROW)*



S. Stemmons Freeway

Existing Cross-Section

S. Stemmons Freeway has 290 feet of right-of-way, as shown in Exhibit 109; however, the proposed improvement will only take place within 22 feet of right-of-way next to each side of the service road. The current configuration, as shown in Exhibit 109, includes two 11-foot-wide travel lanes and green spaces on both Northbound and Southbound.

Proposed Cross-Section

The proposed reconfiguration would incorporate a 10-foot-wide shared-use path and a 10-foot-wide parkway between the shared-use path and travel lanes.

Benefits of the Proposed Improvement

- Shared-use paths on both sides support higher pedestrian traffic and other modes of transportation serving as the active transportation element in this corridor
- Parkway separate the roadway from the path, enhancing pedestrian safety, and provide space for landscaping, improving aesthetic and environmental appeal

Exhibit 109. *Typical Existing Cross-Section on S. Stemmons Freeway (290' ROW)*

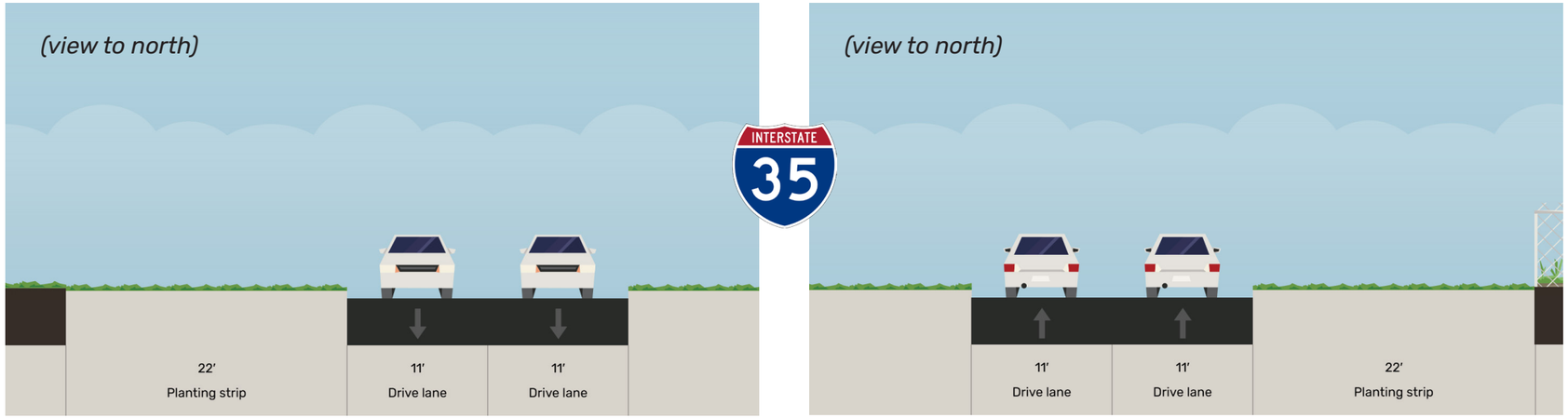
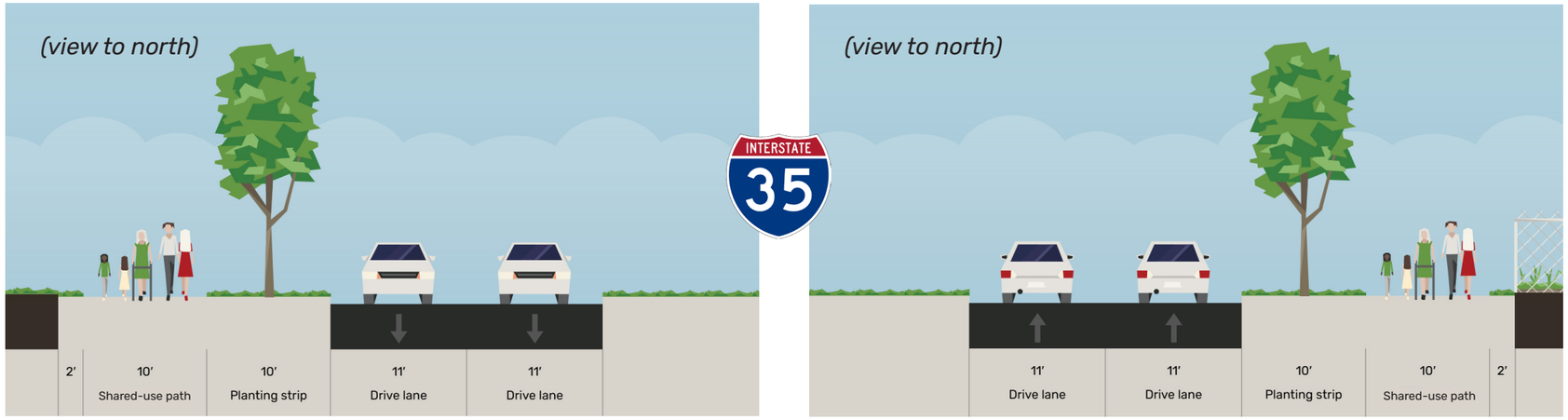


Exhibit 110. *Proposed Typical Cross-Section on S. Stemmons Freeway (290' ROW)*



Tower Ridge Drive (Lake Sharon Drive to Brookview Drive)

Existing Cross-Section

This segment of Tower Ridge Drive has around 60 feet of right-of-way available. The current configuration of the segment, as shown in Exhibit 111, includes two 12-foot-wide travel lanes and a 12-foot-wide two-way left-turn lane. The surrounding right-of-way varies but most commonly includes an 8-foot-wide sidewalk directly adjacent to the roadway on the street's western side and around 9 feet of green space on the eastern side. This segment also features a discontinuous 6-foot-wide sidewalk on its eastern side.

Proposed Cross-Section

The proposed reconfiguration of this segment would incorporate replacing the existing 8-foot-wide sidewalk with 6-foot-wide sidewalks on both sides, separated from the roadway by a 6-foot-wide buffer. The number of lanes would be reduced from three to two, and 5-foot-wide bike lanes with 2-foot-wide buffers would be added.

Benefits of the Proposed Improvement

- Lane reduction from three to two lanes helps to calm traffic, lowers vehicle speeds, and reduces the likelihood and severity of a collision
- Wide dedicated buffered bike lanes provide a safer space for cyclists, separate from vehicle traffic, and encourage cycling by providing a comfortable riding area
- The multimodal design balances connectivity for vehicles, cyclists and pedestrians, and creates a safer, more attractive corridor for community use
- A green space buffer on both sides side of the street separates the roadway from the path, enhancing pedestrian safety, and provides space for landscaping, improving aesthetic and environmental appeal. These buffers can be adjusted throughout the corridor depending on the specific context within the right-of-way.

Exhibit 111. *Typical Existing Cross-Section on Tower Ridge Drive (Lake Sharon Drive to Brookview Drive) (60' ROW)*

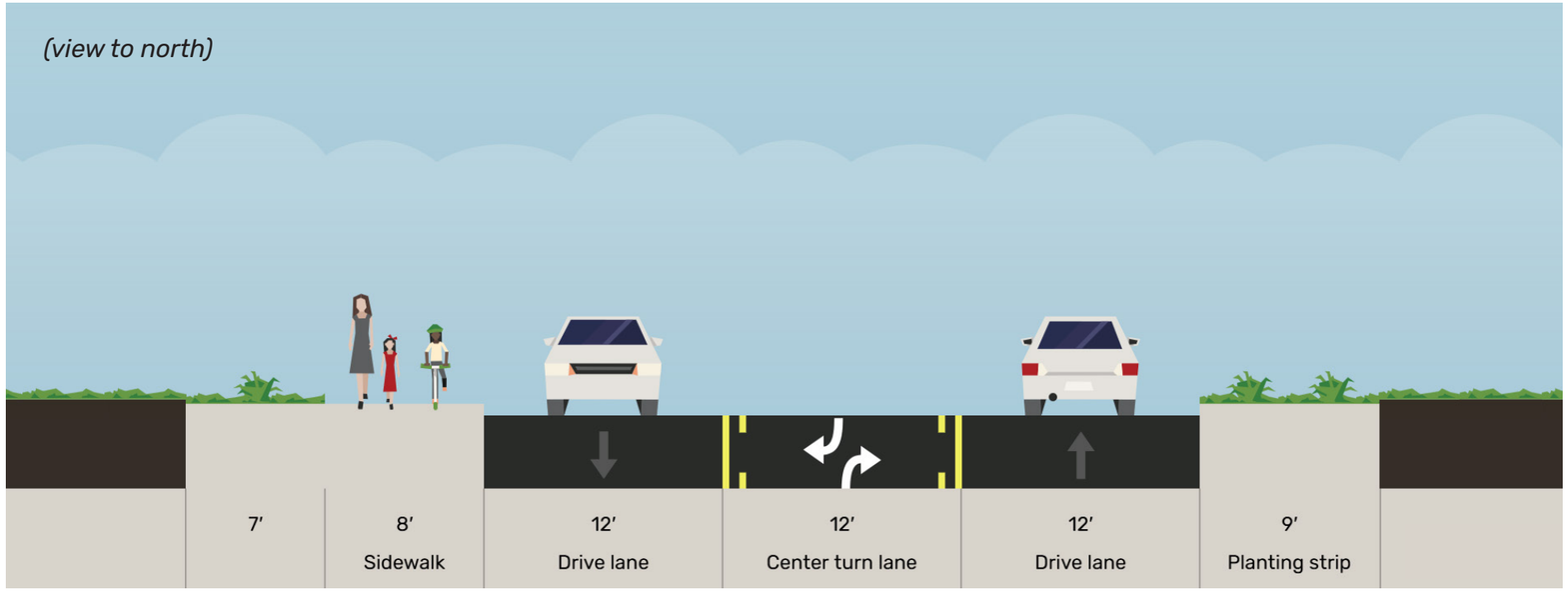
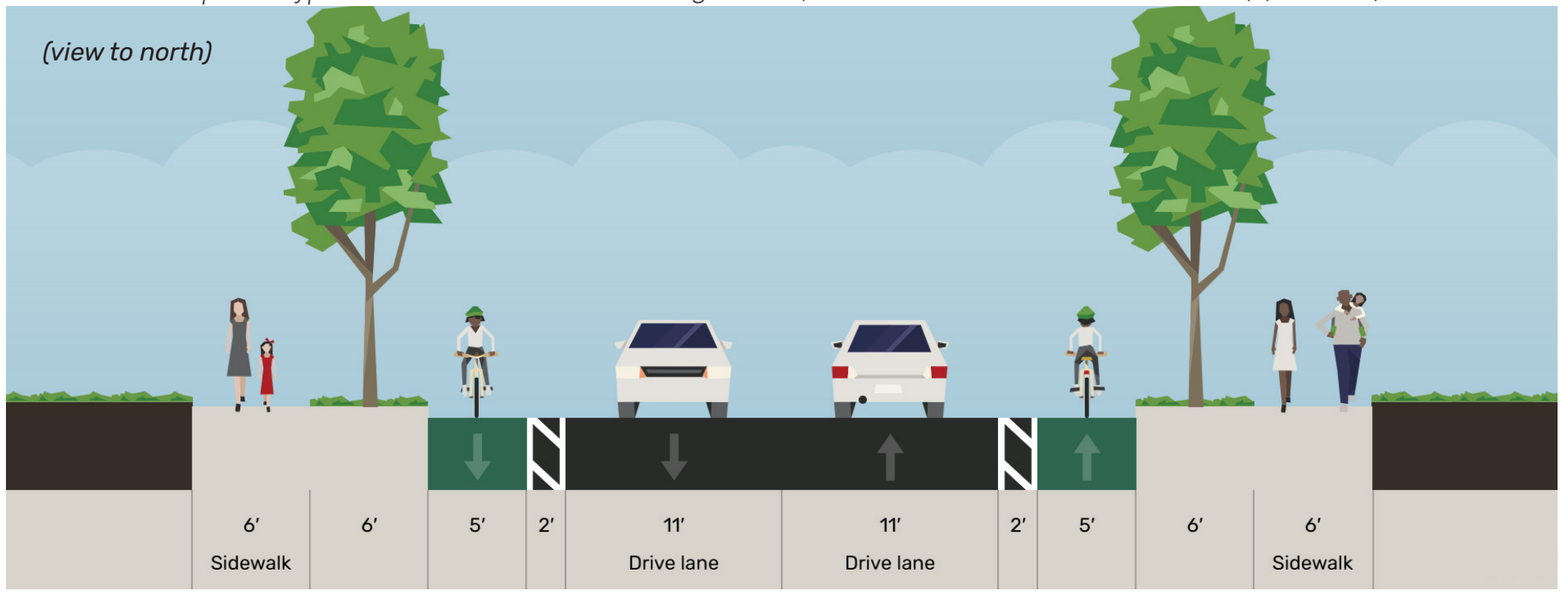


Exhibit 112. *Proposed Typical Cross-Section on Tower Ridge Drive (Lake Sharon Drive to Brookview Drive) (60' ROW)*



Tower Ridge Drive (Brookview Drive to Meadowview Drive)

Existing Cross-Section

South of Brookview Drive, Tower Ridge Drive narrows from three to two lanes. This segment of Tower Ridge Drive, between Brookview Drive to Meadowview Drive, has around 60 feet of right-of-way available. The current configuration of the segment, as shown in Exhibit 113, includes two 11.5-foot-wide travel lanes, a 4-foot-wide sidewalk and 11-foot-wide buffer on the western side, and a 22-foot-wide green space on the eastern side.

Proposed Cross-Section

The proposed reconfiguration of this segment would involve installing a 10-foot-wide shared-use path on both sides of the roadway.

Benefits of the Proposed Improvement

» Shared-use paths provide a space for both pedestrians and cyclists. Shared-use paths are especially appropriate considering the presence of high-density land uses adjacent to the corridor.

» The multimodal design balances connectivity for vehicles, cyclists and pedestrians, and creates a safer, more attractive corridor for community use

» A green space buffer on both sides side of the street separates the roadway from the path, enhancing pedestrian safety, and provides space for landscaping, improving aesthetic and environmental appeal. These buffers can be adjusted throughout the corridor depending on the specific context within the right-of-way.

Exhibit 113. *Typical Existing Cross-Section on Tower Ridge Drive (Brookview Drive to Meadowview Drive) (60' ROW)*

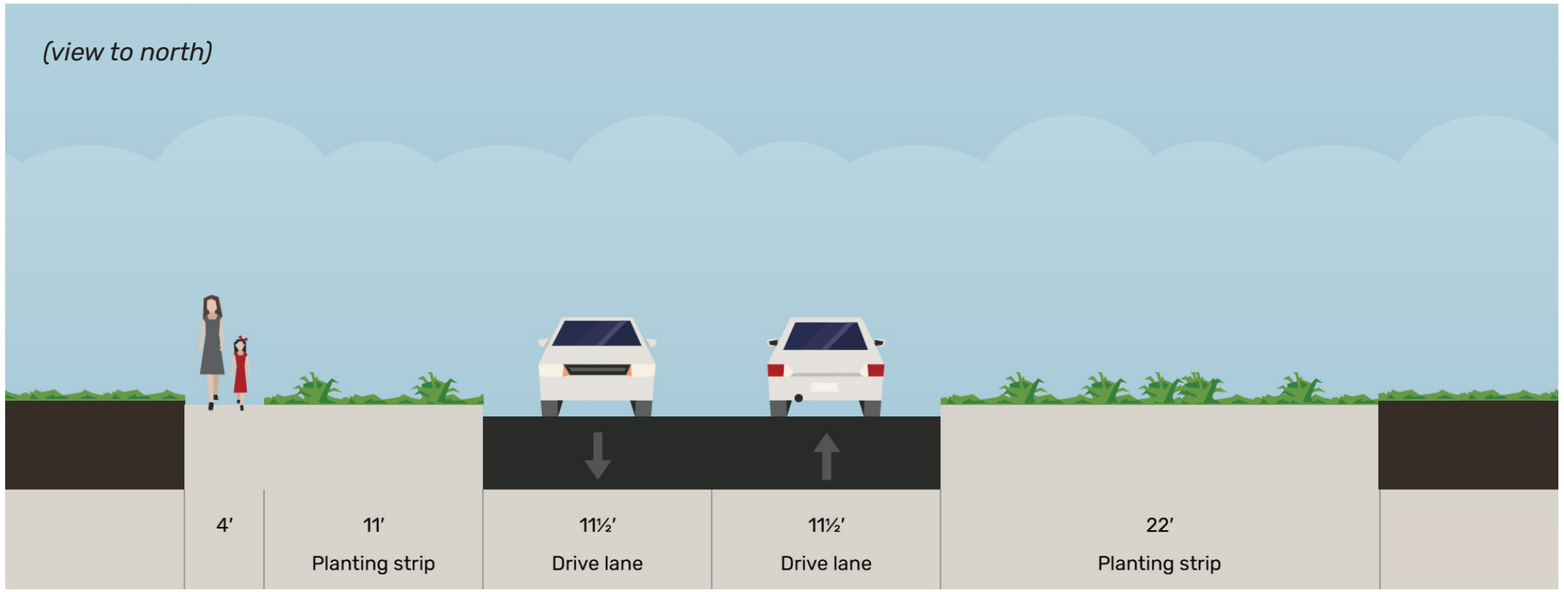
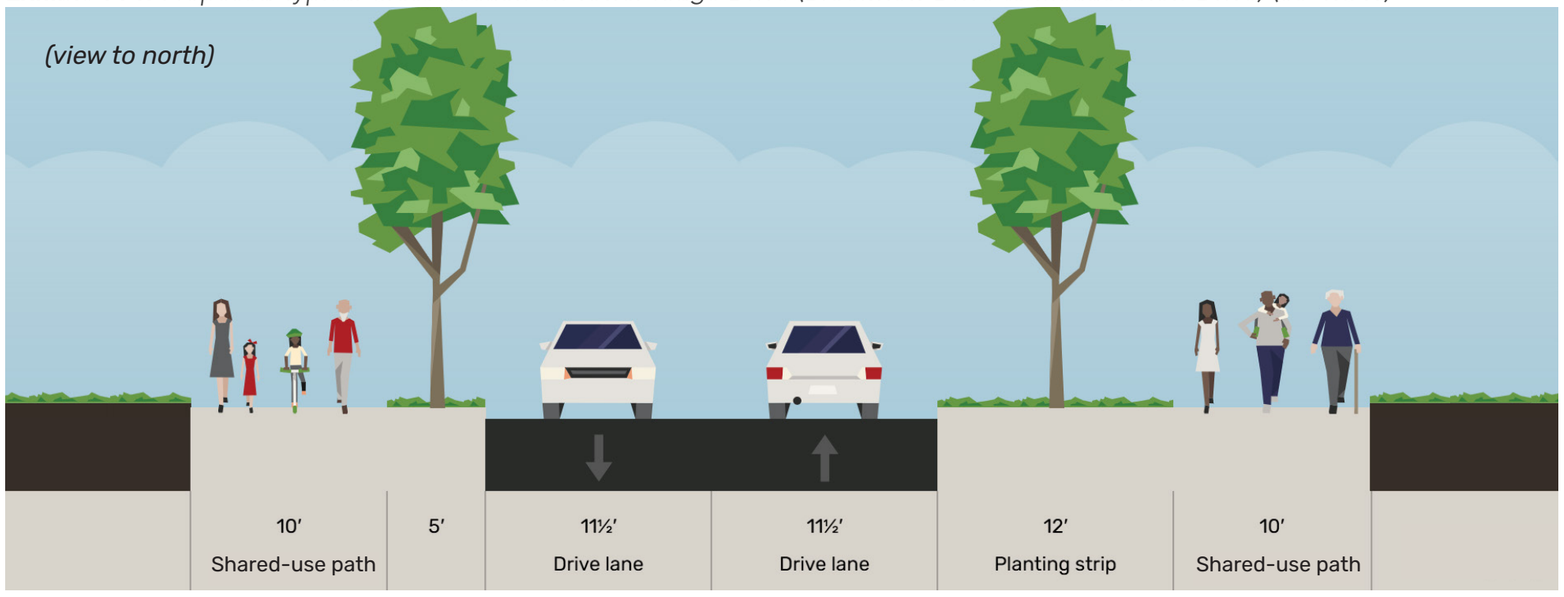


Exhibit 114. *Proposed Typical Cross-Section on Tower Ridge Drive (Brookview Drive to Meadowview Drive) (60' ROW)*



Tower Ridge Drive (Meadowview Drive to Cliff Oaks Drive)

Existing Cross-Section

The right-of-way available on the segment of Tower Ridge Drive between Meadowview Drive and Cliff Oaks Drive varies from 54 to 60 feet. The current configuration of the segment, as shown in Exhibit 115, includes two 10.5-foot-wide travel lanes; an 18-foot-wide green space on the street's western side; and an 8-foot-wide buffer, 5-foot-wide sidewalk and 8-foot-wide green space on the street's northern side.

Proposed Cross-Section

The proposed reconfiguration of this segment would involve converting the travel lanes to shared bike and vehicle travel lanes using sharrows. A 5-foot-wide sidewalk would be installed on the west side of the road.

Benefits of the Proposed Improvement

- Shared bike and travel lanes allow for bike travel on the low-speed roadway
- Continuous 5-foot-wide sidewalks on both sides of the street provide dedicated space for pedestrians and connect with the pedestrian infrastructure on the other sections of Tower Ridge Drive
- A green space buffer on both sides side of the street separates the roadway from the path, enhancing pedestrian safety, and provides space for landscaping, improving aesthetic and environmental appeal. These buffers can be adjusted throughout the corridor depending on the specific context within the right-of-way

Exhibit 115. *Typical Existing Cross-Section on Tower Ridge Drive (Meadowview Drive to Cliff Oaks Drive) (60' ROW)*

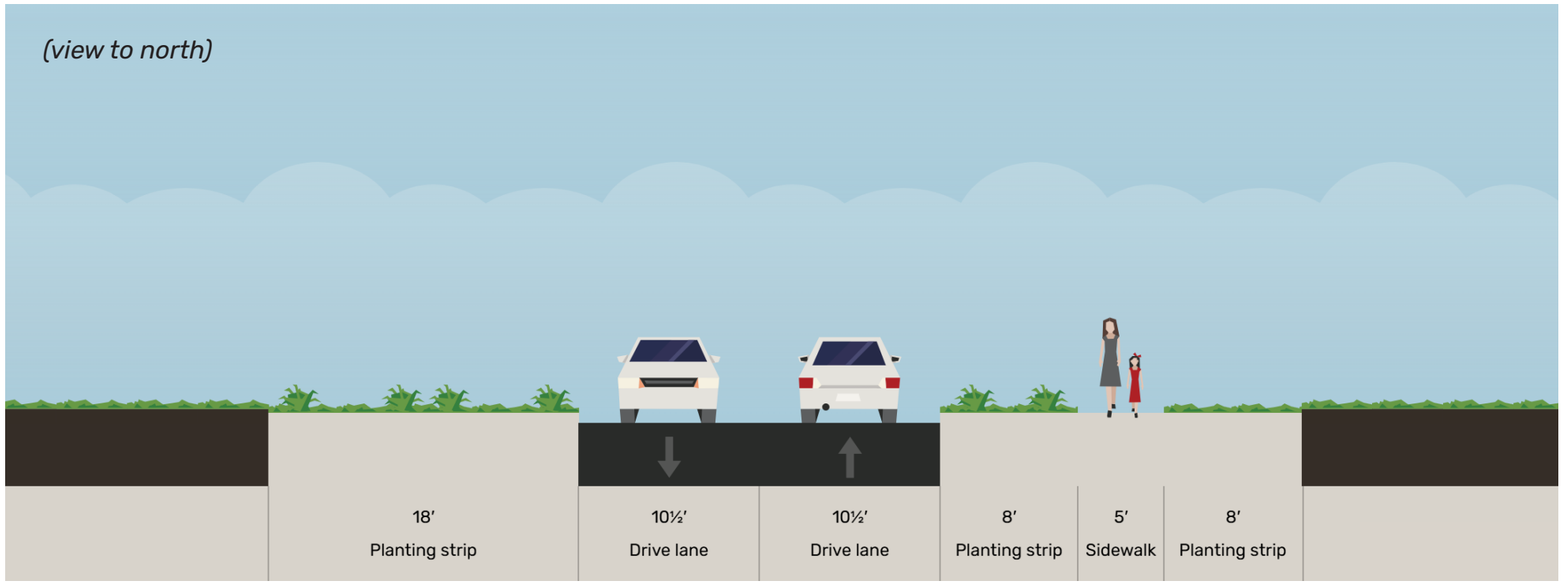
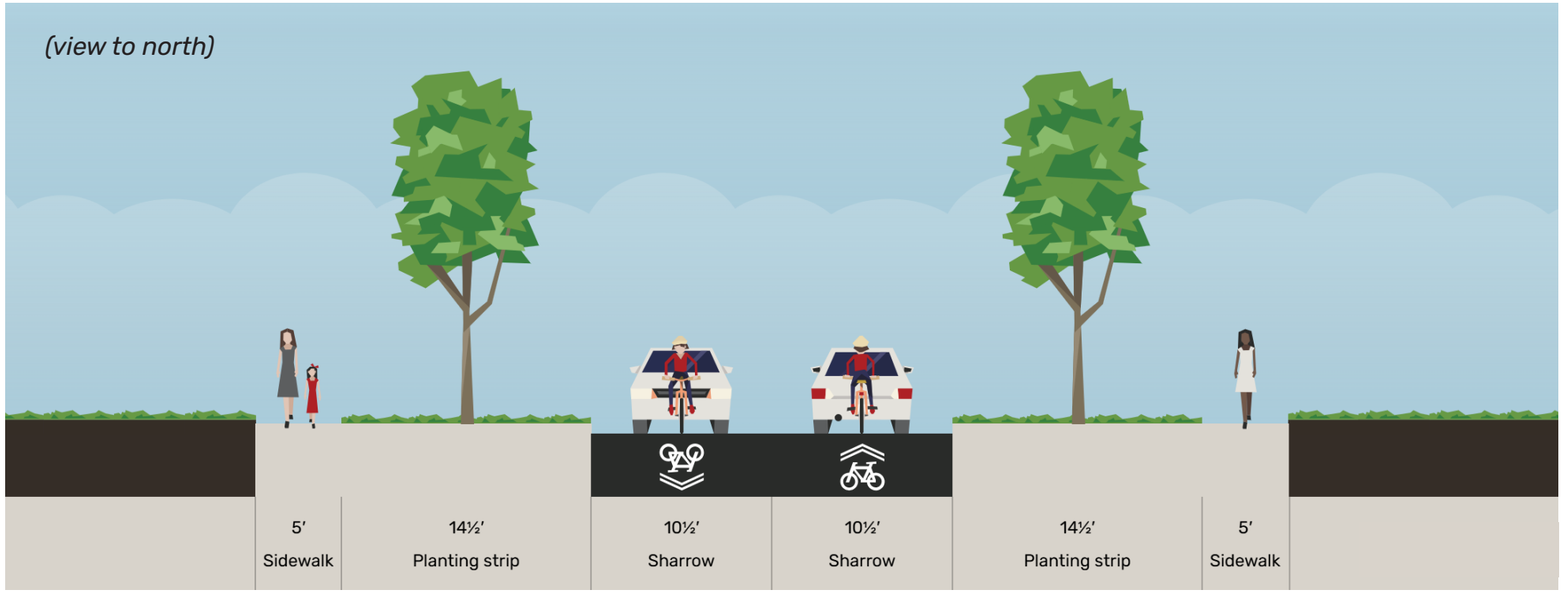


Exhibit 116. *Proposed Typical Cross-Section on Tower Ridge Drive (Meadowview Drive to Cliff Oaks Drive) (60' ROW)*



Tower Ridge Drive (Cliff Oaks Drive to FM 2181)

Existing Cross-Section

The planned extension of Tower Ridge Drive south of Cliff Oaks Drive is has not yet been built.

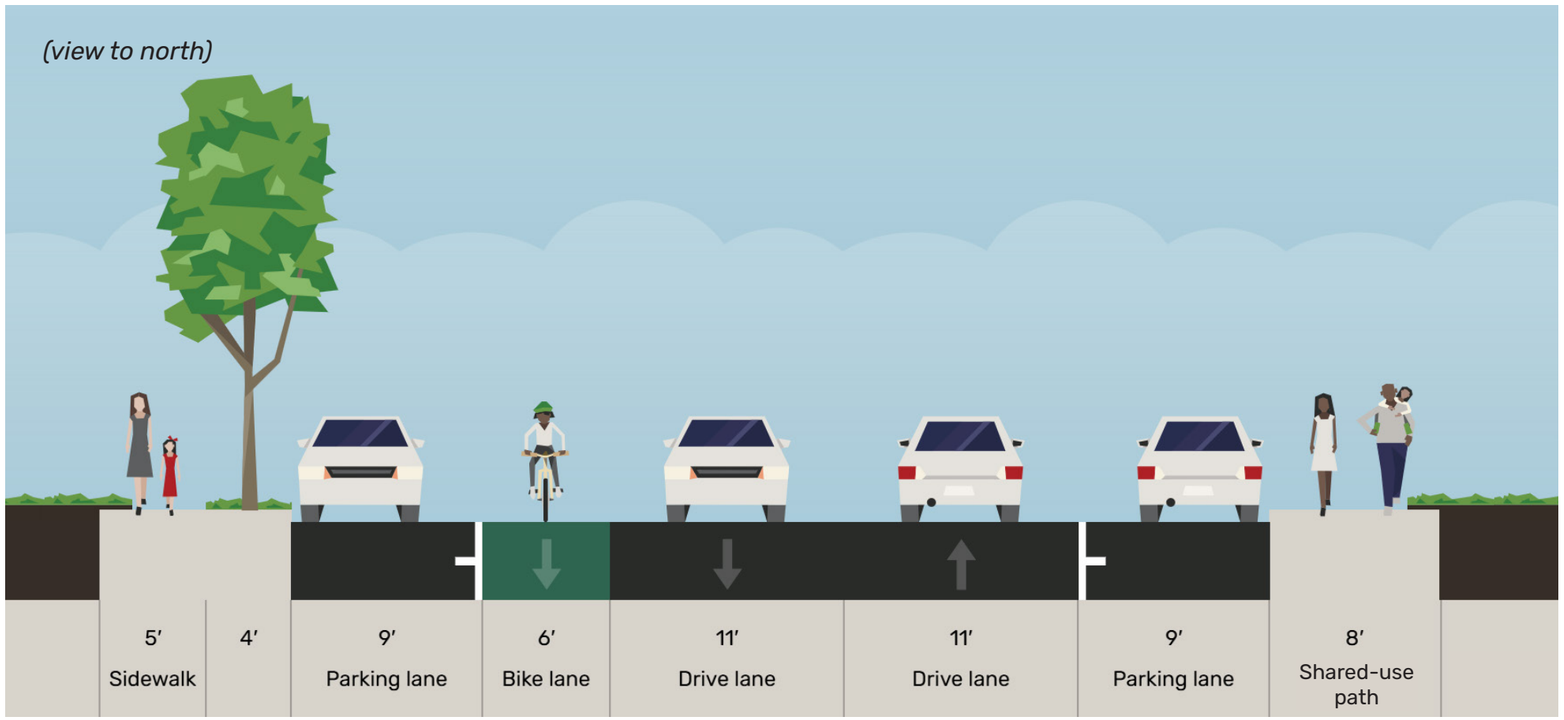
Proposed Cross-Section

The configuration of this segment, which is currently under construction, has two 11-foot travel lanes, two 9-foot parking lanes, and one 6-foot bike lane. Additionally, a 5-foot-wide sidewalk on the west side of the road and 8-foot-wide shared-use path on the east side provide pedestrian accommodations. The shared-use path is located outside of the existing right-of-way in an easement and can be adjusted depending on the available right-of-way.

Benefits of the Proposed Improvement

- Dedicated bike lanes, even without a buffer, provide a safer space for cyclists, separate from vehicle traffic. Cyclists traveling north can utilize the shared-use path on the east side of the road
- Continuous 5-foot-wide sidewalk provides a dedicated space for pedestrians, and the 8-foot-wide shared-use path serves both pedestrians and cyclists
- Parking lanes add a buffer between pedestrians and vehicles, creating a safer and more comfortable environment for active transportation. Street parking also contributes to lower vehicle speeds along the corridor

Exhibit 117. *Proposed Typical Cross-Section on Tower Ridge Drive (Cliff Oaks Drive to FM 2181) (63' ROW)*



Vintage Drive

Existing Cross-Section

Vintage Drive typically has 50 feet of right-of-way. The current configuration, as shown in Exhibit 118, includes a two 13-foot-wide travel lanes, 7-foot-wide parkways, sidewalks on each side of the street with a minimum of 4 feet, and green space.

Proposed Cross-Section

The proposed reconfiguration of Vintage Drive would widen the existing meandering sidewalk on the road's eastern side to an 8-foot-wide shared-use path with a parkway of varying size. The existing 4.5-foot-wide sidewalk on the west side would be widened to meet the standard of 5 feet for sidewalks.

Benefits of the Proposed Improvement

- A shared-use path on the eastern side can support higher pedestrian traffic and other modes of transportation, serving as the active transportation element in this corridor and connecting through Eagle Pass Park and down to Hawk Elementary School
- Standard sidewalk on western side maintains walkability and accessibility on both sides of the street
- Parkways separate the roadway from the sidewalk, enhancing pedestrian safety, and provide space for landscaping, improving aesthetic and environmental appeal

Exhibit 118. *Typical Existing Cross-Section on Vintage Drive (50' ROW)*

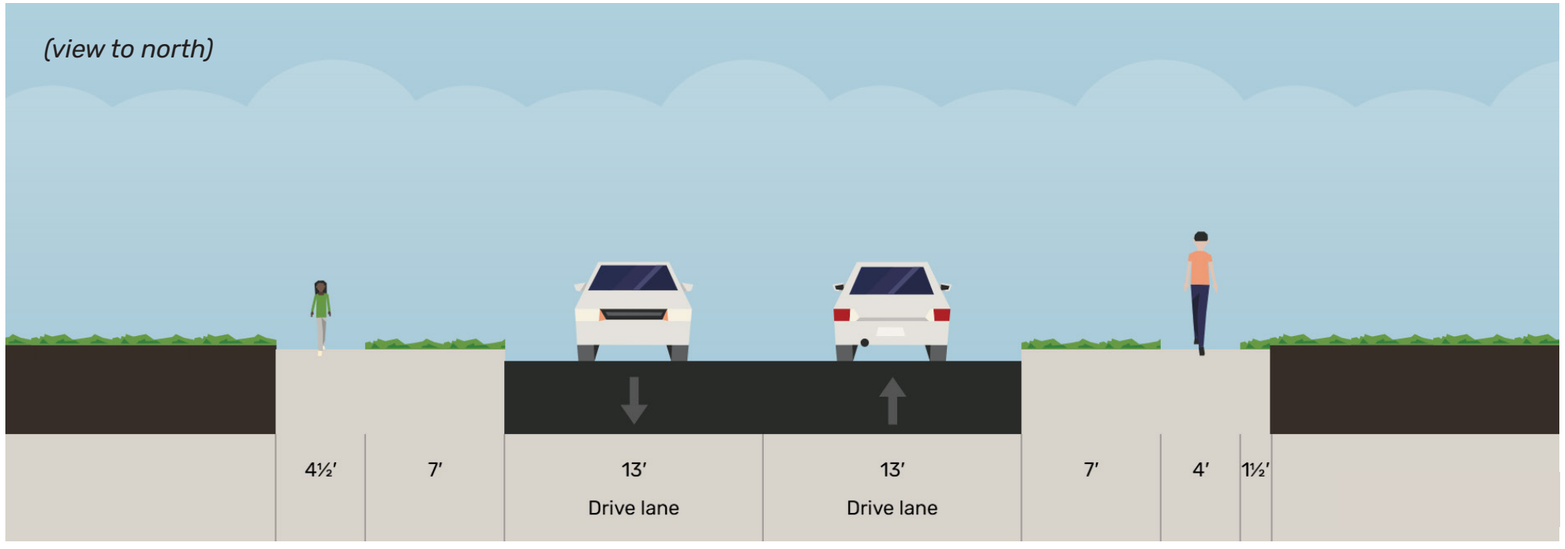
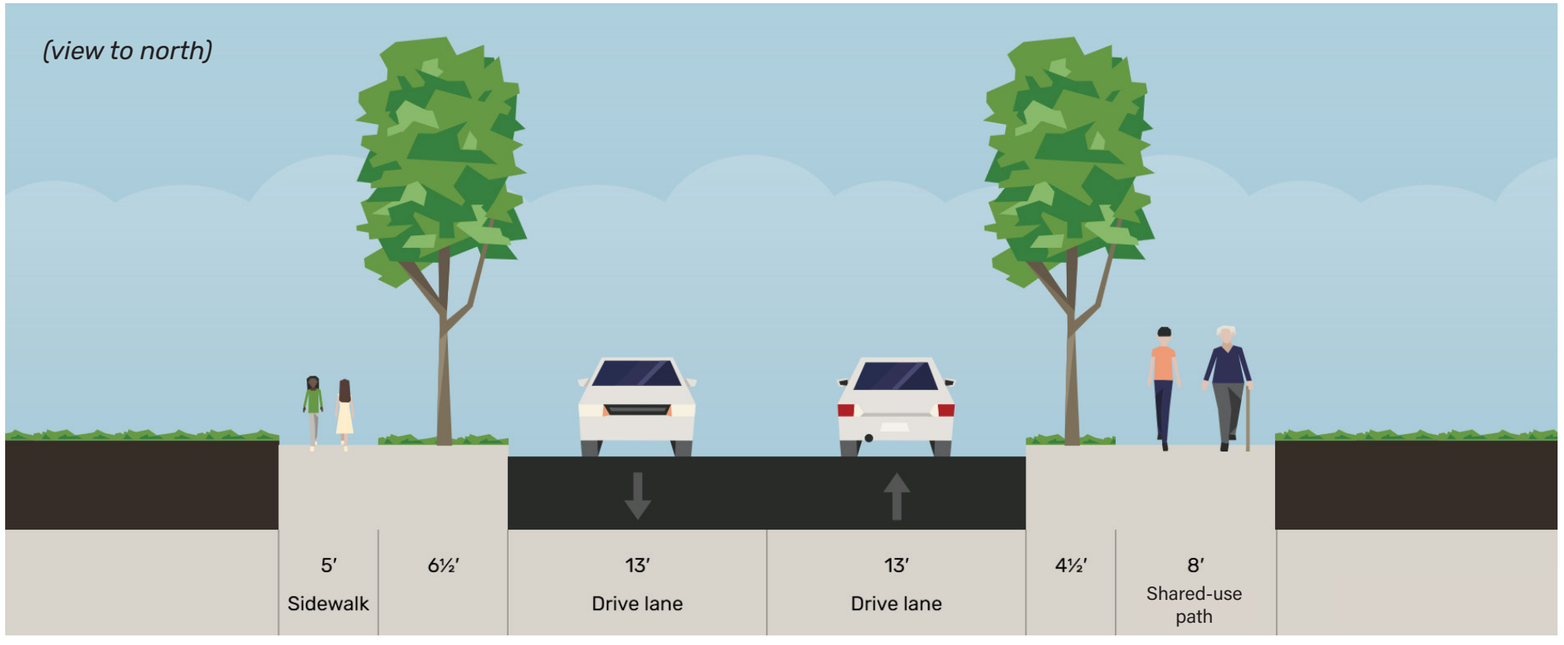


Exhibit 119. *Proposed Typical Cross-Section on Vintage Drive (50' ROW)*



Shared Streets

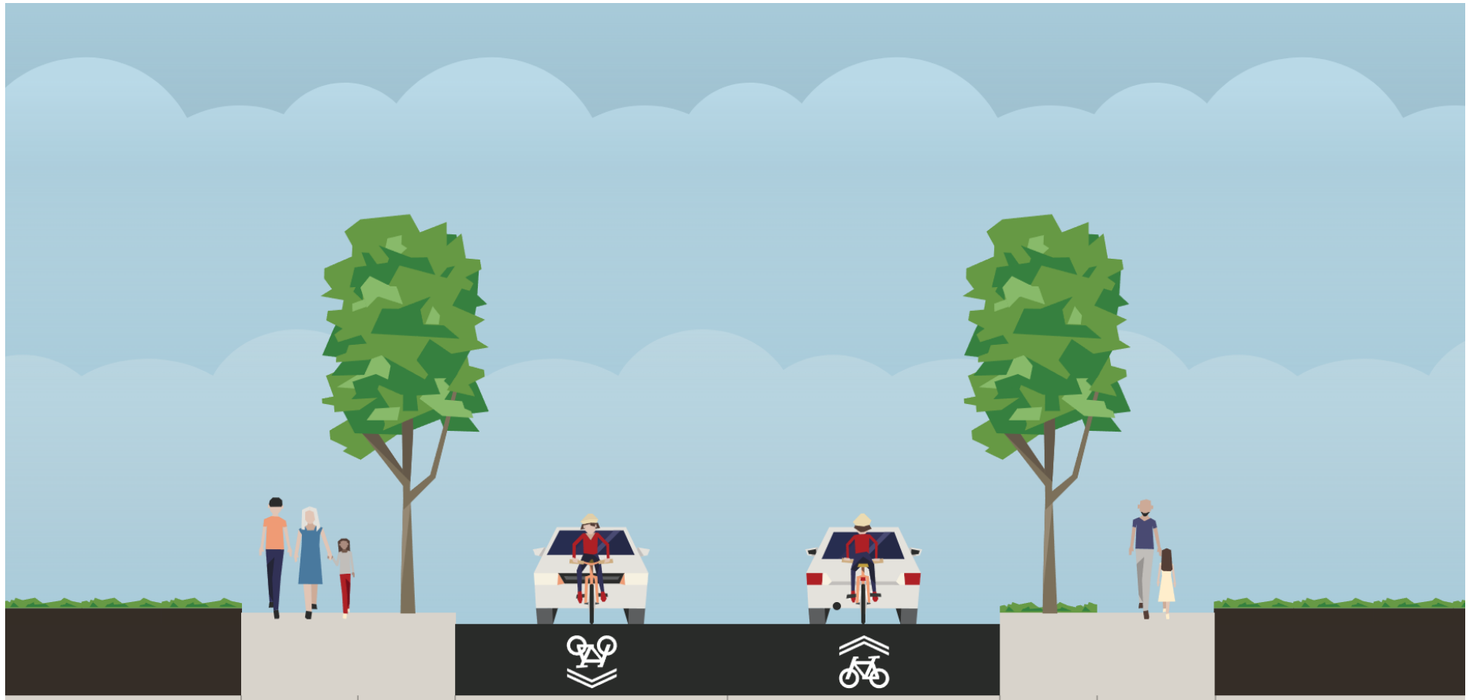
Proposed Cross-Section

The proposed cross-section for a shared street, as shown in Exhibit 120, would incorporate shared roads, parkways, and sidewalks on each side of the street.

Benefits of the Proposed Improvement

- Standard sidewalks provide pedestrian safety and accessibility on both sides of the street
- The shared roads allow for continuity of the active transportation network on streets with limited right-of-way
- Parkway buffer separate the roadway from the path, enhancing pedestrian safety, and provide space for landscaping, improving aesthetic and environmental appeal

Exhibit 120. *Proposed Concept of a Cross-Section on Shared Streets*



	6′ Sidewalk	5′	14′ Sharrow	14′ Sharrow	5′	6′ Sidewalk	

Intersections and Transitions

Typical sections define the functionality along a length of street, but specific treatments for passage of a typical intersection through an intersection need to be addressed based upon the conditions at each intersection. Similarly, transitioning from one bike/ped facility type to another (e.g. bike lanes to shared use paths) require careful consideration of the prevailing conditions and the user groups intended for use of the facilities.

The Urban Bikeway Design Guide, Third Edition, published by the National Association of City Transportation Officials in 2025, contains many examples of various conditions and potential treatments for intersection and transition treatments. One example of a transitional treatment is what has been installed by the City of Austin on a side street (Peyton Gin Road) with bike lanes approaching a major arterial street (N. Lamar Boulevard) that has shared use paths (Exhibit 121).

Exhibit 121. *Bike Lanes along Peyton Gin Road approaching N. Lamar Boulevard, Austin, TX*

5 Recommendations and Implementation

Project Recommendations

Based upon a synthesis of the review of existing conditions, addressing of public and stakeholder comments, application of best practices and leveraging of ongoing transportation initiatives, an active transportation network and a set of supporting policies and programs have been developed.

Active Transportation Network

Exhibit 44 on page 35 and Exhibit 124 on page 78 show the network recommendations described in Chapter 4. The proposed projects are assigned as Tier I, Tier II or Tier III to guide their relative priority of implementation.

Project Implementation

The following strategy is recommended to advance the projects and programs of the Active Transportation Plan.

1. The elements of the Tier I network should be continuously advanced for funding and implementation of the enhanced and completed high quality network.
2. The elements of the Tier II network may advance short segments of the larger network and should be brought to a logical terminus while awaiting completion of the network.
3. The network elements in the Tier III network would be implemented as opportunities arise in conjunction with development and as special funding is available such as might be dedicated for safe routes for schools and parks under the Transportation Alternatives program.

Tier I

The priority network of trails, SUPs and bike lanes that provide connectivity to the high profile destinations in the City.

Tier II

The second tier of projects, which will be completed in conjunction with ongoing or planned projects.

Tier III

The remaining trails, bike lanes and bike routes that connect to the various neighborhoods, schools and parks that are not in the priority network nor in an ongoing or planned project.

Prioritization

In addition to the three-tier priority project framework, advancement of highly desired active transportation projects should focus on providing easily implementable and high-value active transportation projects emphasizing ADA compliance, safety, network connectivity, and promoting walking and cycling activity within the City.

An example of a screening methodology for advancing projects is shown in Exhibit 122. As the network grows and becomes more established, many of these criteria can be altered to support the maintenance and expansion of a more comprehensive and defined network.

Exhibit 122. *Proposed Prioritization Methodology for Bike/Ped Projects*

Criteria	Metric
Multi-Modal Opportunity	How many bus routes are within ½ mile of the project?
	Does the project involve a strong ADA compliance component?
	Is this project within ½ mile of an identified scooter corral?
Access/Place-Based Connections	How many high-value civic/health (clinics/pharmacies/hospitals) destinations are within ½ mile?
	How many high-value recreational amenities (community centers/pools) are within ½ mile?
	How many high-value tourist attractions are within ½ mile?
Network Connectivity	Does the project provide a key connection between bike/ped facilities or to a major bike path or attraction?
	Does the project remove a barrier to overall bike/ped network development?
Target Populations	Does the project support access to known key service points for at-risk disadvantaged groups?
Public Safety	How many annual fatal or severe crashes involved bike/ped users (last 5 years)?
	Would the proposed improvement resolve/mitigate contributing factors associated with the crash?
	Will the improvement include lighting or shading improvements?
Imminent Funding	Is the project on the roadway that is part of the bond program, CIP project listing, Rapid Replacement Program, or TxDOT project?
Schools	Is the project within ¼ mile of a school? Does the school participate in a Safe Routes to School Program? Is the improvement consistent with its program?
Activity Promotion	Will this activity directly help promote walking and cycling? Is it adjacent to or provide access to major walking/cycling events or known area bike/ped activity?

Exhibit 124. *List of Proposed Bike/Ped Network Improvements*

Proj. No.	Road	From	To	Project	Tier
1	FM 2181	W City Limit	E City Limit	Install 10' SUP on south side of road and 8' SUP on north side of road	Tier III
2	Oakmont Dr	FM 2181	Robinson Rd	Install 6' sidewalk on both sides of road; restripe road to have two 11' lanes; stripe 5' bike lane and 2' buffer on both sides	Tier I
3	Meadowview Dr	Oakmont Dr	IH 35 Service Road	Install shared street signage; restripe road to have two 11’ lanes; stripe 9’ parking lane on both sides; install 8' SUP on north side of road and 6' sidewalk on south side of road	Tier I
4	Robinson Rd	W City Limit	Post Oak Dr	Install 10' SUP on north side of road; install 5' sidewalk on south side of road	Tier III
5	Church Dr	Post Oak Dr	IH 35 Service Road South	Restripe road to have two 12' lanes; stripe 6' bike lane on both sides; install 5' sidewalk on south side	Tier III
6	Post Oak Dr	IH 35 Service Road South	Robinson Rd	Restripe road to have two 11.5' lanes; stripe 6.5' bike lane and 5' buffer on both sides; install 5' sidewalk on west side	Tier III
7	Post Oak Dr	Robinson Rd	Lake Sharon Dr	Install 10' SUP on east side of road; install 6' sidewalk on west side of road	Tier III
8	Post Oak Dr	Lake Sharon Dr	FM 2181	Install 8' SUP on both sides of road; restripe road to have two 11' lanes; stripe 5' buffer and 6' bike lane on both sides	Tier III
9	Shady Shores Rd	Post Oak Dr	E City Limit	Install 10' SUP on north side of road; install 6' sidewalk on south side of road; reconstruct road to have two 12' lanes, 4' buffer and 6' bike lane	Tier I
10	IH 35 Service Road North	N City Limit	S City Limit	Install 10' SUP on east side of road	Tier III
11	IH 35 Service Road South	S City Limit	N City Limit	Install 10' SUP on west side of road	Tier III
12	N Corinth St	Shady Shores Rd	Corinth Pkwy	Reconstruct road to have two 10' lanes and two 8' parking lanes; install shared street signage; install 8' shared use path on both sides	Tier I
13	Shady Rest Ln	Corinth Pkwy	Fritz Ln	Install 10' SUP on west side of road; stripe 5' bike lanes on both sides	Tier I
14	Fritz Ln	Shady Rest Ln	Meadows Rd	Install 10' SUP on south side of road and 6' sidewalk on north side of road	Tier II
15	Meadows Rd	Fritz Ln	Shady Shores Rd	Install 8' SUP on east side of road and 5' sidewalk on west side of road	Tier II
16	Corinth Pkwy	IH 35 Service Road North	Creek Bend Ct	Restripe road to have two 11' lanes; stripe 8' parking lane and 5' bike lane on both sides; install 6' sidewalk on both sides	Tier I
17	Dobbs Rd	Corinth Pkwy	IH 35 Service Road North	Realign road; reconstruct road to have two 12' lanes; stripe 7' buffer and 5' bike lane on both sides; install 6' sidewalk on west side	Tier I
18	Tower Ridge Dr	Lake Sharon Dr	200' south of Brookview Dr	Restripe road to have two 11' lanes; stripe 2' buffer and 6' bike lane on both sides; install 6' sidewalk on both sides	Tier I
19	Tower Ridge Dr	200' south of Brookview Dr	Meadowview Dr	Install 10' SUP on both sides of road	Tier I
20	Tower Ridge Dr	Meadowview Dr	Cliff Oaks Dr	Install shared street signage; install 5' sidewalk on both sides of road	Tier II
21	Future Tower Ridge Dr Ext.	Cliff Oaks Dr	FM 2181	Construct road to have two 11' lanes; stripe 6' bike lane on west side; stripe 9' parking lane on both sides; install 5' sidewalk on west side and 8' SUP on east side	Tier II
22	Cliff Oaks Dr	Tower Ridge Dr	Garrison Rd	Install 10' SUP on south side of road and 8' SUP on north side of road	Tier III

Proj. No.	Road	From	To	Project	Tier
23	Garrison Rd	FM 2181	Cliff Oaks Dr	Install 8' SUP on both sides of road	Tier III
24	Garrison Rd	Cliff Oaks Dr	IH 35 Service Road South	Restripe road to have two 11.5' lanes; stripe 3' buffer and 5' bike lane on both sides; install 6' sidewalk on both sides	Tier III
25	Lake Sharon Dr	W City Limit	IH 35 Service Road South	Restripe road to have two 12' lanes; stripe 5' buffer and 7' bike lane on both sides; install 6' sidewalk on south side of road; install 10' sidewalk on north side of road	Tier I
26	Creekside Dr	Oakmont Dr	Post Oak Dr	Restripe road to have two 11' lanes; stripe 8.5' parking lane on both sides; install 10' SUP on south side of road; install 6' sidewalk on north side of road	Tier II
27	Future Creekside Dr Ext	Post Oak Dr	Future Parkridge Dr Ext	Install 10' SUP on south side of road; install 6' sidewalk on north side of road	Tier II
28	Silver Meadow Dr	Future Parkridge Dr Ext	Corinth Pkwy	Install 10' SUP on north side of road	Tier II
29	Corinth Pkwy	Lake Sharon Dr	IH 35 Service Road North	Restripe road to have two 12' lanes; stripe 7' bike lane and 5' buffer on both sides; install 6' sidewalk on west side of road and 5' sidewalk on east side of road	Tier III
30	Pecan Creek Cir	Post Oak Dr	End of existing trail north of Aspen St	Install 10' SUP on east side of road	Tier III
31	New Trail A	IH 35 Service Road South	Church Dr	Install 8' paved trail	Tier I
32	Parkridge Dr	Summit Ridge Dr	End of Parkridge Dr	Restripe road to have two 11' lanes; stripe 2' buffer and 6' bike lane on both sides; install 8' SUP on east side of road	Tier I
33	Future Parkridge Dr Ext	End of Parkridge Dr	Church Dr	Install 10' median; install 8' SUP on east side of road	Tier I
34	New Trail B	Future Parkridge Dr Ext	IH 35 Service Road South	Install 8' paved trail	Tier III
35	New Trail C	Existing paved trail	Corinth Pkwy	Install 10' paved trail	Tier III
36	New Trail D	Existing paved trail	E City Limit	Install 8' unpaved trail	Tier III
37	New Trail E	Tree House Ln	New Trail D	Install 8' unpaved trail	Tier III
38	New Trail F	Tower Ridge Dr	IH 35 Service Road South	Install 8' unpaved trail	Tier III
39	Corinth Pkwy	Creek Bend Ct	Quail Run Dr	Restripe road to have two 12' lanes; stripe 7' bike lane and 5' buffer on both sides; install 6' sidewalk on west side of road and 5' sidewalk on east side of road	Tier I
40	Vintage Dr	Robinson Rd	900' S of Creekside Dr	Install 8' SUP on east side of road and 5' sidewalk on west side of road	Tier III
41	New Trail G	Oakmont Dr	650' E of Oakmont Dr	Install 10' paved trail	Tier III
42	New Trail H	FM 2499	Oakmont Dr	Install 10' paved trail	Tier III
43	New Trail I	W City Limit	W City Limit	Install 8' unpaved trail	Tier III
44	New Trail J	New Trail I	Enchanted Oaks Cir	Install 8' unpaved trail	Tier III

Proj. No.	Road	From	To	Project	Tier
45	Blue Jay Dr	Meadowview Dr	FM 2181	Install shared street signage	Tier III
46	New Road A	FM 2181	Parkridge Dr	Construct road to have 10' SUP on one side	Tier II
47	New Trail K	FM 2181	End of existing trail	Install 8' unpaved trail	Tier III
48	New Trail L	End of New Trail K	Parkridge Dr	Install 8' paved trail	Tier II
49	New Trail M	FM 2181	Oak Bluff Dr	Install 8' unpaved trail	Tier III
50	New Trail N	Parkridge Dr	New Trail L	Install 8' paved trail	Tier II
51	New Road B	Parkridge Dr	FM 2181	Construct road to have 10' SUP on one side	Tier III
52	New Trail O	New Trail N	New Road B	Install 8' unpaved trail	Tier III
53	Meadow Oaks Dr	Lake Sharon Dr	Alcove Ln	Restripe road to have two 12' lanes; stripe 4' buffer and 6' bike lane on both sides; install 6' sidewalk on both sides	Tier III
54	New Trail P	Lake Sharon Dr	Indian Lake Trl	Install 10' paved trail	Tier III
55	Walton Drive	Existing Regional Trail	Shady Rest Ln	Install 10' SUP on both sides of road	Tier II
56	Dobbs Rd	Corinth Pkwy	E City Limit	Install 10' SUP on south side of road	Tier II
57	Carpenter Ln	Dobbs Rd	Corinth Pwky	Expand ROW to 50'; reconstruct road to have two 11' lanes; install 8' shared use path on both sides	Tier III
58	FM 2499	FM 2181	S City Limit	Install 8' SUP on both sides of road	Tier III
59	Old Highway 77	N City Limit	N Corinth St	Expand ROW to 60'; construct road to have two 10' lanes; install shared street signage; install 8' parking lane on both sides; install 8' SUP on west side and 6' sidewalk on east side	Tier II
60	Quail Run Dr	Corinth Pkwy	IH 35 Service Road North	Install 8' SUP on both sides of road	Tier II

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2025 Active Transportation Plan

SHADY SHORES RD
N CORINTH ST
SHADY REST LN
CORINTH PKWY
ROBINSON RD
CHURCH DR
OAKMONT DR
POST OAK DR
CORINTH PARKWAY
DOBBS RD
CORINTH PKWY
LAKE SHARON DR
MEADOWVIEW DR
TOWER RIDGE DR
PARKRIDGE DR
CLIFF OAKS DR
GARRISON RD
Corinth Community Park
Oakmont Country Club
Meadowview Park
2499
2181
2181
35

Facility Status
- Existing
- Planned

Facility Type
- Shared-Use Path, both sides
- Shared-Use Path, one side
- Shared Street/Parking Lanes + Sidewalks
- Buffered Bike Lanes + Sidewalks
- Bike Lanes + Sidewalks
- Parking-Protected Bike Lane + Sidewalks
- Regional Trail
- Local Trail, Paved
- Local Trail, Unpaved
- Buffered Bike Lanes + Shared-Use Path
- Bike Lanes + Shared-Use Path
- Shared Street

- Existing Signal
- Proposed Signal
- Proposed Pedestrian Hybrid Beacon
- Proposed Trail Grade Separation
- Existing Street
- Planned Street
- City Limits
- Railroads
- Lakes
- Streams
- Parks

- Tier I Project
- Tier II Project
- Tier III Project

N

0 0.25 0.5 Miles

Exhibit 125. *Proposed Bike/Ped Network Improvements*

Code, Policy and Program Recommendations

Code Recommendations

The existing foundation for active transportation in Corinth could be enhanced by amending the current Unified Development Code. Example language for sidewalks, bicycle facilities and bicycle parking is outlined in Exhibit 126. Example ordinances for micromobility users and providers can be seen in Appendix C: Micromobility Plan.

Exhibit 126. *Active Transportation Code Language Recommendations*

Code Topic	Example Language
Sidewalks and Bicycle Facilities – General Requirements	a) Where required, sidewalks shall be installed on both sides of the local residential, collector and arterial streets right-of-way and adjacent to the property line and parallel to the curb line. All major and minor arterials, collectors and other thoroughfares appearing on the City's Active Transportation Plan shall have bike facilities installed in accordance with its Street Design Manual or equivalent as determined by the City Engineer and/or the Planning Department.
	b) Sidewalks shall be 5-feet-wide if separated from the curb and be separated from the adjacent travel lane by at least 3 feet; if tied to the back of a curb or edge of roadway, the sidewalk should be at least 7-feet wide.
	c) The sidewalk must be wide enough to provide a minimum clear width of 4 feet at encroachments, including street lights, traffic signs, traffic control devices, utility installations, or other facilities.
	d) All new sidewalks must adhere to the City Design Manual's technical standards and design requirements and applicable state and federal disability rights laws.
	e) Sidewalks determined to be in high pedestrian traffic areas, or pedestrian-oriented developments determined by the City Planning Department may be required to be wider than the minimum widths.
	f) A SUP shall be required within the street right-of-way if the street is within a 2-mile radius of a public school. A SUP may be substituted for one of the required sidewalks.
Bicycle Facilities	a) Bicycle parking facilities shall be provided for new buildings or facilities, additions to or enlargements of existing buildings, or for changes in the use of buildings or facilities that result in the need for additional auto parking facilities in accordance with City parking requirements.
	b) One bicycle space shall be required for every 20 dwelling units in a multifamily (apartment-style) building, with fractions rounded to the next highest whole number.
	c) Individual bicycle parking spaces shall be a minimum of 75 inches by 24 inches wide for each space. Where double-sided multi-racks are utilized in overlapping of bicycle parking spaces, the minimum bicycle parking space shall be 100 inches long by 36 inches wide.
	d) Bicycle parking racks shall be located in areas visible from the public right-of-way and shall be provided with adequate lighting if intended for use after dark.
	e) Bicycle parking racks shall be placed a minimum of 24 inches away from walls and other elements that may create an obstacle to accessing the bike parking spaces.
	f) The City may authorize a reduction in the number of required off-street parking spaces for development uses that make special provisions to accommodate bicyclists, such as bicycle lockers, employee showers, and changing areas for employees.
	g) Bicycle parking spaces may be installed to alleviate vehicle parking space requirements if the development is located adjacent to a bike lane or an off-road bike path or adjacent to a street with an existing bike lane or off-road path. The provision of bicycle parking spaces can be used to reduce the number of required vehicle parking spaces by up to 10%. Up to six bicycle parking spaces (bike racks) can be used for every vehicle parking space.

Policy and Program Recommendations

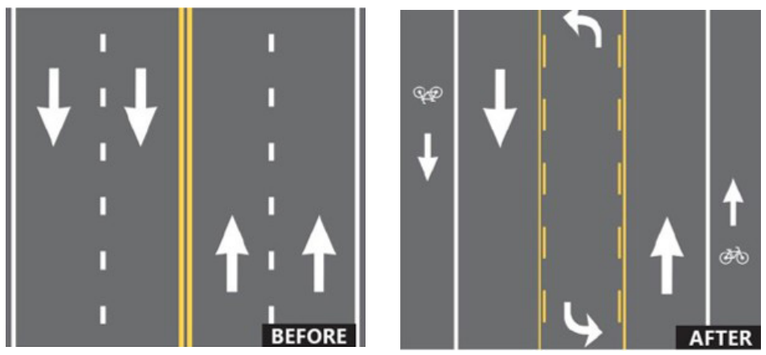
Integrate street infrastructure that provides balanced transportation options and design features into street design and construction to create safe and inviting environments for all users to walk, bicycle and use public transportation.

» Ensure that sidewalks, crosswalks, public transportation stops and facilities, and other aspects of the transportation right-of-way are ADA-compliant and meet the needs of people with different types of disabilities, including mobility, vision, and hearing impairments.

It is recommended that a code review workshop be conducted to review existing codes and provide recommendations to ensure ADA compliance and adequate provision of bicycle and pedestrian facilities in city codes and ordinances.

» Prioritize incorporating street design features and techniques that promote safe and comfortable travel by pedestrians, bicyclists, and public transportation riders, such as roundabouts, road diets, high street connectivity, and physical buffers and separations between vehicular traffic and users.

Exhibit 127. *Illustration of a Road Diet*



Road diets are a roadway reconfiguration which reduces the number of lanes on an existing road, usually from 4 lanes to 3 lanes (Exhibit 127) or from 5 lanes to 3 lanes to create buffered bike lanes. According to the FHWA, benefits include traffic calming; reduction of rear-end and left-turn crashes due to the dedicated left-turn lane (4 lane road diet); and the addition of dedicated or protected bike lanes to encourage bicycling by basic and advanced cyclists. Average daily traffic (ADT) can be an indicator of if a road diet is appropriate on a given road. Guidance for feasibility of a 4-to-3-lane road diet is shown in Exhibit 128. For further information about road diets, see Appendix A: Complete Streets Design Manual.

Exhibit 128. *Thresholds for Road Diet to One Thru Lane Each Way*

Average Daily Traffic Volumes	Feasibility
<10,000	Great candidate for Road Diets in most instances. Operations will most likely not be affected.
10,00-15,000	Good candidate for Road Diets in many instances. Agencies should conduct intersection analysis and consider signal retiming to determine any effect on operations.
15,000-20,000	Good candidate for Road Diets in some instances. Agencies should conduct a corridor analysis. Operations may be affected at this volume depending on the "before" condition.
20,000+	Agencies should complete a feasibility study to determine whether this is a good location for a Road Diet. There are several examples across the country where Road Diets have been successful with ADTs as high as 26,000. Operations may be affected at this volume.

Source: FHWA, Road Diet FAQ

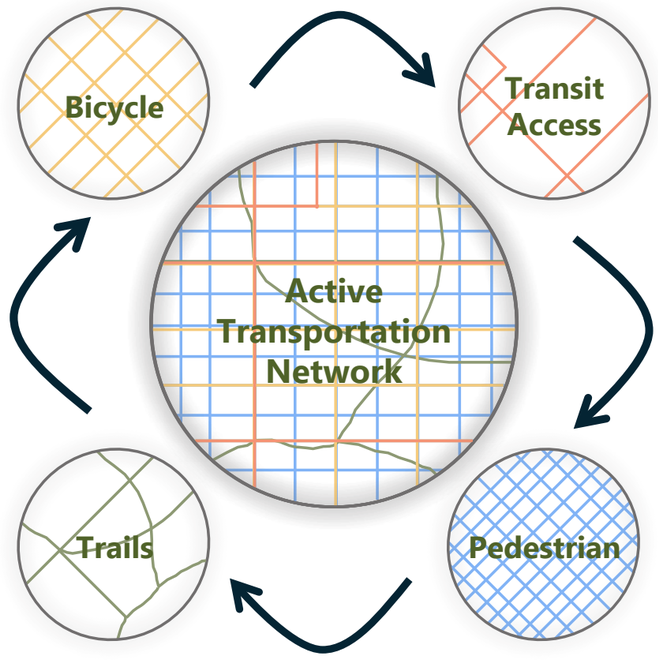
Make practices that balance transportation options a routine part of everyday operations.

» As necessary, restructure and revise the zoning and subdivision codes and other plans, laws, procedures, rules, regulations, guidelines, programs, templates, and design manuals, including the Unified Development Code, to integrate, accommodate, and balance the needs of all users in all street projects on public and private streets.

» Develop or revise street and trail standards and design manuals, including cross-section templates and design treatment details, to ensure that standards support and do not impede Complete Streets.

Coordinate with related policy documents, including the Park, Recreation & Open Space Master Plan, Downtown Plan, Comprehensive Plan and the Active Transportation Plan.

» Encourage targeted outreach and public participation in community decisions concerning street design and use, targeting those who do not currently travel by bike or foot but desire to.



Make public transportation an interconnected part of the transportation network.

» Partner with DCTA to enhance and expand public transportation services and infrastructure throughout the City of Corinth, beginning with the planned TOD in the downtown area.

Encourage the development of a public transportation system that increases personal mobility and travel choices, conserves energy resources, preserves air quality, and fosters economic growth.

» Work with DCTA to provide destinations and activities that can be reached by public transportation and are of interest to public transportation-dependent populations, including youth, older adults, and people with disabilities.

» Collaborate with DCTA to incorporate infrastructure to assist users in employing multiple means of transportation in a single trip in order to increase transportation access and flexibility.

Examples include, but are not limited to:

- Seamless bicycle access to the transit system
- Secure bicycle storage at transit stops
- Connections to trails and recreational destinations

» Ensure safe and accessible pedestrian routes to transit stops.

» Work with the DCTA to ensure that public transportation facilities and vehicles are fully accessible to persons with disabilities.

Promote safety of all users.

» Identify intersections and other locations where collisions have occurred or that present safety challenges for pedestrians, bicyclists, or other users; consider gathering additional data through methods such as walkability/ bikeability solutions to safety issues.

» Collaborate with schools, senior centers, advocacy groups and public safety departments to provide community education about safe travel for pedestrians, bicyclists, and other users.

Sidewalk Network Enhancements and Expansion Recommendations

Provide children with safe and appealing opportunities for walking and bicycling to school to decrease rush-hour traffic and fossil fuel consumption, encourage exercise and healthy living habits in children, and reduce the risk of injury to children by vehicle traffic near schools.

1. Support Safe Routes to School Programs.
    - Work with local public and private school districts to pursue encouragement programs such as Walk and Bike to School Days, as well as Walking School Bus/ Bike Train programs at elementary schools, where parents take turns accompanying groups of children to school on foot or via bicycle.
    - Gather baseline data on attitudes about and levels of walking and bicycling to school through student tallies and parent surveys; gather additional data each spring and fall to measure progress.
    - Work with local public and private school districts and advocates to obtain Safe Routes to School funding to implement education programs.
    - Work with local and private school districts to encourage education programs that teach students walking and bicycling behaviors, and educate parents and drivers in the community about the importance of safe driving.
    - Work with law enforcement to enforce speed limits and traffic laws, assist in ensuring safe crossings, and promote safe travel behavior within the schools.
    - Encourage parents to get children to school through active travel such as walking or bicycling.
2. Prioritize safety and roadway improvements around our schools.
    - Conduct walkability and bikeability audits along routes to schools to identify opportunities and needs for infrastructure improvements.
    - Ensure that speed limits in areas within 1,000 feet of schools are no greater than 15 mph below the posted speed limit.
    - Assess traffic speeds, volumes, and vehicle types around schools; implement traffic calming in areas immediately around schools where indicated by speed and volume; consider closing streets to through traffic during school hours if other methods cannot reduce the threat to safety.
    - Pursue Safe Routes to School funding to implement infrastructure improvements.

Create safe routes to parks and open spaces.

1. Encourage the development of parks and open space with a network of safe and convenient walking and bicycle routes, including routes that access other popular destinations, such as schools.
2. Implement traffic calming measures near parks where advisable due to vehicle speeds and volumes.
3. Improve intersections at park access points to create greater visibility for all users and provide accessible curb ramps and additional time to cross the street.
4. Improve public transportation connections to trails, parks, and other recreational locations.
5. Ensure that all parks and open spaces are accessible by safe bicycling, walking, micromobility, and public transit routes.
6. Ensure that trails, parks, and open spaces have secure bicycle parking facilities.

Ensure that residents of all ages and income levels can walk and bicycle to meet their daily needs.

1. Improve bicycle, pedestrian, and public transportation access to residential areas, educational and child care facilities, employment centers, grocery stores, retail centers, recreational areas, historic sites, hospitals and clinics, and other destination points.

Source: Seattle Public Schools

Funding Recommendations

Appendix G provides a list of the funding sources that could be pursued to implement the active transportation, Complete Streets, and micromobility projects. Corinth may leverage their local resources by tapping into state, federal and other resources to enhance their active transportation network and programs.

As can be seen in the tables in the appendix, there are numerous funding opportunities available for project and program development from sources at the local, state and federal level. Some funding sources require significant efforts to prepare an application, and some funding sources are highly competitive and/or over-subscribed. There should be careful consideration of the competitive strength of the projects and the inter-agency support needed for the pursuit.

Grant Matching Fund Assistance

The City of Corinth should establish a Matching Funds Program that could be utilized as matching funds for state and federal grant pursuits.

Local Support to Implement Active Transportation Plan Recommendations

There are many individuals in the communities that have skills that can be utilized by the City of Corinth to assist with grant writing, project conceptual designs, illustrative graphics and other grant writing support. Many are willing to offer their assistance at little or no cost for the betterment of their community. The City of Corinth should utilize the local talent of its active citizens and consulting community to develop and promote the Active Transportation Plan.

Source: TxDOT

SafeRoutes

Source: Valley Transportation Authority

S | S
4 | A

Source:USDOT

Active Transportation Plan

City of Corinth, Texas
Adopted June 5th, 2025

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Corinth Active Transportation Plan

Appendix A: Complete Streets Design Manual

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Table of Contents

Selected chapters adopted with permission from the Los Angeles County Complete Streets Model Design For Living Streets.

Suzanne Bogert | Ryan Snyder | Colleen Callahan | Michael Ronkin I Jean Armbruster | Edward Belden, LEED-AP | Pippa Brashear | Madeline Brozen | Marty Bruinsma | Dan Burden | Julia Campbell, LEED AP, EIT | Lisa Cirill, M.S., P.A.P.H.S | Art Cueto | J.R. DeShazo | Peter Eun | Charlie Gandy | Norman Garrick, Ph.D | Said Gharbieh, BSc, MSc, FCIHT, FCIT, MBIM | Ellen Greenberg, PE | Gayle Haberman | Andre Haghverdian, PE | Holly Harper | Billy Hattaway | Brett Hondorp, AICP | Julia Lave Johnston | Peter Lagerwey | Brad Lancaster | Stephanie Landregan, FASLA, LEED-AP | Ian Lockwood, PE | Loeb Fellow | Jana Lynott, AICP | Mukul Malhotra | Tim Mann, RLA | Barbara McCann | Cullen McCormick | Jessica Meaney | Lys Mendez | Rock Miller, PE | Kelly Morphy | Michael Moule, PE, TE, PTOE | Deborah Murphy, Associate AIA | Narasimha Murthy, Ph.D., TE | Margot Ocañas | Lisa Padilla, AIA, LEED-AP | Simon Pastucha | Jen Petersen, Ph.D | Grace Phillips | Francis Reilly | James Rojas | David Sargent | Will Schroeer | Jessica Scully | Chanda Singh | Heather Smith | Pat Smith, ASLA, AICP, Certified Arborist | Gary Toth | Michael Wallwork, PE | Michele Weisbart | Scott Windley | Will Wright | Sky Yim | Paul Zykofsky, AICP, Associate AIA

1. Introduction

Background

A growing number of communities are discovering the value of their streets as important public spaces for many aspects of daily life. People want streets that are safe to cross or walk along, offer places to meet people, link healthy neighborhoods, and have a vibrant mix of retail. More people are enjoying the value of farmers' markets, street festivals, and gathering places. And more people want to be able to walk and ride bicycles in their neighborhoods.

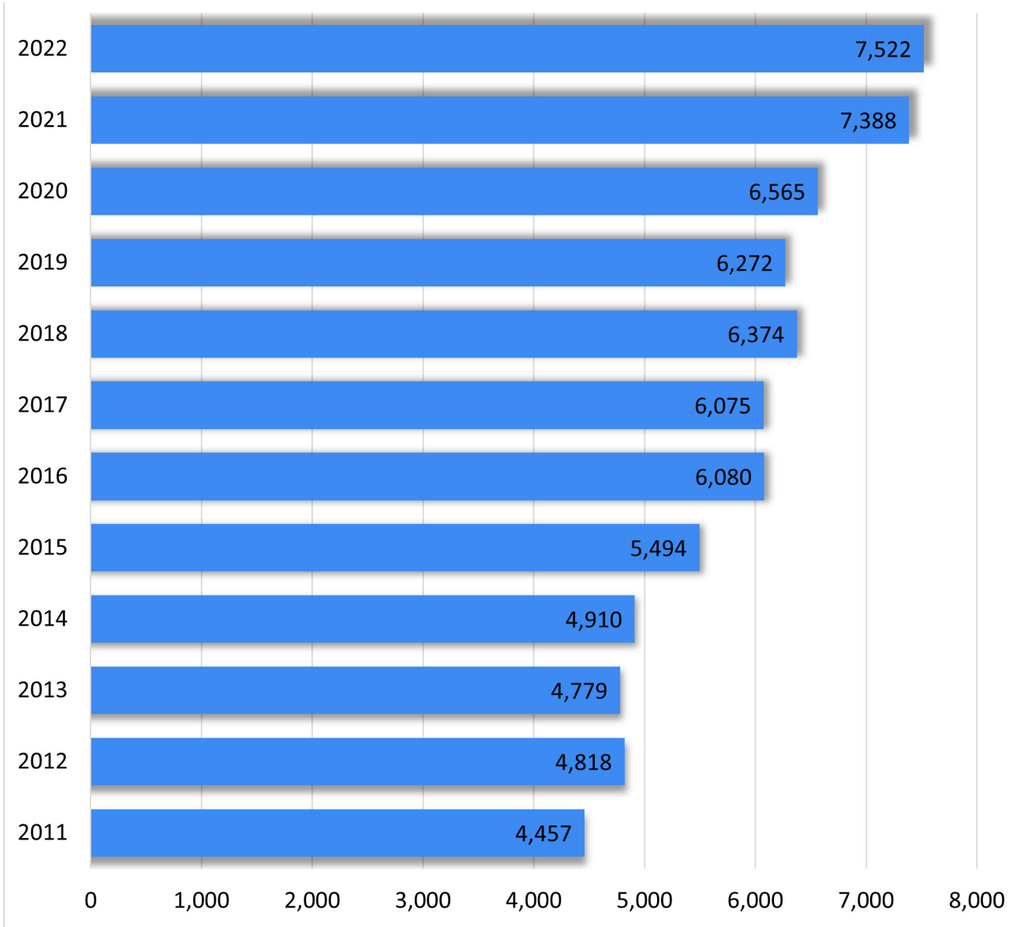
People from a wide variety of backgrounds are forming partnerships with schools, health agencies, neighborhood associations, environmental organizations, and other groups in asking their city councils to create streets and neighborhoods that fit this vision.

As a result, an increasing number of cities are looking to modify the way they design their streets. According to Smart Growth America, as of 2023, 503 Complete Streets policies have been adopted across the United States.

Additionally, safety is a mounting concern. On a national level, America is experiencing increasing pedestrian fatalities. According to the U.S. Department of Transportation (USDOT), pedestrian fatalities increased by 68% between 2011 and 2022.

Street with accommodations for multimodal transportation

Exhibit 1. *Total Pedestrian Fatalities in the U.S., 2011-2022*



Complete Streets

According to the National Complete Streets Coalition (NCSC), Complete Streets is a **process and approach** that enables safe access to streets for all users. Complete Streets aims to redesign or reimagine existing **streets** that have an outdated design that can be dangerous or deadly for users without a personal vehicle.

There is no single solution, approach, or road design which applies to all streets. A Complete Streets approach considers the environmental and social context of the area and applies a safety and equity lens. It also involves emphasizing those persons or communities whose needs have historically not been met by traditional roadway design, including those with disabilities, those without access to vehicles, and other historically disadvantaged communities.

> Complete Streets are streets for everyone. Complete Streets is an approach to planning, designing, building, operating, and maintaining streets that enables safe access for all people who need to use them, including pedestrians, bicyclists, motorists and transit riders of all ages and abilities.
> - NCSC, Smart Growth America

Complete street elements may include:

- Sidewalks
- Bike lanes (or paved shoulders) and storage
- Special bus lanes
- Comfortable and accessible public transportation stops
- Frequent and safe crosswalks and ramps
- Median islands
- Accessible pedestrian signalS
- Curb extensions and curb cuts
- Narrower travel lanes
- Roundabouts
- Wayfinding signage
- Lighting
- Shade structures
- Scooter corrals
- Seating
- Trash bins
- Xeriscaping
- Bioswales
- Curbside access management, and more.

Benches and landscaping

Pedestrian refuge area

ADA accessibility ramp

Buffered bike lane

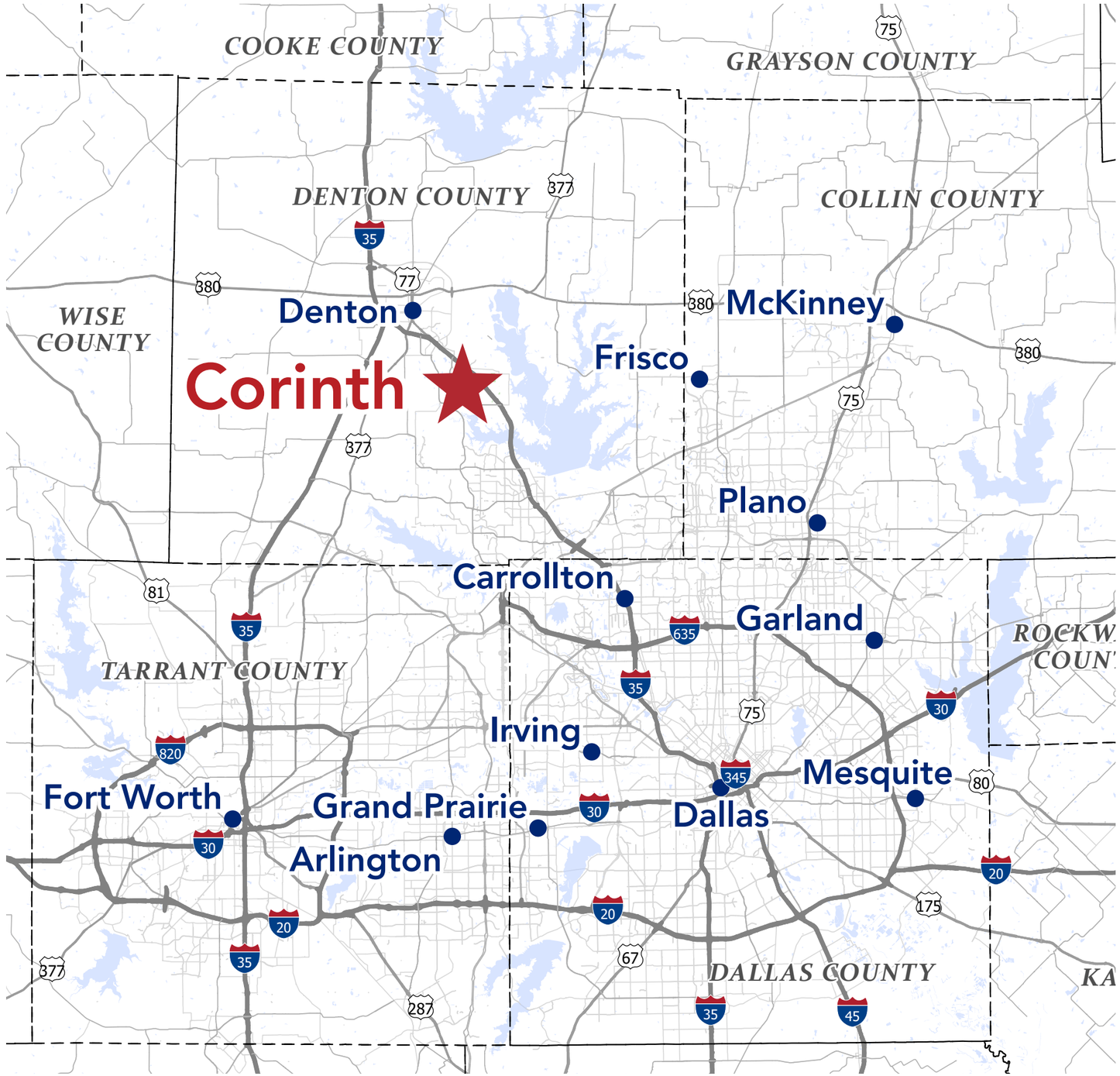
Area Context

The City of Corinth, Texas has identified the need for street design standards which advance the needs of all users of the transportation network. In the area, low-density residential land uses, industrial activity, climate, and auto-centric design and development have contributed to a sprawling effect, exacerbating a car-centric transportation system.

Located just southeast of Denton in the Dallas-Fort Worth Metroplex, Corinth is home to around 22,500 people[1]. In 2022, 78.2% of workers in the City of Corinth drove alone to work, compared to 75.1% in Texas[2].

Corinth's 2040 Comprehensive Plan, Envision Corinth, lists Complete, Connected, and Safe Neighborhoods as one of its guiding principles, with "sidewalks, trails, and green infrastructure as street improvements that enhance quality of life and the experience of Corinth." A Complete Streets approach to transporation network design is one tool to assist Corinth in achieving this vision. In combination with the Active Transportation Plan, the Complete Streets Manual will help address various issues within Corinth and provide the City with guidance for designing and building streets that serve all users.

Exhibit 2. *Area Context of Corinth*



1 U.S. Census Bureau. "AGE AND SEX." ACS 5-Year Estimates Subject Tables, Table S0101, 2022. Accessed on September 4, 2024.
2 U.S. Census Bureau. "COMMUTING CHARACTERISTICS BY SEX." ACS 5-Year Estimates Subject Tables, Table S0801, 2022. Accessed on September 4, 2024.

2. Vision, Goals, Policies & Benchmarks

This chapter sets the framework for the street design manual. A manual should not prescribe how to design every segment of every street; rather, after clearly defining what a community wants to accomplish with its streets, designers can apply this framework along with the specific guidance from other chapters to meet the community's goals.

Vision

The vision of the Complete Streets Design Manual is to encourage and guide the planning, design, and implementation of streets rights-of-way to enable safe access and mobility for all users including pedestrians, bicyclists, motorists, and transit riders of all ages and abilities. Complete Streets should:

- Integrate connectivity and traffic calming with pedestrian-oriented site and building design to create safe and inviting places
- Foster vibrant and resilient commercial activity
- Strengthen and enhance neighborhoods as envisioned by community members without displacing current residents
- Encourage active and healthy lifestyles
- Vary in character by neighborhood, density, and function

Goals

Goals state the broad, overriding outcomes a city wants to achieve. The goals of designing living streets are to:

- Serve the land uses that are adjacent to the street
- Encourage people to travel by walking, bicycling, and transit, and to drive less
- Provide transportation options for people of all ages, physical abilities, and income levels
- Enhance the safety and security of streets, from both a traffic and personal perspective
- Promote the economic well-being of both businesses and residents
- Increase civic space and encourage human interaction

Policies

Policies (or objectives) assist in implementing the goals and overall vision. Proposed policies are related to the elements of Complete Streets established by the National Complete Streets Coalition and are listed in Exhibit 3.

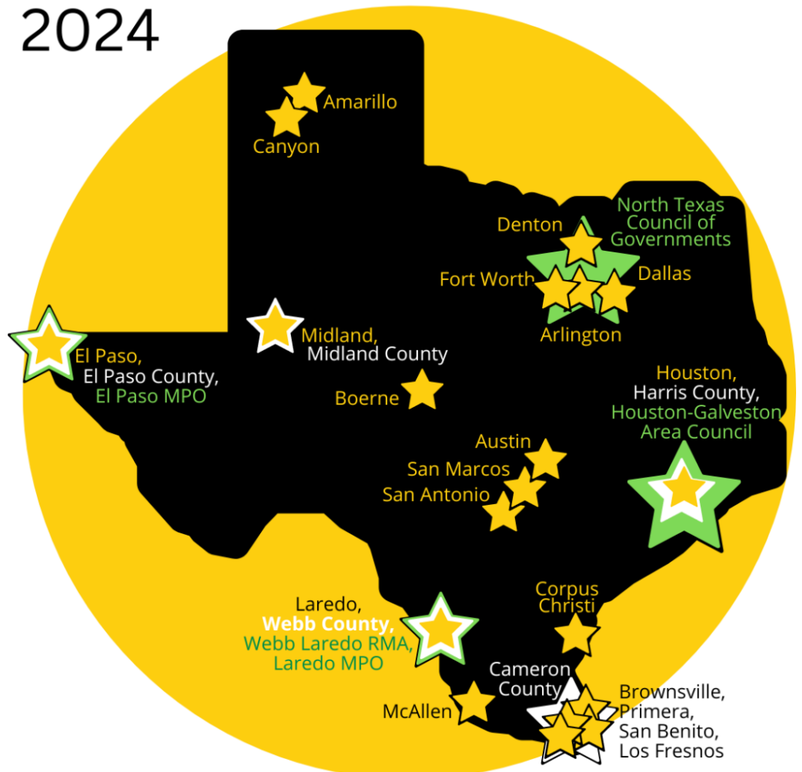
Alley activation: Denver, CO.

Exhibit 3. *Street Elements and Policies*

Complete Streets Elements	Living Streets Policies
Vision	Cities should develop policies and practices that cause them to design their streets according to the bullet points in the Vision section above.
Connectivity	Cities should design, operate, and maintain a transportation system that provides a highly connected network of streets that accommodate all modes of travel. Cities should seek opportunities to repurpose rights-of-way, and to add new rights-of-way to enhance connectivity for pedestrians, bicyclists, and transit. Cities should prioritize non-motorized connectivity improvements to services, schools, parks, civic uses, regional connections, and commercial uses. Cities should require large, new developments to provide interconnected street networks with small blocks that connect to existing or planned streets on the perimeter of the development.
Jurisdiction	A city's living streets policy document is intended to cover all roads, streets, and alleys in the city. Every city agency, including public works, planning, redevelopment, street services, and others should follow the policies in this document. Cities should require all developers to obtain and comply with their standards.
Exceptions	Living streets should be included in all street construction, reconstruction, repaving, and rehabilitation projects, except under one or more of the following conditions: A. A project involves only ordinary maintenance activities designed to keep assets in serviceable condition, such as mowing, cleaning, sweeping, spot repair, concrete joint repair, or pothole filling, or when interim measures are implemented on temporary detour or haul routes. B. The city council exempts a project due to an excessively disproportionate cost of establishing a bikeway, walkway, or transit enhancement as part of a project. C. The city engineer and the director of the planning department jointly determine that incorporation of Complete Streets elements in the construction is not practically feasible or cost effective because of significant or adverse environmental impacts to waterways, flood plains, remnants of native vegetation, wetlands, mountainsides, or other critical areas, or due to impacts on neighboring land uses, including from right of way acquisitions. D. The director of the planning department issues a documented exception where changes to the street may detract from the historical or cultural nature of the street or neighborhood.
Sensitivity	Cities should design their streets with full input from local stakeholders. Cities should design their streets with a strong sense of place. They should use architecture, landscaping, streetscaping, public art, signage, etc. to reflect the community, neighborhood, history, and natural setting.
Context	Cities should plan their streets in harmony with the adjacent land uses and neighborhoods.
Implementation Plan	Cities should either implement living streets designs on every street, or initiate the process by preparing and adopting bicycle plans, pedestrian plans, green streets plans, Safe Routes to School plans, and an Americans with Disabilities Act transition plan. Cities should draw on all sources of transportation funding to implement living streets.

Design	Cities should adopt new living streets design guidelines to guide the planning, funding, design, construction, operation, and maintenance of new and modified streets while remaining flexible to the unique circumstances of different streets where sound engineering and planning judgment will produce context-sensitive designs. Cities should incorporate the street design guidelines' principles into all city plans, manuals, rules, regulations, and programs as appropriate. As new and better practices evolve, cities should incorporate those as well. Cities should provide well-designed pedestrian accommodation in the form of sidewalks or shared-use pathways on all arterial and collector streets and on local streets. Cities should provide frequent, convenient and safe street crossings. These may be at intersections designed to be pedestrian friendly, or at mid-block locations where needed and appropriate. Cities should provide bicycle accommodation along all avenues, boulevards, and connector streets. Where physical conditions warrant, cities should plant trees and manage streetwater whenever a street is newly constructed, reconstructed, or relocated.
Performance Measures	Use performance measures described in the following section.

Exhibit 4. *Texas Vision Zero Cities, Counties and Regional Agencies*



Source: Vision Zero Texas

VISION ZERO

Vision Zero is a strategy to eliminate all traffic fatalities and severe injuries, while increasing safe, healthy, equitable mobility for all. Implemented in Europe in the 1990s, cities across the USA have successfully implemented its strategies.

Several communities near Corinth have joined the Vision Zero movement with their own Vision Zero policies or plans (Exhibit 4), including the nearby City of Denton and the North Central Texas Council of Governments (NCTCOG).

Creating Benchmarks and Performance Measures

Conventional street design applies traditional performance measures, which focus on auto mobility measures. The most common is the Level of Service (LOS), which seeks to maintain flow of vehicles and leads to widening streets and intersections, removing on-street parking, and other strategies to accommodate the flow of traffic. Because LOS focuses on a singular solution of resolving congestion by adding intersection or roadway capacity, it can undermine the basic tenets of Complete Streets if the needs of other users and the urban context are not considered.

To meet the goals and tenets of living streets, communities should adopt the following aspirational benchmarks and performance measures.

Benchmarks

- Every street and neighborhood is comfortable to walk along.
- Every child can walk or bike to school safely.
- Seniors, children, and disabled people can cross all streets safely and comfortably.
- An active way of life is available to all.

Performance Measures

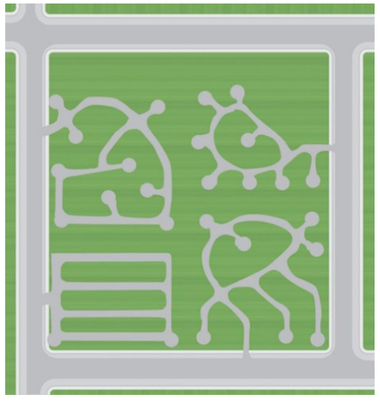
- Street fatalities and injuries decrease for all age groups.
- The number of trips by walking, cycling, and transit increases.
- Prevailing speeds of vehicles on local streets decrease.
- Resident satisfaction increases.

3. Street Networks And Classifications

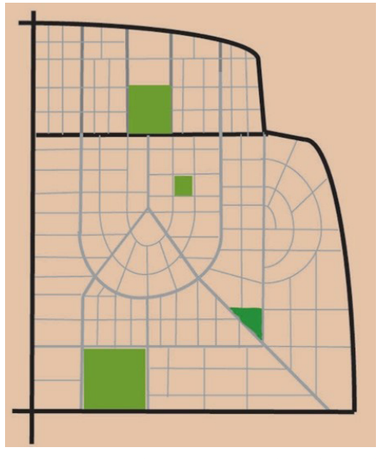
The United States has a long history of developing beautifully designed master planned communities. These include Savannah; Charleston; Washington; D.C.; Boston; Santa Monica; and San Francisco. The success of these cities is partially attributed to their well-designed street networks. Well-planned street networks help create sustainable cities that support the environmental, social, and economic needs of their residents.

Over 40,000 Americans perish each year in traffic crashes (NHTSA, 2021). A well-designed and -maintained street network can be a powerful tool for reducing traffic crashes and fatalities while creating beautiful places.

Sustainable street networks improve traffic safety, increase the number of people walking and bicycling, reduce vehicle trips, and reduce response times for emergency service vehicles.



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



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

Principles of Sustainable Street Networks

Sustainable street networks come in many shapes and forms but have the following overarching principles in common:

- The sustainable street network both shapes and responds to the natural and built environment.
- The sustainable street network fosters trips by foot, bike, and transit because these are the most sustainable types of trips.
- The sustainable street network is built to accommodate walking.
- The sustainable street network works in harmony with pedestrian, bicycle, transit, and private vehicle networks. They connect and interact with the vehicle network.
- The sustainable street network protects, respects, and enhances a city's natural features and ecological systems.
- The sustainable street network maximizes social and economic activity.

Street Characteristics and Classification

A sustainable street network provides a pattern of multimodal streets that serve all community land uses and facilitate easy access to local, city, and regional destinations. The pattern results in distribution of traffic that is consistent with the desired function of the street. It offers its users a choice of several routes that connect origins with their destinations.

The street network works best when it provides a variety of street types. These types are defined by the pattern of the street network itself and the design of individual street segments. Natural and built features, including topography and important community destinations, should be taken into account to create unique designs.

In new subdivisions, integrating a network of shared-use paths and earthen trails into the street network should be considered. Under this concept, every fourth or fifth "street" provides quiet, comfortable access for bicyclists, pedestrians, joggers, skaters, and others along a linear parkway with limited motor vehicle traffic. Where these provisions intersect streets, they should be treated as intersections with appropriate treatments.

This type of network would allow people to circulate in their new communities to schools, parks, stores, and offices while staying primarily on dedicated paths and trails. These networks can also link to paths and trails along waterways, utility corridors, rail rights-of-way, and other more common active transportation corridors. The illustration below shows this concept.

The types of streets used in the network differ in terms of their network continuity, cross-section design, and adjoining land use. The individual streets themselves will change in character depending on their immediate land use context.

Integrating bicycle and pedestrian paths into new development. (Credit: Michele Weisbart)

Context: The Transect

Street design should consider the context of the area in which the street exists. The appropriate Complete Street design will support and enhance the surrounding character while providing flexibility to accommodate future changes.

Context is defined as the environment in which the street is built and includes the placement and frontage of buildings, adjacent land uses and open space, and historic, cultural, and other characteristics that form the built and natural environments of a given place. The transect defines the context and assists in creating an appropriate design.

The transect zones range from Natural (T1) to Urban Core (T6). In the least-intensive T-Zones of a community, T1 and T2, a rural road or highway is appropriate.

Urban zones do not exist as "stand alone" zones, but rather are organized in relationship to each other within a community. Each zone is highly walkable and assumes the pedestrian mode as a viable and often preferred travel mode, especially for the ¼ mile, five-minute walk.

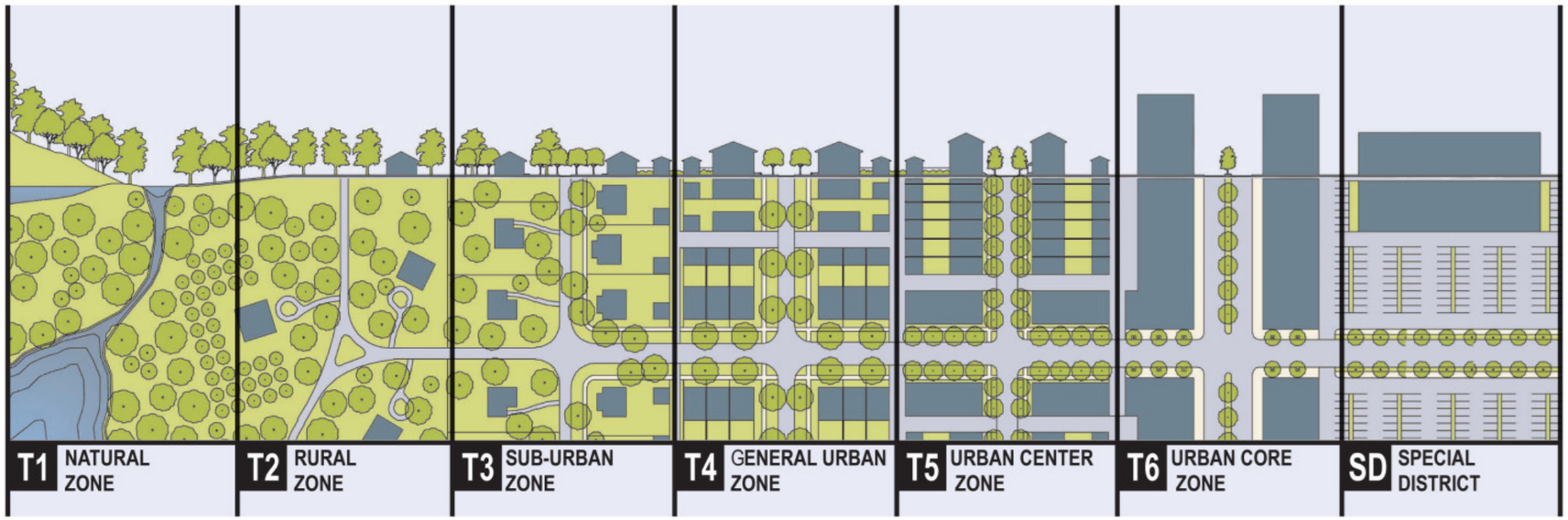
The T3 suburban zone defines the urban to rural edge. Of all the T-Zones, T3 appears most like conventional sprawl. It has single-family dwellings, a limited mix of uses and housing types, and tends to be more automobile-oriented than T4, T5, or T6. The five-minute test of walkable distance (¼ mile radius) limits the overall size of a T3 transect zone. The T3 zone often defines the edge of the more developed urban condition so is sometimes called the "neighborhood edge."

For example, knowing that a particular area is a T5, Town Center, defines the context for the built environment including the street design criteria and elements, such as the width of sidewalks, the presence of on-street parking, and the use of tree wells instead of planting strips. Buildings built to the sidewalk with parking on the street and behind, for instance, are appropriate in T5 and T6. Referring to a set of tables and design recommendations correlated to the transect helps the designer determine how a street should function in each T-Zone.

Contexts will not always flow evenly and incrementally from T1 to T6: there may be gaps. For example, T2 jumps to T5 may occur, or a rural community may have only T2 with a community center that is not urban enough to be T5 (for example, a church, convenience store, antique store, and gas station at the one intersection in the whole town).

An important element of the design process is to ensure the traveled way design fits the context of the intended design. Through use of a regulating plan, the appropriate street design will be established to fit the context, purpose, and type of street.

Exhibit 5. *The transect model zones. (Credit: Duany, Plater, Zyberk & Company)*



Street Configurations

The following are standards for creating a Complete Street network.

» Establish a block size maximum of 1,600 linear feet (perimeter):

- Ensure greater accessibility within the block through alleys, service courts, and other access ways
- Where block size is exceeded, retrofit large blocks with new street, alleys, pedestrian and/or bicycle connections
- For existing street networks, do not allow street closures that would result in larger blocks

» Require multiple street connections between neighborhoods and districts across the whole region. This is achieved by having boulevards and avenues that extend beyond the local area. Adjacent neighborhoods must also be connected by multiple local streets.

» Connect streets across urban freeways so that pedestrians and bicyclists have links to neighborhoods without having to use streets with freeway on and off ramps.

» Maintain network quality by accepting growth and expansion of the street network (including development, revitalization, intensification, or redevelopment) while avoiding increases in street width or in number of lanes.

» Provide on-street curbside parking on most streets. Exceptions can be made for very narrow streets, streets with bus lanes, or where there is a better use of the space.

» Establish maximum speeds of 20 to 35 mph:

- Use design features that support lower-speed environments
- On local streets, the speed should be 20 to 25 mph or less

» Maintain network function by discouraging:

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

» Classify major streets using the common street and context types presented on the following pages. However, some streets are unique and deserve a special category that lies outside the common street network types. Chapter 4. Traveled Way Design contains guidance related to cross sections of these street typologies.

Types and Roles of Streets

Federal Highway Function and Classification system contains the conventional classification system that is commonly accepted to define the function and operational requirements for streets. These classifications are also used as the primary basis for geometric design criteria.

Traffic volume, trip characteristics, speed and level of service, and other factors in the functional classification system relate to the mobility of motor vehicles, not bicyclists or pedestrians, and do not consider the context or land use of the surrounding environment. This approach, while appropriate for high speed rural and some suburban roadways, does not provide designers with guidance on how to design for living streets or in a context-sensitive manner.

The street types described here provide mobility for all modes of transportation with a greater focus on the pedestrian. The functional classification system can be generally applied to the street types in this document. Designers should recognize the need for greater flexibility in applying design criteria, based more heavily on context and the need to create a safe environment for pedestrians, rather than strictly following the conventional application of functional classification in determining geometric criteria.

The terms for street types for Complete Streets are described in the following sections.

Boulevard

A boulevard is a street designed for high vehicular capacity and moderate speed, traversing an urbanized area. Boulevards serve as primary transit routes. Boulevards should have sidewalks and buffered bike lanes. They may be equipped with bus lanes or side access lanes buffering sidewalks and buildings. Many boulevards also have landscaped medians.

Boulevard example. (Credit: Ryan Snyder)

Street

A street is a local, multi-movement facility suitable for all urbanized transect zones and all frontages and uses. A street is urban in character, with raised curbs (except where curbless treatments are designed), drainage inlets, sidewalks, parallel parking, and trees. Character may vary in response to the commercial or residential uses lining the street.

Street example. (Credit: Billy Hattaway)

Avenue

An avenue is a street of moderate to high vehicular capacity and low to moderate speed acting as a short distance connector between urban centers and may be equipped with a landscaped median.

Avenue example. (Credit: Ryan Snyder)

Alley/Lane

An alley or lane is a narrow street, often without sidewalks. Alleys and lanes connect streets and can provide access to the backs of buildings and garages.

Alley example. (Credit: Ryan Snyder)

Special Street Typologies

The special street typologies listed below have particular functions within the street network.

Exhibit 6. *Special Street Typologies*

Street Type	Description	Comment
Main Street	Slower vehicle speeds, favors pedestrians most, contains the highest level of streetscape features, typically dominated by retail and other commercial uses.	Functions differently than other streets in that it is a destination.
Transit Mall	The traveled way is for exclusive use by buses or trains, typically dominated by retail and other commercial uses.	Excellent pedestrian and emergency vehicle access to and along the transit mall is critical. Bicycle access may be supported.
Bike Boulevard	A through street for bicycles, but short distance travel for motor vehicles.	Usually a local street with low traffic volumes.
Festival Street	Contains traffic calming, flush curbs, and streetscape features that allow for easy conversion to public uses such as farmers' markets and music events.	
Shared Space	Slow, curbless street where pedestrians, motor vehicles, and bicyclists share space.	May support café seating, play areas, and other uses.

4. Traveled Way Design

Streets and their geometric design have traditionally focused on the movement of motor vehicles, resulting in street environments that neglect other users. This emphasis can be seen in wide travel lanes, large corner radii, and turn lanes that severely impede the safety of pedestrians and the overall connectivity for non-automobile users. The geometric design of the traveled way and intersections has usually reflected the need to move traffic as quickly as possible. Existing roadway designs need to be considered to reclaim the public right-of-way for pedestrians and bicyclists and create living streets.

Traveled way design is defined as the part of the street right-of-way between the two faces of curbs and can include parking lanes, bicycle lanes, transit lanes, general use travel lanes, and medians. The design of the traveled way is critical to the design of the entire street right-of-way because it affects not just the users in the traveled way, but those using the entire right-of-way, including the areas adjacent to the street. As a note on terminology, "traveled way" in this document is more or less the equivalent of "roadway" in most conventional design manuals: the curb-to-curb portion of a curbed street.

Principles of Traveled Way Design

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

- **Design to accommodate all users**. Street design should accommodate all users of the street, including pedestrians, bicyclists, transit users, automobiles, and commercial vehicles. A well-designed traveled way provides appropriate space for all street users to coexist.
- **Design using the appropriate speed for the surrounding context**. The right design speed should respect the desired role and responsibility of the street, including the type and intensity of land use, urban form, the desired activities on the sidewalk, such as outdoor dining, and the overall safety and comfort of pedestrians and bicyclists. The speed of vehicles impacts all users of the street and the livability of the surrounding area. Lower speeds reduce crashes and injuries.
- **Design for safety.** The safety of all street users, especially the most vulnerable users (children, the elderly, and disabled) and modes (pedestrians and bicyclists) should be paramount in any design of the traveled way. The safety of streets can be dramatically improved through appropriate geometric design and operations.

Building on the momentum of Complete Streets that have been successfully implemented in different parts of the nation and around the world, there is a strong need to retrofit existing streets and create new types of street environments that reflect the values and desires of all users. This chapter discusses different factors affecting traveled way design. Individual geometric design elements such as lane width and sight distance are examined in detail.

The benefits and constraints of each element are examined and the appropriate location and correct use of each element is defined to maximize the creation of living streets.

Wide, uninviting street. (Credit: Dan Burden)

Senior citizens need more time to cross the street. (Credit: Ryan Snyder)

Factors Affecting Street Design

Pedestrians

Walking is the most basic mode of transportation, yet pedestrians are often ignored in roadway design. Certain areas generate high pedestrian activity, such as downtowns, residential, commercial and entertainment areas, and schools. Yet even in areas of low pedestrian activity, such as along commercial strip-developed arterials, pedestrian needs and safety must be addressed, as drivers usually don't expect pedestrians

As speeds increase, drivers are less attentive to what is happening on the side of the road, reaction time is increased, and the pedestrian has a higher chance of dying or becoming severely injured in case of a crash.

Most pedestrian crashes occur when a person crosses the road, and the most common crash type is a conflict between a crossing pedestrian and a turning vehicle at an intersection. But designing for pedestrians should not focus primarily on avoiding crashes; the goal of roadway and intersection design should be to create an environment that is conducive to walking, where people can walk along and cross the road, where the roadside becomes a place people want to be. The two most effective methods to achieve these goals are to minimize the footprint dedicated to motor vehicle traffic and to slow down the speed of moving traffic. This approach allows the designer to use many features that enhance the walking environment, such as trees, curb extensions, and street furniture, which in turn slow traffic: a virtuous cycle. All streets should have sidewalks except for rural roads and shared-space streets.

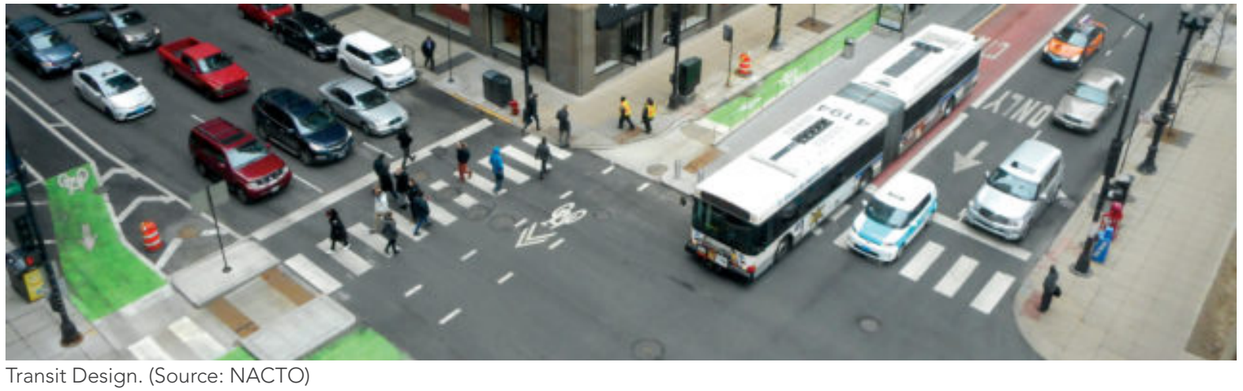
Bicyclists

All streets should be designed with the expectation that bicyclists will use them. This does not mean every street needs a dedicated bicycle facility, nor will every road accommodate all types of bicyclists. Minimizing the footprint dedicated to motor vehicle traffic and slowing down the speed of moving traffic benefits bicyclists. Ideally, all multi-lane streets should have buffered bike lanes. On multi-lane streets where buffered bike lanes are not feasible because of space constraints, other bikeway treatments should be considered.

Public Transportation

Designing for transit vehicles on roadways takes into consideration many factors. Buses have operational characteristics that resemble trucks. Buses usually operate in mixed traffic, they stop and start often for passengers, and they must be accessible to people boarding the bus. The consequences for roadway design include lane width, intersection design (turning radius or width of channelization lane), signal timing (often adjusted to give transit an advantage—queue jumping), pedestrian access (crossing the street at bus stops), sidewalk design (making room for bus shelters in the furniture zone), and bus stop placement and design (farside/nearside at intersections, bus pullouts, or bulb outs).

Where express bus service or Bus Rapid Transit is provided, exclusive bus lanes are desirable. These have unique operating characteristics that are beyond the scope of this manual.



Transit Design. (Source: NACTO)

Design Vehicles

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

For design purposes, the WB-40 (wheel-base 40 feet) is appropriate unless larger vehicles are more common. On bus routes and truck routes, designing for the bus (CITY-BUS or similar) or large truck (either the WB-50 or WB-62FL design vehicle) may be appropriate, but only at intersections where these vehicles make turns. For example, for intersection geometry design features such as corner radii, different design vehicles should be used for each intersection or even each corner, rather than a "one-size-fits-all" approach, which results in larger radii than needed at most corners. The design vehicle should be accommodated without encroachment into opposing traffic lanes. It is generally acceptable to have encroachment onto multiple same-direction traffic lanes on the receiving roadway.

Furthermore, it may be inappropriate to design a facility by using a larger "control vehicle," which uses the street infrequently, or infrequently makes turns at a specific location. An example of a control vehicle is a vehicle that makes no more than one delivery per day at a business. Depending on the frequency, by under designing, the control vehicle can be allowed to encroach on opposing traffic lanes or make multiple-point turns.

Design Speed

The application of design speed for living streets is philosophically different than for conventional transportation practices. Traditionally, the approach for setting design speed is to use as high a design speed as practical. This has many negative effects. For pedestrians in particular, when in a collision with a vehicle, the vehicle's speed has drastic effects on the pedestrian's chance of surviving (Exhibit 7). According to the USDOT, a pedestrian is 70% more likely to die in a crash with a vehicle when the vehicle's speed is 40 mph compared to 20 mph.

Speed kills places as well as people, and places efficiency over access. Because high design speeds reduce access to places on foot, they degrade the social and retail life of a street and devalue the adjacent land. Local economies thrive on attracting people.

In contrast to this approach, the goal for Complete Streets is to establish a design speed that creates a safer and more comfortable environment for motorists, pedestrians, and bicyclists. This approach also increases access to adjacent land, thereby increasing its value. For Complete Streets, design speeds of 20 to 35 mph are desirable. Alleys and narrow roadways intended to function as shared spaces may have design speeds as low as 10 mph.

Design speed does not determine nor predict exactly at what speed motorists will travel on a roadway segment; rather, design speed determines which design features are allowable (or mandated). Features associated with high-speed designs, such as large curb radii, straight and wide travel lanes, ample clear zones (no on-street parking or street trees), guardrails, etc., degrade the walking experience and make it difficult to design living streets. In the end, the design of the road encourages high speeds and creates a vicious cycle. A slower design speed allows the use of features that enhance the walking environment, such as small curb radii, narrower sections, trees, on-street parking, curb extensions, and street furniture, which in turn slow traffic: a virtuous cycle.

Design speeds higher than 35 mph should not normally be used within communities, or in Transects T3 and above. Speeds greater than 30 mph or 35 mph are not recommended.

Street with high auto LOS. (Credit: Dan Burden)

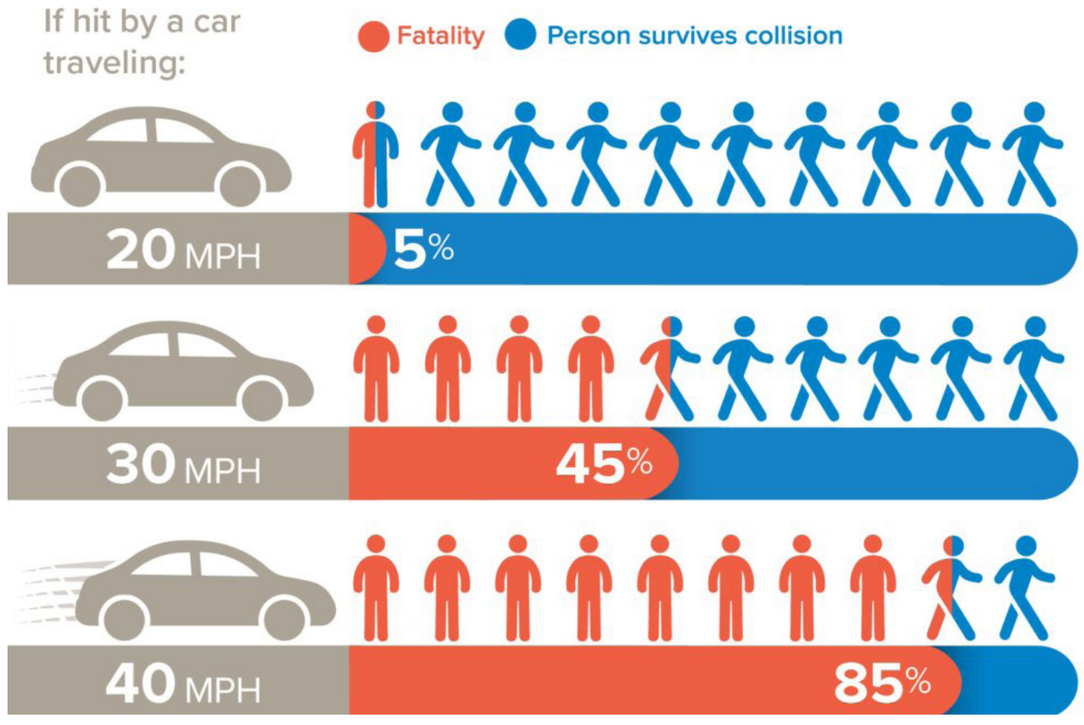
Communities that have streets functioning at speeds greater than 35 mph may want to re-design the corridor to reduce the speed to 35 mph or less. When the speed reduction cannot be achieved, measures to improve pedestrian safety for those crossing the corridor should be evaluated and installed when appropriate.

Traffic Volume and Composition

Traffic volume data collection is an integral part of transportation planning and decision making. Traffic volume data are collected for various periods of the day depending on the purpose for which the data is used. For most analyses it is necessary to collect peak period and daily traffic.

There are special types of traffic volume counts such as vehicle classification counts and average vehicle occupancy. The traffic volumes collected are also used for a variety of studies, including forecasting. Traffic volume on a segment of a road or at an intersection can be collected either manually or by using tubes.

Exhibit 7. *Vehicle Travel Speeds and Pedestrian Injuries (Source: National Traffic Safety Board)*



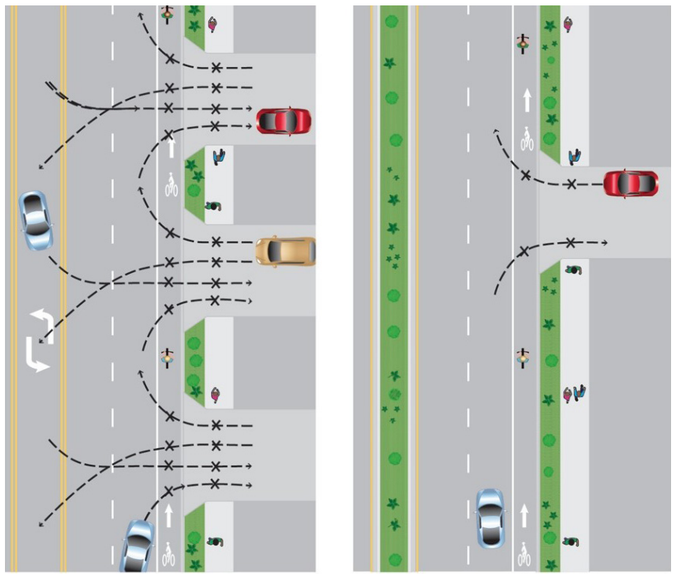
Access Management

A major challenge in street design is balancing the number of access points to a street. The presence of many driveways in addition to the necessary intersections creates many conflicts between vehicles entering or leaving a street and bicyclists and pedestrians riding or walking along the street. When possible, new driveways should be minimized and old driveways should be eliminated or consolidated, and raised medians should be placed to limit left turns into and out of driveways.

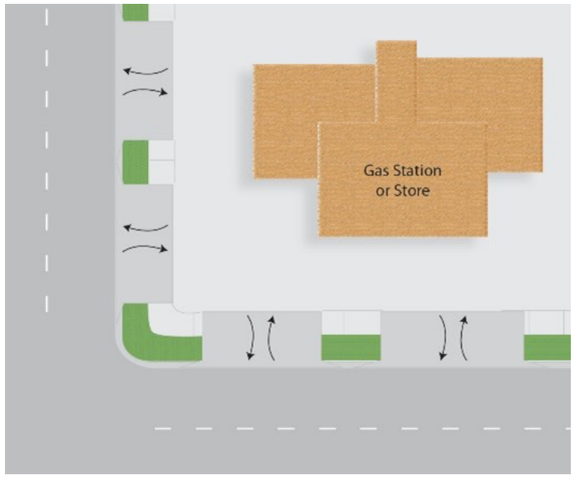
Benefits of Access Management

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

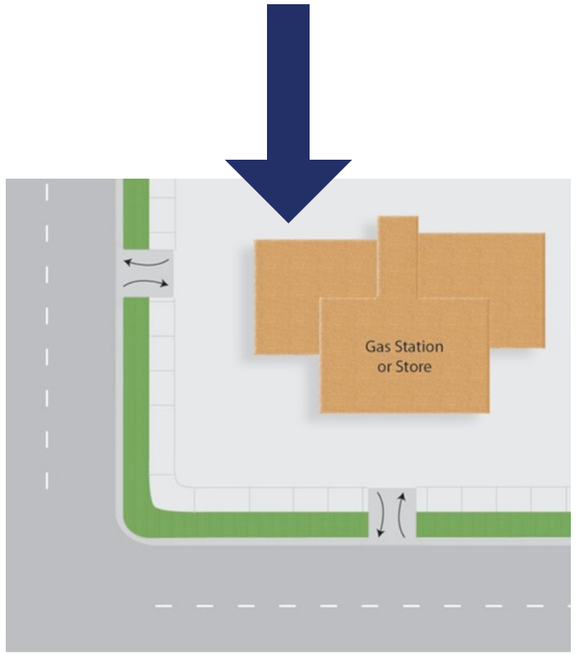
- The number of conflict points is reduced, especially by replacing center-turn lanes with raised medians.
- Pedestrian crossing opportunities are enhanced with a raised median.
- Universal access for pedestrians is easier, since the sidewalk is less frequently interrupted by driveway slopes.
- Fewer driveways result in more space available for higher and better uses (e.g., more parking spaces).
- Improved traffic flow may reduce the need for road widening, allowing part of the right-of-way to be recaptured for other users.



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



Corner with many wide driveways. (Credit: Michele Weisbart)



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

Cross Sectional Elements

Complete Streets design treats streets as part of the public realm. The street portion of the public realm is shaped by the features and cross section elements used in creating the street. Attention to what features are included, where they are placed, and how the cross section elements are assembled are necessary for successful design.

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

Parking assist lane. (Credit: Michael Wallwork)

On-Street Parking

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

However, cities should manage demand for on-street parking by charging market-rate prices. Free or under-priced parking encourages people to drive instead of taking transit, biking, or walking. Parking expert Donald Shoup recommends setting variable parking prices to target a 15% vacancy rate for curb parking. In addition to encouraging people to curtail driving, it also creates turnover that benefits retailers by making convenient parking available for short shopping trips.

Where angle parking is proposed for on-street parking, designers should consider the use of reverse-in angle (or front out) parking in lieu of front-in angled parking. Motorists pulling out of reverse-in angled parking can better see the active street they are entering. This is especially important to bicyclists. Moreover, people exiting cars do so on the curb side and are not likely to step into an active travel lane.

Another tool for on-street parking is the park assist lane. Often when on-street parking is provided on busy roads, drivers find it difficult to enter and leave their parked vehicle. Where space is available, consideration should be given to adding a park assist lane between the parking lane and travel way to provide 3 feet of space so car doors can be opened and vehicles can enter or depart with a higher degree of safety and less delay. Bike lanes can serve this function as well. Parking assist lanes also narrow the feel of the travel lane and slow traffic.

Bicycle Facilities

Bicycle facilities within the traveled way may include bicycle lanes of various configurations, cycle tracks, and other types of shared roadways (with or without shared lane markings).

Transit Facilities

Transit accommodations within the traveled way may include dedicated transit lanes, bus bulbs, bus pullouts, and other features.

Travel Lanes

Travel lane widths should be provided based on the context and desired speed for the area that the street is located in. In low-speed urban environments, lane widths are typically measured to the curb face instead of the edge of the gutter pan. Consequently, when curb sections with gutter pans are used, the vehicle, bike, and parking lane all include the width of the gutter pan.

In order for drivers to understand how fast they should drive, lane widths have to create some level of driver discomfort when driving too fast. When designated bike lanes or multi-lane configurations are used, there is more room for large vehicles, such as buses, to operate in, but car drivers will feel more comfortable driving faster than is desired.

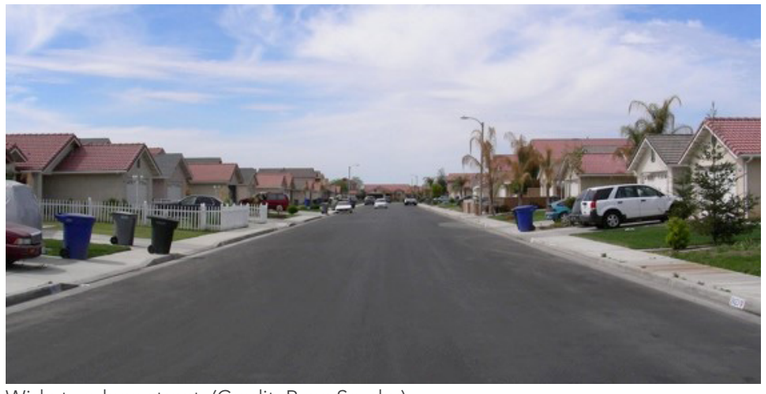
Alleys can be designed as one-way or two-way. Right-of-way width should be a minimum of 20 feet with no permanent structures located within the right-of-way that would interfere with vehicle access to garages or parking spaces, access for trash collection, and other operational needs. Pavement width should be a minimum of 12 feet. Coordination with local municipalities on operational requirements is essential to ensure that trash collection and fire protection services can be completed.

Turn Lanes

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

Left-turn lanes are considered to be acceptable in an urban environment since there are negative impacts to roadway capacity when left turns block the through movement of vehicles. Sometimes just a left-turn pocket is sufficient, just long enough for one or two cars to wait out of traffic. The installation of a left-turn lane can be beneficial when used to perform a road diet such as reducing a four lane section to three lanes with the center lane providing for turning movements.

In urban places, normally no more than one left-turn lane should be provided. While right turns from through lanes may delay through movements, they also create a reduction in speed due to the slowing of turning vehicles. The installation of right-turn lanes increases the crossing distance for pedestrians and the speed of vehicles; therefore, exclusive right-turn lanes should rarely be used except at "T" intersections. When used, they should be mitigated with raised channelization islands.



Wide two-lane street. (Credit: Ryan Snyder)

Narrow two-lane street. (Credit: Michael Ronkin)

Medians

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

Medians can be used to create tree canopies over travel lanes, contributing to a sense of enclosure. As shown in Exhibit 8, medians vary in width. Recommended widths depend on available right-of-way and function. Because medians require a wider right-of-way, the designer must weigh the benefits of a median with the issues of pedestrian crossing: distance, speed, context, and available roadside width.

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

Exhibit 8. *Median Types and Widths*

Median Type	Minimum Width	Recommended Width
Median for access control	4 feet	6 feet
Median for pedestrian refuge	6 feet	8 feet
Median for trees and lighting	6 feet (1)	10 feet (2)
Median for single left-turn lane	10 feet (3)	10 feet (2)
Median for single left-turn lane and pedestrian refuge	16 feet (4)	16 feet

Notes:
[1] Six feet measured curb face to curb face is generally considered the minimum width for proper growth of small caliper trees (less than 4 inches).
[2] Wider medians provide room for larger caliper trees and more extensive landscaping.
[3] A 10-foot lane provides for a turn lane without a concrete traffic separator.
[4] Includes a 10-foot turn lane and a 6-foot pedestrian refuge.

Other Geometric Design Elements

Vertical Alignment

The American Association of State Highway and Transportation Officials (AASHTO) *Geometric Design of Highways and Streets manual* (AASHTO Green Book) provides acceptable values for designing vertical curves for living streets. The values used in design of vertical curve design should be selected based on the design speed appropriate for the context of the street. Using higher values can contribute to increased vehicle speeds and may require increased modification to the natural terrain, increasing negative impacts to the natural environment.

Horizontal Alignment

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

Sight Distance

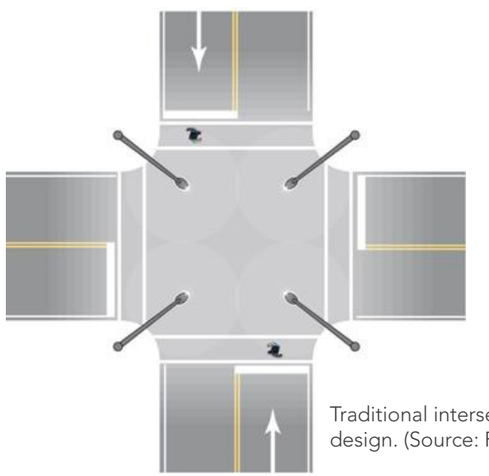
Stopping Sight Distance

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

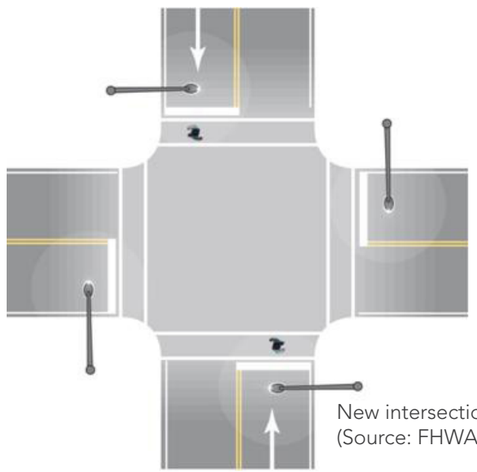
Intersection Sight Distance

Intersection sight distance should be calculated in accordance with the AASHTO Green Book using the design speed appropriate for the street being evaluated. When executing a crossing or turning maneuver onto a street after stopping at a stop sign, stop bar, or crosswalk, drivers will move slowly forward to obtain sight distance (without intruding into the crossing travel lane) stopping a second time as necessary.

Therefore, when curb extensions are used or on-street parking is in place, the vehicle can be assumed to move forward on the second step movement, stopping just shy of the travel lane, increasing the driver's potential to see farther than when stopped at the stop bar. As a result, the increased sight distance provided by the two-step movement allows parking to be located closer to the intersection.



Traditional intersection lighting design. (Source: FHWA-HRT-08-053)



New intersection lighting design. (Source: FHWA-HRT-08-053)

Horizontal Clearance/Clear Zone

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

In urban areas, horizontal clearance based on clear zone requirements for rural and suburban highways is not practical because urban areas are characterized by more bicyclists and pedestrians, lower speeds, more dense abutting development, closer spaced intersections and accesses to property, higher traffic volumes, and restricted right-of-way. Therefore, streets with curbs and gutters in urban areas do not have sufficiently wide roadsides to provide clear zones.

Consequently, while there are specific horizontal clearance requirements for these streets, they are based on clearances for normal operation and not based on maintaining a clear roadside for errant vehicles. The minimum horizontal clearance is 1.5 feet measured from the face of the curb. This is primarily intended for sign posts and poles, so they aren't hit by large vehicles with overhangs maneuvering close to the curb.

Traveled Way Lighting

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

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

FHWA-HRT-08-053, Informational Report on Lighting Design for Midblock Crosswalks, (April 2008) is a very good resource. It also contains very useful information about lighting design for pedestrians at intersections.

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

5. Intersection Design

Most conflicts between roadway users occur at intersections, where travelers cross each other's path. Good intersection design indicates to those approaching the intersection what they must do and who has to yield. Exceptions to this include places where speeds are low (typically less than 18 mph) or where a shared space design ("naked streets") causes users to approach intersections with caution. Conflicts for pedestrians and bicyclists are exacerbated due to their greater vulnerability, lesser size, and reduced visibility to other users.

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

Lively intersection. (Credit: Dan Burden)

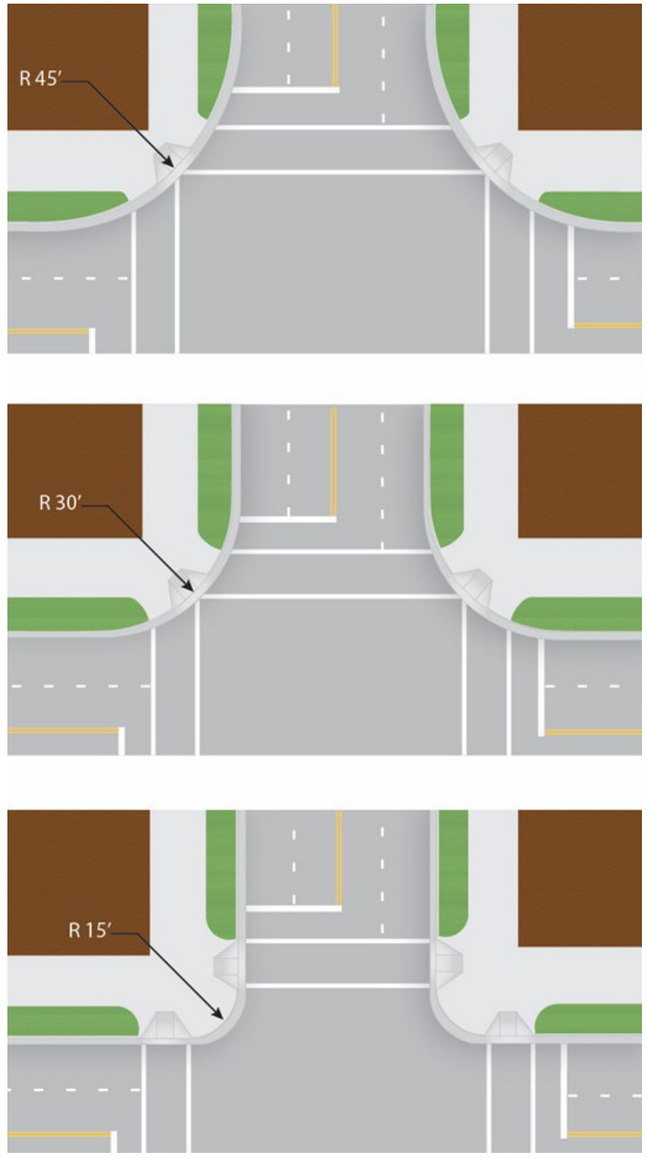
Principles of Intersection Design

The following principles apply to the design of intersections:

- Good intersection designs are compact.
- Conflicts should be avoided.
- Simple right-angle intersections are best for all users since many intersection problems are worsened at skewed and multi-legged intersections.
- Uninterrupted/free-flowing movements should be avoided.
- Access management practices should be used to remove additional vehicular conflict points near the intersection.
- Signal timing should consider the safety and convenience of all users and should not hinder bicycle or foot traffic with overly long waits or insufficient crossing times.

Intersection Geometry

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



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

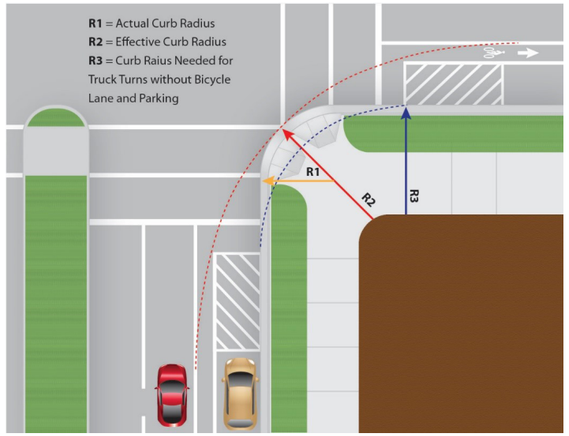
Corner Radii

This intersection geometry feature has a significant impact on the comfort and safety of non-motorized users. Small corner radii provide the following benefits:

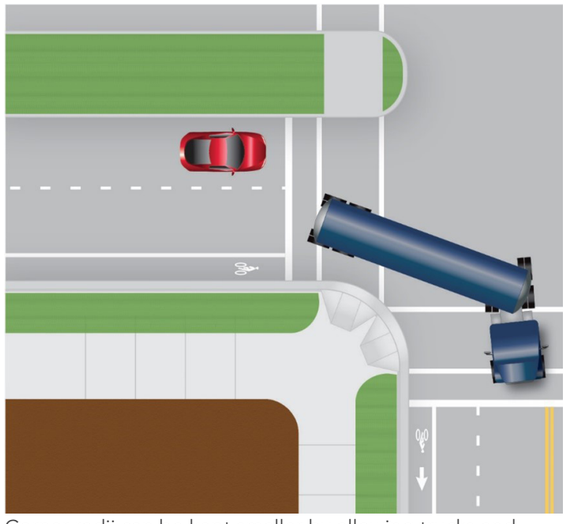
- Smaller, more pedestrian-scale intersections resulting in shorter crossing distances
- Slower vehicular turning speeds
- Reduced pedestrian crossing distance and crossing time
- Better geometry for installing perpendicular ramps for both crosswalks at each corner
- Simpler, more appropriate crosswalk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

When designing corner radii for Complete Streets, the default design vehicle should be the passenger vehicle. Therefore, the default corner radius is 15 feet. Larger design vehicles should be used only where they are known to regularly make turns at the intersection, and corner radii should be designed based on the larger design vehicle traveling at crawl speed. In addition, designers should consider the effect that bicycle lanes and on-street parking have on the effective radius, increasing the ease with which large vehicles can turn.

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



The effective corner radius controls turning speeds and the ability of large vehicles to turn. (Credit: Michele Weisbart)



Corner radii can be kept smaller by allowing trucks and buses to turn into multiple receiving lanes. (Credit: Michele Weisbart)

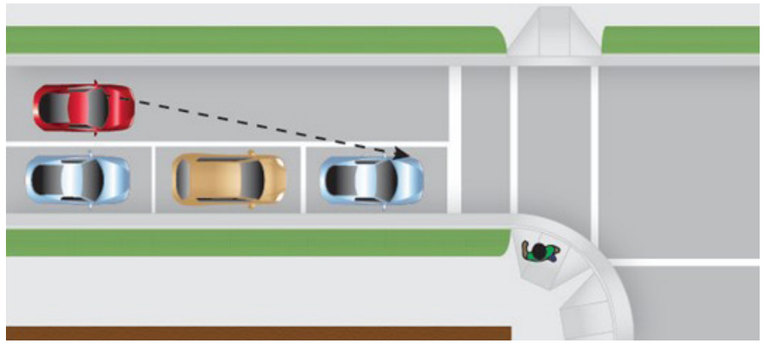
Curb Extensions

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

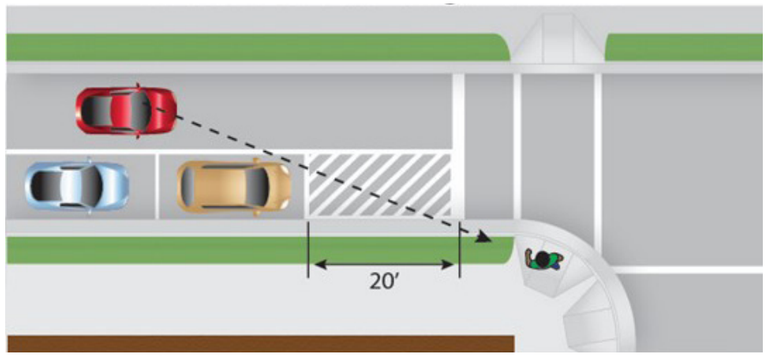
Curb extensions offer many benefits related to livability:

- Reduced pedestrian crossing distance resulting in less exposure to vehicles and shorter pedestrian clearance intervals at signals
- Improved visibility between pedestrians and motorists
- A narrowed roadway, which has a potential traffic calming effect
- Additional room for street furniture, landscaping, and curb ramps
- Slower turning vehicles
- Additional on-street parking potential due to improved sight lines at intersections. Since curb extensions allow pedestrians to walk out toward the edge of the parking lane without entering the roadway, pedestrians can better see vehicles and motorists can better see pedestrians.
- Management of streetwater runoff

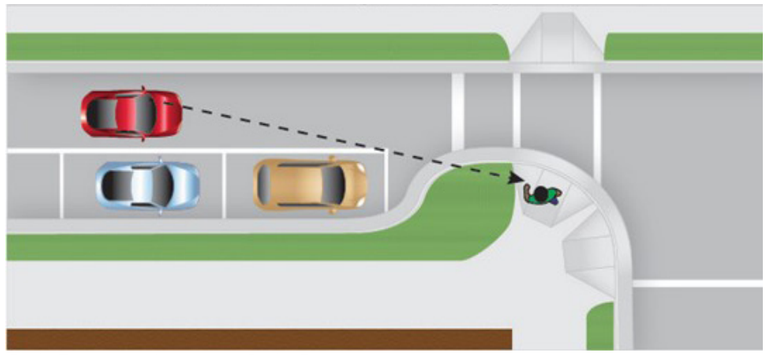
To fully achieve livability goals, the curb extension and parking area can be integrated into the furniture zone portion of the sidewalk corridor. This technique involves using similar surface materials for the curb extension, parking area, and the sidewalk. Instead of the curb extensions appearing to jut out into the street, the parking appears as "parking pockets" in the furniture zone.



Parked Vehicles Decrease Sight Distance

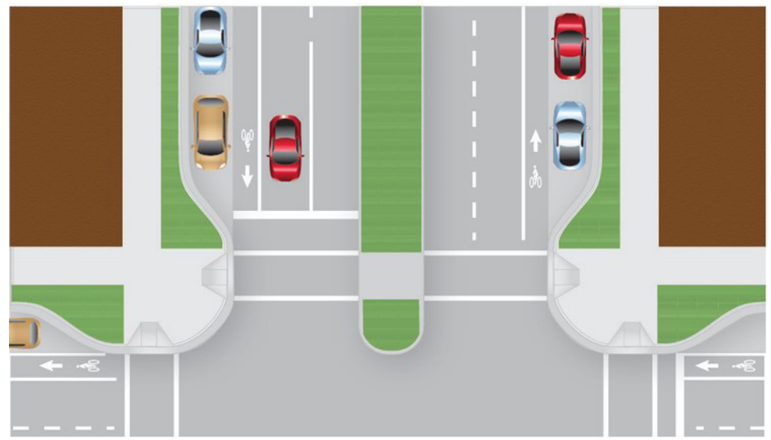


Parked Setback for Sight Distance



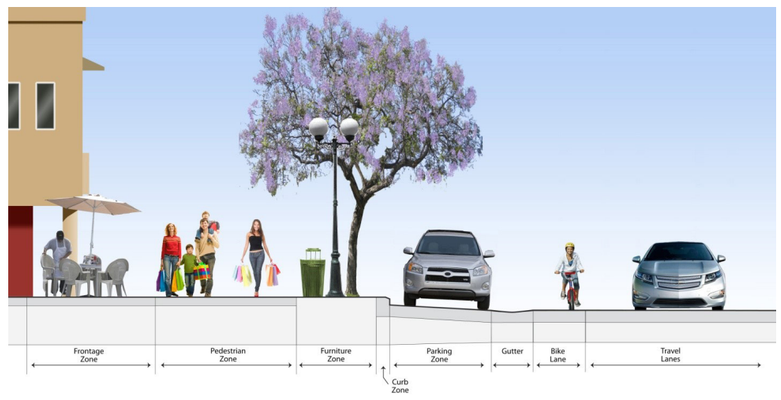
Curb Extension Improves Sight Distance

(Credit: Michele Weisbart)



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

To reinforce this design where street grades permit, the gutter line and drainage grates should be placed between the travel lane and the parking lane/curb extensions. This is called a "valley gutter" and creates a stronger visual cue separating the parking lane from the bicycle lane or travel lane. It can sometimes allow existing drainage infrastructure to be left in place.



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

Skewed Intersections

Skewed intersections are generally undesirable and introduce the following complications for all users:

- The travel distance across the intersection is greater, which increases exposure to conflicts and lengthens signal phases for pedestrians and vehicles.
- Skews require users to crane their necks to see other approaching users, making it less likely that some users will be seen.
- Obtuse angles encourage speeding.

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

- Every reasonable effort should be made to design or redesign the intersection closer to a right angle. Some right-of-way may have to be purchased, but this can be offset by the larger area no longer needed for the intersection, which can be sold back to adjoining property owners or repurposed for a pocket park, rain garden, greenery, etc.
- Pedestrian refuges should be provided if the crossing distance exceeds approximately 40 feet.
- General use travel lanes and bike lanes may be striped with dashes to guide bicyclists and motorists through a long undefined area

Multi-leg intersections (more than two approaching roadways) are generally undesirable and introduce the following complications for all users:

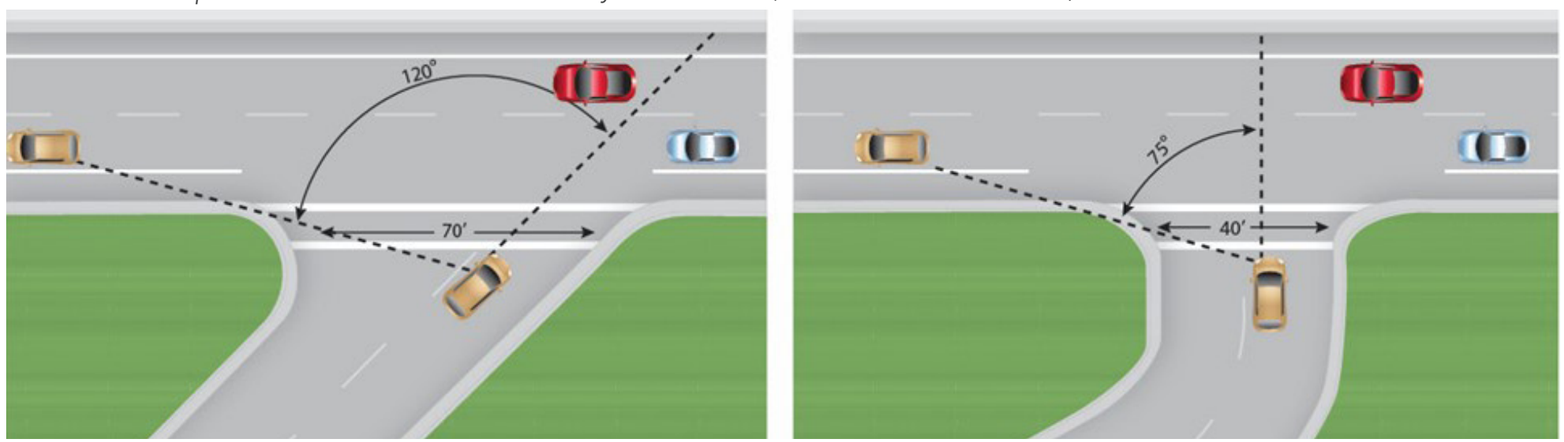
- Multiple conflict points are added as users arrive from several directions.
- Users may have difficulty assessing all approaches to identify all possible conflicts.
- At least one leg will be skewed.
- Users must cross more lanes of traffic and the total travel distance across the intersection is increased.

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

- Every reasonable effort should be made to design the intersection so there are no more than four legs. This is accomplished by removing one or more legs from the major intersection and creating a minor intersection farther up or downstream.
- As an alternative, one or more of the approach roads can be closed to motor vehicle traffic, while still allowing access for pedestrians and bicyclists.
- Roundabouts should be considered.
- Pedestrian refuges should be created if the crossing distance exceeds approximately 40 feet.
- General use travel lanes and bike lanes may be striped with dashes to guide bicyclists and motorists through a long undefined area.

Skewed intersection in Corpus Christi

Exhibit 9. *Realigning the skewed intersection in the graphic on the left to the right-angle connection in the graphic on the right results in less exposure distance and better visibility for all users. (Credit: Michele Weisbart)*



Crosswalk And Ramp Placement

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

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

- Allow crossings on all legs of an intersection, unless there are no pedestrian accessible destinations on one or more of the corners. Closing a crosswalk usually results in a pedestrian either walking around several legs of the intersection, exposing them to more conflicts, or crossing at the closed location, with no clear path or signal indication as to when to cross.
- Provide marked crosswalks at signalized intersections.
- Place crosswalks as close as possible to the desired line of pedestrians, which is generally in line with the approaching sidewalks.
- Provide crossing distance as short as possible to reduce the time that pedestrians are exposed to motor vehicles; this is usually as close as possible to right angles across the roadway, except for skewed intersections.
- Ensure that there are adequate sight lines between pedestrians and motorists. This typically means that the crosswalks should not be placed too far back from the intersection.
- When a raised median is present, extend the nose of the median past the crosswalk with a cut-through for pedestrians.
- Provide one ramp per crosswalk (two per corner for standard intersections with no closed crosswalks). Ramps must be entirely contained within a crosswalk (the crosswalk can be flared to capture a ramp that cannot be easily relocated). Align the ramp run with the crosswalk when possible, as ramps that are angled away from the crosswalk may lead some users into the intersection.

At intersections where roads are skewed or where larger radii are necessary for trucks, it can be difficult to determine the best location for crosswalks and sidewalk ramps. In these situations, it is important to balance the recommended practices above. Tighter curb radii make implementing these recommendations easier.

Crosswalk On-Street Parking Near Intersections

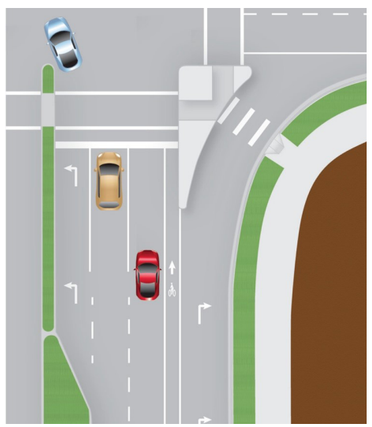
On-street parking should be positioned far enough away from intersections to allow for good visibility of pedestrians preparing to cross the street. Curb extensions allow parking to be placed closer to the intersection.

Right-Turn Channelization Islands

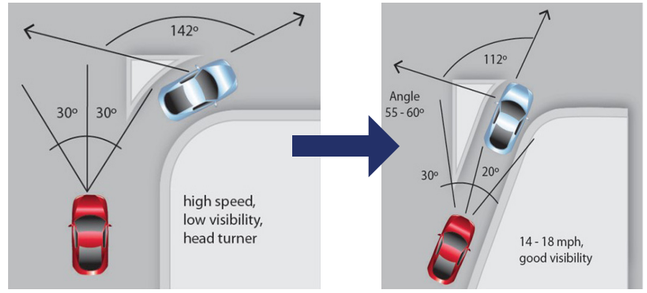
Right-turn lanes should generally be avoided as they increase the size of the intersection, the pedestrian crossing distance, and the likelihood of right-turns-on-red by inattentive motorists who do not notice pedestrians on their right. However, where there are heavy volumes of right turns (approximately 200 vehicles per hour or more), a right-turn lane may be the best solution to provide additional vehicle capacity without adding additional lanes elsewhere in the intersection. For turns onto roads with only one through lane and where truck turning movements are rare, providing a small corner radius at the right-turn lane often provides the best solution for pedestrians' safety and comfort.

At intersections of multi-lane roadways where trucks make frequent right turns, a raised channelization island between the through lanes and the right-turn lane is a good alternative to an overly large corner radius and enhances pedestrian safety and access. If designed correctly, a raised island can achieve the following objectives:

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



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



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

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

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

These goals are best accomplished by creating an island that is roughly twice as long as it is wide. The corner radius will typically have a long radius (150 feet to 300 feet) followed by a short radius (20 feet to 50 feet). When creating this design, it is necessary to allow large trucks to turn into multiple receiving lanes. This design is often not practical for right-turn lanes onto roads with only one through lane. This right-turn channelization design is different from designs that provide free-flow movements (through a slip lane) where right-turning motorists turn into an exclusive receiving lane at high speed. Right turns should be signal-controlled in this situation to provide for a signalized pedestrian walk phase.

Signalized Intersections

Signalized intersections provide unique challenges and opportunities for livable communities and Complete Streets. On one hand, signals provide control of pedestrians and motor vehicles with numerous benefits. Where signalized intersections are closely spaced, signals can be used to control vehicle speeds by providing appropriate signal progression on a corridor.

Traffic signals allow pedestrians and bicyclists to cross major streets with only minimal conflict with motor vehicle traffic. On the other hand, traffic signals create challenges for non-motorized users. Signalized intersections often have significant turning volumes, which conflict with concurrent pedestrian and bicycle movements. In many cases, roundabouts offer safer, more convenient intersection treatment than signals.

To improve livability and pedestrian safety, signalized intersections should:

- Provide signal progression at speeds that support the target speed of a corridor whenever feasible
- Provide short signal cycle lengths, which allow frequent opportunities to cross major roadways, improving the usability and livability of the surrounding area for all modes
- Ensure that signals detect bicycles
- Place pedestrian signal heads in locations where they are visible
- At locations with many crossing pedestrians, time the pedestrian phase to be on automatic recall, so pedestrians don't have to seek and push a pushbutton.
- Where few pedestrians are expected and automatic recall of walk signals is not desirable, place pedestrian pushbuttons in convenient locations, using separate pedestals if necessary. Use the recommendations regarding pushbutton placement for accessible pedestrian signals found in the Manual on Uniform Traffic Control Devices (MUTCD).
- Include pedestrian signal phasing that increases safety and convenience for pedestrians, as discussed in more detail below

Operational Design

Approximately 2% of intersections are signalized, and approximately 20% of all intersection crashes occur at signalized intersections. Unfortunately, in many locations signalization is the only option because of right-of-way limitations, high vehicle volumes, and the need to create gaps to provide reasonable operation for all users.

Over the years, the most common signal hardware has changed from post-mounted signals to overhead mast arms. This change has lifted drivers' eyes upward and created a situation in many east/west streets where drivers must look toward a rising or setting sun that can block vision of a signal. In urban areas the large mast arms are intrusive. As part of the conversion to healthier streets, changing to post-mounted signals in urban areas could lower the cost of installing and maintaining signals, reduce the vision intrusion, and help lower a driver's vision back to pedestrians. Pole-mounted signals provide two advantages for pedestrians and bicyclists:

- Drivers have to stop back from the crosswalk to see the indication so they are less likely to encroach into the crosswalk, and more likely to see pedestrians and bicyclists when turning right.
- Mast-arm signals encourage higher speeds since drivers can see several in a row. If they are green, drivers are more likely to accelerate. But pole-mounted signals are typically only visible to drivers closer to the intersection, causing them to drive slower.

Pole-mounted signal. (Credit: Ryan Snyder)

Phasing

A signal phase is defined as the cycle length allocated to a traffic movement at an intersection receiving the right-of-way, or to any combination of traffic movements receiving the right-of-way simultaneously. The combination of all phases is equal to one cycle length.

Basic Signal Timing

The "timing" is the time in seconds allocated to various vehicular and pedestrian movements. A traffic control signal transmits information to the users by selective illumination of different color lights at a signalized intersection. The illuminated color indicates the user should take a specific action at the signalized intersection:

- **Green time**. Green time is when motorists and bicyclists may proceed through the intersection.
- **Yellow time**. Yellow time is the cycle phase before changing to the red interval that prohibits traffic movement. It signifies to users the light is about to turn red and they should stop if they can safely do so, or continue proceeding if that is safer. A properly timed yellow time interval is important to reduce signal violations by users passing through the intersection.
- **All-red time**. All-red time is that portion of a traffic cycle time where all vehicles are prohibited from any movements at the intersection. The all-red time follows the yellow time interval and precedes the next green interval. The purpose of the all-red time is to allow vehicles that entered the intersection late during the yellow time to clear the intersection before the traffic signal displays green time for conflicting approaches.

Left-Turn Phasing

The most commonly used "left turn" phases at an intersection with a left-turn lane are:

- **Permissive**. Under permissive left-turn phasing, through traffic may proceed straight through the intersection with a green ball, as side traffic is stopped (with a red ball); the left-turning vehicles are permitted to make the turn when they find a safe and adequate gap from the approaching vehicles. Permissive left-turn phases create conflicts with pedestrians crossing the street as the timing puts the two on a collision course.
- **Protected**. Under protected left-turn phasing, drivers can only turn left with a left-turn green arrow. Protected left-turn phases are preferred to permissive phases because they eliminate the inherent conflict between left-turning vehicles and pedestrians. Protected left turns provide the greatest safety for pedestrians. Permissive phases are typically used to maintain a higher LOS for motorists.

Permissive left-turn signal.

Protected left-turn signal.

(Credit: Michele Weisbart)

Pedestrian Phasing

Basic pedestrian signal timing principles should be combined with innovative pedestrian signal timing techniques to enhance pedestrian safety and convenience.

Pedestrian signal heads provide indications exclusively intended for controlling pedestrian traffic. These signal indications consist of the illuminated symbols of a WALKING PERSON (symbolizing WALK) and an UPRAISED HAND (symbolizing DON'T WALK). Pedestrian signal head indications have the following meanings:

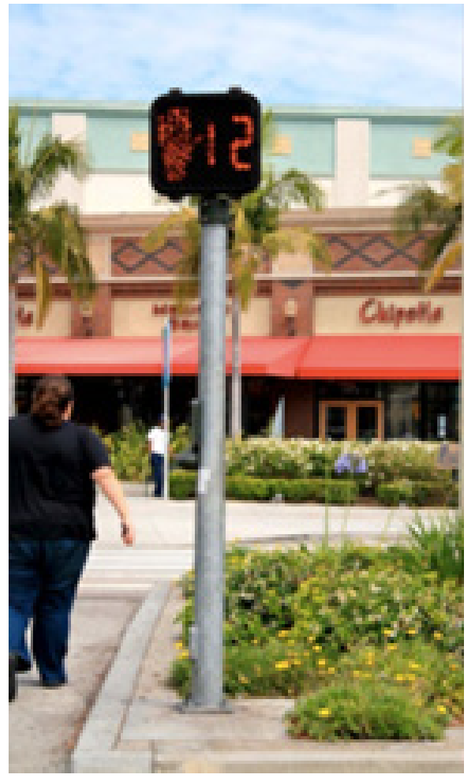
- A steady WALKING PERSON (WALK) signal indication means that a pedestrian facing the signal indication is permitted to start to cross the roadway in the direction of the signal indication, possibly in conflict with turning vehicles.
- A flashing UPRAISED HAND (DON'T WALK) signal indication means that a pedestrian shall not start to cross the roadway in the direction of the signal indication, but that any pedestrian who has already started to cross shall proceed to the far side of the traveled way of the street or highway, unless otherwise directed by a traffic control device to proceed only to a median or pedestrian refuge area.
- A steady UPRAISED HAND (DON'T WALK) signal indication means that a pedestrian shall not enter the roadway in the direction of the signal indication.

The following text discusses the timing of each of these indicators.

Walk Interval

The WALK interval (white walking person) must typically be a minimum of 7 seconds. However, to provide more convenience for pedestrians, and possibly more safety due to better pedestrian behavior, the WALK interval should be maximized using the following techniques:

- Instead of providing the minimum WALK interval, maximize the WALK interval within the available green interval. This is accomplished by subtracting the necessary pedestrian clearance interval (discussed below) from the available green time for the concurrent vehicular movements.
- Except at intersections where pedestrians are relatively few, and anywhere that vehicle signals are set on fixed time, WALK intervals should be set on "recall" so that they are automatically provided during every signal cycle.
- Where a major street intersects a minor side street, the WALK interval for crossing the minor street can be set on recall, concurrent with the green interval for the parallel through vehicle movement, which is typically set



Pedestrian countdown signals.
(Credit: Michele Weisbart)

to recall as well. This minimizes pedestrian delay along the major street with no impact to motor vehicle capacity.

Pedestrian Clearance Interval

The procedures for calculating the timing of the pedestrian clearance interval (flashing orange hand) are included in the Manual on Uniform Traffic Control Devices (MUTCD). The pedestrian clearance interval is calculated to allow a pedestrian traveling at a walking speed of 3.5 feet per second to travel the length of the crosswalk. The crosswalk length should be measured from the center of one curb ramp to the center of the opposing curb ramp. This speed allows pedestrians, especially seniors, children, and disabled people, to clear the intersection.

The MUTCD includes another test that requires the total of the WALK interval plus the pedestrian clearance interval to be sufficient to allow a pedestrian traveling at a walking speed of 3 feet per second to travel the length of the crosswalk, measured from the top of one ramp to the bottom of the opposing ramp. Any additional time that is required to satisfy this second requirement should be added to the walk interval. In neighborhoods where high numbers of slow pedestrians are present, such as near senior centers, rehabilitation centers, and disabled centers, the interval should be set for even slower speeds.

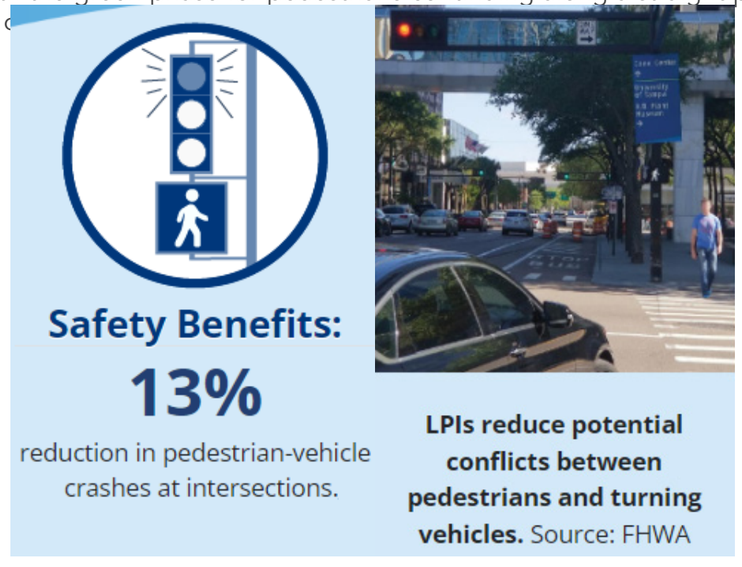
The MUTCD also requires that countdown pedestrian signals be installed for all pedestrian signals. These signals count down the pedestrian clearance interval and provide more information to pedestrians, allowing them to more easily adjust their walking patterns to ensure they are out of the crosswalk before the end of the pedestrian clearance interval. Research on pedestrian countdown signals has determined:

- Pedestrians understand how they work.
- Fewer people start walking in the pedestrian clearance interval.
- Very few pedestrians are left in the crosswalk during the steady orange hand.
- Drivers do not accelerate to beat the light.
- Research in San Francisco shows a 25% reduction in all crashes.

Other Signal Design Changes for Pedestrians

Where appropriate, use signal timing and operations techniques that minimize conflicts with pedestrians and motor vehicles, including the following:

- Protected only left-turn phases
- Leading pedestrian intervals (LPI) where the pedestrian WALK interval is displayed 2 to 5 seconds prior to the concurrent green interval. This enables pedestrians to enter the crosswalk before drivers turn, increasing their chances of being seen by drivers.
- Prohibiting right-turns-on-red where there are restricted sight lines between motorists and pedestrians, where there are an unusual number of pedestrian conflicts with turns on red compared to right-turns-on-green, or where a leading pedestrian interval is used
- Signs that remind drivers to yield to pedestrians when turning at signals
- Pedestrian-user-friendly-intelligent (PUFFIN) signals, which detect slower pedestrians in crosswalks and add clearance interval time to the pedestrian signal
- Pedestrian scrambles, which stop traffic on all legs of the intersection and allow pedestrians to cross diagonally, may be used where turning vehicles conflict with very high pedestrian volumes. Although pedestrians can cross in any direction during the pedestrian phase, pedestrians typically have to wait for both vehicle phases before they get the walk signal again. Scramble intersections can incorporate a walk phase concurrent with the green phase for pedestrians continuing along a straight path to eliminate this c



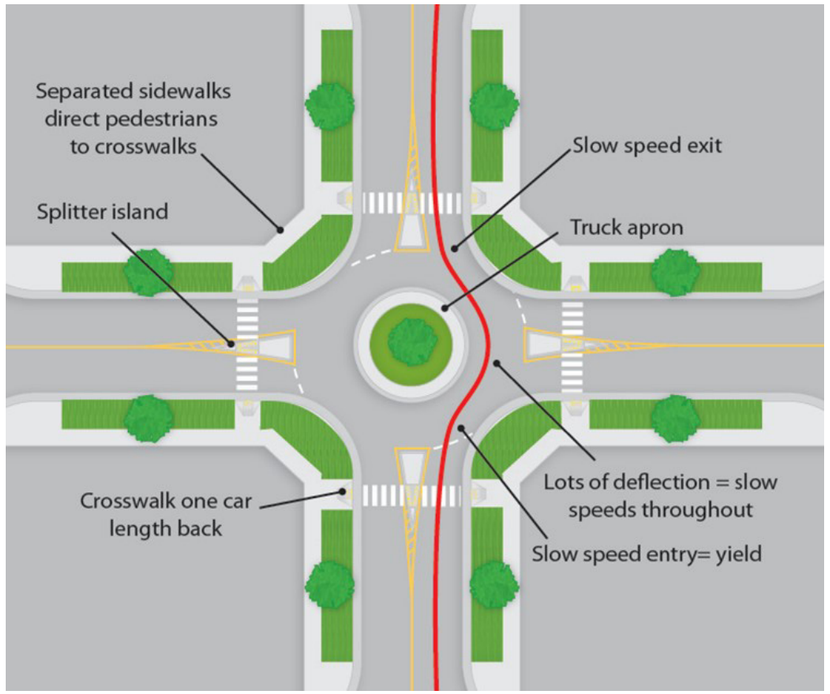
Benefits of LPIs. (Source: FHWA)

Roundabouts

Modern roundabouts are potentially the cheapest, safest, and most aesthetic form of traffic control for many intersections. A roundabout is an intersection design with the following characteristics and features.

Users approach the intersection, slow down, stop and/or yield to pedestrians in a crosswalk, and then enter a circulating roadway, yielding to drivers already in the roundabout. The circulating roadway encircles a central island around which vehicles travel counterclockwise. Splitter islands force drivers to turn right, and provide a refuge for pedestrians. Deflection encourages slow traffic speeds, but allows movement by trucks. A landscaped visual obstruction in the central island obscures the driver's view of the road ahead, to discourage users from entering the roundabout at high speeds. Pedestrians are not allowed to access the central island, which should not contain attractions. The central island can vary in shape from a circle to a "square-a-bout" in historic areas, ellipses at odd shaped intersections, dumbbell, or even peanut shapes.

Each leg of a roundabout has a triangular splitter island that provides a refuge for pedestrians, prevents drivers from turning left (the "wrong-way"), guides drivers through the roundabout by directing them to the edge of the central island, and helps to slow drivers. Roundabouts can range from quite small to quite large, from a central island diameter of about 12 feet for a traffic calming device at a neighborhood intersection to 294 feet to the back of sidewalk on a large multi-lane roundabout.



Single-lane roundabout. (Credit: Michele Weisbart)

Advantages of Roundabouts

Roundabouts reduce vehicle-to-vehicle and vehicle-to-pedestrian conflicts and, thanks to a substantial reduction in vehicle speeds, reduce all forms of crashes and crash severity. In particular, roundabouts eliminate the most dangerous and common crashes at signalized intersections: left-turn and right-angle crashes. Other benefits of roundabouts include the following:

- Little to no delay for pedestrians, who have to cross only one direction of traffic at a time
- Improved accessibility to intersections for bicyclists through reduced conflicts and vehicle speeds
- A smaller carbon footprint (no electricity is required for operation and fuel consumption and air pollution are reduced as motor vehicles spend less time idling and don't have to accelerate as often from a dead stop)
- The opportunity to reduce the number of vehicle lanes between intersections (e.g., increased vehicle capacity at intersections allows reducing a five-lane road to a two-lane road)
- Little to no stopping during periods of low flow
- Significantly reduced maintenance and operational costs because the only costs are related to the landscape and litter control
- Reduced delay, travel time, and vehicle queue lengths
- Lowered noise levels
- Simplified intersections, facilitated U-turns
- The ability to create a gateway and/or a transition between distinct areas through landscaping
- When constructed as a part of a new road or the reconstruction of an existing road, the cost of a roundabout is minimal and can be cheaper than the construction of an intersection and the associated installation of traffic signals and additional turn lanes

The primary disadvantage to roundabouts is that sight-impaired people can have difficulty navigating around large roundabouts. But this can be mitigated with ground level wayfinding devices.

General Design Elements of Roundabouts

Central Island

The design of the central island is an important element of a roundabout. In conjunction with well-designed approach and departure lanes, the central island controls vehicle speeds through deflection and controls the size of vehicles that can pass through and turn at a roundabout. It provides space for landscaping to beautify an intersection or create a focal point or community enhancement, but it also provides space for the inclusion of a vertical element such as a tree, which is important in providing long range conspicuity of a roundabout.

Splitter Islands

Splitter islands and/or medians on each approach serve several functions. Most importantly, they provide a refuge for pedestrians crossing at the roundabout, breaking the crossing into two smaller crossings. This allows pedestrians to select smaller gaps and cross more quickly. Splitter islands and medians direct vehicles toward the edge of the central island and limit the ability of drivers to make left turns the wrong way into the circulating roadway. Splitter islands should have a minimum width of 6 feet, and preferably 8 feet, from the face-of-curb to the opposite face-of-curb.

Truck Apron

Because central islands must be made large enough to deflect and hence control the speed of passenger vehicles, they can limit the ability of trucks to pass through or turn at a roundabout. To accommodate large vehicles, a truck apron (a paved, load-bearing area) is included around the edge of the central island. The truck apron is often paved with a fairly rough texture, and raised enough to discourage encroachment by smaller high-speed passenger cars. The truck apron should be 3 inches high.

Pedestrian Crossing

Pedestrian crossings are located one car length away from the circulating roadway to shorten the crossing distance, separate vehicle-to-pedestrian conflicts from vehicle-to-vehicle conflicts, and allow pedestrians to cross between waiting vehicles.

Roundabout: San Diego, CA. (Credit: Michael Wallwork)

Signing and Marking

Signing and marking should be in compliance with the current version of the MUTCD. For detailed design guidance on roundabouts, refer to the NCHRP Report 672, Roundabouts: An Informational Guide, Second Edition, 2010. However, care must be taken not to oversign roundabouts by including every sign allowed at roundabouts, except for needed directional signs; most roundabouts are designed so their function and use are self-explanatory.

Accessibility

Multi-lane roundabouts are more complex for pedestrians and bicyclists to use because of the additional lanes, slightly higher speeds, and longer crossing distances. Crossing by some pedestrians with disabilities is a more complex task. As a consequence, the current draft (Proposed Right-of-Way Accessibility Guidelines) PROWAG includes a requirement to install accessible pedestrian signals at all crosswalks across any roundabout approach with two or more lanes in one direction. The PROWAG requirement does not specify the type of signal except that it must be accessible, including a locator tone at the pushbutton, with audible and vibrotactile indications of the pedestrian walk interval.

Mini-Roundabouts

Mini-roundabouts are a new form of roundabout that includes a traversable central island and traversable splitter islands to accommodate large vehicles.

Appropriate Applications

Mini-roundabouts are used in low-speed urban environments, where operating speeds are 30 mph or less, and right-of-way constraints preclude the use of a standard roundabout. The design is based on passenger vehicles passing through the roundabout without traveling over the central island, whereas large vehicles will turn over the central island and in some cases, the splitter islands.

Design

The design of mini-roundabouts is similar to other roundabouts in that the design vehicle for each movement must be determined following a capacity analysis. The design is undertaken using the same combination of design vehicle templates and speed curves.

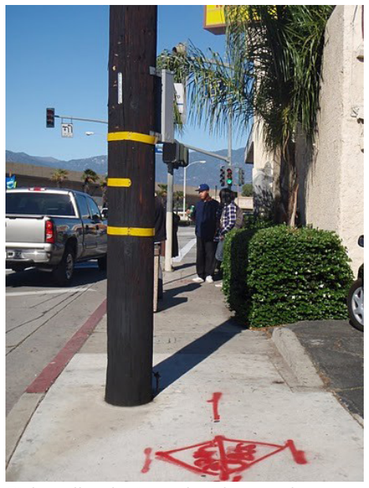
Mini-roundabout/neighborhood traffic circle. (Credit: Ryan Snyder)

6. Universal Pedestrian Access

Nowhere is the concept of universal access more important than in the design of the pedestrian environment. While perhaps not intuitively obvious at first glance, this is the realm of streets with the greatest variation in user capabilities, and where attention to design detail is essential to effectively balance user needs. This is also the realm where signs and street furniture are located, and where transitions are made between modes (e.g., driver or passenger to pedestrian via parking, bus stop/train station, or bike rack). The pedestrian environment includes sidewalks, curb ramps, crosswalks, bus stops, signs, and street furniture.

Without design guidelines, sidewalks are often too narrow, utility poles obstruct travel, steep driveway ramps are impassable to wheelchair users, and bus stops become blocked by the disorderly placement of shelters, poles, trash receptacles, and bike racks.

With well-defined guidelines, sidewalks can be built to accommodate pedestrians of all ages and physical abilities, and become inviting pedestrian environments, as the picture below shows.



Sidewalks designed without adequate guidelines (Credit: Chanda Singh)

Designing the pedestrian realm for universal access enables persons with disabilities to live independently and lead full, enriched lives; they are able to go to work and to school, to shop, and otherwise engage in normal activities. Moreover, walking environments that accommodate people with disabilities improve walking conditions for everyone. People with strollers can make their way about with ease. Children can have more independence to travel within their communities. Inaccessible pedestrian networks, on the other hand, can lead to people becoming housebound and socially isolated, which in turn can lead to a decline in well-being and a host of associated negative health outcomes such as depression.

This chapter describes the legal framework for accessible design of streets and sidewalks, various users of streets and sidewalks and their needs, and important elements of pedestrian facility design. The chapter ends with sidewalk design guidelines.

Principles of Universal Pedestrian Access

The following design principles inform the recommendations made in this chapter and should be incorporated into every pedestrian improvement:

The walking environment should be **safe**, **inviting**, and **accessible** to people of all ages and physical abilities.

The walking environment should be **easy to use** and **understand**.

The walking environment should seamlessly **connect** people to places. It should be characterized by **continuous** and well-designed sidewalks, curb ramps, and street crossings.

Legal Framework

Under Title II of the Americans with Disabilities Act (ADA) of 1990, state and local governments and public transit authorities must ensure that all of their programs, services, and activities are accessible to and usable by individuals with disabilities. They must ensure that new construction and altered facilities are designed and constructed to be accessible to persons with disabilities. State and local governments must also keep the accessible features of facilities in operable working condition through maintenance measures including sidewalk repair, landscape trimming, work zone accessibility, and snow removal.

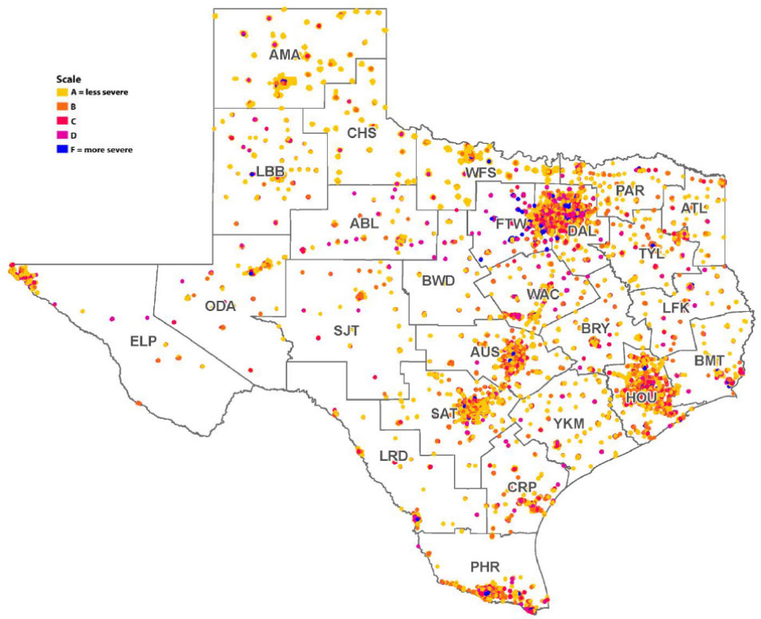
Public Right-of-Way Accessibility Guidelines (PROWAG)

Under the ADA, the Architectural and Transportation Barriers Compliance Board (U.S. Access Board) is responsible for developing the minimum accessibility guidelines needed to measure compliance with ADA obligations when new construction and alterations projects are planned and engineered. **PROWAG** contains requirements to ensure that pedestrian facilities located in the public right-of-way are readily accessible and usable by pedestrians with` disabilities. As of September 2023, these standards are enforceable by law. In 2017, the Texas Department of Licensing and Regulation began allowing TxDOT to use the PROWAG as its de facto "standards."

PROWAG requires the provision of curb ramps where street level pedestrian walkways cross curbs whenever streets, roadways, or highways are altered. Resurfacing, rehabilitation, reconstruction, historic restoration, or changes or rearrangement of structural parts or elements of a facility, among other things, constitute an alteration under the ADA. This means that when resurfacing a street "involves work on a street or roadway spanning from one intersection to another, and includes overlays of additional material to the road surface, with or without milling", the accessibility and usability of the pedestrian walkway for persons with disabilities must be ensured.

The PROWAG specifies guidelines for pedestrian access routes, alternate pedestrian access routes, accessible pedestrian signals, crosswalks, transit stops, and on-street parking.

Exhibit 10. *TxDOT ADA Transition Plan Pedestrian Access Inventory*



ADA Transition Plans

In addition to the PROWAG guidelines, Title II of the ADA also requires states and localities to develop ADA Transition Plans that remove barriers to disabled travel.

These plans must:

- Inventory physical obstacles and their location
- Provide adequate opportunity for residents with disabilities to provide input into the Transition Plan
- Describe in detail the methods the entity will use to make the facilities accessible
- Provide a yearly schedule for making modifications
- Name an official/position responsible for implementing the Transition Plan
- Set aside a budget to implement the Transition Plan

ADA Transition Plans are intended to ensure that existing inaccessible facilities are not neglected indefinitely and that the community has a detailed plan in place to provide a continuous pedestrian environment for all residents.

The Texas Department of Transportation (TxDOT) ADA Transition Plan was completed in 2022. The plan included a self-evaluation of TxDOT's services, policies, and practices along with a plan to modify policies or practices that discriminate against people with disabilities and physical changes to facilities necessary to achieve "program success". Since 2004, TxDOT has authorized over $280 million in funding to remove the identified barriers and plans to spend $500 million between fiscal years 2022-2025.

The 2022 update identified barriers on TxDOT's physical assets, shown in Exhibit 4 (sidewalks, curb ramps, bus stops, pedestrian signals, safety rest areas, administrative buildings, information centers, ferries), services, and means of communication (website, public engagement). The plan included an implementation plan to eliminate these barriers systematically over continuous four-year planning cycles.

Users and Needs

To fully accommodate everyone, designers must consider the widely varying needs and capabilities of the people in the community. People walk at different speeds, some are able to endure long treks, while others can only go short distances. Some use wheelchairs and are particularly sensitive to uneven pavement and surface materials. Others have limited sight and rely on a cane.

People's strengths, sizes, and judgmental capabilities differ significantly. The needs of one group of users may be at odds with those of another group of users. For instance, gradual ramps and smooth transitions to the street help people in wheelchairs, but present challenges for the sight-impaired when they can't easily find the end of the sidewalk and beginning of the street.

This section identifies the unique constraints individuals with different types of disabilities and limitations face as pedestrians. Understanding their needs will help ensure more universal design of the sidewalk network.

People With Mobility Impairments

People with mobility impairments range from those who use assistive devices, such as wheelchairs, crutches, canes, orthotics, and prosthetic devices, to those who use no such devices but face constraints walking long distances on non-level surfaces or on steep grades.

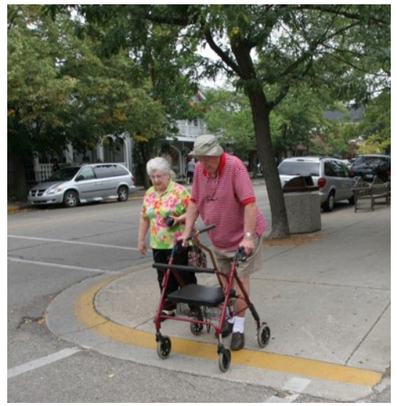
Wheelchair and scooter users are most affected by the following:

- Uneven surfaces that hinder movement
- Rough surfaces that make rolling difficult and can cause pain, especially for people with back injuries
- Steep uphill slopes that slow the user
- Steep downhill slopes that cause a loss of control
- Cross slopes that make the assistive device unstable
- Narrow sidewalks that impede the ability of users to turn or to cross paths with others
- Devices that are hard to reach, such as push buttons for walk signals and doors
- The lack of time to cross the street

Walking-aid users are most affected by the following:

- Steep uphill slopes that make movement slow or impossible
- Steep downhill slopes that are difficult to negotiate
- Cross slopes that cause the walker to lose stability
- Uneven surfaces that cause these users to trip or lose balance
- Long distances
- Situations that require fast reaction time
- The lack of time to cross the street

Prosthesis users often move slowly and have difficulty with steep grades or cross slopes.



Walking-aid users need clear sidewalks (Credit: Dan Burden)

Steep cross slopes create difficulties for wheelchair users (Credit: Michael Ronkin)

People With Visual Impairments

People with visual impairments include those who are partially or fully blind, as well as those who are colorblind. Visually impaired people face the following difficulties:

Limited or no visual perception of the path ahead

- Limited or no visual information about their surroundings, especially in a new place
- Changing environments where they rely on memory
- Lack of non-visual information
- Inability to react quickly
- Unpredictable situations, such as complex intersections that are not at 90 degrees
- Inability to distinguish the edge of the sidewalk from the street
- Compromised ability to detect the proper time to cross a street
- Compromised ability to cross a street along the correct path
- Need for more time to cross the street

People With Cognitive Impairments

People with cognitive impairments encounter difficulties in thinking, learning, and responding, and in performing coordinated motor skills. Cognitive disabilities can cause some to become lost or have difficulty finding their way. They may also not understand standard street signs and traffic signals. Some may not be able to read and benefit from signs with symbols and colors.

Sight-impaired pedestrians need additional sensory cues. (Credit: Dan Burden)

Children and Older Adults

Children and many older adults don't fall under specific categories for disabilities, but must be taken into account in pedestrian planning. Children are less mentally and physically developed than adults and have the following characteristics:

- Less peripheral vision
- Limited ability to judge speed and distance
- Difficulty locating sounds
- Limited or no reading ability so don't understand text signs
- Occasional impulsive or unpredictable behavior
- Little familiarity with traffic
- Difficulty in carrying packages

The natural aging process generally results in at least some decline in sensory and physical capability. As a result, many older adults experience the following:

- Declining vision, especially at night
- Decreased ability to hear sounds and detect where they come from
- Less strength to walk up hills and less endurance overall
- Reduced balance, especially on uneven or sloped sidewalks
- Slowed reaction times to dangerous situations
- Slowed walking speed
- Increased fragility and frailty: their bodies are more likely to be seriously injured in a fall or vehicular crash and their recovery becomes longer and more tenuous. This makes older pedestrians the most vulnerable pedestrians.

Pedestrian Facility Design

To provide a seamless path of travel throughout the community that is accessible to all, designers should consider five important elements: sidewalks, curb ramps, crosswalks, signals, and bus stops.

Sidewalks

Sidewalks should provide a comfortable space for pedestrians between the roadway and adjacent land uses. Sidewalks along city streets are the most important component of pedestrian mobility. They provide access to destinations and critical connections between modes of travel, including automobiles, transit, and bicycles. General provisions for sidewalks include pathway width, slope, space for street furniture, utilities, trees and landscaping, and building ingress/egress.

Sidewalks include four distinct zones as illustrated in Exhibit 12: the frontage zone, the pedestrian (a.k.a walking) zone, the furniture zone, and the curb zone. The minimum widths of each of these zones vary based on street classifications as well as land uses. The Street Classifications section in this chapter describes these recommendations in more detail as applied to individual cities. The table at the end of this chapter recommends minimum widths for each zone for different street types and land uses.

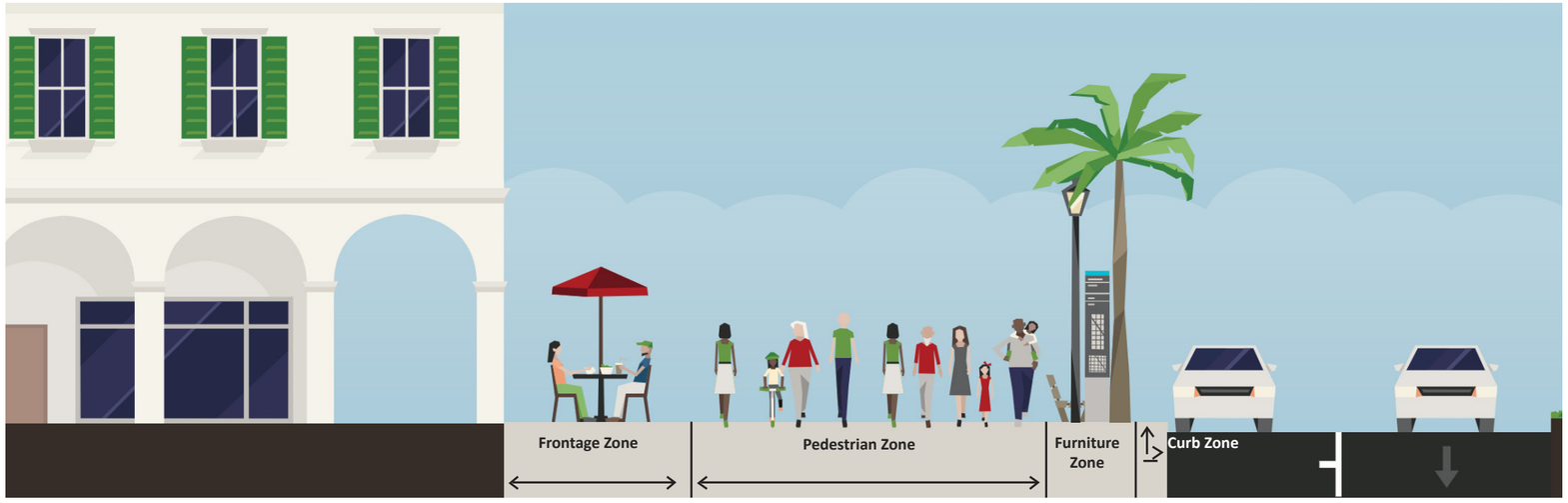
Frontage Zone

The frontage zone is the portion of the sidewalk located immediately adjacent to buildings, and provides shy distance from buildings, walls, fences, or property lines. It includes space for building-related features such as entryways and accessible ramps. It can include landscaping as well as awnings, signs, news racks, benches, and outdoor café seating. In single-family residential neighborhoods, landscaping typically occupies the frontage zone.

Furniture Zone

The furniture zone is located between the curb line and the pedestrian zone. The furniture zone should contain all fixtures, such as street trees, bus stops and shelters, parking meters, utility poles and boxes, lamp posts, signs, bike racks, news racks, benches, waste receptacles, drinking fountains, and other street furniture to keep the pedestrian zone free of obstructions. In residential neighborhoods, the furniture zone is often landscaped. Resting areas with benches and space for wheelchairs should be provided in high volume pedestrian districts and along blocks with a steep grade to provide a place to rest for older adults, wheelchair users, and others who need to catch their breath.

Exhibit 11. *Sidewalk Zones*



Pedestrian Zone

The pedestrian zone, situated between the frontage zone and the furniture zone, is the area dedicated to walking and should be kept clear of all fixtures and obstructions. Within the pedestrian zone, the Pedestrian Access Route (PAR) is the path that provides continuous connections from the public right-of-way to building and property entry points, parking areas, and public transportation.

This pathway is required to comply with ADA guidelines and is intended to be a seamless pathway for wheelchair and white cane users. As such, this route should be firm, stable, and slip-resistant, and should comply with maximum cross slope requirements (2% grade). The walkway grade shall not exceed the general grade of the adjacent street. Aesthetic textured pavement materials (e.g., brick and pavers) are best used in the frontage and furniture zones, rather than the PAR. The PAR should be a minimum of 4 feet, but preferably at least 5 feet in width to provide adequate space for two pedestrians to comfortably pass or walk side by side. All transitions (e.g., from street to ramp or ramp to landing) must be flush and free of changes in level. The engineer should determine the pedestrian zone width to accommodate the projected volume of users. In no case will this zone be less than the width of the PAR.

Non-compliant driveways often present significant obstacles to wheelchair users. The cross slope on these driveways is often much steeper than the 2% maximum grade. Driveway aprons that extend into the pedestrian zone can render a sidewalk impassable to users of wheelchairs, walkers, and crutches. They need a flat plane on which to rest all four supports (two in the case of crutches). To provide a continuous PAR across driveways, aprons should be confined to the furniture and curb zones.

Curb Zone

The curb zone serves primarily to prevent water and cars from encroaching on the sidewalk. It defines the areas of pedestrian and automobile activity in the right-of-way. It is the area people using assistive devices must traverse to get from the street to the sidewalk, so its design is critical to accessibility.

Other Sidewalk Guidelines

- Landscaped buffers or fences should separate sidewalks from off-street parking lots or off-street passenger loading areas.
- Pedestrian and driver sight distances should be maintained near driveways. Fencing and foliage near the intersection of sidewalks and driveways should ensure adequate sight distance as vehicles enter or exit.
- Where no frontage zone exists, driveway ramps usually violate cross slope requirements. In these situations, sidewalks should be built back from the curb at the driveway as shown in the adjacent photo.

Routing sidewalks around driveway ramps maintain a flush surface. (Credit: Dan Burden)

Land Use and Sidewalk Design Guidelines

The sidewalk design guidelines in this chapter integrate design and land use to provide safe and convenient passage for pedestrians. Sidewalks should have adequate walking areas and provide comfortable buffers between pedestrians and traffic. These guidelines will ensure sidewalks in all development and redevelopment provide access for people of all ages and physical abilities.

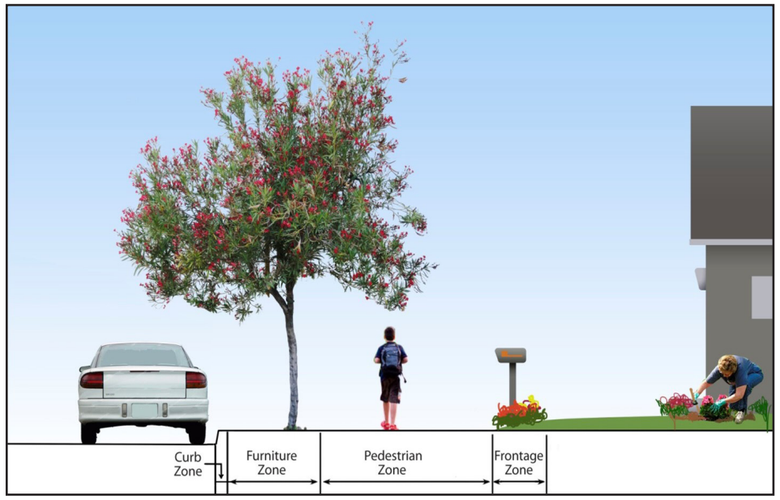
Sidewalks will vary according to the type of street. A local street with residences will require different sidewalk dimensions than a boulevard with commercial establishments. The following descriptions indicate the type of pedestrian activity expected at each of the specified land uses. The graphics illustrate the minimum widths of the sidewalk zones for each of the contexts. The matrix in the following section provides specific minimum requirements for the four sidewalk zones according to combinations of land use and street classifications.

The furnishing zone serves an important function for the pedestrian by creating a more comfortable and safer pedestrian zone. Street furniture is an opportunity to provide a barrier between vehicular traffic and pedestrians, but it can also serve other purposes depending on the choice of furniture. Seating creates a place to rest or gather; bicycle racks and shelters allow for the orderly parking of bikes; and trash receptacles help keep the public space clean. Street furniture should be shaded during the day and lighted at night.

Low/Medium Density Residential

These streets are typically quieter than others and generally do not carry transit vehicles or high volumes of traffic. Pedestrians require a pleasant walking environment within these neighborhoods, as well as access land uses and transit on nearby streets. Of the four sidewalk zones, the furniture zone is often the widest, to provide room for street trees.

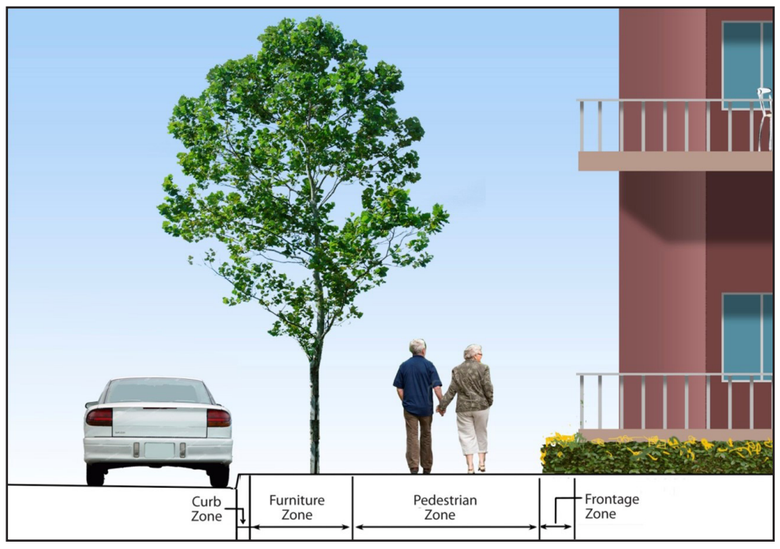
Exhibit 12. *Low/Medium Density Residential Sidewalk Zone Design (Credit: Marty Bruinsma)*



Medium/High Density Residential

These streets support greater volumes of pedestrians. Streets with transit service require good pedestrian links to bus stops. The pedestrian zone should be wider than in low/medium density residential.

Exhibit 13. *Medium/High Density Residential Sidewalk Zone Design (Credit: Marty Buinsma)*



Neighborhood Commercial

These streets often have grocers, laundromats, drug stores, and other neighborhood-serving retail establishments. Sidewalks in neighborhood commercial areas should accommodate pedestrians walking from residences to stores. Of the four sidewalk zones, the pedestrian zone should be the widest, with a generous frontage zone to provide room for features next to buildings such as newspaper boxes. These sidewalk designs should consider cars crossing sidewalks as they enter and exit commercial driveways.

General/Regional Commercial

These streets have retail, office, civic, and recreational uses concentrated along boulevards and avenues. Transit service runs along these streets and pedestrians need buffers from traffic. Of the four sidewalk zones, the pedestrian and furniture zones are favored. These sidewalks also should be designed with the understanding that a significant number of cars will cross sidewalks as they enter and exit commercial driveways

Mixed/Multi-Use

The sidewalks along these streets should support significant pedestrian volumes due to their integrated nature and higher densities. Of the four sidewalk zones, the pedestrian and frontage zones will be favored. Transit service runs along these streets and sidewalks will require buffers from traffic.

Downtown Core/Main Street

The downtown core or Main Street is a pedestrian-oriented area where the greatest numbers of pedestrians are encouraged and expected. This land use serves as the retail, restaurant, and entertainment center of a community. This area will need the widest sidewalks, the widest crosswalks, the brightest street lighting, the most furnishings, and other features that will enhance the pedestrian environment. Of the four sidewalk zones, the pedestrian and frontage zones will be favored, with a furniture zone wide enough for trees.

Industrial

Industrial streets are zoned for manufacturing, office warehousing, and distribution. Pedestrian volumes are likely to be lower here given that these land uses typically employ fewer people per square foot than general commercial areas. Employees will need good sidewalks to get to work.

Exhibit 14. *Mixed/Multi-Use Sidewalk Zone Design (Credit: Marty Buinsma)*

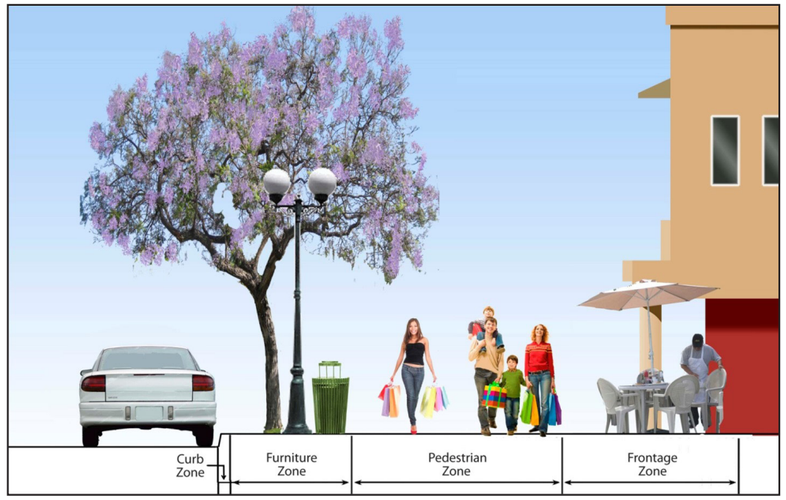
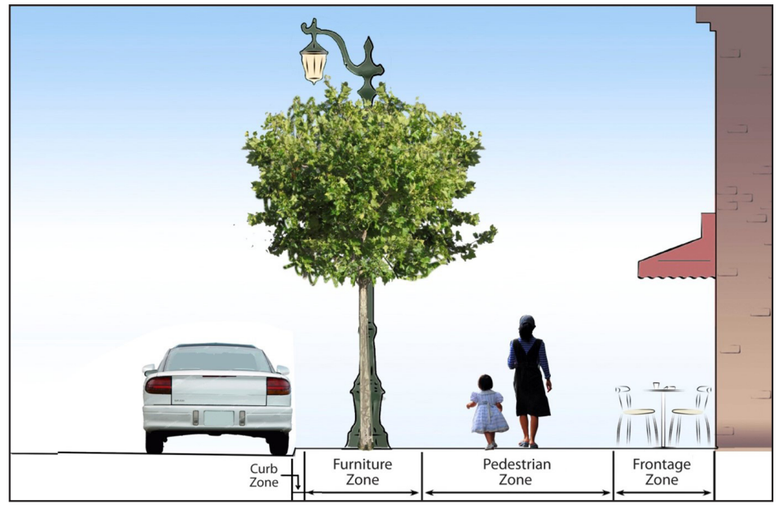


Exhibit 15. *Downtown/Main Street Sidewalk Zone Design (Credit: Marty Buinsma)*



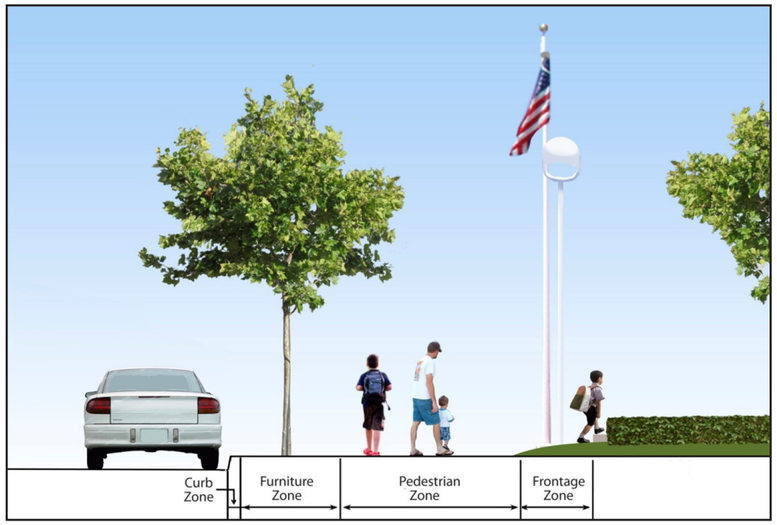
Office Park

These streets are home to national and regional offices of financial institutions, government, large companies, and other uses. Cities can expect pedestrians during the morning and evening commutes walking to and from their cars. Visitors will use the sidewalks throughout the day and employees will need them during the lunch hour. The furniture zone should provide adequate buffer from parking lots.

Public Facilities

Public facilities streets, particularly streets near schools, libraries, and civic centers, require special attention and treatment. High pedestrian volumes are expected during peak times, such as school pick-up and drop-off, and during the morning and evening commute hours. Sidewalk design should accommodate these peak travel times and include adequate furniture zones to buffer pedestrians from the street. Public facilities are located in various types of streets ranging from local streets to boulevards with transit service.

Exhibit 16. *Downtown/Main Street Sidewalk Zone Design (Credit: Marty Bruinsma)*



Design Specifications by Roadway Type and Land Use

Exhibit Exhibit 17 lists minimum widths for the frontage, pedestrian, furniture, and curb zones, as well as minimum total widths. These minimums should not be considered the recommended final design width; in many cases, wider zones will be needed.

Exhibit 17. *Sidewalk Zone Widths for Each Land Use Context*

Land Use Type	Boulevard	Avenue	Street
Low / Medium Density Residential	Not Applicable	Frontage: 18″ Pedestrian: 5′ Furniture: 4′, 6′-8′ at bus stops, and where large trees are desired Curb: 6 Min. Width: 11′	Frontage: 18″ Pedestrian: 5′ Furniture: 4′ Curb: 6″ Min. Width: 11′
Medium / High Density Residential	Frontage: 18″ Pedestrian: 6′ Furniture: 5′, 6′-8′ at bus stops, and where large trees are desired Curb: 6″ Min. Width: 13′	Frontage: 18″ Pedestrian: 6′ Furniture: 5′, 6′-8′ at bus stops, and where large trees are desired Curb: 6″ Min. Width: 13′	Frontage: 18″ Pedestrian: 6′ Furniture: 4′, 6′-8′ at bus stops, and where large trees are desired Curb: 6″ Min. Width: 12′
Neighborhood Commercial	Not Applicable	Frontage: 18″ Pedestrian: 6′ Furniture: 5′, 6′-8′ at bus stops, and where large trees are desired Curb: 6″ Min. Width: 13′	Frontage: 18″ Pedestrian:6′ Furniture: 4′, 6′-8′ at bus stops, and where large trees are desired Curb: 6″ Min. Width: 12′
General Commercial	Frontage: 18″ Pedestrian: 6′ Furniture: 5′, 6′-8′ at bus stops, and where large trees are desired Curb: 6″ Min. Width: 13′	Frontage: 18″ Pedestrian: 6′ Furniture: 5′, 6′-8′ at bus stops, and where large trees are desired Curb: 6″ Min. Width: 13′	Not Applicable
Mixed / Multi-Use	Frontage: 30″, 8′ with café seating Pedestrian: 6′ Furniture: 5′, 6′-8′ at bus stops, and where large trees are desired Curb: 6″ Min. Width: 14′	Frontage: 30″, 8′ with café seating Pedestrian: 6′ Furniture: 4′, 6′-8′ at bus stops, and where large trees are desired Curb: 6″ Min. Width: 13′	Frontage: 18″ Pedestrian: 6′ Furniture: 4′ Curb: 6″ Min. Width: 12′
Industrial	Frontage: 18″ Pedestrian: 5′ Furniture: 5′ Curb: 18″ Min. Width: 13′	Frontage: 18″ Pedestrian: 5′ Furniture: 4′ Curb: 18″ Min. Width: 12′	Frontage: 18″ Pedestrian:5′ Furniture: 4′ Curb: 18″ Min. Width: 12′
Downtown Core / Main Street	Frontage: 30″, 8′ with café seating Pedestrian: 6′ Furniture: 5′, 6′-8′ at bus stops, and where large trees are desired Curb: 6″ Min. Width: 14′	Frontage: 30″, 8′ with café seating Pedestrian: 6′ Furniture: 5′, 6′-8′ at bus stops, and where large trees are desired Curb: 6″ Min. Width: 14′	Frontage: 30″, 8′ with café seating Pedestrian: 6′ Furniture: 5′ Curb: 6″ Min. Width: 14′

Land Use Type	Boulevard	Avenue	Street
Transit-Oriented Districts	Frontage: 30″ Pedestrian: 8′ Furniture: 5′, 6′-8′ at bus stops, and where large trees are desired Curb: 6″ Min. Width: 16′	Frontage: 30″ Pedestrian:8′ Furniture: 5′, 6′-8′ at bus stops, and where large trees are desired Curb: 6″ Min. Width: 16′	Frontage: 18″ Pedestrian:6′ Furniture: 5′, 6′-8′ at bus stops, and where large trees are desired Curb: 6″ Min. Width: 13′
Office Park	Frontage: 18″ Pedestrian: 5′ Furniture: 5′ Curb: 6″ Min. Width: 12′	Frontage: 18″ Pedestrian:5′ Furniture: 5′ Curb: 6″ Min. Width: 12′	Not Applicable
Public Facilities	Frontage: 30″ Pedestrian: 8′ Furniture: 5′, 6′-8′ at bus stops, and where large trees are desired Curb: 6″ Min. Width: 16′	Frontage: 30″ Pedestrian: 8′ Furniture: 5′, 6′-8′ at bus stops, and where large trees are desired Curb: 6″ Min. Width: 16′	Frontage: 18″ Pedestrian:6′ Furniture: 5′, 6′-8′ at bus stops, and where large trees are desired Curb: 6″ Min. Width: 13′

Curb Ramps

Proper curb ramp design is essential to enable pedestrians using assistive mobility devices (e.g., scooters, walkers, and crutches) to transition between the street and the sidewalk. These design guidelines provide a basic overview of curb ramp design. The ADA requires installation of curb ramps in new sidewalks and whenever an alteration is made to an existing sidewalk or street.

Roadway resurfacing is considered an alteration and triggers the requirement for curb ramp installations or retrofits to current standards. Curb ramps are typically installed at intersections, mid-block crossings (including trail connections), accessible on-street parking, and passenger loading zones and bus stops.

The following define the curb ramp components along with minimum dimensions:

» Landing – the level area at the top of a curb ramp facing the ramp path. Landings allow wheelchairs to enter and exit a curb ramp, as well as travel along the sidewalk without tipping or tilting. This landing must be the width of the ramp and measure at least 4 feet by 4 feet. There should also be a level (not exceeding a 2% grade) 4-foot by 4-foot bottom landing of clear space outside of vehicle travel lanes.

» Approach – the portion of the sidewalk on either side of the landing. Approaches provide space for wheelchairs to prepare to enter landings.

» Flare – the transition between the curb and sidewalk. Flares provide a sloped transition (10% maximum slope) between the sidewalk and curb ramp to help prevent pedestrians from tripping over an abrupt change in level. Flares can be replaced with curb where the furniture zone is landscaped.

» Ramp – the sloped transition between the sidewalk and street where the grade is constant and cross slope at a minimum. Curb ramps are the main pathway between the sidewalk and street.

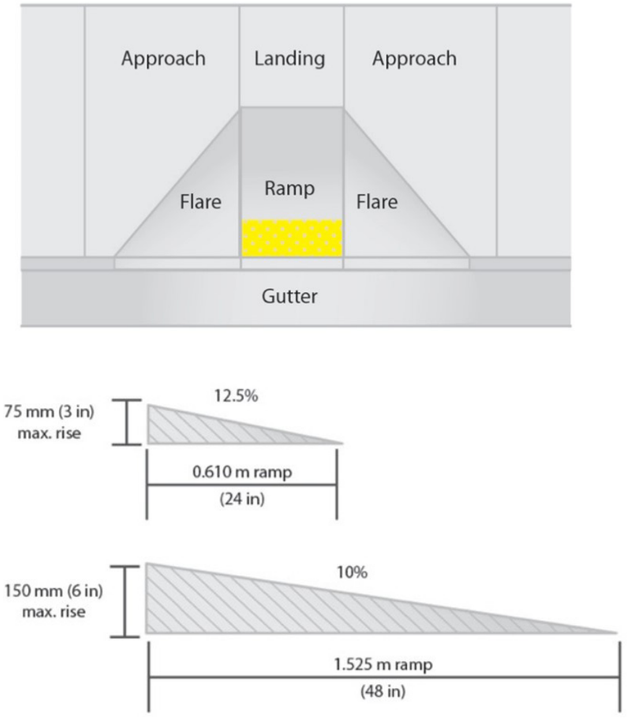
» Gutter – the trough that runs between the curb or curb ramp and the street. The slope parallel to the curb should not exceed 2% at the curb ramp.

» Detectable Warning – surface with distinct raised areas to alert pedestrians with visual impairments of the sidewalk-to-street transition.

Curb Ramp Types

There are several different types of curb ramps. Selection should be based on local conditions. The most common types are diagonal, perpendicular, parallel, and blended transition. PROWAG provides additional design guidance and curb ramp examples appropriate for a variety of contextual constraints.

Exhibit 18. *Curb Ramp Components And Alternate Slopes*



(Credit: Michele Weisbart)

Diagonal Curb Ramps

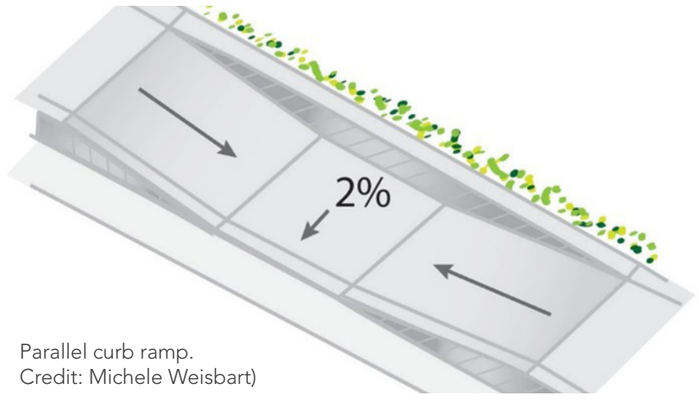
Diagonal curb ramps are single curb ramps at the apex of the corner. These have been commonly installed by many jurisdictions to address the requirements of the ADA, but have since been identified as a non-preferred design type as they introduce dangers to wheelchair users. Diagonal curb ramps send wheelchair users and people with strollers or carts toward the middle of the intersection and make the trip across longer.

Perpendicular Curb Ramps

Perpendicular curb ramps are placed at a 90-degree angle to the curb. They must include a level landing at the top to allow wheelchair users to turn 90 degrees to access the ramp, or to bypass the ramp if they are proceeding straight. Perpendicular ramps work best where there is a wide sidewalk, curb extension, or planter strip. Perpendicular curb ramps provide a direct, short trip across the intersection.

Parallel Curb Ramps

Parallel curb ramps are oriented parallel to the street; the sidewalk itself ramps down. They are used on narrow sidewalks where there isn't enough room to install perpendicular ramps. Parallel curb ramps require pedestrians who are continuing along the sidewalk to ramp down and up. Where space exists in a planting strip, parallel curb ramps can be designed in combination with perpendicular ramps to reduce the ramping for through pedestrians. Careful attention must be paid to the construction of the bottom landing to limit accumulation of water and/or debris.



Parallel curb ramp.
Credit: Michele Weisbart)

Curb Ramp Placement

One ramp should be provided for each crosswalk, which usually translates to two per corner. This maximizes access by placing ramps in line with the sidewalk and crosswalk, and by reducing the distance required to cross the street, compared with a single ramp at the apex.

A single ramp at the apex requires users to take a longer, more circuitous travel path to the other side and causes users to travel toward the center of the intersection where they may be in danger of getting hit by turning cars; being in the intersection longer exposes the user to greater risk of being hit by vehicles. A single ramp at the apex should be avoided in new construction and may be used only for alterations where a design exception is granted because of existing utilities and other significant barriers. In all cases, reducing the curb radius makes ramp placement easier

Blended Transitions

Blended transitions are situations where either the entire sidewalk has been brought down to the street or crosswalk level, or the street has been brought up to the sidewalk level. They work well on large radius corners where it is difficult to line up the crosswalks with the curb ramps, but have drawbacks.

Children, persons with cognitive impairments, and guide dogs may not distinguish the street edge. Turning vehicles may also encroach onto the sidewalk. For these reasons, bollards, planting boxes, or other intermittent barriers should be installed to prevent cars from traveling on the sidewalk. Detectable warnings should also be placed at the edge of the sidewalk to alert pedestrians with visual impairments of the transition to the street.

Municipalities should follow the standards and guidelines for curb ramps provided in Exhibit 19 on page A-42.

Exhibit 19. *Curb Ramp Design Standards and Guidelines*

Curb Ramp Type	Characteristic	ADA Standards	PROWAG
Perpendicular	Maximum slope of ramps	8.33%	8.3%
	Maximum cross-slope of ramps	2.1%	2.1%
	Maximum slope of flared sides	10%	10%
	Minimum ramp width	36”	48”
	Minimum landing length	36”	48”
	Minimum landing width		48”
	Maximum gutter slope		5%
	Changes in level	Flush	Flush
	Truncated domes	24” min. from back of curb, full width of ramp	24” min. from back of curb, full width of ramp
Diagonal (at apex)	Maximum slope of ramps	8.33%	Not allowed except in alterations
	Maximum cross-slope of ramps	2.1%	
	Maximum slope of flared sides	10%	
	Minimum ramp width	36”	
	Minimum landing length	36	
	Changes in level	Flush	
Parallel and Combination	Maximum slope of ramps	8.33%	8.3%
	Maximum cross-slope of ramps	2.1%	2.1%
	Maximum slope of flared sides	10%	
	Minimum ramp width	36”	48”
	Minimum landing length	36”	48”
	Minimum landing width	48”	48”
	Changes in level	Flush	Flush
	Truncated domes	24” min. from back of curb, full width of ramp	24” min. from back of curb, full width of ramp

Detectable Warnings

Curb ramps remove the curb that visually impaired persons use to identify the location of a street. Detectable and color-contrasted warning strips must be placed at the back of curbs so partially sighted people can see them. They should be as wide as the ramp and a minimum of 24-inches deep. One corner should be located at the back of the curb and the other corner may be up to 5 feet from the back of the curb. The strips are most effective when adjacent to smooth pavement so the difference is easily detected.

ADAAG Standards

The Americans with Disabilities Act Accessibility Guidelines (ADAAG) standards for detectable warnings are as follows.

- General: Detectable warnings shall consist of a surface of truncated domes and shall meet standards for size, spacing, contrast and edges
- Base diameter: 0.9 inches minimum; 1.4 inches maximum
- Top diameter: 50% of base diameter minimum to 65% maximum
- Height: 0.2 inches
- Center-to-center spacing: 1.6 inches minimum to 2.4 inches maximum
- Base-to-base spacing: 0.65 inches minimum
- Visual contrast: light on dark, or dark on light with adjacent walking surface
- Platform edges: 24 inches wide and shall extend the full public use area of the platform

Required truncated dome.(Credit: Ryan Snyder)

PROWAG Standards

PROWAG standards for detectable warnings include the following:

- Width: as wide as the ramp and 24-inches deep
- Location: back of the curb or no more than 6 inches from the edge of the pavement where there is no curb
- Used at:
  - The base of curb ramps
  - Blended transitions at crosswalks
  - Pedestrian refuge islands
  - Driveways that are controlled with yield or stop control devices
  - The edge of transit platforms and where railroad tracks cross the sidewalk

Signals

Signalized street crossings require special consideration of people with disabilities.

Crossing Times

In planning for people with disabilities, slower speeds must be considered. This is critical in setting the timing of the walk phase of signalized intersections. PROWAG requires that transportation agencies use an assumed walking speed of 3.5 feet/second for signal timing, with a minimum walk interval of 7 seconds. In situations where a large number of older adults or persons with disabilities cross, this may be inadequate to meet their needs. Some cities instead use 2.8 feet/second.

Cities may also use PUFFIN (Pedestrian-User-Friendly-Intelligent) traffic signals to ensure that all pedestrians have adequate time to cross. PUFFIN crossings use infrared monitors to detect the presence of pedestrians in the crosswalk, and will hold the signal red for cross traffic until the pedestrian has left the crosswalk. PUFFIN crossings help slower pedestrians, but also help the flow of traffic because they allow the normal pedestrian design speed to be set at a higher level.

Pedestrian-Activated Push Button

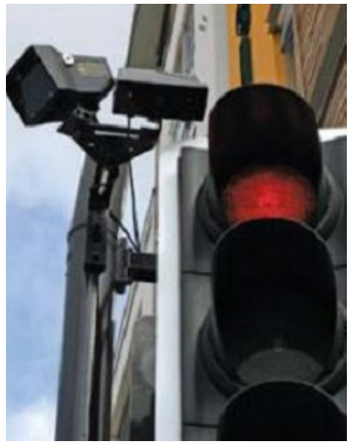
Pedestrian-activated traffic controls require pedestrians to push a button to activate a walk signal. As noted in Chapter 7, Pedestrian Crossings" pedestrian-activated signals are generally discouraged.

The WALK signal should automatically come on except under circumstances described in that chapter. Where pedestrian-activated traffic controls exist, they should be located as close as possible to curb ramps without reducing the width of the path. The buttons should be at a level that is easily reached by people in wheelchairs near the top of the ramp. The U.S. Access Board guidelines recommend buttonsraised above or flush with their housing and large enough (a minimum of 2 inches) for people with visual impairments to see them. The buttons should also be easy to push.

Accessible Pedestrian Signal (APS)

Wayfinding for pedestrians with visual impairments is significantly improved with the use of APS at signalized intersections. In fact, APS is the most commonly requested accommodation under Section 504 of the Rehabilitation Act of 1973. APS communicates information about pedestrian timing in non-visual formats such as audible tones, verbal messages, and/or vibrating surfaces.

These devices should be installed close to the departure location and on the side away from the center of the intersection. Since they are typically only audible 6 to 12 feet from the push button, 10 feet should separate two APS devices on a corner. If two accessible pedestrian pushbuttons are placed less than 10 feet apart or on the same pole, each accessible pedestrian pushbutton shall be provided with a pushbutton locator tone, a tactile arrow, a speech walk message for the WALKING PERSON (symbolizing WALK) indication, and a speech pushbutton information message. Volumes of the walk indication and push button locator tone shall automatically adjust in response to ambient sound.



Automated pedestrian sensor used for a PUFFIN signal. (Source: FHWA)

General Guidelines

The land uses included in Exhibit 17 on page A-39 cover those of most municipalities. For those few areas not covered, the following list provides general guidelines for sidewalks:

- The recommended minimum frontage zone width is 18 inches.
- The recommended minimum pedestrian zone width is 5 feet.
- The recommended minimum curb zone width is 6 inches or 18 inches where pedestrian or freight loading is expected and may conflict with obstacles in the furniture zone.
- The recommended minimum furniture zone width is 4 feet and 6 feet to 8 feet where bus stops exist.
- Low curbs (3 to 4 inches high) reduce the division between the traveled way and the sidewalk. They are favored in areas with significant pedestrian traffic. Low curbs also improve the geometry and feasibility of providing two perpendicular curb ramps per corner.

Some judgment may be needed on a case-by-case basis to establish actual widths of each of the four zones.

Accessible pedestrian signal. (Credit: Guidelines for Accessible Pedestrian Signals)

7. Pedestrian Crossings

Walking requires two important features in the built environment: people must walk along streets and they must get across streets. Crossing a street should be easy, safe, convenient, and comfortable. While pedestrian behavior and intersection or crossing design affect the street crossing experience, motorist behavior (whether and how motorists stop for pedestrians) is the most significant factor in pedestrian safety.

A number of tools exist to improve pedestrian safety and to make crossing streets easier. Effective traffic management can address concerns about traffic speed and volume. A motorist driving more slowly has more time to see, react, and stop for a pedestrian. The number of pedestrians also influences motorists; in general, motorists are more aware of pedestrians when there is more pedestrian activity. Most tools to address crossing challenges are engineering treatments, but tools from the enforcement, education, and planning toolboxes are also important.

Providing marked crosswalks is only one of the many possible engineering measures. When considering how to provide safer crossings for pedestrians, the question should not be: "Should I provide a marked crosswalk?" Instead, the question should be: "What are the most effective measures that can be used to help pedestrians safely cross the street?" Deciding whether to mark or not mark crosswalks is only one consideration in creating safe and convenient pedestrian crossings.

This chapter describes a number of measures to improve pedestrian crossings, including marked and unmarked crosswalks, raised crossing islands and medians, and lighting.

Crossings are a necessary part of the pedestrian experience. (Credit: Sky Yim)

Principles of Pedestrian Crossings

The following principles should be incorporated into every pedestrian crossing improvement:

- Pedestrians must be able to cross roads safely. Cities have an obligation to provide safe and convenient crossing opportunities.
- The safety of all street users, particularly more vulnerable groups, such as children, the elderly, and those with disabilities, and more vulnerable modes, such as walking and bicycling, must be considered when designing streets.
- Pedestrian crossings must meet accessibility standards and guidelines.
- Real and perceived safety must be considered when designing crosswalks—crossings must be "comfortable." A "safe" crossing that no one uses serves no purpose.
- Crossing treatments that have the highest crash reduction factors (CRFs) should be used when designing crossings.
- Safety should not be compromised to accommodate traffic flow.
- Good crossings begin with appropriate speed. In general, urban arterials should be designed to a maximum of 30 mph or 35 mph (note: 30 mph is the optimal speed for moving motor vehicle traffic efficiently).
- Every crossing is different and should be selected and designed to fit its unique environment.

The following issues should also be considered when planning and designing crossings:

- Ideally, uncontrolled crossing distances should be no more than 21 feet, which allows for one 11-foot lane and one 10-foot lane. Ideally, streets wider than 40 feet should be divided (effectively creating two streets) by installing a median or two crossing islands.
- The number of lanes should be limited to a maximum of three lanes per direction on all roads (plus a median or center turn lane).
- There must be a safe, convenient crossing at every transit stop.
- Double (or triple) left or right turns concurrent (permissive) with pedestrian crossings at signalized intersections must never be allowed.
- Avoid concurrent movements of motor vehicles and people at signalized intersections.
- People should never have to wait more than 90 seconds to cross at signalized intersections.
- Pedestrian signals should be provided at all signalized crossings where pedestrians are allowed.

Curb extensions and medians make crossing four-lane streets safer and more manageable. (Credit: Dan Burden)

Performance Measures

Performance measures establish how well a crossing is performing. In all cases, baseline data should be collected to allow for before and after analysis. Performance measures for pedestrian crossings include the following:

- The number of pedestrians crossing at a particular crossing location goes up.
- The pedestrian crash rates go down (for an accurate determination, entire corridors should be analyzed since crashes at any one location may be infrequent).
- Pedestrian fatalities and serious injuries should decrease.
- The numbers of children, seniors, and people with disabilities crossing the street should reflect their percentage in the larger population.
- The speed of motorists either turning at an intersection or traveling at a mid-block crossing goes down.
- Motorists do not block intersections (including crosswalks).
- At uncontrolled intersections, the percentage of motorists who stop for pedestrians goes up.

Lively streets with many pedestrians indicate a walkable neighborhood: Chicago.

Pedestrian Crossing Toolbox

Many engineering measures may be used at a pedestrian crossing, depending on site conditions and potential users. Marked crosswalks are commonly used at intersections and sometimes at mid-block locations. Marked crosswalks are often the first measure in the toolbox followed by a series of other measures that are used to enhance and improve marked crosswalks. The decision to mark a crosswalk should not be considered in isolation, but rather in conjunction with other measures to increase awareness of pedestrians. Without additional measures, marked crosswalks alone may not increase pedestrian safety, particularly on multi-lane streets.

Marked Crosswalks

Crosswalks are present by law at all intersections, whether marked or unmarked, unless the pedestrian crossing is specifically prohibited. At mid-block locations, crosswalks only exist where marked. At these non-intersection locations, the crosswalk markings legally establish the crosswalk. Crosswalks should be considered at mid-block locations where there is strong evidence that pedestrians want to cross there, due to origins and destinations across from each other and an overly long walking distance to the nearest controlled crossing. Marked crosswalks alert drivers to expect crossing pedestrians and direct pedestrians to desirable crossing locations. Marking crosswalks at every intersection is not necessary or desirable.

Crosswalk Markings

According to the MUTCD, the minimum crosswalk marking shall consist of solid white lines. They shall not be less than 6 inches or greater than 24 inches in width.

Placement

The best locations to install marked crosswalks are:

- All signalized intersections
- Crossings near transit locations
- Trail crossings
- High land use generators
- School walking routes
- When there is a preferred crossing location due to sight distance
- Where needed to enable comfortable crossings of multi-lane streets between controlled crossings spaced at convenient distances

Controlled Intersections

Intersections can be controlled by traffic signals or STOP signs. Marked crosswalks should be provided on all intersection legs controlled by traffic signals, unless the pedestrian crossing is specifically prohibited. Marked crosswalks may be considered at STOP-controlled intersections. Factors to be considered include high pedestrian volumes, high vehicle volumes, school zone location, high volume of elderly or disabled users, or other safety related criteria.

Uncontrolled Intersections and Mid-block Crosswalks

Intersections without traffic signals or STOP signs are considered uncontrolled intersections. The decision to mark a crosswalk at an uncontrolled location should be guided by an engineering study.

Factors considered in the study should include vehicular volumes and speeds, roadway width and number of lanes, stopping sight distance and triangles, distance to the next controlled crossing, night time visibility, grade, origin-destination of trips, left turning conflicts, and pedestrian volumes. The engineering study should be based on the FHWA study, Safety Effects of Marked Versus Unmarked Crosswalks at Uncontrolled Locations.

The following list provides some of the key recommendations from the study:

- It is permissible to mark crosswalks on two-lane roadways.
- On multi-lane roadways, marked crosswalks alone are not recommended under the following conditions (the other tools listed in this section can be considered to enhance the crosswalk):
  - ADT > 12,000 w/o median
  - ADT > 15,000 w/ median
  - Speeds greater than 40 mph
- Raised medians can be used to reduce risk.
- Signals or other treatments should be considered where there are many young and/or elderly pedestrians.

Frequency of Marked Crosswalks at Uncontrolled Locations

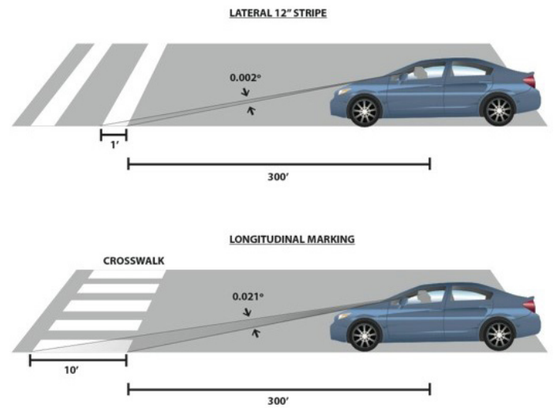
Marked crosswalks should be spaced so people can cross at preferred locations. If people are routinely crossing streets at non-preferred locations, consideration should be given to installing a new crossing. Pedestrians need crossings with appropriate devices (islands, curb extensions, advanced yield lines, etc.) of multi-lane streets where there are strong desire lines. Along urban streets, a well-designed crossing should be provided at least every 1/8 mile.

Example of staggered continental crosswalk. (Credit: Michael Ronkin)

High-Visibility Crosswalks

Because of the low approach angle at which pavement markings are viewed by drivers, the use of longitudinal stripes in addition to or in place of transverse markings can significantly increase the visibility of a crosswalk to oncoming traffic. While research has not shown a direct link between increased crosswalk visibility and increased pedestrian safety, high-visibility crosswalks have been shown to increase motorist yielding and channelization of pedestrians, leading the Federal Highway Administration to conclude that high-visibility pedestrian crosswalks have a positive effect on pedestrian and driver behavior.

Colored and stamped crosswalks should only be used at controlled locations. Staggered longitudinal markings reduce maintenance since they avoid vehicle wheel paths.



Longitudinal crosswalk markings are more visible than lateral crosswalk markings. (Credit: Michele Weisbart)

Typical crosswalk markings: Continental, Ladder, Staggered Continental. (Credit: Michele Weisbart)

Crosswalks and Accessibility

The Pedestrian Access Route continues through the crosswalk and must conform to the surface condition, width, and slope requirements.

Longitudinal crosswalk markings provide the best visibility for pedestrians with limited vision.

Decorative crosswalk pavement materials should be chosen with care to ensure that smooth surface conditions and high contrast with surrounding pavement are provided. Textured materials within the crosswalk are not recommended. Without reflective materials, these treatments are not visible to drivers at night. Decorative pavement materials often deteriorate over time and become a maintenance problem while creating uneven pavement. The use of color or material to delineate the crosswalks as a replacement for retro-reflective pavement markings should not be used, except in slow-speed districts where intersecting streets are designed for speeds of 20 mph or less.

Decorative crosswalk treatments made of distinctive materials can become uneven over time. (Credit: Ryan Snyder)

Raised Crossing Islands/Medians

Raised islands and medians (continuous raised areas separating opposite flows of traffic) are the most important, safest, and most adaptable engineering tools for improving street crossings. A crossing island is shorter and located just where a pedestrian crossing is needed. Raised medians and crossing islands are commonly used between intersections when blocks are long (500 feet or more in downtowns) and in the following situations:

- Speeds are higher than desired
- Streets are wide
- Traffic volumes are high
- Sight distances are poor

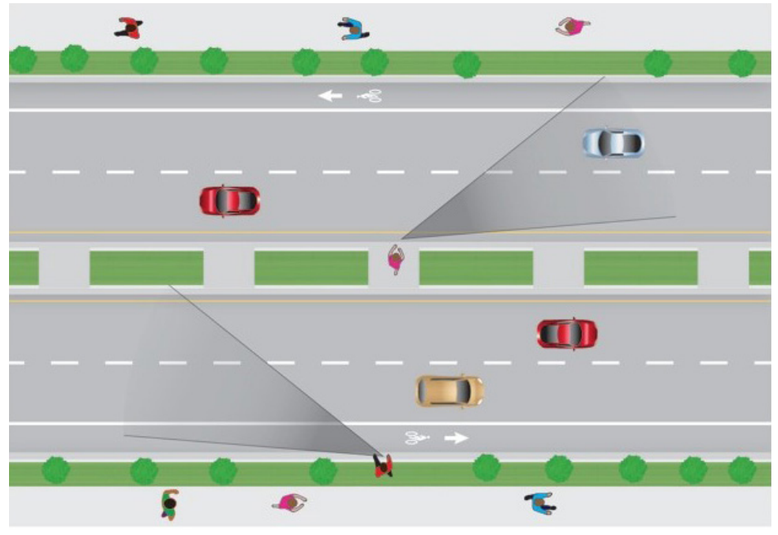
Raised islands have nearly universal applications and should be placed where there is a need for people to cross the street. They are also used to slow traffic.

Staggered median crossing. (Credit: Marcel Schmaedick)

Benefits of Raised Crossing Islands

The use of raised crossing islands changes a complex task, crossing a wide street with traffic coming from two opposing directions all at once, into two simpler and smaller tasks. With their use, conflicts occur in only one direction at a time, and exposure time can be reduced from more than 20 seconds to just a few seconds.

On streets with traffic speeds higher than 30 mph, it may be unsafe to cross without a median island. At 30 mph, motorists travel 44 feet each second, placing them 880 feet out when a pedestrian starts crossing an 80-foot-wide multi-lane road. In this situation, this pedestrian may still be in the last travel lane when the car arrives there; that car was not within view at the time he or she started crossing. With an island on multi-lane roadways, people would cross two or three lanes at a time instead of four or six. Having to wait for a gap in only one direction of travel at a time significantly reduces the wait time to cross. Medians and crossing islands have been shown to reduce crashes by 40% (Federal Highway Administration, Designing for Pedestrian Safety course).



Medians and crossing islands allow pedestrians to complete the crossing in two stages. (Credit: Michele Weisbart)

Angled median crossing. (Credit: Paul Zykofsky)

Crossing islands: Berkeley, CA. (Credit: Ryan Snyder)

As a general rule, crossing islands are preferable to signal-controlled crossings due to their lower installation and maintenance cost, reduced waiting times, and their safety benefits. Crossing islands are also used with road diets, taking four-lane undivided, high-speed roads down to better performing three-lane roadways (two travel lanes and a center turn lane); portions of the center turn lane can be dedicated to crossing islands. Crossing islands can also be used with signals.

Where to Place Crossing Islands

Crossing islands are often used for trails, high pedestrian flow zones, transit stations, schools, work centers, and shopping districts.

Crossing islands, like most traffic calming features, perform best with both tall trees and low ground cover. This greatly increases their visibility, reduces surprise, and lowers the need for a plethora of signs. When curves or hill crests complicate crossing locations, median islands are often extended over a crest or around a curve to where motorists have a clear (six second or longer) sight line of the downstream change in conditions. Lighting of median islands is essential. The suggested minimum width of a crossing island is 6 feet. When used on higher speed roads, and where there is space available, inserting a 45-degree bend to the right helps orient pedestrians to the risk they encounter from motorists during the second half of their crossing.

Raised Crosswalks

Raised crosswalks slow traffic and put pedestrians in a more visible position. They are trapezoidal in shape on both sides and have a flat top where the pedestrians cross. The level crosswalk area must be paved with smooth materials; any texture or special pavements used for aesthetics should be placed on the beveled slopes, where they will be seen by approaching motorists. They are most appropriate in areas with significant pedestrian traffic and where motor vehicle traffic should move slowly, such as near schools, on college campuses, in Main Street retail environments, and in other similar places. They are especially effective near elementary schools where they raise small children by a few inches and make them more visible.

Raised crosswalk: University of North Carolina Campus, Chapel Hill, NC. (Credit: Ryan Snyder)

Curb Extensions

Curb extensions extend the sidewalk or curb line out into the parking lane, which reduces the effective street width. Curb extensions significantly improve pedestrian crossings by reducing the pedestrian crossing distance, visually and physically narrowing the roadway, improving the ability of pedestrians and motorists to see each other, and reducing the time that pedestrians are in the street. Reducing street widths improves signal timing since pedestrians need less time to cross.

Motorists typically travel more slowly at intersections or mid-block locations with curb extensions, as the restricted street width sends a visual cue to slow down. Turning speeds are lower at intersections with curb extensions (curb radii should be as tight as is practicable). Curb extensions also prevent motorists from parking too close to the intersection.

Curb extensions also provide additional space for two curb ramps and for level sidewalks where existing space is limited, increase the pedestrian waiting space, and provide additional space for pedestrian push button poles, street furnishings, plantings, bike parking and other amenities. A benefit for drivers is that extensions allow for better placement of signs (e.g., stop signs and signals).

Curb extensions are generally only appropriate where there is an on-street parking lane. Where street width permits, a gently tapered curb extension can reduce crossing distance at an intersection along streets without on-street parking, without creating a hazard. Curb extensions must not extend into travel lanes or bicycle lanes.

Example of curb extensions. (Credit: Marcel Schmaedick)

Curb extensions can impact other aspects of roadway design and operation as follows:

- » May impact street drainage and require catch basin relocation
- » May impact underground utilities
- » May require loss of curbside parking, though careful planning often mitigates this potential loss, for example by relocating curbside fire hydrants, where no parking is allowed, to a curb extension
- » May complicate delivery access and garbage removal
- » May impact snow plows and street sweepers
- » May affect the turning movements of larger vehicles such as school buses and large fire trucks

Curb extensions. (Credit: Michele Weisbart)

Pedestrian "Scrambles"

Exclusive pedestrian phases (i.e. pedestrian "scrambles") may be used where turning vehicles conflict with very high pedestrian volumes and pedestrian crossing distances are short. Although pedestrians can cross in any direction during the pedestrian phase, pedestrians typically have to wait for both vehicle phases before they get the WALK signal again. This creates delay for pedestrians traveling straight, but can be mitigated by allowing pedestrians continuing along the same direction to get a WALK signal during the green signal phase and while turns are prohibited for traffic.

Pedestrian scramble. (Credit: Dan Burden)

Signs

Signs can provide important information to improve road safety by letting people know what to expect, so they can react and behave appropriately. Sign use and placement should be done judiciously, as overuse breeds noncompliance and disrespect. Too many signs create visual clutter.

Regulatory signs, such as STOP, YIELD, or turn restrictions, require driver actions and can be enforced. Warning signs provide information, especially to motorists and pedestrians unfamiliar with an area.

Advance pedestrian warning signs should be used where pedestrian crossings may not be expected by motorists, especially if there are many motorists who are unfamiliar with the area. The fluorescent yellow/green color is designated specifically for pedestrian, bicycle, and school warning signs (Section 2A.10 of the 2009 MUTCD) and should be used for all new and replacement installations. This bright color attracts the attention of drivers because it is unique.

Sign R1-5 should be used in conjunction with advance yield lines, as described below. Sign R1-6 may be used on median islands, where they will be more visible to motorists than signs placed on the side of the street, especially where there is on-street parking.

All signs should be periodically checked to make sure that they are in good condition, free from graffiti, reflective at night, and continue to serve a purpose.

All sign installations need to comply with the provisions of the MUTCD.

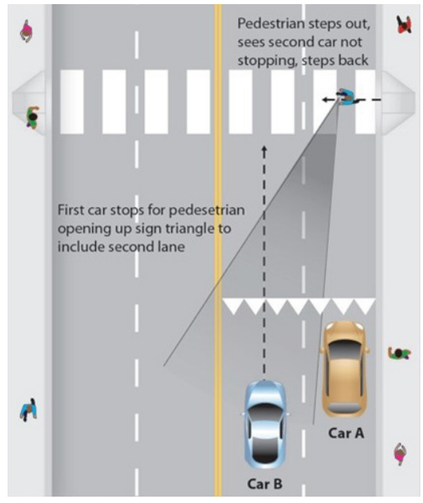
R1-6 R1-6a

R1-5 R1-5a R1-5b R1-5c

Advanced Yield/Stop Signs

Stop lines are solid white lines 12 to 24 inches wide, extending across all approach lanes to indicate where vehicles must stop in compliance with a stop sign or signal. Advance stop lines reduce vehicle encroachment into the crosswalk and improve drivers' view of pedestrians. At signalized intersections a stop line is typically set back between 4 and 6 feet.

At uncontrolled crossings of multi-lane roads, advance yield lines can be an effective tool for preventing multiple threat vehicle and pedestrian collisions. Section 3B.16 of the MUTCD specifies placing advanced yield markings 20 to 50 feet in advance of crosswalks, depending upon location-specific variables such as vehicle speeds, traffic control, street width, on-street parking, potential for visual confusion, nearby land uses with vulnerable populations, and demand for queuing space. Thirty feet is the preferred setback for effectiveness at many locations. This setback allows a pedestrian to see if a car in the second (or third) lane is stopping after a driver in the first lane has stopped.



Advanced yield signs.
(Credit: Michele Weisbart)

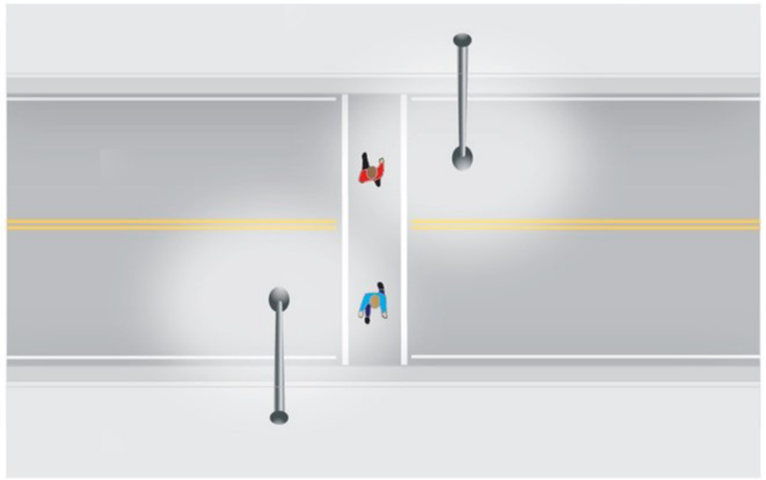

Example of advanced yield signs. (Credit: Sky Yim)

Lighting

Lighting is important to include at all pedestrian crossing locations for the comfort and safety of the road users. Lighting should be present at all marked crossing locations. Lighting provides cues to drivers to expect pedestrians earlier.

FHWA HT-08-053, The Information Report on Lighting Design for Mid-block Crosswalks, found that a vertical illumination of 20 lux in front of the crosswalk, measured at a height of 5 feet from the road surface, provided adequate detection distances in most circumstances. Although the research was constrained to mid-block placements of crosswalks, the report includes a brief discussion of considerations in lighting crosswalks co-located with intersections. The same principle applies at intersections. Illumination just in front of crosswalks creates optimal visibility of for pedestrians.

Other good guidance on crosswalk lighting levels comes from the Illuminating Engineering Society of North America (IESNA) intersection guidance to illuminate pedestrians in the crosswalk to vehicles (see the adjacent image). Crosswalk lighting should provide color contrast from standard roadway lighting. Exhibit 20 shows IESNA's recommended illumination by street type.



Proper placement of crosswalk illumination. (Credit: Michele Weisbart)

Exhibit 20. *Recommended Illumination by Street Type*

Functional Classification	Average Maintained Illumination at Pavement by Pedestrian Area Classification [FC]		
	High	Medium	Low
Major/Major (boulevard)	3.4 fc	2.6 fc	1.8 fc
Major/Collector (boulevard/avenue)	2.9 fc	2.2 fc	1.5 fc
Major/Local (avenue)	2.6 fc	2.0 fc	1.3 fc
Collector/Collector (avenue)	2.4 fc	1.8 fc	1.2 fc
Collector/Local (street)	2.1 fc	1.6 fc	1.0 fc
Local/Local (street)	1.8 fc	1.4 fc	0.8 fc

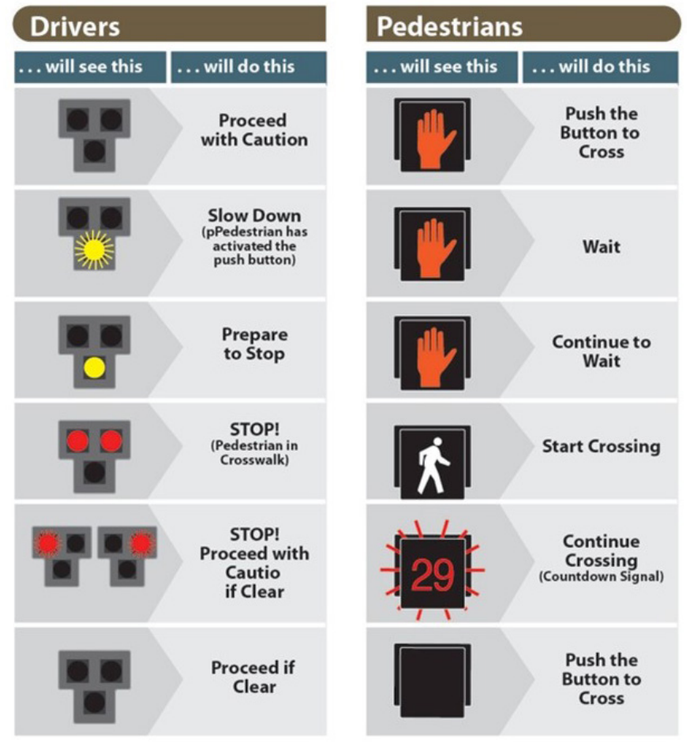
Pedestrian Hybrid Beacon

A pedestrian hybrid beacon (PHB) is used to warn and control traffic at an unsignalized location to to help pedestrians cross streets or highways at a marked crosswalk. Exhibit 21 shows the sequence of PHB displays.

In accordance with the MUTCD, a minimum number of 20 pedestrians per hour is needed to warrant installation. This is substantially less than the minimum needed for a full signal installation justified under the Pedestrian Warrant in the MUTCD.

If a PHB is used, it should be placed in conjunction with signs, crosswalks, and advanced yield lines to warn and control traffic at locations where pedestrians enter or cross a street or highway. A pedestrian hybrid beacon should only be installed at a marked crosswalk. Installations should be done according to the MUTCD Chapter 4F, "Pedestrian Hybrid Beacons."

Exhibit 21. *PHB Display Sequence*

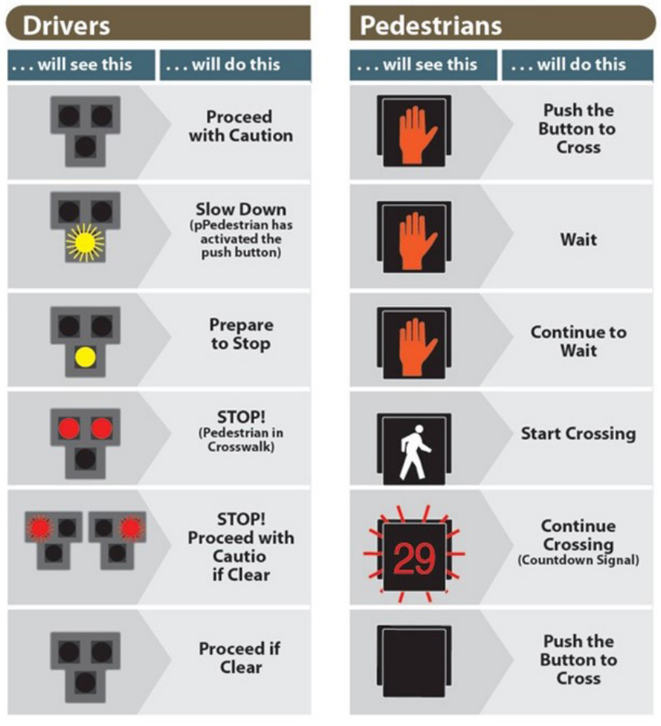


Rectangular Rapid Flash Beacon (RRFB)

The RRFB uses rectangular-shaped high-intensity LED-based indications, flashes rapidly in a wig-wag "flickering" flash pattern, and is mounted immediately between the crossing sign and the sign's supplemental arrow plaque.

According to the FHWA, RRFBs can reduce up to 47% of pedestrian crashes[1] and increase motorist yielding rates up to 98%[2]. RRFBs are especially effective at multilane crossings on roads with speed limits less than 40mph. Chapter 4L of the MUTCD provides guidance on the location and design of RRFBs.

Exhibit 22. *Pedestrian hybrid beacon phases. Credit: Michele Weisbart)*



Rectangular rapid-flash beacon in Broken Arrow, Oklahoma.

1 (CMF ID: 9024) NCHRP Research Report 841 Development of Crash Modification Factors for Uncontrolled Pedestrian Crossing Treatments, (2017).
2 Fitzpatrick et al. "Will You Stop for Me? Roadway Design and Traffic Control Device Influences on Drivers Yielding to Pedestrians in a Crosswalk with a Rectangular Rapid-Flashing Beacon." Report No. TTI-CTS-0010. Texas A&M Transportation Institute, (2016).

8. Bikeway Design

Principles of Bikeway Design

The following principles inform the recommendations made in this chapter:

- » Bicyclists should have safe, convenient, and comfortable access to all destinations.
- » Every street is a bicycle street, regardless of bikeway designation.
- » Street design should accommodate all types, levels, and ages of bicyclists.
- » Bicyclists should be separated from pedestrians.
- » Bikeway facilities should take into account vehicle speeds and volumes, with
    - Shared use on low volume, low-speed roads.
    - Separation on higher volume, higher-speeds roads.
- » Bikeway treatments should provide clear guidance to enhance safety for all users.
- » Since most bicycle trips are short, a complete network of designated bikeways has a grid of roughly ½ mile.

Further information on the design of bicycle facilities can be found in the Urban Bikeway Design Guide published by the National Association of Transportation Officials (NACTO).

Planning for a Range of Bikeway Users

Many early bikeway designs assumed that bicyclists resemble pedestrians in their behavior. This led to undesirable situations: bicyclists being under-served by inadequate facilities, pedestrians resenting bicyclists in their space, and motorists being confused by bicyclists entering and leaving the traffic stream in unpredictable ways. Only under special circumstances (e.g., on shared-use paths or shared-space streets) should bicyclists and pedestrians share the same space.

Bicyclists operate a vehicle and are legitimate road users, but they are slower and less visible than motor vehicles. Bicyclists are also more vulnerable in a crash than motorists. They need accommodation on busy, high-speed roads and at complex intersections. In congested urban areas, bicyclists provided with well-designed facilities can often proceed faster than motorists.

Bicyclists use their own power, must constantly maintain their balance, and don't like to interrupt their momentum. Typical basic bicyclist speeds range from 10 to 15 mph, enabling them to make trips of up to 5 miles in urban areas in about 25 minutes, the equivalent of a typical suburban commuter trip time. Bicyclists may wish to ride side-by-side so they can interact socially with a riding companion.

Well-designed bicycle facilities guide cyclists to ride in a manner that generally conforms to the vehicle code: in the same direction as traffic and usually in a position 3 to 4 feet from the right edge of the traveled way or parked cars to avoid debris, drainage grates, and other potential hazards. Cyclists should be able to proceed through intersections in a direct, predictable, and safe manner.

Cyclist skill level also provides a wide variety of speeds and expected behaviors, influencing the characteristics and infrastructure preferences of different cyclists, as depicted in Exhibit 23 on page A-54. Bicycle infrastructure should be developed using planning and designing options, from shared roadways to separate facilities, to accommodate as many user types as possible and to provide a comfortable experience for the greatest number of cyclists.

Plan bicycle facilities for various skill levels. (Credit: Dan Burden)

Exhibit 23. *Bicycling experience continuum.*

Bikeway Types

A designated bikeway network provides a system of facilities that offers enhancement or priority to bicyclists over other roadways in the network. However, it is important to remember that all streets in a city should safely and comfortably accommodate bicyclists, regardless of whether the street is designated as a bikeway. Several general types of bikeways are listed below with no implied order of preference.

Bike Routes

A term used for planning purposes or to designate recommended bicycle touring routes, a bike route can be any bikeway type.

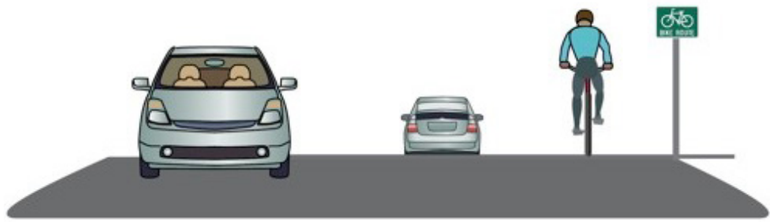
On-Street

Shared Street

A shared street is a street in which bicyclists ride in the same travel lanes as other traffic. There are no specific dimensions for shared roadways. On narrow travel lanes, motorists have to cross over into the adjacent travel lane to pass a cyclist. Shared roadways work well and are common on low-volume, low-speed neighborhood residential streets, rural roads, and even many low-volume highways.

Bicycle Boulevards

A bicycle boulevard is a street that has been modified to prioritize through bicycle traffic but discourage through motor vehicle traffic. Traffic calming devices control traffic speeds and discourage through trips by automobiles. Traffic controls limit conflicts between automobiles and bicyclists and give priority to through bicycle movement at intersections.



Bicycle route. (Credit: Marty Bruinsma)

Bicycle boulevard: Swantner Drive, Corpus Christi.

Shoulder Bikeways

This facility accommodates bicycle travel on rural highways and country roads by providing a suitable area for bicycling and reducing conflicts with faster moving motor vehicles.

Bike Lanes

Portions of the traveled way designated with striping, stencils, and signs for preferential use by bicyclists, bike lanes are appropriate on avenues and boulevards. They may be used on other streets where bicycle travel and demand is substantial. Where on-street parking is provided, bike lanes are striped on the left side of the parking lane

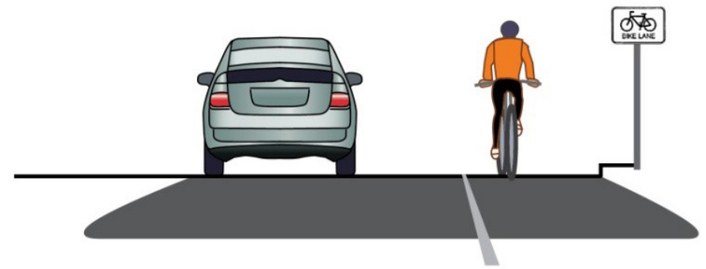
Off-Street

Cycle Tracks

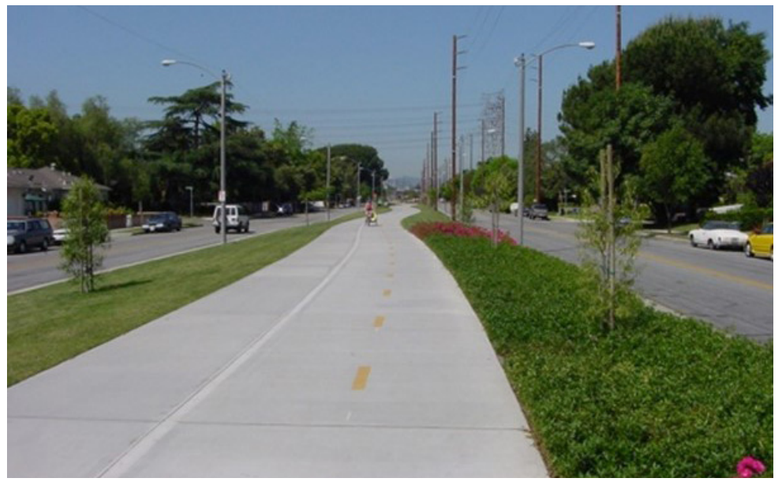
Cycle tracks are specially designed bikeways separated from the parallel motor vehicle travelway by a line of parked cars, landscaping, or a physical buffer that motor vehicles cannot cross. Cycle tracks are effective in attracting users who are concerned about conflicts with motorized traffic.

Shared-Use Paths

Shared-use paths (SUP) are facilities separated from motor vehicle traffic by an open space or barrier, either within the street right-of-way or within an independent right-of-way. Bicyclists, pedestrians, joggers, and skaters often use these paths. Shared-use paths in long, relatively uninterrupted corridors like waterways, utility corridors, and rail lines are often called hike and bike trails.



Bike lane. (Credit: Marty Bruinsma)



Shared-use path: Burbank, CA. (Credit: Ryan Snyder)

Shared-use path. (Credit: Marty Bruinsma)

Integrating with the Street System

Most bikeways are part of the street; therefore, well-connected street systems are very conducive to bicycling, especially those with a fine-meshed network of low-volume, low-speed streets suitable for shared roadways. In less well-connected street systems, where wide streets carry the bulk of traffic, bicyclists need supplementary facilities, such as short sections of paths and bridges, to connect otherwise unconnected streets.

There are no hard and fast rules for when a specific type of bikeway should be used, but some general principles guide their selection. As a general rule, as traffic volumes and speeds increase, greater separation from motor vehicle traffic is desirable. Other factors to consider are users (more children or recreational cyclists may warrant greater separation), adjacent land uses (multiple driveways may cause conflicts with shared-use paths), available right-of-way (separated facilities require greater width), and costs.

As a general rule, designated bicycle facilities (e.g., bike lanes and cycle tracks) should be provided on all major streets (avenues and boulevards), as these roads generally offer the greatest level of directness and connectivity in the network, and are typically where destinations are located. There are occasions when it is infeasible or impractical to provide bikeways on a busy street, or the street does not serve the mobility and access needs of bicyclists.

The following guidelines should be used to determine if it is more appropriate to provide facilities on a parallel local street:

- Conditions exist such that it is not economically or environmentally feasible to provide adequate bicycle facilities on the street.
- The street does not provide adequate access to destination points within reasonable walking distances, or separated bikeways on the street would not be considered safe.
- The parallel route provides continuity and convenient access to destinations served by the street.
- Costs to improve the parallel route are no greater than costs to improve the street.
- If any of these factors are met, cyclists may actually prefer the parallel local street facility in that it may offer a higher level of comfort (bicycle boulevards are based on this approach).

Off-street paths can also be used to provide transportation in corridors otherwise not served by the street system, such as along rivers and canals, through parks, along utility corridors, on abandoned railroad tracks, or along active railroad rights-of-way. While paths offer the safety and scenic advantages of separation from traffic, they must also be designed to offer frequent connections to the street system and to destinations such as residential areas, employment sites, shopping, and schools. Street crossings must be well designed with measures such as signals or median refuge islands.

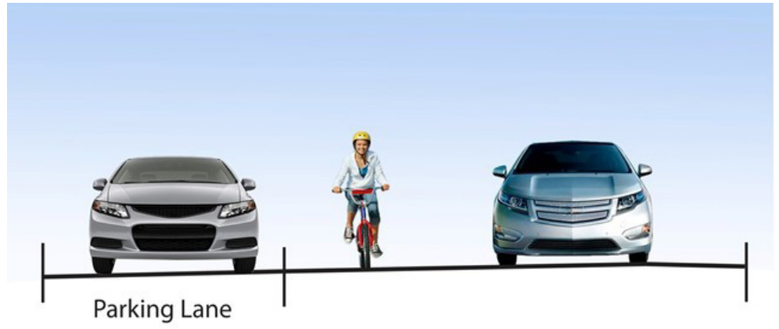
Characteristics of Bikeway Types

The following sections provide design guidance for each type of bikeway.

Shared Roadways

Shared roadways are the most common bikeway type. There are no specific width standards for shared roadways. Most are fairly narrow; they are simply the streets as constructed. Shared roadways are suitable on streets with low motor vehicle speeds or traffic volumes, and on low-volume rural roads and highways. The suitability of a shared roadway decreases as motor vehicle traffic speeds and volumes increase, especially on rural roads with poor sight distance.

Many local streets carry excessive traffic volumes at speeds higher than they were designed to carry. These can function better as shared roadways if traffic speeds and volumes are reduced. For a local street to function acceptably as a shared roadway, traffic volumes should not be more than 3,000 to 5,000 vehicles per day, and speeds should be 25 mph or less. If traffic speeds and volumes exceed those thresholds, separated facilities (e.g., bike lanes) should be considered or traffic calming should be applied to reduce the vehicle speeds/volumes. Many traffic-calming techniques can make these streets more amenable to bicycling.

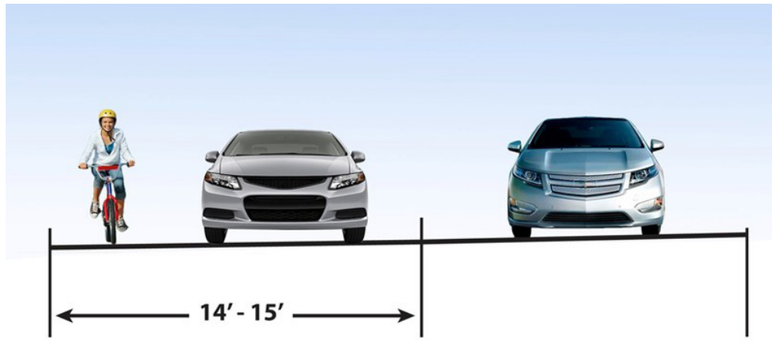


Shared roadway. (Credit: Michele Weisbart)

Wide Curb Lanes

On streets where bike lanes would be more appropriate but with insufficient width for bike lanes, wide curb lanes may be provided. This may occur on retrofit projects where there are physical constraints and all other options, such as narrowing travel lanes, have been pursued. Wide curb lanes are not particularly attractive to most cyclists; they simply allow a passenger vehicle to pass cyclists within a travel lane, if cyclists are riding far enough to the right.

Wide curb lanes may also encourage higher motor vehicle speeds, which is contrary to the design principles of this manual; wide lanes should never be used on local residential streets. A 14- to 15-foot-wide lane allows a passenger car to pass a cyclist in the same lane. Widths 16 feet or greater encourage the undesirable operation of two motor vehicles in one lane. In this situation, a bike lane should be striped.

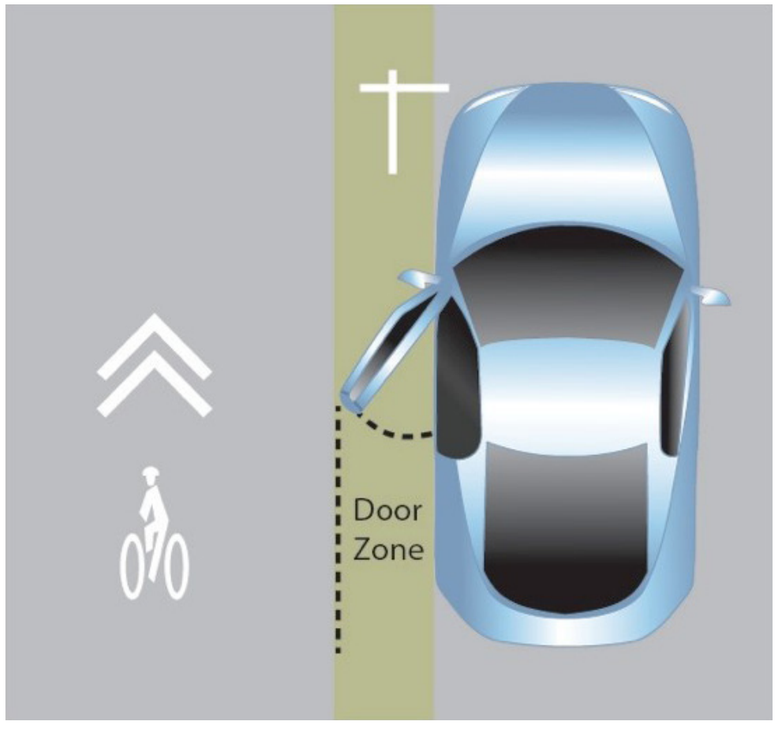


Wide curb lane. (Credit: Michele Weisbart)

Sharrows

Shared-lane marking stencils ("SLMs," also commonly called "sharrows") may be used as an additional treatment for shared roadways. The stencils can serve a number of purposes: they remind bicyclists to ride farther from parked cars to prevent "dooring" collisions, they make motorists aware of bicycles potentially in the travel lane, and they show bicyclists the correct direction of travel.

Sharrows installed next to parallel parking should be a minimum distance of 11 feet from the curb. Installing farther than 11 feet from the curb may be desired in areas with wider parking lanes or in situations where the sharrow is best situated in the center of the shared travel lane to promote cyclists taking the lane. Placing the sharrow between vehicle tire tracks increases the life of the markings and decreases long-term maintenance costs.



Sharrow. (Credit: Michele Weisbart)

Example of a sharrow: Los Angeles, CA. (Credit: Ryan Snyder)

Bicycle Boulevards

A bicycle boulevard is an enhanced shared roadway; a local street is modified to function as a prioritized through street for bicyclists while maintaining local access for automobiles. This is done by adding traffic-calming devices to reduce motor vehicle speeds and through trips, and installing traffic controls that limit conflicts between motorists and bicyclists and give priority to through bicyclist movement.

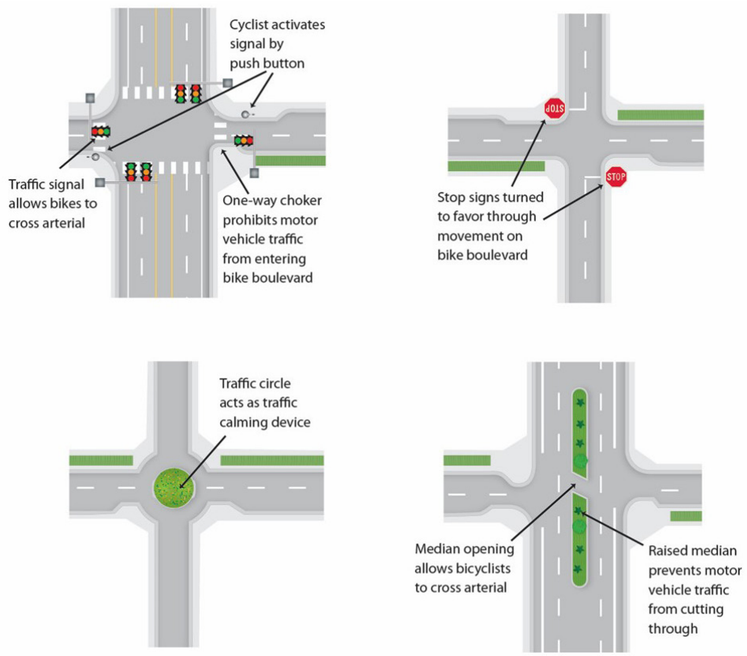
One key advantage of bicycle boulevards is that they attract cyclists who do not feel comfortable on busy streets and prefer to ride on lower traffic streets. Bicycle travel on local streets is generally compatible with local land uses (e.g., residential and some retail). Residents who want slower traffic on neighborhood streets often like measures that support bicycle boulevards. By reducing traffic and improving crossings, bicycle boulevards also improve conditions for pedestrians. Successful bicycle boulevard implementation requires careful planning with residents and businesses to ensure acceptance.

Elements of Bicycle Boulevards

A successful bike boulevard includes the following design elements:

- Selecting a direct and continuous street, rather than a circuitous route that winds through neighborhoods. Bike boulevards work best on a street grid. If any traffic diversion will likely result from the bike boulevard, selecting streets that have parallel higher-level streets can prevent unpopular diversion to other residential streets.
- Placing motor vehicle traffic diverters at key intersections to reduce through motor vehicle traffic (diverters are designed to allow through bicyclist movement).
- Turning stop signs toward intersecting streets, so bicyclists can ride with few interruptions.
- Replacing stop-controlled intersections with mini-circles and mini-roundabouts to reduce the number of stops cyclists have to make.
- Placing traffic-calming devices to lower motor vehicle traffic speeds.
- Placing wayfinding and other signs or markings to route cyclists to key destinations, to guide cyclists through difficult situations, and to alert motorists of the presence of bicyclists.
- Where the bike boulevard crosses high-speed or high-volume streets, providing crossing improvements such as:
  - Signals, where a traffic study has shown that a signal will be safe and effective. To ensure that bicyclists can activate the signal, loop detection should be installed in the pavement where bicyclists ride.
  - Roundabouts where appropriate.
  - Median refuges wide enough to provide a refuge (8 feet minimum) and with an opening wide enough to allow bicyclists to pass through (6 feet). The design should allow bicyclists to see the travel lanes they must cross.

Traffic circles allow for landscaping opportunities. (Credit: Ryan Snyder)



Components of bike boulevards. (Credit: Michele Weisbart)

Shoulder Bikeways

Paved shoulders are provided on rural highways for a variety of safety, operational, and maintenance reasons; they also provide a place for bicyclists to ride at their own pace, out of the stream of motorized traffic.

When providing shoulders for bicycle use, a minimum width of 6 feet is recommended. This allows a cyclist to ride far enough from the edge of pavement to avoid debris and far enough from passing vehicles to avoid conflicts. On roads with prevailing speeds over 45 mph, 8 feet is preferred. If there are physical width limitations, a minimum 4-foot shoulder may be used

Bike Lanes

Bike lanes are a portion of the traveled way designated for preferential use by bicyclists; they are most suitable on avenues and boulevards. Bike lanes may also be provided on rural roads where there is high bicycle use. Bike lanes are generally not recommended on local streets with relatively low traffic volumes and speeds, where a shared roadway is the appropriate facility. There are no hard and fast mandates for providing bike lanes, but as a general rule, most jurisdictions consider bike lanes on roads with traffic volumes in excess of 3,000-5,000 ADT or traffic speeds of 30 mph or greater.

Bike lanes have the following advantages:

- They enable cyclists to ride at a constant speed, especially when traffic in the adjacent travel lanes speeds up or slows down (stop-and-go).
- They enable bicyclists to position themselves where they will be visible to motorists.
- They encourage cyclists to ride on the traveled way rather than the sidewalk.

Bike lanes are created with a solid stripe and stencils. Motorists are prohibited from using bike lanes for driving and parking, but may use them for emergency avoidance maneuvers or breakdowns. Bike lanes are one-way facilities that carry bicycle traffic in the same direction as adjacent motor-vehicle traffic. Bike lanes should always be provided on both sides of a two-way street. One exception is on hills where topographical constraints limit the width to a bike lane on one side only; the bike lane should be provided in the uphill direction as cyclists ride slower uphill, and they can ride in a shared lane in the downhill direction.

The minimum bike lane width is 5 feet from the face of a curb, or 4 feet on open shoulders. If on-street parking is permitted, the bike lane should be placed between parking and the travel lane with a preferred width of 6 feet so cyclists can ride outside the door zone. Streets with high volumes of traffic and/or higher speeds need wider bike lanes (6 feet to 8 feet) than those with less traffic or slow speeds. On curbed sections, a 4-foot-(minimum 3-foot) wide smooth surface should be provided between the gutter pan and stripe. This minimum width enables cyclists to ride far enough from the curb to avoid debris and drainage grates and far enough from other vehicles to avoid conflicts. By riding away from the curb, cyclists are more visible to motorists than when hugging the curb. Where on-street parking is permitted, delineating the bike lane with two stripes, one on the street side and one on the parking side, is preferable to a single stripe.

Bike Lanes on Two-Way Streets

Basic bike lanes on two-way streets comprise the majority of bike lanes. They should follow the design guidelines for width with and without on-street parking.

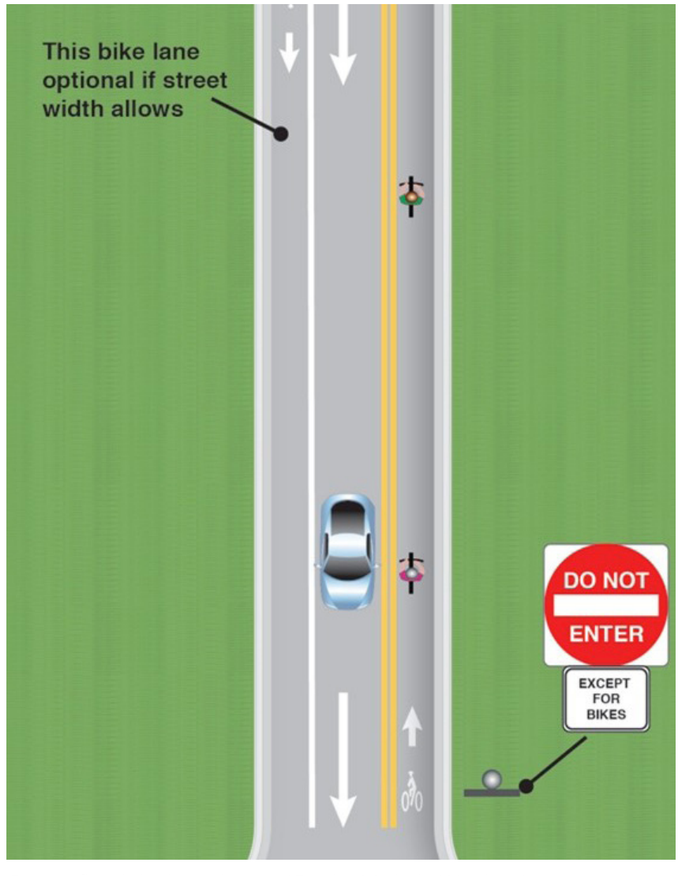
Bike Lanes on One-Way Streets

Bike lanes on one-way streets should generally be on the right side of the traveled way and should always be provided on both legs of a one-way couplet. The bike lane may be placed on the left of a one-way street if it decreases the number of conflicts (e.g., those caused by heavy bus traffic or parking) and if cyclists can safely and conveniently transition in and out of the bike lane. If sufficient width exists, the bike lanes can be striped on both sides

Contra-Flow Bike Lanes

Contra-flow bike lanes are provided to allow bicyclists to ride in the opposite direction of motor vehicle traffic. They convert a one-way traffic street into a two-way street: one direction for motor vehicles and bikes and the other for bikes only. Contra-flow lanes are separated with yellow center lane striping. Combining both directions of bicycle travel on one side of the street to accommodate contra-flow movement results in a two-way cycle track.

Contra-flow bike lanes are useful in that they provide a substantial savings in out-of-direction travel with direct access to high-use destinations, and safety is improved because of reduced conflicts compared to the longer route. The contra-flow design introduces new design challenges and may create additional conflict points as motorists may not expect on-coming bicyclists.



Contra-flow bike lane design. (Credit: Michele Weisbart)

Bike Lanes and Bus Lanes

In most instances, bicycles and buses can share the available road space. On routes heavily traveled by both bicyclists and buses, separation can reduce conflicts (stopped buses hinder bicycle movement and slower moving bicycles hinder buses). Ideally, shared bicycle/bus lanes should be 13 feet to 15 feet wide to allow passing by both buses and bicyclists.

Separate bus lanes and bike lanes should be considered to reduce conflicts between passengers and bicyclists, with the bus lane at the curbside. Buses will be passing bicyclists on the right, but the fewer merging and turning movements reduce overall conflicts.

Buffered Bike Lanes

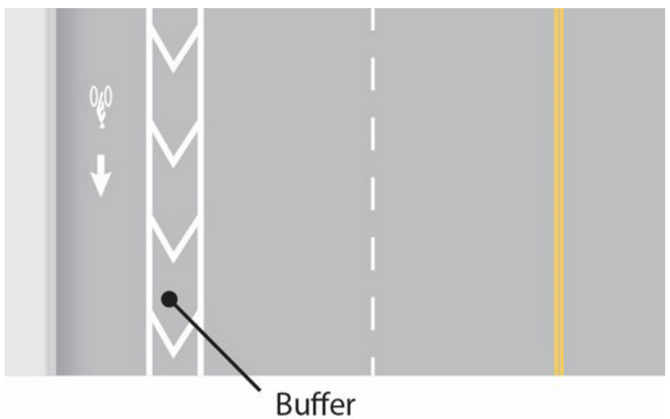
Buffered bike lanes provide a painted divider between the bike lane and the travel lanes. This additional space can improve the comfort of cyclists as they don't have to ride as close to motor vehicles. Buffered bike lanes can also be used to slow traffic as they narrow the travel lanes. An additional buffer may be used between parked cars and bike lanes to direct cyclists to ride outside of the door zone of the parked cars. Buffered bike lanes are most appropriate on wide, busy streets. They can be used on streets where physically separating the bike lanes with cycle tracks is undesirable for cost, operational, or maintenance reasons.

Raised Bike Lanes

Bike lanes are typically an integral portion of the traveled way and are delineated from motor vehicle lanes with painted stripes. Though most bicyclists ride on these facilities comfortably, others prefer more separation. Raised bike lanes incorporate the convenience of riding on the street with some physical separation. This is done by elevating the bicycle lane surface 2 to 4 inches above street level, while providing a traversable curb to separate the bikeway from the motor vehicle travelway. This treatment offers the following advantages:

- Motorists know they are straying from the travel way when they feel the slight bump created by the curb.
- The mountable curb allows motorists to make turns into and out of driveways.
- The mountable curb allows cyclists to enter or leave the bike lane (e.g., for turning left or overtaking another cyclist).
- The raised bike lane drains toward the centerline, leaving it clear of debris and puddles.
- Novice bicyclists are more likely to ride in the bike lane, leaving the sidewalk for pedestrians.

Raised bike lanes can be constructed at little additional expense for new roads. Retrofitting streets with raised bike lanes is more costly; it is best to integrate raised bike lanes into a larger project to remodel the street due to drainage replacement. Special maintenance procedures may be needed to keep raised bike lanes swept.



Painted buffer bike lanes. (Credit: Michele Weisbart)

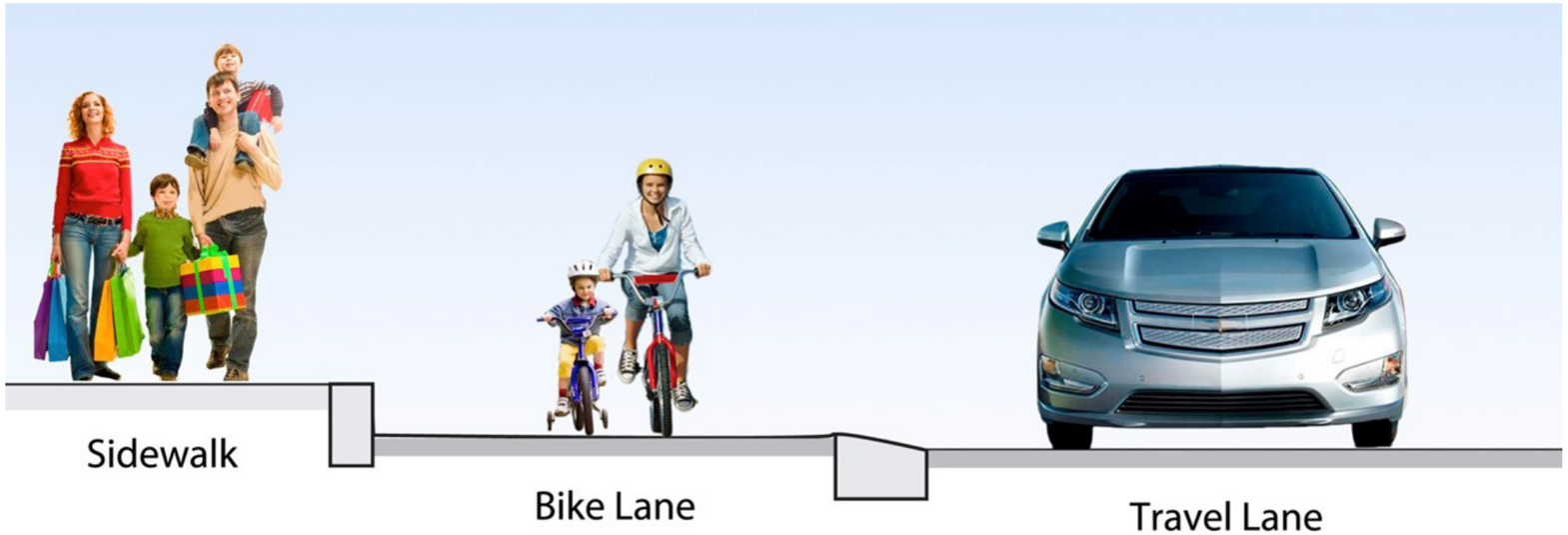
Cycle Tracks

Cycle tracks, also known as protected bike lanes, are bikeways located on or adjacent to streets where bicycle traffic is separated from motor vehicle traffic by physical barriers, such as on-street parking, posts/bollards, and landscaped islands. They can be well suited to downtown areas where they minimize traffic conflicts with pedestrians. Streets selected for cycle tracks should have minimal pedestrian crossings and driveways. They should also have minimal loading/unloading activity and other street activity. The cycle tracks should be designed to minimize conflicts with these activities as well as with pedestrians and driveways.

Cycle tracks can be provided on new facilities, but they require more width than other types of bikeways. They are best suited for existing streets where surplus width is available; the combined width of the cycle track and the barrier is more or less the width of a travel lane. The area to be used by bicycles should be designed with adequate width for street sweeping to ensure that debris will not accumulate. Cycle tracks tend to work most effectively where there are few uncontrolled crossing points with unexpected traffic conflicts.

Cycle track concerns include treatment at intersections, uncontrolled midblock driveways and crossings, wrong-way bicycle traffic, and difficulty accessing or exiting the facility at midblock locations. There is some controversy regarding the comparative safety of cycle tracks. Recent studies have concluded that cycle tracks are as safe as other treatments when high usage is expected and when measures such as separate signal phases for right-turning motor vehicle and through cyclists, and left-turning cyclists and through motor vehicles, are deployed to regulate crossing traffic.

Cycle track. (Credit: Dan Burden)

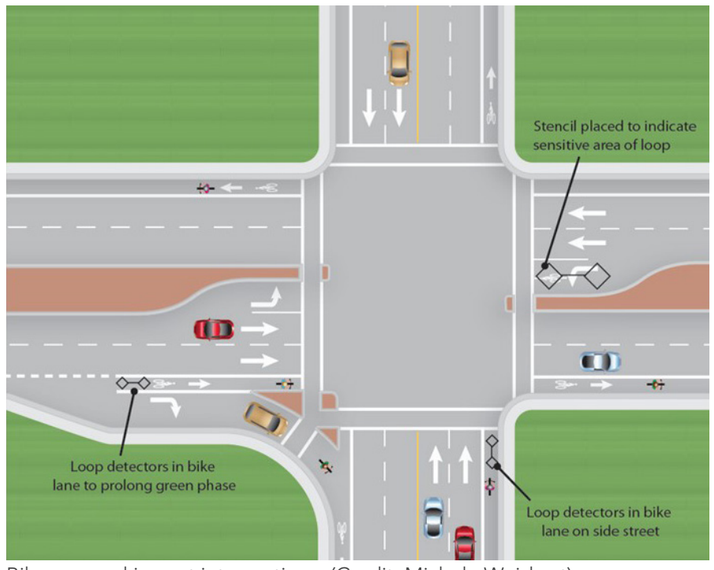


Raised bike lanes. (Credit: Michele Weisbart)

Intersections

Intersections are junctions at which different modes of transportation meet and facilities overlap. A well-designed intersection facilitates the interchange between bicyclists, pedestrians, motorists, and transit so traffic flows in a safe and efficient manner. Designs for intersections with bicycle facilities should reduce conflicts between bicyclists (and other vulnerable road users) and vehicles by heightening visibility, denoting a clear right-of-way, and ensuring that the various users are aware of each other. Intersection treatments can resolve both queuing and merging maneuvers for bicyclists, and are often coordinated with timed or specialized signals.

Chapter 5. Intersection Design provides general principles of geometric design; all these recommendations will benefit cyclists. The configuration of a safe intersection for bicyclists may include additional elements such as color, signs, medians, signal detection, and pavement markings. Intersection design should take into consideration existing and anticipated bicyclist, pedestrian, and motorist movements. In all cases, the degree of mixing or separation between bicyclists and other modes is intended to reduce the risk of crashes and increase bicyclist comfort. The level of treatment required for bicyclists at an intersection will depend on the bicycle facility type used, whether bicycle facilities are intersecting, the adjacent street function, and the adjacent land use.



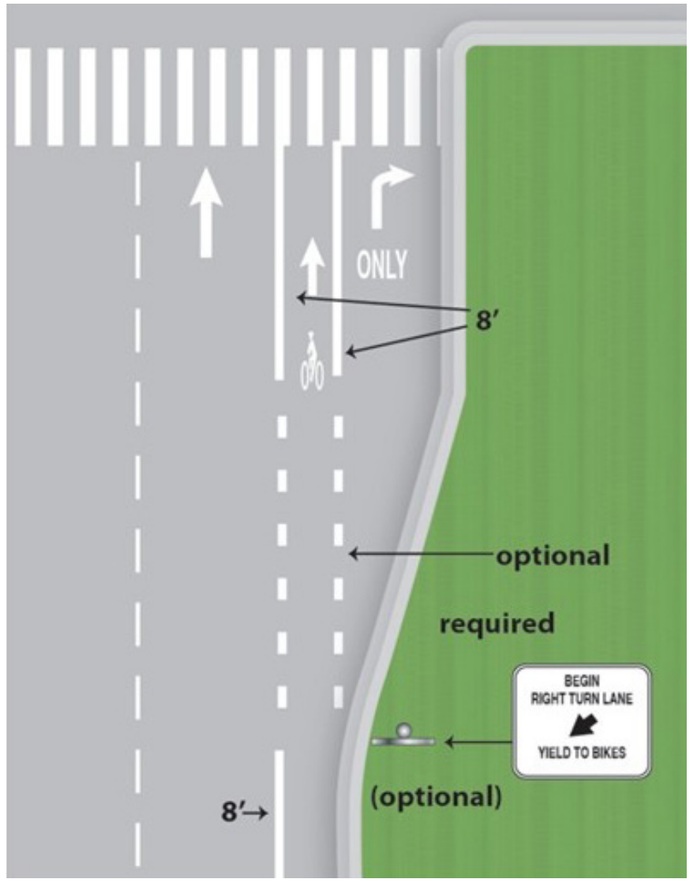
Bikeway markings at intersections. (Credit: Michele Weisbart)

Bikeway Markings at Intersections

Continuing marked bicycle facilities at intersections (up to the crosswalk) ensures that separation, guidance on proper positioning, and awareness by motorists are maintained through these potential conflict areas. The appropriate treatment for right-turn only lanes is to place a bike lane pocket between the right-turn lane and the rightmost through lane. If a full bike lane pocket cannot be accommodated, a shared bicycle/right-turn lane can be installed that places a standard-width bike lane on the left side of a dedicated right-turn lane. A dashed stripe delineates the space for bicyclists and motorists within the shared lane. This treatment includes signs advising motorists and bicyclists of proper positioning within the lane. Sharrows are another option for marking a bikeway through an intersection where a bike lane pocket cannot be accommodated.

Bike Signal Heads

Bicycle signal heads may be installed at signalized intersections to improve identified safety or operational problems for bicyclists; they provide guidance for bicyclists at intersections where bicyclists may have different needs from other road users (e.g., bicycle-only movements and leading bicycle intervals) or to indicate separate bicycle signal phases and other bicycle-specific timing strategies. A bicycle signal should only be used in combination with an existing conventional or hybrid beacon. In the United States, bicycle signal heads typically use standard three-lens signal heads in green, yellow, and red with a stencil of a bicycle.



Bike lane markings at intersections with right-turn lanes. (Credit: Michele Weisbart)

Bicycle Signal Detection

Bicycle detection is used at actuated traffic signals to alert the signal controller of bicycle crossing demand on a particular approach. Bicycle detection occurs either through the use of push buttons or by automated means (e.g., in-pavement loops, video, and microwave). Inductive loop vehicle detection at many signalized intersections is calibrated to the size or metallic mass of a vehicle, meaning that bicycles may often go undetected. The result is that bicyclists must either wait for a vehicle to arrive, dismount, and push the pedestrian button (if available), or cross illegally. Loop sensitivity can be increased to detect bicycles.

Proper bicycle detection must accurately detect bicyclists (be sensitive to the mass and volume of a bicycle and its rider); and provide clear guidance to bicyclists on how to actuate detection (e.g., what button to push or where to stand).

Bicycle signal head: Long Beach, CA. (Credit: Charlie Gandy)

Bike Boxes

A bike box is a designated area at the head of a traffic lane at a signalized intersection that provides bicyclists with a safe and visible way to get ahead of queuing traffic during the red signal phase. Appropriate locations include:

- At signalized intersections with high volumes of bicycles and/or motor vehicles, especially those with frequent bicyclist left-turns and/or motorist right-turns
- Where there may be right- or left-turning conflicts between bicyclists and motorists
- Where there is a desire to better accommodate left-turning bicycle traffic
- Where a left-turn is required to follow a designated bike route or boulevard or access a shared-use path, or when the bicycle lane moves to the left side of the street
- When the dominant motor vehicle traffic flows right and bicycle traffic continues through (such as at a Y intersection or access ramp)

Bicycle box: Portland, OR. (Credit: Ryan Snyder)

Bicycle Countdowns

Near-side bicycle signals may incorporate a "countdown to green" display to provide information about how long until the green bicycle indication is shown, enabling riders to push off as soon as the light turns green.

Leading Bicycle Intervals

Based on the Leading Pedestrian Interval, a Leading Bicycle Interval (LBI) can be implemented in conjunction with a bicycle signal head. Under an LBI, bicyclists are given a green signal while the vehicular traffic is held at all red for several seconds, providing a head start for bicyclists to advance through the intersection. This treatment is particularly effective in locations where bicyclists are required to make a challenging merge or lane change (e.g., to access a left-turn pocket) shortly after the intersection, as the LBI would give them sufficient time to make the merge before being overtaken by vehicular traffic. This treatment can be used to enhance a bicycle box.

Two-Stage Turn Queue Boxes

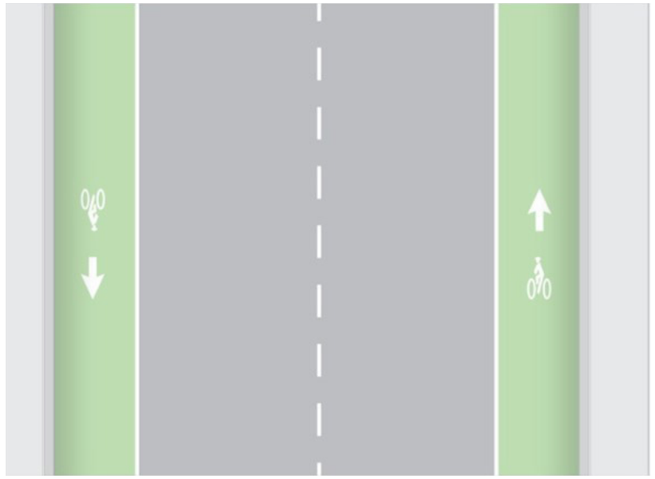
On right side cycle tracks, bicyclists are often unable to merge into traffic to turn left due to physical separation. This makes the provision of two-stage left-turns critical in ensuring these facilities are functional. The same principles for two-stage turns apply to both bike lanes and cycle tracks. While two-stage turns may increase bicyclist comfort in many locations, this configuration will typically result in higher average signal delay for bicyclists due to the need to receive two separate green signal indications (one for the through street, followed by one for the cross street) before proceeding.

Colored Pavement Treatments

Pavement coloring is useful for a variety of applications in conjunction with bicycle facilities. The primary goal of colored pavements is to differentiate specific portions of the traveled way, but colored pavements can also visibly reduce the perceived width of the street.

Colored pavements are used to highlight conflict areas between bicycle lanes and turn lanes, especially where bicycle lanes merge across motor vehicle turn lanes. Colored pavements can be used in conjunction with sharrows (shared lane markings) in heavily used commercial corridors where no other provisions for bicycle facilities are evident.

While a variety of colored treatments have been used, the trend is for spring green as the preferred color for bicycle facilities of this type, especially in areas where conflicts or shared use is intended. Maintenance of color and surface condition are considerations. Traditional traffic paints and coatings can become slippery. Long life surfaces with good wet skid resistance should be considered.



Colored bicycle lanes. (Credit: Michele Weisbart)

Green-colored bicycle lanes: San Francisco, CA.
(Credit: San Francisco Municipal Transportation Agency)

Wayfinding

The ability to navigate through a region is informed by landmarks, natural features, signs, and other visual cues. Wayfinding is a cost-effective and highly visible way to improve the bicycling environment by familiarizing users with the bicycle network, helping users identify the best routes to destinations, addressing misperceptions about time and distance, and helping overcome a barrier to entry for infrequent cyclists (e.g., "interested but concerned" cyclists).

A bikeway wayfinding system is typically composed of signs indicating direction of travel, location of destinations, and travel time/distance to those destinations; pavement markings indicating to bicyclists that they are on a designated route or bike boulevard and reminding motorists to drive courteously; and maps providing users with information regarding destinations, bicycle facilities, and route options.

Wayfinding signs: Seattle, WA. (Credit: Ryan Snyder)

Bicycle Parking

Secure bicycle parking at likely destinations is an integral part of a bikeway network. Bicycle thefts are common and lack of secure parking is often cited as a reason people hesitate to ride a bicycle. The same consideration should be given to bicyclists as to motorists, who expect convenient and secure parking at all destinations. Bicycle parking should be located in well-lit, secure locations close to the main entrance of a building, no further from the entrance than the closest automobile parking space. Bike parking should not interfere with pedestrian movement.

Bike racks along sidewalks should support the bicycle well, and make it easy to lock a U-shaped lock to the frame of the bike and the rack. The two examples show an "inverted –U" rack and an art design rack: both meet these criteria. Refer to the APBP Bike Parking Guidelines for additional information.

Maintenance

Maintenance is a critical part of safe and comfortable bicycle access. Two areas that are of particular importance to bicyclists are pavement quality and drainage grates. Rough surfaces, potholes, and imperfections, such as joints, can cause a rider to lose control and fall. Care must be taken to ensure that drainage grates are bicycle-safe; otherwise a bicycle wheel may fall into the slots of the grate, causing the cyclist to fall. The grate and inlet box must be flush with the adjacent surface. Inlets should be raised after a pavement overlay to the new surface. If this is not possible or practical, the new pavement should taper into drainage inlets so the inlet edge is not abrupt.

The most effective way to avoid drainage-grate problems is to eliminate them entirely with the use of inlets in the curb face. This may require more grates to handle bypass flow, but is the most bicycle-friendly design

Inverted U Bike Rack. (Credit: Sky Yim)

Bicycle racks can double as public art: Los Angeles, CA.
(Credit: Sky Yim)

Implementation

Implementation of a bikeway network often requires an implementation plan. Some bikeways, such as paths, bicycle boulevards, and other innovative techniques described in this guide, will require a capital improvement project process, including identifying funding, a public and environmental review process, and plan preparation. Other bikeway improvements piggy-back onto planned construction, such as resurfacing, reconstruction, or utility work.

The majority of bikeway facilities are provided on streets in the form of shared roadways or bicycle lanes. Shared roadways usually require virtually no change to existing roadways, except for some directional signs, occasional markings, and minor changes in traffic control devices; removing unnecessary centerline stripes is a strategy that can be implemented after resurfacing projects. Striped bike lanes are implemented on existing roads through use of the strategies below.

Resurfacing

The cost of striping bicycle lanes is negligible when incorporated with resurfacing, as this avoids the high cost of stripe removal; the fresh pavement provides a blank slate. Jurisdictions will need to anticipate opportunities and synchronize restriping plans with repaving and reconstruction plans. If new pavement is not anticipated in the near future, grinding out the old lane lines can still provide bike lanes. There are three basic techniques for finding room for bike lanes: lane narrowing, road diets, and parking removal.

Lane Narrowing

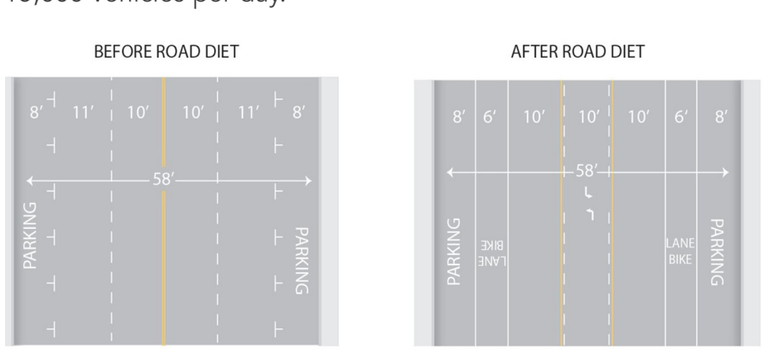
Where all existing or planned travel lanes must be retained, travel lanes can be narrowed to provide space for bike lanes. Recent studies have indicated that the use of 10-foot travel lanes does not result in decreased safety in comparison with wider lanes for vehicle speeds up to 35 mph. Eleven-foot lanes can be used satisfactorily at higher speeds especially where trucks and buses frequently run on these streets. However, where a choice between a 6-foot bike lane and an 11-foot travel lane must be made, it is usually preferable to have the 6-foot bike lane. Parking lanes can also be narrowed to 7 feet to create space for bike lanes.

Road Diets

Reducing the number of travel lanes provides space for bicycle lanes. Many streets have more space for vehicular traffic than necessary. Some streets may require a traffic and/or environmental analysis to determine whether additional needs or impacts may be anticipated. The traditional road diet changes a four-lane undivided street to two travel lanes, a continuous left-turn lane (or median), and bike lanes. In other cases, a four-lane street can be reduced to a two-lane street without a center-turn lane if there are few left-turn movements.

One-way couplets are good lane-reduction candidates if they have more travel lanes in one direction than necessary for the traffic volumes. For example, a four-lane one-way street can be reduced to three lanes and a bike lane. Since only one bike lane is needed on a one-way street, removing a travel lane can free enough room for other features, such as on-street parking or wider sidewalks. Both legs of a couplet must be treated equally, so there is a bike lane in each direction.

Road diets are suitable for roads with daily traffic of less than 15,000 vehicles per day.



Fitting in bicycle lanes with road diets. (Credit: Michele Weisbart)

Parking Removal

On-street parking is vital on certain streets (such as residential or traditional central business districts with little or no off-street parking), but other streets have allowable parking without a significant visible demand. In these cases, parking prohibition can be used to provide bike lanes with minimal public inconvenience.

Utility Work

Utility work often requires reconstructing the street surface to complete restoration work. This provides opportunities to implement bike lanes and more complex bikeways such as bike boulevards, cycle tracks, or paths. It is necessary to provide plans for proper implementation and design of bikeway facilities prior to the utility work. It is equally necessary to ensure that existing bikeways are replaced where they exist prior to utility construction.

Redevelopment

When streets are slated for reconstruction in conjunction with redevelopment, opportunities exist to integrate bicycle lanes or other facilities into the redevelopment plans.

Paved Shoulders

Adding paved shoulders to existing roads can be quite expensive if done as stand-alone, capital improvement projects, especially if ditch lines have to be moved, or if open drains are changed to enclosed drains. But paved shoulders can be added at little extra cost if they are incorporated into projects that already disturb the area beyond the pavement, such as laying utility lines or drainage work.

9. Transit Accommodations

Public transit serves a vital transportation function for many people; it is their access to jobs, school, shopping, recreation, visitation, worship, and other daily functions. For transit to provide optimal service, streets must accommodate transit vehicles, pedestrian access, and the needs of the mobility challenged. Transit connects passengers to destinations and can play a key role in promoting placemaking and sustainable urban form.

This chapter provides design guidance for both transit stops and transit street operations, including bus stop layout, placement, and transit lanes. The chapter ends with a discussion of ways to accommodate higher frequency transit services, such as light rail, street cars, and Bus Rapid Transit (BRT).

Denton County Transportation Authority (DCTA)'s A-train currently pass through Corinth.
(Source: DCTA)

Essential Principles of Transit Accommodations

Public transit should be planned and designed as part of the street system. It should interface seamlessly with walking, bicycling, car, taxi, or paratransit networks whenever possible. Transit should be planned on the following principles:

- Transit has the highests priority on city streets. On some streets transit may have a higher priority than private vehicles.
- The busiest transit lines have designated bus lanes.
- On selected streets where there is sufficient ridership, only buses and trains are permitted in the travelled way.
- Transit stops should be easily accessible, with safe and convenient crossing opportunities.
- Transit stops should be active and attractive public spaces that attract people on a regular basis, at various times of day, and all days of the week.
- Transit stops should include amenities for passengers waiting to board. In commercial areas, stops should provided space for a variety of amenities too.
- Serve residents, shoppers, and commuters alike.
- Transit stops should be visible from a distance.
- Transit stop placement and design influences accessibility to transit and network operations, and influences travel behavior/mode choice.
- Zoning, land use, and design guidelines around transit stations should encourage walking and a mixed use development.
- Streets connecting neighborhoods to transit facilities should be attractive, comfortable, and safe for all users.

Access to Transit

Transit services plays a key role in building and sustaining ridership; all transit trips require pedestrian or ADA transit access.

Where necessary, transit stops should have safe and convenient street crossings as transit users experience increased safety risks while crossing streets to access transit stops. Every transit stop should be evaluated for potential street crossings. If the crossing is deemed unsafe, mitigation can occur in several ways: a crossing can be provided at the existing stop, the stop can be moved to a location with a safer crossing, barriers can be placed to prevent street crossings, or the stop can be removed completely if the safety risk is too great. For street crossing measures, see Chapter 7. Pedestrian Crossings.

Eliminating or consolidating stops can be beneficial to transit operations and users by reducing the number of times a bus, streetcar, or light rail train has to stop. The trade-offs are added walking time for users but quicker route times, resulting in a shorter journey overall. For example, this might mean a two to three minute longer walk for some passengers but an eight to 10 minute shorter bus ride for all.

Transit needs to serve people of all ages and abilities. (Source: CCRTA)

Bus Stops

The following sections provide guidance for designing bus stops.

Layout

A well placed and configured transit stop offers the following characteristics:

- Clearly defines the stop as a special place
- Provides a visual cue on where to wait for a transit vehicle
- Does not block the path of travel on the adjacent sidewalk
- Allows for ease of access between the sidewalk, the transit stop, and the transit vehicle
- Is kept free of trash and debris and is well-maintained

Layout guidelines include the following:

- Consolidate streetscape elements to create a clear waiting space and minimize obstructions between the sidewalk, waiting area, and boarding area
- Consider the use of special paving treatments or curb extensions (where there is on-street parking) to distinguish transit stops from the adjacent sidewalks
- Integrate transit stops with adjacent activity centers whenever possible to create active and safe places
- Avoid locating bus stops adjacent to driveways, curb cuts, and land uses that generate a large number of automobile trips (gas stations, drive-thru restaurants, etc.)

Transit stops are required by the ADA to be accessible. Specifically, the PROWAG requires a clear loading area (minimum 5 feet by 8 feet) perpendicular to the curb with a maximum 2.1% cross-slope to allow a transit vehicle to extend its lift to allow people with disabilities to board. The loading area should be located where the transit vehicle has its lift and be accessible directly from a transit shelter. The stop must also provide 30 by 48 inches of clear space within a shelter to accommodate wheelchairs.

Transit-Specific Streetscape Elements

The essential streetscape elements for transit include signs, shelters, and benches.

Flag signs indicate where people are to wait and board a transit vehicle. The signs should clearly identify the transit operator, route number, and schedule. Maps showing the transit lines servicing that stop, local destinations, and additional transfer transit lines should also be provided. Flag signs should be located toward the front of the stop.

Benches should be provided at transit stops with headways longer than five minutes.

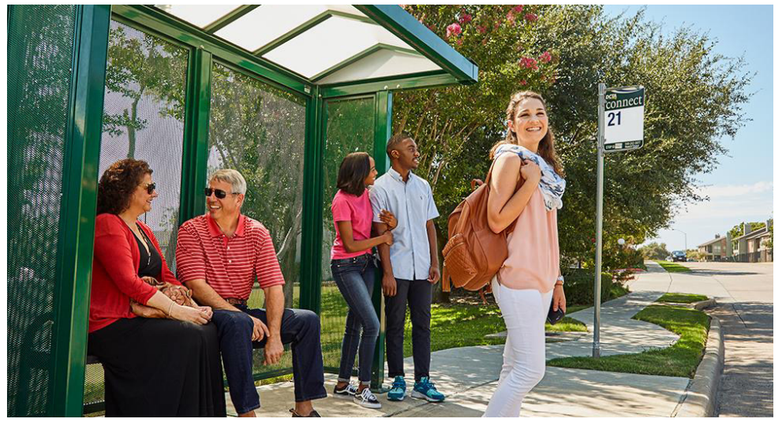
Shelters provide comfort and security for passengers by keeping them out of the rain, sun, heat, wind and rain. Shelters vary in size and design; standard shelters are 3- to 7-feet-wide and 6- to 16-feet long. They include covered seating and sign panels that can be used for transit information. Shelters should:

- Be provided at transit stops with headways longer than 10 minutes.
- Have electrical connections to power lighting and/or real-time transit information, or accommodate solar power.
- Should be located in a sidewalk's furniture zone so they do not conflict with the pedestrian zone. Shelters may be placed in the sidewalk's frontage zone provided that they do not block building entrances or the pedestrian zone.

Transit stops should also provide other amenities to make waiting for the next bus comfortable:

- Trash/recycling receptacles should be provided and maintained at most stops.
- Depending on service frequency and the number of passengers boarding and alighting, electronic "next bus" readouts can be used to inform passengers when to expect the next bus. Cell phone applications can also be used.
- High volume bus stops and stations should include space for vendors to sell goods and services.

DCTA A-Train station in Denton. (Source: DCTA)



DCTA bus station. (Source: DCTA)

Bus Stop Placement

A bus stop's optimal placement depends on the operational characteristics of both the roadway and the transit system. The placement of bus stops at the far side of signalized intersections is generally considered to be preferable to near side or mid-block locations. However, each location has its advantages and disadvantages, as shown in Exhibit 24 on page A-69.

In general, bus stops should be located at the far side of a signalized intersection in order to enhance the effectiveness of traffic signal synchronization or bus signal priority projects. Near-side bus stops are appropriate for stop sign-controlled intersections. But in all cases priority should be given to the location that best serves the passengers, with passenger safety being the primary concern.

Signal Treatment for Transit Services

Signal prioritization is a component of technology-based "intelligent transportation systems" (ITS). These systems are often used by roadway authorities in conjunction with transit agencies to help improve a roadway system's overall operations by:

- Reducing traffic signal delays for transit vehicles
- Improving intersection operational throughput
- Reducing the need for transit vehicles to stop for traffic at intersections
- Decreasing intersection wait times and increasing transit route frequency
- Improving transit system reliability and reducing waiting times

Signal prioritization projects include signal timing or phasing projects and transit signal priority projects.

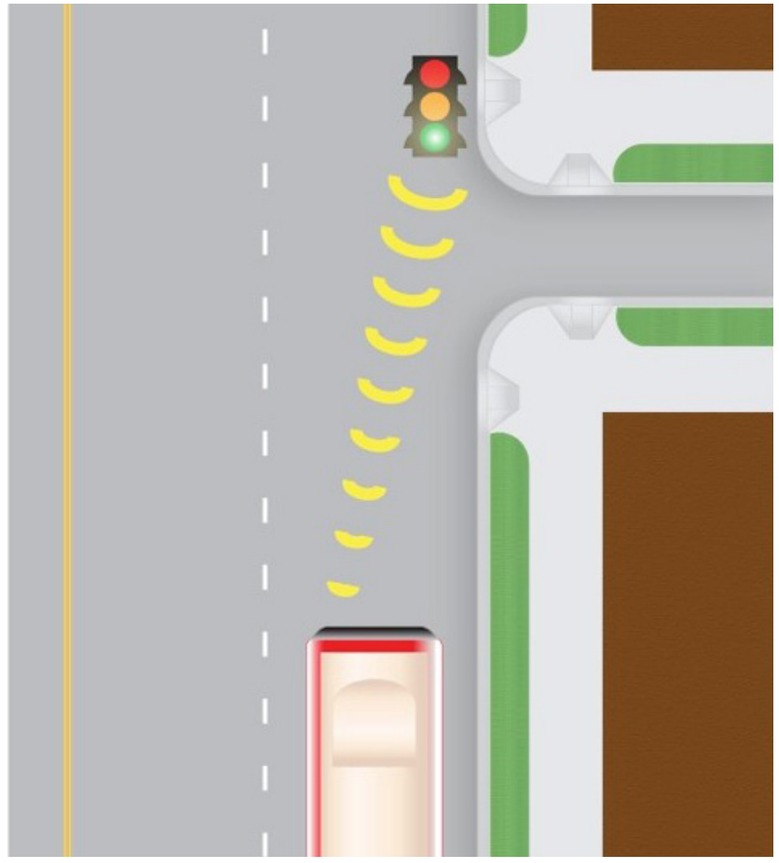
Signal timing projects optimize the traffic signals along a corridor to make better use of available green time capacity by favoring a peak directional traffic flow. These passive systems give priority to roadways with significant transit use within a district-wide traffic signal timing scheme. Transit signal prioritization can also be achieved by timing a corridor's traffic signals based on a bus's average operating speed instead of an automobile's average speed.

Transit signal-priority projects alter a traffic signal's phasing as a transit vehicle approaches an intersection. This active system requires the installation of specialized equipment at an intersection's traffic signal controller and on the transit vehicle. It can either give an early green signal or hold a green signal that is already being displayed in order to allow buses that are operating behind schedule to get back on schedule. Signal-priority projects also help improve a transit system's schedule adherence, operating time, and reliability.

Transit signal preemption projects provide a green light for emergency vehicles and transit vehicles.

Although they may use similar equipment, signal-priority and preemption are two different processes. Signal-priority modifies the normal signal operation process to better accommodate transit vehicles, while signal pre-emption interrupts the normal signal to favor transit or emergency vehicles. Preemption turns all other lights red and supersedes signal priority. This allows the bus to reduce travel times and improves safety by bringing all cross traffic, including cyclists and pedestrians, to a stop to allow the emergency or transit vehicle to pass.

The placement of a bus stop at the far side of a signalized intersection increases the effectiveness of transit signal-priority projects. Signal treatments should be used along streets with significant bus service.



Signal-priority technology can help to reduce delay for buses (Credit: Michele Weisbart)

Exhibit 24. *Bus Stop Placement Considerations*

Source: Federal Transit Administration, BRT Stops, Spacing, Location, and Design

Location	Advantages	Disadvantages
Near Side (immediately before an intersection)	» Minimizes interference when traffic is heavy on the far side of the intersection » Passengers access buses closest to crosswalk » Intersection available to assist in pulling away from curb » No double stopping » Buses can service passengers while stopped at a red light » Provides driver with opportunity to look for oncoming traffic including other buses with potential passengers	» Conflicts with right turning vehicles are increased » Stopped buses may obscure curbside traffic control devices and crossing pedestrians » Sight distance is obscured for crossing vehicles stopped to the right of the bus. » The through lane may be blocked during peak periods by queuing buses » Increases sight distance problems for crossing pedestrians
Far Side (immediately after an intersection)	» Minimizes conflicts between right-turning vehicles and buses » Provides additional right-turn capacity by making curb lane available for traffic » Minimizes sight distance problems on approaches to intersection » Encourages pedestrians to cross behind the bus » Requires shorter deceleration distances for buses » Gaps in traffic flow are created for buses re-entering the flow of traffic at signalized intersections	» Intersections may be blocked during peak periods by queuing buses » Sight distance may be obscured for crossing vehicles » Increases sight distance problems for crossing pedestrians » Stopping far side after stopping for a red light interferes with bus operations and all traffic in general » May increase number of rear-end accidents since drivers do not expect buses to stop again after stopping at a red light
Mid-Block (within a block)	» Minimizes sight distance problems for vehicles and pedestrians » Passenger waiting areas experience less pedestrian congestion	» Intersections may be blocked during peak periods by queuing buses » Sight distance may be obscured for crossing vehicles » Increases sight distance problems for crossing pedestrians » Stopping far side after stopping for a red light interferes with bus operations and all traffic in general » May increase number of rear-end accidents since drivers do not expect buses to stop again after stopping at a red light

Bus Bulbs

Bus bulbs are curb extensions that extend the length of the transit stop on streets with on-street parking. They improve transit performance by eliminating the need for buses to merge into mixed traffic after every stop. They also facilitate passenger boarding by allowing the bus to align directly with the curb; waiting passengers can enter the bus immediately after it has stopped. They improve pedestrian conditions by providing additional space for people to wait for transit and by allowing the placement of bus shelters where they do not conflict with a sidewalk's pedestrian zone.

Bus bulbs also reduce the crossing distance of a street for pedestrians if they are located at a crossing. In most situations, buses picking up passengers at bus bulbs block the curbside travel lane; but this is mitigated by the reduced dwell time, as it takes less time for the bus driver to position the bus correctly, and less time for passengers to board.

One major advantage of bus bulbs over pulling over to the curb is that they require less parking removal: typically two on-street parking spots for a bus bulb instead of four for pulling over.

The following conditions should be given priority for the placement of transit bus bulbs:

- Where transit performance is significantly slowed by the transit vehicle's merging into a mixed-flow travel lane
- Roadways served by express or Bus Rapid Transit (BRT) lines
- Stops that serve as major transfer points
- Areas with heavy transit and pedestrian activity and where narrow sidewalks do not allow for the placement of a bus shelter without conflicting with the pedestrian zone

Bus bulbs should not be considered for stops with any of the following:

- A queue-jumping lane provided for buses
- On-street parking prohibited during peak travel periods
- Near-side stops located at intersections with heavy right-turn movements, except along streets with a "transit-first" policy

Characteristics

Bus bulbs should be long enough to accommodate all doors of a transit vehicle to allow for the boarding and alighting of all passengers, or be long enough to accommodate two or more buses (with a 5-foot clearance between buses and a 10-foot clearance behind a bus) where there is frequent service such as with BRT or other express lines. Bus bulbs located on the far side of a signalized intersection should be long enough to accommodate the complete length of a bus so that the rear of the bus does not intrude into the intersection.

Bus bulb. (Source: NACTO)

Exhibit 25. *Standard Transit Vehicle and Transit Bus Bulb Dimensions*

Vehicle	Length (feet)	Number of Buses at Stops	Platform Length (feet)	
			Near Side	Far Side
Standard Bus	40	1	35	45
		2	55	65
Articulated Bus	60	1	80	90
		2	120	130

Source: Federal Transit Administration, August 2004. Characteristics of Bus Rapid Transit for Decision Making Project NO: FTA-VA-26-7222-2004.1

Bicycle Connections

Connecting bicycle facilities to transit stations promotes cycling and helps to reduce automobile use. Secure bicycle parking must be provided at or within close proximity to a bus stop and is preferably sheltered. Accommodations can be bike racks or lockers. Bike stations and automated bicycle parking are typically placed at transit locations with high levels of bicycle use.

Buses with bicycle racks to encourage cyclists use transit services. (Source: CCRTA)

Bus Lanes

Bus lanes provide exclusive or semi-exclusive use for transit vehicles to improve the transit system's travel time and operating efficiency by separating transit from congested travel lanes. They can be located in an exclusive right-of-way or share a roadway right-of-way. They can be physically separated from other travel lanes or differentiated by lane markings and signs.

Bus lanes can be located within a roadway median or along a curb-side lane, and are identified by lane markings and signs. They should generally be at least 11-feet wide, but where bicycles share the lane with buses, 13- to 15-feet wide is preferred. When creating bus lanes, cities should consider the following:

- Exclusive transit use may be limited to peak travel periods or shared with high-occupancy or emergency service vehicles.
- On-street parking may be allowed depending on roadway design, especially with bus lanes located in the center of the street.
- A mixed-flow lane or on-street parking may be displaced; this is preferable to adding a lane to an already wide roadway, which increases the crossing distance for pedestrians and creates other problems discussed in other chapters.
- Within a mixed-flow lane, the roadway can be delineated by striping and signs.
- High-occupancy vehicles and/or bicycles may be permitted to use bus lanes.

Pedestrian access to stations becomes an issue when bus lanes are located in roadway medians.

Urban Design

Bus stops and amenities vary in complexity and design from standardized off-the-shelf signs and furniture to specially designed elements. The design of the bus stop elements, location of the bus stop in relation to adjacent land uses or activities, and the quality of the roadway's pedestrian environment contribute to a bus stop's placemaking. Transit agencies prefer a branded look to their stops so they are easily identified, but often there is room for customized designs to fit in with the neighborhood, with at least some of the features and amenities.

Accommodating Light Rail, Street Cars, and BRT

A growing number of streets have light rail lines, street cars, or BRT that serve as high-frequency transit. These services require careful considerations to incorporate their footprint into existing street design. The various options for accommodating light rail, street cars, and BRT within streets include:

- Center-running
- Two-way split-side, with one direction of transit flow in each direction
- Two-way single-side, with both directions of transit flow on one side of the street right-of-way
- One-way single-side, with transit running one direction (either with or against the flow of vehicular traffic) and usually operating in a one-way couplet on parallel streets.

For each configuration, transit can operate in a reserved guideway or in mixed street traffic. When installing light rail or street cars within streets, the safety of pedestrians and bicyclists needs to be prioritized. If poorly designed, these transit lines introduce hazards and serve to divide neighborhoods where crossings are highly limited and/or difficult. In general, in areas of high pedestrian activity, the speed of the transit service should be compatible with the speed of pedestrians.

The potential for each configuration is influenced by the street type. Some transit configurations will not work effectively in combination with certain street types. Exhibit 26 below outlines the compatibility of each configuration with the four street types.

Exhibit 26. *Street Types and Transit Configurations*

	Center Running		Two-Way Split Side		Two-Way Single Side		One-Way Single Side	
Street Type	Reserved Guideway	In Street	Reserved Guideway	In Street	Reserved Guideway	In Street	Reserved Guideway	In Street
Boulevard	Y	N	N	Y	Y	N	Y*	Y
Multi-way Boulevard	Y	N*	Y	Y	N	N	Y*	Y
Avenue	Y	Y	Y*	Y	Y*	N	Y	Y
Street	N	Y	Y	Y	N*	N	Y	Y

Notes
Y = Recommended street type/transit configuration combination
N = Not recommended/possible street type/transit configuration combination
**Denotes configurations that mat be possible under certain circumstances, but are not usually optimal*
Source: Integration of Transit into Urban Thoroughfare Design, DRAFT White Paper prepared by the Center for Transit-Oriented Development, updated: November 9, 2007.

10. Traffic Calming

Traffic calming is the combination of mainly physical measures that (i) reduce the negative effects of motor vehicle use, (ii) alter driver behavior, and (iii) improve conditions for non-motorized street users.

The phrase, "the combination of mainly physical measures," means physical measures plus a supportive policy environment such that traffic calming is permitted and encouraged.

"Reduce the negative effects of motor vehicle use" means changing the role and design of streets to accommodate motorists in ways that reduce the negative social and environmental effects on individuals, neighborhoods, districts, retail areas, corridors, downtowns, and society in general (e.g., reduced speeds, reduced sense of intrusion/dominance, reduced energy consumption and pollution, reduced sprawl, and reduced automobile dependence).

"Alter driver behavior" means that the street design helps drivers self-enforce lower speeds, resulting in less aggressive driving and increased respect for non-motorized users of the streets.

"Improve conditions for non-motorized street users" means promoting walking and cycling, changing expectations of all street users to support equitable use of the street, increasing safety and comfort (i.e., the feeling of safety), improving the aesthetics of the street, and supporting the context of the street.

The definition of traffic calming is broad enough to apply to a myriad of contexts and situations but specific enough to have independent meaning so that it is not confused with other street design elements and design approaches.

Through design, traffic calming aims to slow the speeds of motorists to the "desired speed" (usually 20 mph or less for residential streets and 25 to 35 mph for boulevards and avenues) in a context-sensitive manner by working with the stakeholders (i.e., residents, business owners, and agencies). Traffic calming is acceptable on all street types where pedestrians are allowed. Traffic calming is applicable to all sizes of towns and cities as well as rural villages and hamlets.

Traffic calming typically connotes a street or group of streets that employ traffic calming measures with a "self-enforcing" quality that physically encourages motorists to drive at the desired speed. When a group of streets are involved, it is normally referred to as "area-wide calming."

Traffic calming measures can also be designed to treat and manage street water.

Traffic calmed street. (Credit: Dan Burden)

Categories of Traffic Calming

From a policy and design perspective, traffic calming measures fall into two broad categories: those that are appropriate for "framework" streets and those that are appropriate for both framework streets and "non-framework" streets.

Framework streets are streets that connect places, neighborhoods, and districts (usually most boulevards and avenues) and/or serve as emergency vehicle routes. The sorts of traffic calming measures that are appropriate on framework streets include "cross-section measures" because emergency response times are generally unaffected by cross-section changes. Non-framework streets are all the other streets in the street network.

The majority of streets in cities are non-framework streets. Non-framework streets provide access to houses, businesses, offices, and parks, and are rarely used by emergency vehicles except for local calls. The sorts of traffic calming measures that are appropriate for non-framework streets include cross-section measures and "periodic measures." Periodic measures are spaced intermittently, rather than continuously. They are very popular on non-framework streets because they are inexpensive when compared to cross-section measures, which typically require construction along the entire length of the street. Examples of both types of measures and guidance for their use are shown in Exhibit 27 and Exhibit 28.

The correct terminology for traffic calming measures is "measures" not "devices." "Devices" implies a degree of portability that does not apply to most traffic calming measures. The use of "devices" also causes confusion with the contents of the Manual of Uniform Traffic Control Devices. Adding street trees and changing the paving material to provide texture or contrast, for example, are measures to alter behavior and perceptions but they are clearly not "devices."

"Route modification measures" are not traffic calming measures. Examples of route modification measures include street closures, partial closures, turn prohibitions, diverters, and one-way streets. Route modifications effectively remove parts of the network.

Route modifications result in circuitous and out-of-direction routing. The resulting trips are longer and burn more fuel; thus, circuitous routing can increase driver frustration and result in higher speeds. Route modification should be used sparingly and generally where traffic is diverted to boulevards to reduce cut-through traffic, or on bike boulevards to reduce their use by through motor vehicle traffic.

Lastly, signs and pavement markings are often used in conjunction with traffic calming measures, but they are traffic control devices, not traffic calming measures.

Exhibit 27. *Cross section traffic calming measure: Santa Monica, CA. (Credit: Ryan Snyder)*

Exhibit 28. *Periodic traffic calming measure: Raised crosswalk in Seattle, WA. (Credit: Ryan Snyder)*

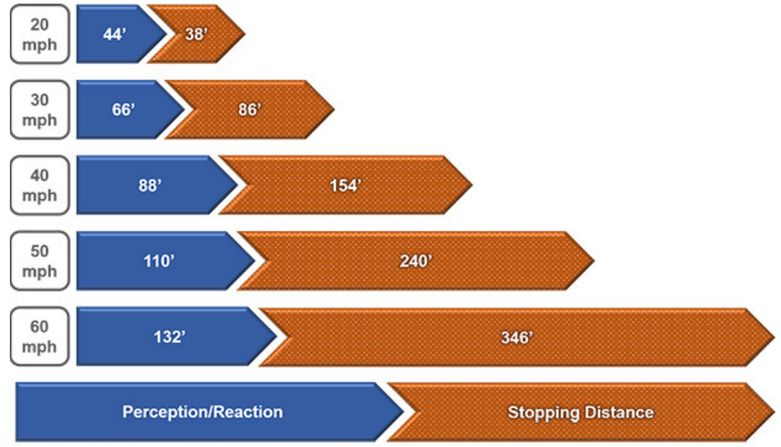
Benefits of Traffic Calming

The greatest benefit of traffic calming is increased safety. Compared with conventionally designed streets, traffic calmed streets typically have fewer collisions and even higher reductions in injuries and fatalities. These dramatic safety benefits are mostly the result of slower speeds for motorists that result in greater driver awareness, wider fields of vision, shorter stopping distances, and less kinetic energy during a collision.

At 20 mph or less, chances are very high that a motorist will not kill or severely injure a pedestrian in a collision. Other contributing factors to these superior safety results include a more legible street environment and design advantages for pedestrians and cyclists. Bulb-outs on corners of intersections, for example, allow pedestrians to see past parked cars prior to crossing the street.

The accommodation and comfort of pedestrians increases greatly as speeds lower. For example, acceptable gaps (i.e., the space between moving vehicles) are better judged at slower speeds. Also, at 25 mph or less drivers are much more likely to yield to pedestrians and let them cross the street than at over 25 mph. The chart below shows that it takes a longer distance to react and a longer distance to brake and come to a full stop as speeds increase.

Exhibit 29. *Vehicle Travel Distance Post-Pedestrian Detection by Speed*



Source: FHWA, "Speed Management is Key to Road Safety", 2022.

Peripheral vision decreases at higher speeds. (Credit: Michele Weisbart)

Emergency Response and Number of Periodic Measures

It is important to have a network of framework streets so that emergency personnel can get to, or reasonably close to, calls without encountering too many periodic measures. In this way, all or most of the length of the responders' trips are on framework streets and, if any periodic measures are encountered, then they are encountered only toward the end of the trip.

From an emergency perspective and a public acceptability perspective, it is important to limit the number of periodic measures in a row on non-framework streets. The rule of thumb is, on the routes between two framework streets there should be no more than 8 to 12 periodic measures. If more than 8 to 12 periodic measures are used in a row, motorists who use the streets will become highly irritated with the measures and will have them removed. This rule of thumb effectively limits the length of single-street traffic calming projects. It also limits the size of the area for area-wide calming (i.e., the maximum limit is 8 to 12 multiplied by the spacing between the measures).

To achieve a desired speed of 20 mph using periodic measures, the spacing between the measures should be about 250 to 300 feet. Typically, measures are constructed at the obvious locations (i.e., pedestrian crossings, intersections, and curves) and then subsequent measures are filled in to attain the correct spacing. In this way, a slow and steady speed profile is achieved; there is little opportunity or utility for motorists to speed up between the measures.

Exceptions

There are two general exceptions to the above recommendations:

- Some local streets should be classified as framework streets due to their long lengths and inability to be effectively calmed with no more than 8 to 12 periodic measures at the correct spacing.
- Periodic measures are appropriate on framework streets in some situations. Examples include locations with heavy pedestrian generators (e.g., at elementary schools, community centers, entertainment venues, and key intersections along a main street or in a downtown).

Designing traffic calming to accommodate emergency response. (Credit: Dan Burden)

Traffic Calming Usage

For cities initiating a traffic calming policy, the most important items to include are the following:

- The correct definition of traffic calming
- General statements of support for traffic calming throughout the city and experimentation with traffic calming for a variety of rationales
- A chart of examples of acceptable measures on different categories of streets
- A reference to traffic calming practices and procedures that will be maintained at the staff level

The last item is important because cities need the flexibility to adapt their programs, include updated practices and measures as they are developed or discovered, and react to changing circumstances. If practices and procedures are adopted by ordinance or resolution, then the traffic calming policy will be out-of-date quickly or will hamper cities' abilities to address unique contexts.

Tort Liability

The low speed environment of a traffic calmed street is a difficult place for someone to be "victimized" by a fault in the road design. Consequently, there are very few tort actions associated with traffic calming. Furthermore, there are fewer collisions and far fewer injuries and deaths on traffic calmed streets than streets with higher speeds. There is no exposure to liability if some simple and routine actions are followed:

- In cities' statements for supporting traffic calming, some broad rationale should be listed so that traffic calming cannot be considered "capricious." Examples should include to increase safety, increase walkability, increase community cohesion, and increase business viability; historic preservation and environmental protection; and to further the goals and objectives of the community and city in a variety of contexts.
- Cities should conduct normal monitoring for maintenance, complaints, incidents, and collisions. This need not be anything more than the normal reporting systems but with some additional attention paid to streets with new modifications.

Traffic Calming Contexts

Early traffic calming efforts in North America started as "programs" and often used a variety of warrants and petitions. However, traffic calming has evolved and there are many reasons to calm traffic; a city doesn't need special permission or warrants to increase the safety and comfort of its streets. In many ways, traffic calming is synonymous with other terms that are used to encourage better street designs. Depending on the term, the emphasis differs, but in all cases traffic calming measures play a role.

Context-Sensitive Design (CSD)

CSD implies that the context (i.e., the social, historical, physical, fiscal, political, environmental, and policy contexts) drives the design as opposed to the conventional street hierarchy. Typically, conventional practices use general design guidelines that are indifferent to the context. Frequently, contexts along conventional streets in cities suffer from some combination of negative effects of motor vehicle use, poor driver behavior, and poor conditions for non-motorized street users. Consequently, CSD often employs traffic calming measures to respect the context of the street and neighborhood.

Safe Routes to School

Safe Routes to School includes a series of operational and physical changes that help students walk and cycle to and from schools. Traffic calming measures are routinely employed with other strategies and changes to create safer walking and bicycling routes to school by slowing traffic.

Neighborhood Traffic Management

This term describes the combination of:

- Route modifications (e.g., turn prohibitions, closures, partial closures, diverters, and one-way streets) to remove parts of the street network, sever linkages, create mazes, or reduce connectivity
- Unwarranted traffic control devices (e.g., stop signs and traffic signals) to annoy or delay motorists who cut through neighborhoods
- Traffic calming to reduce poor driver behavior (e.g., speeding and aggressive driving)

Please note that in most situations, diminishing the street network is not considered good practice. Bicycle boulevards are a primary exception to this rule; traffic control devices are desirable on bicycle boulevards to discourage through motor vehicle traffic. Route modifications may also be used to reduce cut-through traffic where the traffic will be diverted to a boulevard.

Competent Street Design

Competent street design combines all of the above. There is little excuse any more to ignore the context or to build incomplete, dangerous, or poorly integrated streets. The issue for traffic calming is not justification but prioritization. If there are problems with a conventionally designed street, then traffic calming is warranted. The questions are how to calm, when to calm, and how the project compares to other priorities in the city.

Obviously, an early priority for any city is to incorporate traffic calming measures into normal street design practices and procedures to help any new/future streets avoid the deficiencies of conventionally designed streets. The harder part is prioritizing the rebuilding or retrofitting of the myriad of already built conventionally designed streets. Rebuilding or retrofitting these streets should be prioritized based on the context, in the broadest sense. Candidates for calming might include:

- Key shopping streets in the downtown area
- Waterfront streets, which commonly attract pedestrians who would benefit if the streets were calmed
- Neighborhood streets
- Large arterials (boulevards) that create barriers in the city

Planning and Design Processes

Traffic calming should be a normal part of any city's planning and design processes. The processes will vary dramatically depending on the context. For example, implementing a road diet in conjunction with a transit facility along a 5-mile boulevard would require a different process than reverting one-way streets back to two-way operation in a downtown. Similarly, a neighborhood traffic calming plan would require a different process than designing a people-friendly Main Street. Also, identifying boulevard streets that are barriers in a city during comprehensive planning would require a different process than altering streets on a college campus or hospital campus.

The common threads that link all of the processes include the following:

- Gaining a good understanding of the context
- Involving the stakeholders in the definition of the problems to be solved and aspirations to be fulfilled
- Educating the stakeholders such that they can have meaningful involvement
- Aligning the project with a broader vision for the area
- Achieving an informed consent regarding the plan

Traffic calming is best done in conjunction with a development, revitalization, utility, or maintenance project; a downtown, corridor, or transit plan; a new street design; or other project. Then the traffic calming layer is simply incorporated into the larger project's processes.

Complete street. (Credit: Ryan Snyder)

Curb extensions enhance retail districts: Asheville, North Carolina. (Credit: Ryan Snyder)

Photo Examples of Traffic Calming Measures

Long, continuous median.
(Credit: Ian Lockwood)

Short median on curve.
(Credit: Michael Wallwork)

Short median with refuge.
(Credit: Ian Lockwood)

Oval median with tree wells.
(Credit: Gary Crammer)

Mid-block curb extension with bioswale.
(Credit: Brad Lancaster

Lateral shifts.
(Credit: Ian Lockwood)

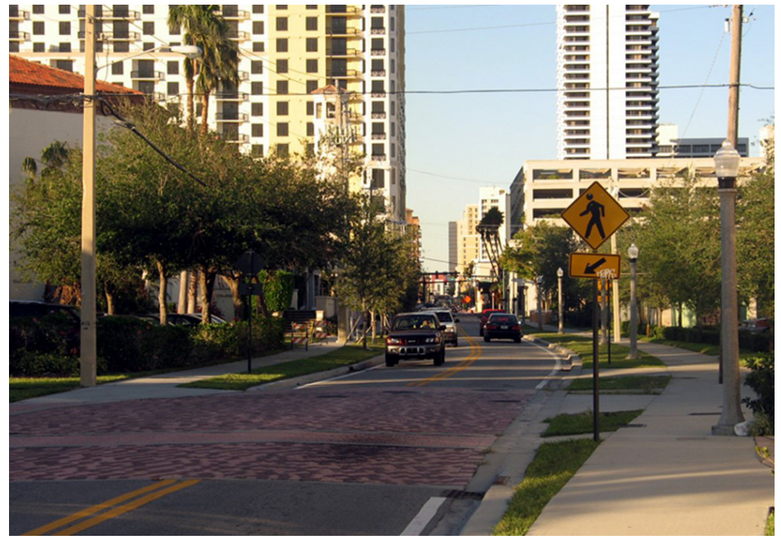
Roundabout.

Mini-roundabout.

Traffic circle with rain garden.
(Credit: Brad Lancaster)

Impeller T-intersection.
(Credit: Ian Lockwood)

Raised intersection.



Raised crosswalk.
(Credit: Ian Lockwood)

Chicane.
(Credit: NACTO)

One-lane chicane.
(Credit: Ian Lockwood)

Speed cushions with passage that straddles centerline. (Credit: Jeff Gulden)

Valley gutter.
(Credit: Ian Lockwood)

Curbless, flush street.
(Credit: Ian Lockwood)

Textured pavement.
(Credit: Ian Lockwood)

11. Re-Placing Streets

Most American cities have come to view streets primarily as conduits for moving vehicles from one place to another (from A to B is the common expression). While moving vehicles is one of their purposes, streets are spaces, even destinations in and of themselves. Conceiving of a street as a public space and establishing design guidelines that serve multiple social functions involves several fundamental steps. Behind them all is a redefinition of whom streets ought to serve. By approaching streets as public spaces, cities redirect their attention from creating traffic conduits to designing a place for the people who use the street.

People put the place back in streets. This chapter describes the need for cities to "re-place" their streets—make streets places and refocus their purpose on the people who use them—and how cities can do so. The chapter outlines the key features and functions of re-placed streets and the design elements used to achieve re-placed streets. The chapter concludes by describing the process cities can follow to ensure streets come to reflect a community's strengths, needs, and aspirations.

(Credit: Sky Yim)

Public Space and the Need to Re-Place Streets

Public spaces are the stages for our public lives. They are the places shared by all members of a community, of any size. Quality public spaces are places where things happen and where people want to be, vital places that highlight local assets, spur rejuvenation, and serve common needs.

Streets comprise a large portion of publicly owned land in cities and towns. Streets are a huge part of any community's public space network, and historically served as meeting places, playgrounds for children, marketplaces, and more. As populations spread out from city centers, streets lost many of these functions and were instead designed and planned for one use: mobility. At best, streets conceived as Complete Streets address the mobility needs of all street users (pedestrians, cyclists, drivers, and transit riders). During the last century, however, automobiles have been prioritized over people as users of our streets.

As part of the public realm, successful streets have a variety of functions beyond allowing automobiles to travel rapidly. For this reason, placemaking, the process of creating high-quality destinations, must be at the core of the planning and design of our streets to meet the following challenges:

» **Population growth and urbanization.** People moving back into cities will need to be accommodated in limited space, putting greater demands on existing streets. If streets continue to largely function to move people traveling in motor vehicles, they will not be able to accommodate this growth. Streets will need to enable people to do more while traveling less and to travel more efficiently.

» **The need to maximize social and economic exchange**. Streets will need to serve the highest and best use for the land they are on, and mobility is only one among many possible uses. Streets need to be designed to maximize social value, which also spurs healthy economic exchange. In this way, streets become arteries distributing prosperity. Streets that invite social interaction are more likely to ensure healthy growth.

» **The need to reduce energy consumption and induce sustainable growth.** Streets that are places promote locality. They enable people to travel comfortably by non-motorized modes, which in turn shortens travel distance demand. With growing concerns regarding fuel resources and climate change, this shift will be critical. Because re-placed streets spur locality-serving commerce and social venues, they also set the stage for and enable healthy and environmentally sustainable practices/behaviors in the surrounding built environment.

» **A desire to create public space.** Beyond being the frames for other development, streets can be public spaces themselves. Access to public space is critical to safe, healthy, and successful communities. When streets are designed as great spaces for people, they reinforce a sense of belonging and build on the strengths of the communities they host.

Active public space. (Credit: Ryan Snyder)

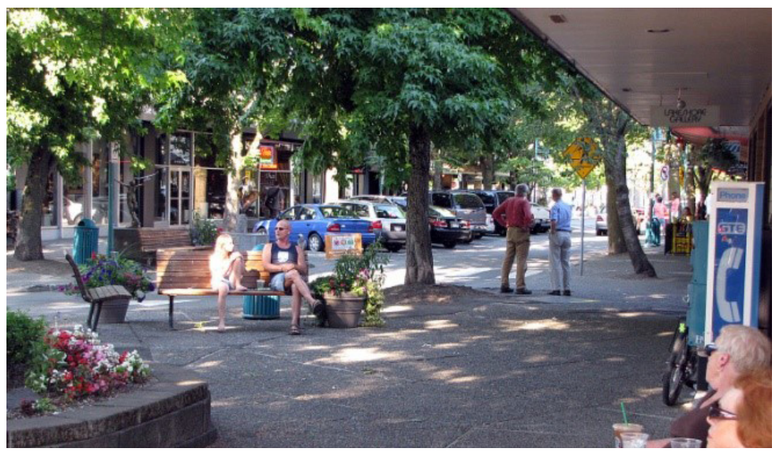
Placemaking for Streets

In order to be places, streets must:

- » Augment and complement surrounding destinations, including other public spaces such as parks and plazas
- » Reflect a community's identity
- » Invite physical activity through allowing and encouraging active transportation and recreation
- » Support social connectivity
- » Promote social and economic equity
- » Be as pleasant and accessible for staying as for going
- » Prioritize the slowest users over the fastest
- » Balance mobility and public space functions

So that people can:

- » Walk and stroll in comfort
- » Sit down in nice, comfortable places, sheltered from the elements
- » Meet and talk—by chance and by design
- » Look at attractive things along the way
- » See places that are interesting
- » Feel safe in a public environment
- » Enjoy other people around them
- » And get where they need to go!



Good public space invites social interaction. (Credit: Dan Burden)

Re-placed streets must be slow streets that are inviting and filled with human activity. This is the most important distinction between streets designed for maximal car throughput and re-placed streets; it requires the necessary scalar adjustment from car- to people-focused street planning. Streets designed for fast and far movement favor people moving by motor vehicles, not people moving under their own power. Human energy limits people to slow and local movement.

Because people, not motors, are essential to long-term growth in places of all kinds, human-scaled streets are an inducement to healthy lifestyles and economic resilience.

Public Art: Alhambra, CA. (Credit: Ryan Snyder)

Design Techniques and Goals for Replaced Streets

A re-placed street balances the moving and staying needs of its users and has multiple, people-serving purposes. The design techniques and goals detailed below describe how to create re-placed streets.

Support and Encourage Activities and Destinations

- » Widen sidewalks to accommodate multiple activities
- » Open streets to multiple activities
- » Encourage/provide active ground floor uses in adjacent buildings
- » Cluster activities and amenities
- » Allow street vendors and performers

Design Street Elements and Adjacent Buildings for the Human Scale

- » Use amenities that are pedestrian-scaled including:
  - Signs
  - Lighting
  - Seating
- » Encourage building design (e.g., through zoning regulations and design guidelines) that is scaled to the human body, such as:
  - Frequent building entrances
  - Building transparency at street level
  - Interesting facades

Good sidewalk buffer: Glendale, CA. (Credit: Ryan Snyder)

Provide a Feeling of Safety and Security on Streets

- » Keep streets well-maintained and both the street and surrounding buildings well-lit
- » Select streets adjacent to round-the-clock-active buildings and public spaces
- » Invite diverse people and uses throughout the day
- » Slow traffic to a comfortable speed to mix with other travel modes through:
  - Low speed design elements
  - Traffic calming techniques
  - Shared space
- » Maintain a buffer between pedestrians and vehicles when there is fast moving traffic using:
  - Planters
  - Bollards
  - Parked cars
  - Kiosks, newsstands, public toilets, lampposts

Connect Both Sides of the Street

» Shorten crossing distance through:
  - Narrow travel lanes
  - Curb extensions and pedestrian islands
  - Building activities connected to the street

» Invite people to cross in more places by:
  - Slowing vehicular traffic
  - Establishing mid-block crossings
  - Making shared streets

Show a Sense of Ownership

» Provide for maintenance and cleanliness

» Engage community/local residents in maintenance

» Accommodate diverse programming appropriate for the season and time-of-day, such as:
  - Greenmarkets/farmers' markets
  - Fairs and festivals
  - Ciclovía-style events
  - Volunteer events

CicLAvia event: Los Angeles, CA. (Credit: Ryan Snyder)

Reflect Community Identity

Unique community identity draws from the natural setting and local history, as well as the cultural backgrounds of community residents and their architectural tastes.

» Showcase local assets including:
  - Monuments and building architecture
  - Views
  - Trees and other plants
  - Other natural features (water, topography)
  - Parks and plazas
  - History
  - People
  - Intersections transformed into meeting places

» Invite a diversity of users:
  - Reference or preserve continuity of local aesthetics

Move Community toward Resiliency

Utilize on-site and local resources where possible.

» Use surface area for energy capture

» Use effective stormwater management techniques including:
  - Bioswales
  - Raingardens

» Use open space for growing food (community gardens)

Statue: Lufkin, TX.

Strategies to Re-Place Streets

Re-placing streets requires building streets around a community's vision that the street can support. Re-placing a street is an opportunity to open a process wherein communities remind themselves of their strengths and establish a shared and sustainable vision for their future. Before a city can proceed with street redesigns that create a sense of place, it must address the following issues.

The Street's Place in the Community

Streets, the built environments they connect, and the people who use them compose a community. Thus, it is important to situate the street in its spatial context and identify the places it connects. It is equally important to identify whose needs the street should serve. This may include tenants and property owners, students, employees, local civic associations, and religious institutions.

Placemaking Participants

At the heart of placemaking is the idea that each community has the means and the potential to create its own public spaces. Before a city can proceed with street redesigns that attend to the multiple functions of public space through placemaking, it is important to identify who needs to be involved to frame the meaning of place and the vision for that community and to provide the needed information, resources, and expertise to realize that vision.

The Community

Since place is an outgrowth of community character, re-placing should invite the collective influence of a community's diverse residents and users. In re-placing a street, it is important to establish who has a stake in the neighborhood, and give all of these groups and individuals the opportunity to come to the table and contribute. As noted above, the groups may include tenants and property owners, students, employees, and community-based groups like civic associations and religious institutions. The appropriate public space functions of streets should be defined by these multiple users, often referred to as "stakeholders."

Multiple Agencies

Within a city, multiple agencies should be included and engaged in re-placing a street. A department of transportation alone cannot create a street that is a place. Any agency with responsibility for the regulation, construction, operations, or maintenance on or adjacent to the street should be included in the project early in the process. In addition to the department of transportation, this might include public works, the parks department, utilities, and the planning or zoning department. All agencies must bring their needs and constraints to the table, but more importantly they must understand the community's vision and goals for making the street a place. They can then begin considering what they need to do to carry out the will of their community.

A Multi-Disciplinary Team

A successful street is a complex place, and the information, insight, and skills required to make it a successful place are many and diverse. It is beyond the experience of any one profession to deal with any of these issues. The role of professionals is as a resource for the community and to implement the community's vision.

Statue: Santa Fe, NM. (Credit: Ryan Snyder)

The Placemaking Process

The placemaking process should be fun, engaging, and empowering for a community; build on existing human resources; and result in increased community social capital. Below are processes especially important to placemaking.

Establish a Community Vision of What the Street Is and Should Be

Infrastructure forecasts what later springs from the built environment: a street's public space functions can be an inducement to a community's growth aspirations and not just an accommodation of existing behavior. Determining the optimal uses and design for a given community's streets involves identifying the strengths and needs of its users. Because it involves a scalar adjustment, this is the most important distinction between a street designed to be a place, with many functions, and a street designed for the single function of maximizing car throughput. A process that allows the community of street users to define these strengths and needs and establishes a vision for the street is critical.

Involve the Public in Assessing the Strength, Needs and Opportunities on the Street

The project must start by going directly to the residents and neighborhoods to evaluate and establish a vision for the street. A critical part of this will be an assessment of whether places on the street are performing well or need improvement. The assessment should include a grassroots identification of needs for enhancement of underperforming places and opportunities for the creation of new places so that the street can achieve the critical mass of places needed to function as a destination itself. In addition to places on the street, the community should be engaged in an on-site diagnosis of the street itself to determine how it is performing. A variety of tools and audits exist for such assessments, but at heart they should engage the community in assessing the characteristics, described in the previous section, that make a street a place.

Establish a Community Vision Based on This Assessment

The community process should result in a community-generated vision for what the street can and should be, including the things people should be able to do on the street and the way that people feel doing them. The vision should be generated by people who use the street. Such a vision is generally quite realistic and practical yet contains innovative ideas because the vision is grounded in reality but is not generated by just one individual or group.

The vision should contain:

- A mission statement of goals
- A definition of how the street will be used and by whom
- A statement of the desired character of the street
- Suggestions and a conceptual idea of how the street could be designed
- Models or examples of places that community members would like the street to be like or elements they would like to use

Develop a Plan Based on This Vision

There will need to be a plan for realizing the vision. It might not include every step to realize the vision, but it should begin to lay out next steps and identify things that all partners, including the agencies, the professionals, and the community, can do to move re-placing the street forward.

Examples of low-cost, short-term devices that transform streets: San Francisco, CA (Credit: Sky Yim)

Prioritize Interventions Based on This Vision

The vision will contain many ideas. However, some will be more important or more critical than others. Additionally, some will be easier to implement than others. The community will need to prioritize individual ideas and strategies in order to begin to take action in re-placing the street.

Select and Implement Short-Term/Temporary/Pilot Projects

First on the action plan should be short-term or pilot projects. Such projects can be a way of testing ideas for long-term change at a lower cost while providing flexibility for adaptation and change. Such projects also give people confidence that change is occurring and that the ideas they have contributed matter.

This is important because re-placing streets takes time, and smaller, simpler changes can provide small steps that keep people engaged in the process of placemaking. Short-term and pilot projects allow people to see how the street is working with changes introduced gradually over time, enabling people's perceptions of how the street functions and what it should be to change and reducing resistance to change.

New York, San Francisco, Portland, and other cities have quickly transformed streets into vibrant public space with such techniques as:

- Establishing non-vehicular space with planter boxes, temporary curbs, and wooden platforms
- Painting the pavement under the newly repurposed space
- Bringing in portable tables, chairs, and awnings
- Incorporating decorative street painting projects

Establish a Maintenance and Management Plan

Maintenance and management is critical because streets are not static—they change daily, weekly, and seasonally—and streets must adapt and be flexible to this change. Thus, public space management may be required. Management becomes especially critical where events, such as farmers' markets, fairs, festivals, and ciclovías, are programmed. Great streets are also well loved and well used. To sustain a quality street environment, the community must commit to long-term investment in the re-placed street.

Examples of low-cost, short-term devices that transform streets. (Credit: Paul Zykofsky)

Additional Resources

Universal Pedestrian Access

- Primary: ADAAG/PROWAG
- Secondary:
  - MUTCD
  - AASHTO "Green Book"
  - FHWA's Designing Sidewalks and Trails for Access
  - NCHRP Project 20-7 (232) ADA Transition Plans: Guide to Best Management Practices
  - NCHRP Project 3-62, Guidelines for Accessible Pedestrian Signals

Bikeway Design

- National Association of City Transportation Officials, Urban Bikeway Design Guide, 2011
- AASHTO Guide for the Development of Bicycle Facilities

Retrofitting Suburbia

- ICF International with Nelson\Nygaard Consulting Associates and Reid Ewing. Transportation Study of the U.S. Route 1 College Park Corridor, July 14, 2008.
- PB Americas, EWA Connectivity Study, May 2009.
- Dunham-Jones, E. and Williamson, J., Retrofitting Suburbia: Urban Design Solutions for Redesigning Suburbs, John Wiley & Sons, 2009. This book focuses more on retrofitting parcels of land, rather than on the streets between them. Nonetheless, it is an excellent resource.

12. Retrofitting Suburbia

Much of suburbia will have to change in order to thrive and meet the health, environmental, and economic challenges of the coming decades. Because of their form, widely separated land uses, and disconnected street networks, most suburban areas lack walkability and require that people travel by car for most of their needs. This has serious environmental consequences (poor air quality, climate change, and high energy consumption) as well as health consequences as suburbanites live in environments that discourage active transportation and favor driving. Residents in these neighborhoods tend to become isolated due to the lack of walkable streets and walkable destinations. Rising fuel costs pinch both family budgets and local economies as people have less discretionary income.

Changing demographics also present challenges. Suburban homes have been built to accommodate young families with children, but fewer households now fit that profile. More and more households are comprised of empty nesters, young singles, divorced adults, and other non-nuclear families, and this trend is expected to grow in the future.

As fuel prices continue to rise and as residents age, suburbs will need to serve more of their residents' needs closer to home, and serve those needs in places that can be reached other than by driving. Suburban areas can be retrofitted to accommodate a new reality that rewards places that are close to more people and reachable in many ways.

This chapter describes how streets can support retrofitting suburbia, provides strategies for retrofitting streets, and recommends priorities and phasing.

Transforming Suburban Streets to Living Streets

Streets play an enormous role in determining a place's quality of life.

Retrofitting Existing Streets

By definition, a retrofit occurs on an existing street. This manual gives design guidance for all streets, existing and new. The following section recommends how to accommodate those design recommendations on existing streets. Many aspects of living streets actually take less space than typical suburban design.

To create a living street in the right-of-way of an existing street, cities should do the following (LaPlante, J., "Retrofitting Urban Arterials Into Complete Streets," 3rd Urban Street Symposium, June 24-27, 2007, Seattle, Washington):

- Narrow travel lanes. Ten or 11-foot lanes are acceptable for most urban boulevards. They are just as safe as 12-foot lanes for posted speeds of 35 mph or less (Dumbaugh, E., "Safe Streets, Livable Streets," Journal of the American Planning Association 71[3] 283-300).
- Seek opportunities to put streets on a road diet; this involves eliminating superfluous travel lanes.
- Common scenarios include
- Convert a four-lane undivided road to a center turn lane, two travel lanes, and two bike lanes. This can handle up to 20,000 ADT and improves safety and access to adjacent destinations; the center turn lane can be replaced with short sections of medians and pedestrian crossing islands in selected locations. On-street parking can be substituted for bike lanes where the context and conditions warrant it.
- Reduce seven-lane roads to five lanes for ADTs of up to 35,000

Suburban development (Credit: Ryan Snyder)

- » Remove a travel lane from three- and four-lane one-way streets
- » Tighten corner curb radii to the minimum needed to provide a usable turning radius for an appropriately selected design vehicle. Occasional encroachment by larger vehicles into other travel lanes is acceptable; intersections should not be designed for the largest occasional vehicle.
- » Eliminate unnecessary turn lanes at intersections, such as right-turn lanes with very few right turning vehicles. Free-flow right-turn lanes, including freeway entry and exit ramp connections to surface streets, should be replaced with yield control.
- » Replace painted channelization islands at intersections with raised islands, to give pedestrians a true refuge, and to break up a long crossing of many lanes into smaller discrete steps.

All of these changes can free up space, which can be used for additional elements. To improve street quality, cities can

- » Paint bike lanes
- » Add sidewalks
- » Add raised medians, which visually narrow the roadway and provide a median refuge for midblock crossings
- » Provide median and parkway landscaping, which further visually narrows the roadway and provides a calming effect
- » Add or retain curb parking, which improves community access, calms traffic, and buffers pedestrians.
- » Add bulb-outs, which shorten pedestrian crossing distances and improve sight lines

Non-Physical Changes

In addition to physical retrofits, cities can and should adapt existing street management and operations to

- » Adjust signal timing for slower speeds and to ensure comfortable crossing times for appropriate populations. In areas with aging populations, for example, crossing times may need to be lengthened.
- » Work with transit agencies to improve bus operations
- » Work with schools to develop a Safe Routes to School Program
- » Reexamine the parking code (for example, off-street parking requirements may be reduced, especially in coordination with additional on-street parking)

Suburban street (Credit: Ryan Snyder)

Street Crossings

A connected sidewalk network includes street crossings. To improve street crossings, jurisdictions can consider the following:

- » Make pedestrian crossing locations safe, comfortable, and more frequent (LaPlante, J., "Retrofitting Urban Arterials Into Complete Streets," 3rd Urban Street Symposium, June 24-27, 2007 Seattle, Washington.)
- » Allow crossing at every corner of all intersections
- » On streets with a bus route, make provisions for pedestrians to cross the street at all bus stops. Bus riders need to cross the street either coming or going.
- » Provide midblock crossings. Pedestrians should not be expected to travel to the closest intersection to cross the street. Signalized intersections in suburban areas are often spaced ¼ mile, ½ mile, or even further apart; it is unreasonable to expect people to walk that far to cross the street. Nor do signalized intersections offer safety benefits to pedestrians, due to the many added turning conflicts at large suburban intersections.

Many of these changes can be made through spot improvement programs. Many are relatively inexpensive; it is not necessary to wait for a reconstruction to create a living street. More substantial retrofits may require reconstruction. A planned surface repaving project is an excellent time to retrofit the corridor to add comfort, convenience, safety, aesthetics, and economic value.

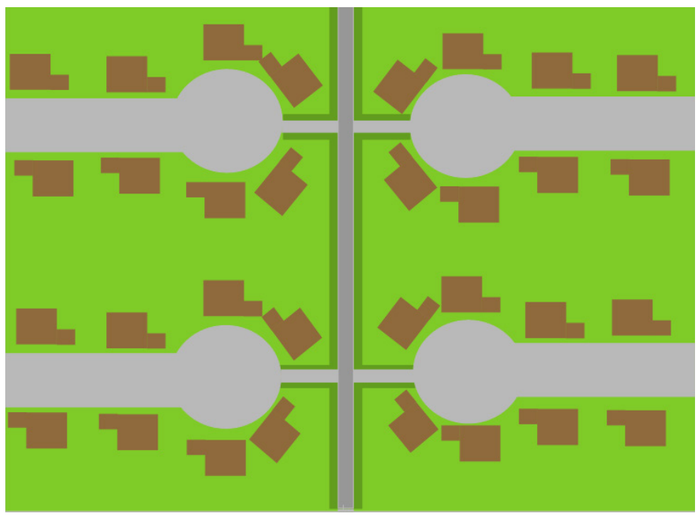
Midblock crosswalk (Credit: Dan Burden)

Re-Establishing Street Networks

Much of today's suburban landscape was built in isolated pods: residential subdivisions, business parks, shopping centers, and schools that are poorly connected to neighboring properties. These pods create barriers to getting around other than in a car, because they create long distances between destinations and because the pods are often surrounded by sound walls, fences or berms, literally blocking potential bicycle and walking routes. These pods don't work well for auto traffic either, since they force all traffic onto busy streets rather than allowing connection and local circulation through local streets.

To create a vibrant suburb that will thrive in new conditions, direct connections must be created or re-created to enable efficient, direct travel by everyone. That means establishing or re-establishing street and sidewalk networks.

Re/establishing a street network can be more challenging, particularly when right-of-way has not been preserved. Some cities have purchased homes at the end of cul-de-sacs, put the connectors in, and then sold the homes. In cases where a city is still developing suburbs, it should make connectivity a fundamental priority by following the principles in Chapter 3, "Street Networks and Classifications."



Connecting cul-de-sacs (Credit: Marty Bruinsma)

Second-Generation Land Use along Transformed Streets

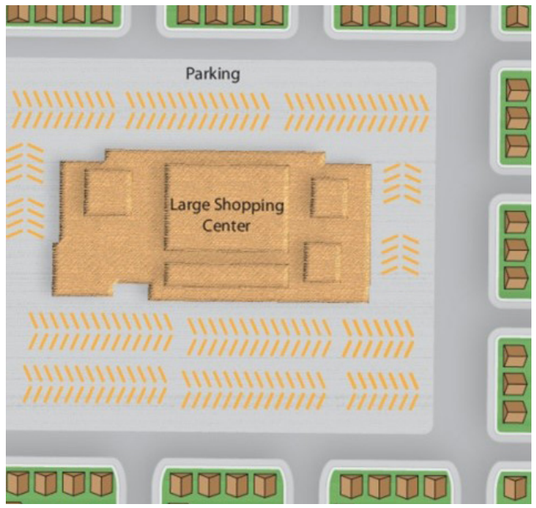


Exhibit 30. *Conversion of shopping center to a neighborhood Credit: Michele Weisbart)*

Not only streets will need to change in suburbia; many land uses are obsolete and/or no longer economically viable. However, street improvements generally should come before land use change in suburban retrofitting. This is because high-quality land uses tend to come to high-quality streets.

The street and the land use work together and determine whether a place is attractive and draws people and investment. To that end, communities retrofitting older suburban areas should use the following three principles:

1. Focus new investment in nodes on streets

In most of suburbia, there will not be enough investment all at once to transform whole corridors. Identify and focus investment at individual nodes.

2. Focus revitalization efforts on creating genuine places in those nodes: compact, mixed-use, and at least internally walkable

Plan for and enable neighborhood-serving commercial districts Where necessary, rezone from automobile-oriented commercial sites (gas stations, convenience stores, and fast food outlets). These car plazas are designed for, and dependent on, vehicular access and offer no relationships with the nearby residential areas. They absorb retail potential and will tend to discourage development of neighborhood-serving commercial districts.

3. Carefully detail the desired outcomes

It is vital that retrofit efforts pay attention to the details described in the individual chapters of this manual. Adopting well-intentioned policy goals is not enough. There must be follow through by incorporating the vision's details in the design and construction of the project. Infill development between nodes that follows the principles of this manual will help to connect the nodes into livable neighborhoods.

Setting Priorities and Phasing

The primary challenge in retrofitting suburbia is less fixing the infrastructure and more creating economically sustainable places, with the emphasis on place.

The priority should be to begin by creating vibrant nodes. Cities should not allow themselves to be daunted by the scale of the retrofit challenge. As with street retrofits, creating places can be done incrementally. The images to the right show such an incremental process.

Exhibit 31. *Example of a transformed suburban street (Credit: Urban Advantage, Inc.)*

Corinth Active Transportation Plan

Appendix B: Complete Streets Best Practices

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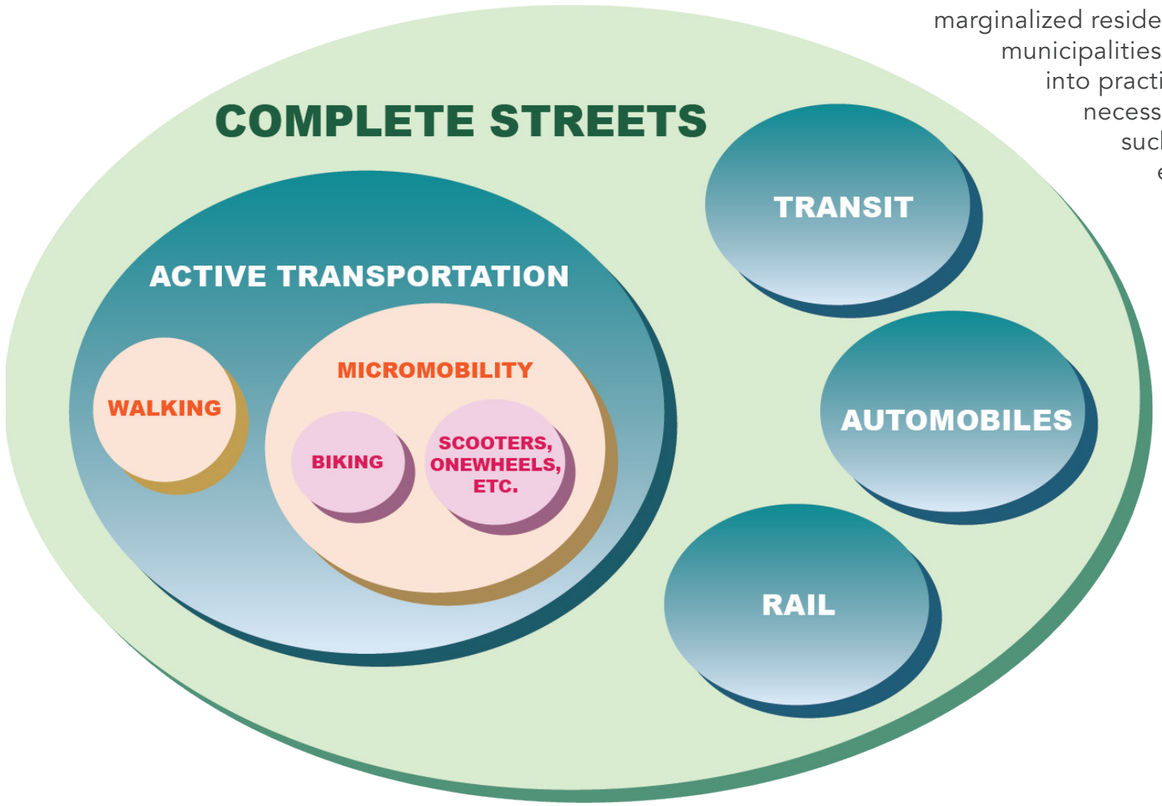
Complete Streets

According to the National Complete Streets Coalition (NCSC), Complete Streets is a process and approach that enables safe access to streets for all users. Complete Streets aims to fix incomplete streets that have an outdated design that can be dangerous or deadly for users without a personal vehicle. Using safety as a priority instead of speed in roadway designs, Complete Streets has emerged as a popular approach in responding to the needs of communities, especially in reducing injuries and fatalities involving pedestrians and cyclists.

Exhibit 32. *Relationship between Complete Streets, Active Transportation, and Micromobility*



One of the goals of Complete Streets is to enhance the access and safety of vulnerable groups who are historically excluded from the planning process or disproportionately affected. The NCSC reported that people of color, low-income residents, and older adults are the most vulnerable groups in the population. By using the Complete Streets approach, everyone, especially these vulnerable groups, will experience improvement in their commute and quality of life.

A great variety of transportation elements are important in achieving Complete Streets, such as sidewalks, bike lanes, and crosswalks. In addition to physical infrastructures, successful Complete Streets programs have a clearly defined policy with diverse stakeholder inputs, including historically marginalized residents. Using it as a framework, municipalities must take steps to put the policy into practice. NCSC has outlined multiple necessary steps to implement the policy, such as evaluating and revising existing processes and design guidelines, as well as training agency staff and community members. For more information about designing for Complete Streets, see Appendix A: Complete Street Design Manual.

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> Complete streets integrate people and places in the design of the public transportation realm to provide safety and comfort for all modes of transportation including pedestrians, bicyclists and vehicles.
>
> - City of Corinth Unified Development Code Section 2.06.02.D.1.b

Active Transportation

Active transportation emphasizes non-motorized modes of transportation, such as walking and biking, as well as traveling with wheelchairs and micromobility devices. The approach encourages residents to walk and bike more to satisfy their mobility needs, thus promoting a healthier lifestyle. Active transportation is a crucial component of Complete Streets. Many street users travel with non-motorized modes; however, current street designs commonly prioritize motor users and neglect the needs of active transportation users, resulting in a disproportionately higher share of pedestrian and cyclist injuries and deaths. With a focus on active transportation, cities can create safer streets that accommodate the needs of all users. Such an approach can also promote alternative transportation modes that are affordable and have low emission.

Best Practices for Complete Streets

A list of eight Complete Streets best practices are recommended based on reports and guidelines published by national and local organizations. Additionally, a review of Corinth's current policies and standards was conducted to inform recommendations related to each best practice. Resources reviewed for this Best Practices Review include:

- National Complete Streets Coalition – Best Complete Streets Policy 2023
- National Association of City Transportation Officials – Designing for Small Things with Wheels
- National Cooperative Highway Research Program – Research Report 855: An expanded functional classification system for highways and streets
- City of Austin – Complete Streets Guide, Sidewalk Program
- City of El Paso Complete Streets
- City of Richardson Complete Streets Policy

1. Develop a Clear Vision and Guiding Principles

All Complete Streets programs should start with a clear vision statement to define program goals and expected outcomes. A clear vision ensures the public understands the intentions of the program so that they can provide accountability. With a vision, cities can also formulate guiding principles, which provide guidelines in formulating policies and action items to implement Complete Streets. A clear vision and list of guiding principles creates a strong foundation for the rest of the Complete Streets program.

El Paso's Complete Streets program, which has been chosen as one of the top 10 programs in 2022 in the nation, has a clear vision statement outlining the purpose and goals of the program. The statement helped guide the city in planning for implementing the Complete Streets approach with various policies and initiatives. Similarly, Austin's Complete Streets program consists of a resolution and an ordinance that provides clear directions for the city to achieve its initial goals. The City of Richardson's recent Complete Streets Policy also outlines five guiding principles, which are:

- Serve all users and modes
- Increase transportation and mobility options
- Establish a connected multimodal transportation network
- Coordinate land use and transportation
- Enhance community health and quality of life

Currently, Corinth does not have a Complete Streets resolution or policy. The City has adopted Ordinance No. 24-04-04-16 to amend parts of the current Zoning Ordinance. The Ordinance briefly mentioned the use of context-sensitive Complete Streets desgin strategies to accommodate different mobility needs. This can be used as a foundation for a Complete Streets Vision Statement.

Recommendations for Local Application

- Draft and adopt a Complete Streets Policy using the National Complete Streets Coalition Policy Framework
- Incorporate Complete Streets and active transportation goals into future plans

Exhibit 33. *El Paso Complete Streets Policy Vision Statement*

(Source: City of El Paso)

2. Create Street Design Standards that Encourage and Protect Active Transportation Users

Existing street design standards are often designed primarily for motorized traffic mobility, without considering the needs of active transportation users. Existing roadway designs generally focus on maintaining the flow of traffic, which results in the widening of lanes and an increase in speed limits. With such standards, these users are generally more at risk than motorized users. The needs of active transportation users also differ from those of motorized users and, therefore, are frequently overlooked by agencies. For instance, pedestrians need benches or resting amenities along streets and cyclists need bicycle parking stations at their destinations. Future design standards should not only protect the safety of all users, but they should also ensure roadways are inviting to all users and further encourage residents to travel using active transportation modes.

A great diversity of street design elements can be incorporated into the design standard to protect active transportation users. One of the key components is the separation of pedestrians and cyclists from motorized users.

The National Cooperative Highway Research Program (NCHRP) emphasizes the need to separate pedestrians and cyclists from vehicle traffic to ensure all users can travel safely at the same time. Implementing a road diet is also a common way to address the needs of active transportation users. For example, El Paso implemented a road diet in the Complete Streets program on Piedras Street. The road diet successfully improved roadway safety and reduced pedestrian injuries, which in turn enhanced pedestrian safety and encouraged them to work and shop along the street more frequently.

Road diet project in Piedras Street, El Paso
(Source: National Complete Street Coalition)

The City of Corinth's Unified Development Code (UDC) mentions Complete Streets in Section 2.06.02.D - MX-C, Mixed-Use Commercial. This section outlines development standards for mixed-use commercial districts, stating:

> "The design of street cross sections shall balance the circulation requirements of automobiles, mass transit where available, bicycles and pedestrians. The development shall utilize context-sensitive Complete Streets design strategies to achieve this balance."

This section also supports various other Complete Streets design elements, including on-street parking, walkable street design elements and dedicated bicycle facilities.

These requirements should be expanded to apply to other zoning districts. By creating enforceable regulations that encourage active transportation, Corinth fosters an environment that includes all roadway users.

Recommendations for Local Application

- Build upon existing Complete Streets requirements in UDC to prioritize active transportation
- Implement road diets on roadways with high rates of injuries and fatalities
- Consider road diets as part of active transportation plan facilities development

3. Create Community Buy-in for Complete Streets

Support from community members is essential for implementing Complete Streets and Active Transportation projects. In the Active Transportation Plan, Chapter 3: Issues, Needs, and Opportunities outlines Corinth residents' involvement in this program and serves as an example for similar projects in the future. Corinth residents, including disadvantaged communities, are actively engaged in the process. This approach is commonly adopted by other cities across the country. For instance, El Paso prioritized historically marginalized groups in its engagement process to ensure the voices of these communities are incorporated into the plan. It set up various engagement events in places where these communities frequently gather so that the city could receive adequate input from such a population.

Municipalities can also organize various community events to promote Complete Streets and raise awareness among the public. These events aim to encourage existing active transportation users to maintain their lifestyles, as well as to encourage other residents to participate. Cities can organize a wide range of events that target various groups in the population, such as bike to work or school day, walkathon, and open street festivals.

Richardson promotes Complete Streets by celebrating Bike Month with different community events. Every year in May, the City holds the Bike & Roll to School Day, Bike to Work Day, and Walk & Roll to School Day. The City also organizes its annual citywide Bike Rodeo to equip residents with essential biking skills. These events encourage residents to incoprate biking and walking in their daily lives and raise awareness on Complete Streets.

Austin has held Viva! Streets Austin which is an open-street, car-free event to encourage walking and biking in the city. Parts of the city's streets are closed off to vehicles to allow pedestrians to use the space freely and safely. This event successfully gathered large crowds of pedestrians and cyclists on the streets. In Galveston, organizations hold a Bike Around the Bay fundraiser every year to promote biking and support local non-profits. Such an event can provide residents with a safe environment to bike and explore their community.

The Rolling into Fall Bicycle Rally take place in Corinth and surrounding cities every year. The event is organized by the Lake Cities Chamber of Commerce and consists of four routes ranging from 10 miles to 40 miles, allowing cyclists of different level to participate. The Corinth Citizen's Police Academy Alumni Association also organizes an annaul Foot Pursuit 5K & Fun Run. These events encourage public participation in biking, running, and walking. Local bicycle and pedestrian advocates or "champions" are needed on the local level to plan, coordinate, and execute community events related to Complete Streets and active transportation.

Recommendations for Local Application

- Identify and uplift local active transportation and Complete Streets champions
- Coordinate with local organizations to encourage participation in state and national events such as Bike to Work Day
- Promote local active transportation advocacy groups and leaders

Rolling into Fall event held in Lake Cities.
(Source: Lake Cities Chamber of Commerce)

Corinth Police Department Foot Pursuit 5K & Fun Run
(Source: Corinth Citizen's Police Academy Alumni Association)

4. Incorporate Context-Sensitive Designs

Streets and land use are inextricably connected, and land use planning can help to uphold Complete Streets principles. For example, future developments featuring new or reconfigured roads should be required to incorporate a Complete Streets approach appropriate to the planned future land use and road users. Because land use plans are often long-term visions for the community, they should be utilized to further active transportation goals.

Street designs should also reflect local context to ensure they take residents' needs into consideration. Balancing the land use types, density, capacity, environmental concerns, and building setbacks affect the level of safety measures required to ensure streets are welcoming for all users. As the NCSC suggests, cities should plan their streets in harmony with the adjacent land uses and neighborhoods. It is equally important to consider the anticipated future context, such as planned transportation and land use developments.

In El Paso's Complete Streets policy, the city reviewed relevant documents, such as the thoroughfare plan and Resilient El Paso plan, to understand the commonalities and gaps with the vision of the Complete Streets policy. With such information, the city identified reports that require amendments and established a timeline to make these changes.

The City of Corinth's UDC discusses context-sensitive design elements for mixed-use districts. The current comprehensive plan does not discuss Complete Streets or context-sensitive designs.

Recommendations for Local Application

- Require consideration of Complete Streets principles in all future land use plans
- Conduct robust public engagement for future street projects to understand and consider the context of the projects

Street design should maintain good harmony with surrounding land uses.

5. Design for All Physical Abilities

Street designs should consider the needs of residents with disabilities to ensure roadways are safe and welcoming to everyone. All sidewalks must comply with the Americans with Disabilities Act (ADA), but cities are encouraged to create standards that go beyond these requirements to create a safer street environment for different types of users. Sidewalks should be wide enough to accommodate multiple people, including those with disabilities, using the space at the same time. Municipalities can conduct an Accessibility Impact Assessment as part of their Complete Streets program to evaluate how existing land uses affect accessibility, with sidewalks as a main component of the report. Such an analysis is helpful in identifying sidewalks that require repairs or upgrades, as well as locations for new sidewalks. Agencies should evaluate sidewalk conditions periodically and engage people with disabilities to have their input in the process.

The City of Austin has a Sidewalk Program that ensures ADA standards are being followed for sidewalks, crossings, and shared streets. This plan prioritizes the inclusion of pedestrians, especially those who are disadvantaged. With equity in mind the plan sets measurable targets that include safety, use, and funding.

Corinth's current Subdivision Regulations require all sidewalks to be at least 4 foot wide to meet the federal ADA requirements. The City's Comprehensive Plan also mentioned it will continue invest in existing pedestrian infrastructure to comply with such requirements.

Recommendations for Local Application

- Conduct a full inventory of sidewalk conditions and create a plan to systematically repair inaccessible sidewalks, prioritizing issues in areas with high concentrations of disadvantaged communities
- Identify gaps in the sidewalk network and create a plan to systematically add sidewalks to fill these gaps, prioritizing gaps in areas with high concentrations of disadvantaged communities

6. Design For All Users, Especially Disadvantaged Communities

Vulnerable communities, including people of color, low-income residents, and older adults, are often excluded from the previous planning process and their needs are neglected. The Complete Streets approach emphasizes addressing the needs of all residents and mitigating the disproportionate impacts experienced by vulnerable groups. Taking their needs into consideration when designing streets can improve the overall safety conditions for all residents and will show significant positive impacts on these historically marginalized groups.

The National Association of City Transportation Officials (NACTO) has stressed the importance of identifying all potential users when creating Complete Streets programs. When municipalities consider the needs of bike lane users, they should not only focus on confident cyclists, but also should consider the needs of vulnerable groups, including people of color, low-income residents, and seniors, as well as the needs of other often-overlooked groups, including people with disabilities, people moving goods, and children. It is important for municipalities to consider the diverse needs of cyclists comprehensively, as each group has its unique needs and requires various planning initiatives or interventions to protect their safety.

The North Central Texas Council of Government's (NCTCOG) Mobility 2045 Plan highlights the importance of nondiscrimination and equity principles in the assessment, analysis, and outreach stages of a planning process. These principles are crucial in enhancing equity in transportation and mobility.

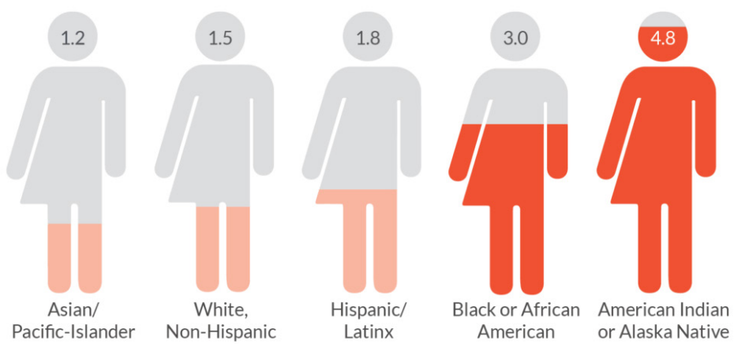
Recommendations for Local Application

- Identify and engage disadvantaged groups in transportation and land use planning and invite them to develop recommendations
- At the conclusion of planning activities, continually engage disadvantaged groups to ensure they have access to up-to-date information on projects and performance measures

NCTCOG Mobility 2045 Update
(Source: NCTCOG

People of color, particularly Native and Black Americans, are more likely to die while walking than any other race or ethnic group

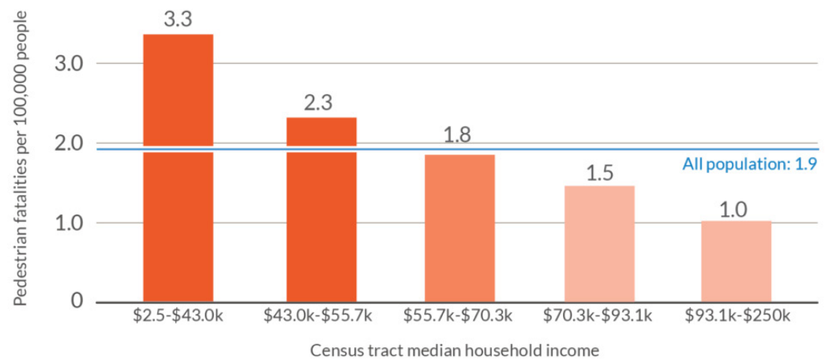
Pedestrian deaths per 100,000 by race & ethnicity (2016-2020)



Source: National Complete Streets Coalition

People walking in lower-income areas are killed at far higher rates

Pedestrian fatalities per 100k people by census tract income



Source: National Complete Streets Coalition

7. Foster Department Coordination

Complete Streets is an interdisciplinary program that requires the involvement of different departments. As various agencies may have competing priorities, they should have good coordination and frequent communication to ensure the Complete Streets program can be successfully implemented. Good coordination helps clearly outline the responsibilities and priorities of each department, which facilitates program implementation and public accountability.

El Paso created a Technical Review Committee for its Complete Streets Plan, which is a working group that consists of representatives from multiple city departments. The committee worked frequently with the Mobility Advisory Committee to coordinate resources and discuss action plans to achieve the initial vision and goals. The two groups worked collaboratively and resulted in great success in implementing Complete Streets initiatives. In Richardson, the Bicycle and Pedestrian Advisory Committee provides recommendations on bicycle and pedestrian-related programs and policies, including its Complete Streets Policy.

Currently, Corinth does not have any board or commission that is dedicated to transportation issues.

Recommendations for Local Application

- For each street project, identify the specific responsibilities of each agency and department involved
- Have consistent communication with state, county, and MPO representatives to stay up to date with funding opportunities and identified needs

8. Create Detailed And Transparent Performance Measures

Each Complete Streets policy should include measurable indicators to evaluate the effectiveness of the program. Unlike traditional street design that primarily focuses on the Level of Service (LOS) as the indicator, Complete Streets focuses on a broader range of performance measures, such as a reduction in injuries and fatalities, an increase in active transportation trips and pedestrian or cyclist facilities, as well as user experiences and perceptions. Meanwhile, agencies should continually monitor the progress of the program and publish results to the public. This allows the public to stay informed about the progress of the program and provides accountability.

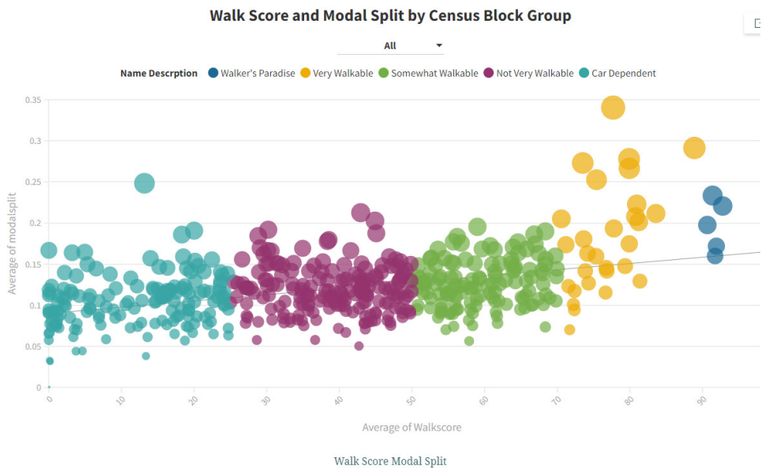
Richardson's Complete Streets Policy requires an annual report presented to the Bicycle and Pedestrian Advisory Committee for review. Such an requirement helps monitor the progress of program implementation.

El Paso's Complete Streets policy used multiple pilot programs to evaluate its progress and refine policy initiatives. The city evaluated a number of indicators, such as changes in speed limits and the number of vehicle and walking trips. These measures have helped the city understand areas that can be improved when implementing the Complete Streets program on a larger scale. The information was also published online to allow El Paso residents to understand program outcomes and progress.

Recommendations for Local Application

- Identify and engage disadvantaged groups in transportation and land use planning and invite them to develop recommendations
- At the conclusion of planning activities, continually engage disadvantaged groups to ensure they have access to up-to-date information on projects and performance measures

Exhibit 34. *Walkability data published on the City of El Paso's website as performance measurement*



Source: City of El Paso

Appendix C: Micromobility Plan

Micromobility Defined

The Federal Highway Administration (FHWA) defines micromobility as:

> Any small, low-speed, human or electric-powered transportation device, including bicycles, scooters, electric-assist bicycles (e-bikes), electric scooters (e-scooters), and other small, lightweight, wheeled conveyances.

Micromobility is one part of a complete active transportation system that is especially helpful for first- and last-mile trips. Micromobility ridership is growing rapidly, especially on college campuses and in cities with a large population of young adults. While bicycles have been a reliable mode of transportation, electric micromobility vehicles (such as e-bikes and e-scooters) and shared micromobility systems have led to an increase in micromobility ridership. According to the National Association of City Transportation Officials (NACTO), even during the COVID-19 pandemic, when almost all established mobility patterns were broken, people continued to ride bikes at comparable levels.

Micromobility is suitable for communities that:

- Have the administrative capabilities to continually monitor shared micromobility companies, including data analysis
- Are able to make necessary infrastructure changes including establishing/expanding bike lanes, widening sidewalks, or introducing traffic-calming measures
- Have had community engagement efforts which revealed the desire for expanded transportation options or decreased congestion
- Want to increase the connectivity of their active transportation system
- Have a generally young, educated population

Shared Micromobility

Shared micromobility entails various forms of micromobility that are shared between more than one person. This is often done either through a public bike or scooter-share system, like MetroBike in Austin, or a private company, like Bird or Lime. Shared micromobility allows the user to forgo the costs associated with owning, maintaining, and storing a micromobility vehicle and instead pay only for operating the vehicle. Shared micromobility often requires the use of a smartphone app to "unlock" vehicles.

Shared micromobility vehicles include bikes, e-bikes, and e-scooters. Ridership has increased steadily in recent years, with 113 million shared micromobility rides taken in the U.S. in 2022 alone (Exhibit 1). The addition of shared e-scooters has created additional demand for shared micromobility.

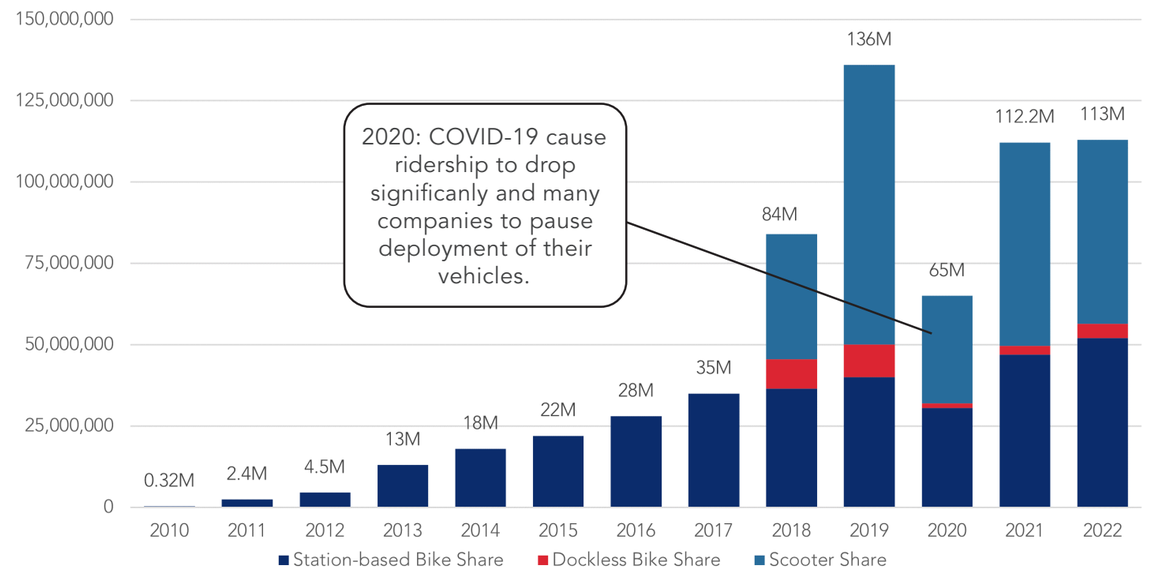
The share of trips taken on micromobility vehicles by e-scooters dropped by 9.6% in 2022 from the previous year, while station-based (docked) bikes saw an increase of 10.6%. This is most likely due to the expansion of large docked bike systems Citi Bike in New York City and Bay Wheels in the San Francisco Bay Area as well as an increased interest in electric bikes (e-bikes) across the country in recent years.

Dockless Vehicles

The majority of shared micromobility vehicles are classified as dockless. A "dock" in the context of micromobility is a place where shared bikes (or, less often, scooters) are stored when not in use. Users begin and end their journeys at these docks. Docks allow the bike-share operators to maintain organization and minimize disturbances to the public right-of-way. Conversely, a dockless vehicle is one without a designated place from which it is rented and returned. Whether a micromobility vehicle is docked or not has large implications for its impact on the public right-of-way and the fabric of a community.

Shared dockless e-scooters from Lime in Corpus Christi, TX

Exhibit 130. *Shared Micromobility Ridership in the U.S., 2010-2022*



Source: NACTO, "Shared Micromobility Snapshot"

Overview of Existing Technologies

The discussion around micromobility is complicated by the ever-changing scope of what micromobility is and the various vehicles. To properly discuss micromobility, it is important to explicitly define each different mode and some important terms. The classification of micromobility vehicles is a necessary first step which enables effective micromobility regulation. Exhibit 132 summarizes each vehicle type's identifying characteristics.

WHAT IS A PEV?

A personal electric vehicle (PEV) is a form of micromobility that includes small, short-distance, single-passenger vehicles that are electrically powered. Examples of this include e-bikes, e-scooters, Segways, and electric skateboards. PEVs offer a low-cost way to travel short distances with minimal effort without access to a motor vehicle. Opposed to non-motorized transportation (NMT) like pedal bikes or kick scooters, PEVs involve little physical exertion.

Exhibit 131. *Micromobility Vehicles Snapshot, adapted from Pedestrian and Bicycle Information Center, http://pedbikeinfo.org/*

Vehicle	e-Bike			Pedal bike	e-Scooter	Kick scooter	Other - Skateboard, e-Skateboard, Onewheel, Hoverboard, Segway
	Class 1	Class 2	Class 3				
Defining Features	Pedal assist	Throttle assist	High-speed pedal assist	User is seated	Motor, deck for standing	Deck for standing	Small, lightweight, single-user
Propelled by	Pedals, motor when pedaling	Pedals, motor even when not pedaling	Pedals, motor when pedaling	Pedals only	Motor or user kicking the ground	User kicking the ground	Motor or user kicking the ground
Typical Speed	20 mph or less	20 mph or less	28 mph or less	15 mph	15-20 mph	10 mph	Typically 20 mph or less
Weight	Typically <100 lbs	Typically <100 lbs	Typically <100 lbs	Typically <50 lbs	Typically <50 lbs	Typically <15 lbs	<50 lbs

Pedal Bike

A pedal bike (or "traditional" bike) is a form of Non-Motorized Transportation (NMT) on which a rider sits on a seat, pushes two pedals with his feet, and steers using a handlebar. Pedal bikes are a common mode of transportation and continue to grow in ridership due to many cities' efforts to expand bicycle infrastructure. Safety issues can arise when proper bike infrastructure is not in place such as protected bike lanes and traffic-calming measures.

Source: PBIC

Electric-assist Bike

Electric-assist bikes (e-bikes) are motorized versions of pedal bikes. These have a similar look but allow the user to travel faster and for longer distances due to the assistance of the motor. e-Bikes can be individually owned or accessed via shared mobility. Many bike-share programs utilize "docks" where bikes are rented and returned at the start and end of a trip. There are some vehicles that blur the lines between e-bikes and entirely new devices, such as sitting scooters or mopeds. For the purposes of this Plan, an e-bike must provide the user the ability to pedal.

Kick Scooter

A kick scooter (or push scooter) is a two-wheeled, manual, single-rider vehicle that is operated by kicking the ground as one stands on a deck. It is a form of non-motorized travel (NMT) and is steered using a handlebar. Kick scooters are smaller and more maneuverable than bicycles but similarly offer the opportunity for physical activity while in use. Kick scooters are often used by children as a form of recreation and short-distance travel but are increasingly used by adults as well[1].

Source: PBIC

Electric Scooter

An electric scooter (e-scooter) is a motorized version of a kick scooter. Modern e-scooters can travel around 15 miles before requiring recharging and are typically recharged once a day. These PEVs can be purchased and privately owned or rented from shared micromobility companies such as Bird, Lime, or Lyft. They are typically dockless, meaning trips on e-scooters don't have to start and end in a certain place. Range and speed vary by model and load, but e-scooters can typically travel up to 15-20 miles per hour. Since 2017, e-scooters have grown in popularity due to their deployment in many major cities by private shared micromobility companies.

Skateboard. Source: PBIC

Other Small, Lightweight Wheeled Conveyances

Other, less used micromobility vehicles include skateboards, Onewheels, hoverboards, Segways, and electric unicycles. These vehicles are usually less than 50 lbs and individually owned.

Onewheel. Source: Floatwheel

Skateboard

A skateboard is a small board on which the user stands and has four wheels on 2 axles. It is powered by the user kicking the ground and does not involve any handlebars for steering. Electric skateboards (e-skateboards) are skateboards with electric motors, controlled by a wireless remote control. Skateboards are a low-cost, very portable transportation option.

Hoverboard. Source: PBIC

Onewheel

A Onewheel consists of a single wheel with two platforms on either side for the user's feet. It is powered by an electric motor and controlled by shifting one's weight onto their front or back foot. A Onewheel does not have a handlebar.

Hoverboard

Hoverboards (or self-balancing boards) are two-wheeled vehicles with electric motors and no handlebars. They are operated by leaning forwards or backwards to control speed and twisting to control direction.

Segway. Source: PBIC

Segway

A Segway is a two-wheeled vehicle with a handlebar which is used to both steer and accelerate/decelerate.

Electric Unicycle

Electric unicycles are similar to Onewheels but differ in their orientation. The user faces completely forward and leans forward or back to control the vehicle.

Electric unicycle. Source: InMotion

Micromobility Benefits

First- and Last-Mile Connections

One of the most significant benefits of micromobility is its role in facilitating first- and last-mile connections to and from transit services. Micromobility vehicles can provide a faster, lower-effort mode choice. This can make transit a more attractive choice for the public and increases transit accessibility.

Intermodal mobility, or the use of more than one transportation mode in a single journey, helps reduce time traveling by car. Micromobility can be a key component of an intermodal commute. Shared micromobility can be an important step in bridging the gap between complete car dependence and other modes. Many private e-scooter users purchased their vehicle after test-driving on a shared e-scooter because of the relatively low commitment of rental[2].

Transit users can change their typical routes with the incorporation of scooters into their travel routine. For example, a bus rider could take a faster train that leaves from a station that is too far to walk but is accessible by scooter, ultimately reaching their destination faster. Additionally, people in areas which are not served by transit can have another, more affordable option besides private automobiles. This broadens the "pedestrian shed", or the area that pedestrians can access in a reasonable distance. Bike sharing systems have been proven to reduce car trips, so much so that they can influence peak-time congestion[3].

Alternative Mode Choice

Micromobility provides an easy and convenient option for transportation besides automobiles, transit, and walking. This allows people to travel by car less, which has many benefits for the community:

- Relieves pressure on the road system, helping to alleviate congestion
- Decreases need for road maintenance
- Decreases noise pollution
- Contributes to the "safety in numbers" effect wherein the presence of other pedestrians creates a safer street for all

Micromobility vehicles also provide some intangible benefits; riding an e-scooter is perceived as a fun activity; scooters are open-air, unlike cars, buses, or rail, but take you farther than walking. Additionally, scooter rides are less subject to traffic or congestion, which makes them a more enticing option.

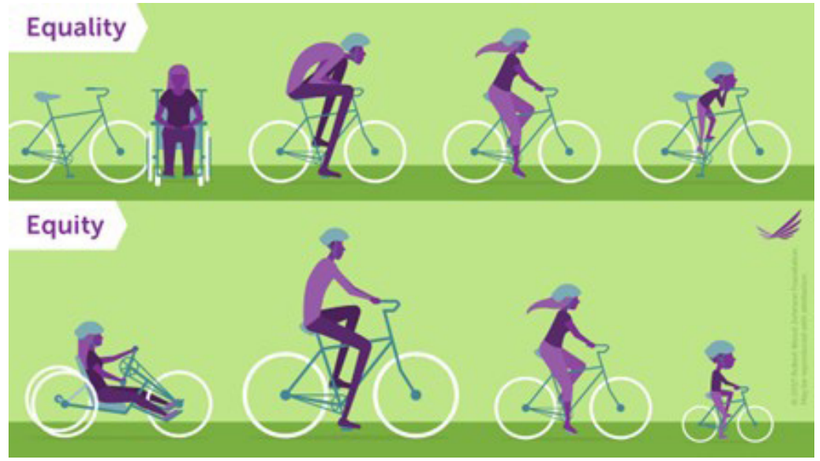
Transportation Equity

According to the FHWA, an equitable transportation system seeks to provide equitable levels of access to affordable and reliable transportation options based on the needs of the populations being served, particularly populations that are traditionally underserved and disadvantaged. Micromobility can be useful for increasing connectivity for disadvantaged populations, increasing access to essential services like grocery stores, job opportunities, and health/social services.

According to the Bureau of Transportation Statistics, in 2022 the average yearly cost to own and operate a car was $10,729. The cost of car ownership continues to rise, increasing the financial burden on those in low-income households[4].

People of low income experience a disproportionate amount of the negative effects of automobile dependency like decreased air quality and noise pollution[5]. Therefore, any reduction in car trips is especially important for these populations. Additionally, pedestrian-automobile crashes are more likely to occur in neighborhoods with higher minority and low-income populations[6]. The shift away from automobile dependency through the introduction and inclusion of alternative transportation options would be beneficial to all, especially to these populations.

Exhibit 132. *Graphic illustrating the diference between transportation equality and transportation equity*



Source: Robert Wood Johnson Foundation, 2017

Sustainability

Research shows that micromobility vehicles reduce carbon emissions and decrease reliance on fossil fuels[7]. While the production of PEVs requires precious resources for battery production, the adoption of micromobility options reduces the use of personal automobiles on short distance trips and assists in first- and last-mile travel, allowing for increased reliance on public transportation. National Renewable Energy Laboratory (NREL) reported that high adoption of shared micromobility can save 2.3 billion gasoline-equivalent gallons per year nationwide, and that increasing access to transit is micromobility's largest contribution to reducing energy consumption in cities[8]. Bicycles are an especially sustainable form of transportation that creates positive health and environmental outcomes. Electric micromobility vehicles are considered a more environmentally friendly choice than cars for short trips and for longer trips when used in conjunction with existing public transit systems. Personal scooters have been proven to replace more car trips than rental scooters[9].

Areas of Concern

Safety

Micromobility users are considered "vulnerable road users" by the FHWA due to the lack of protection of an enclosed vehicle. Interactions between micromobility and users of more established modes like drivers and pedestrians can be dangerous[10]. Misuse while operating the vehicles, as well as the improper placement of the vehicles after use, are of concern.

In its first 100 million e-scooter rides, Lime reported nine fatalities of riders. In the first 50 million rides on Bird scooters, there were five reported fatalities. This puts the fatality rates for Lime and Bird riders at about one in 10 million rides. From May 2018 to October 2019, there were 19 fatalities on e-scooters. Of these, 15 involved a motor vehicle (Exhibit 134). e-Scooters and bikes have similar fatality rates[11]. In comparison, the 2021 fatality rate for automobiles in the U.S. was 1.37 deaths per 100 million miles traveled[12].

Existing EMS and hospital visit data estimates that injuries due to e-scooter crashes occur at a rate of 87-251 emergency room visits per million trips and 29-62 hospital admissions per million trips. Comparatively, bicycles are safer, with 110-180 emergency room visits per million trips and 5-10 hospital admissions per million trips[13]. Further research on injury rates is needed to make definitive conclusions on the safety of the various micromobility vehicles.

To mitigate safety issues, communities can employ several tactics:

- Guidelines for proper use – Local governments can create and enforce guidelines for proper use of micromobility through the passage of ordinances which cater to the specific needs of the community. Speed, helmet use, parking, and operation zones are examples of guidelines for the operation of a micromobility vehicle. A dual strategy of education and enforcement should be employed for the most effective strategy for creating behavioral changes.
- Require safe vehicles – Standing e-scooter injuries are mostly due to falling[14]. Various aspects of vehicle design can have large effects on the stability of a ride including wheel size and weight distribution. Shared-use micromobility permits can restrict permitted vehicles to only those that are proven to have more stability and require them to be regularly inspected and maintained.
- Geofencing – Geofencing is an effective tool in controlling the operation of e-bikes and e-scooters. These virtual boundaries can restrict both where and how fast users are riding. Shared micromobility providers and municipalities can impose speed limits and even prevent their use entirely in certain areas, such as those with high pedestrian traffic.
- Road conditions – Half of all EMS visits due to e-scooter injuries in Austin were attributed to poor road surface conditions[15]. Cities should prioritize high-quality roads, sidewalks, and bicycle lanes as well as regular maintenance.

MICROMOBILITY DATA ISSUES

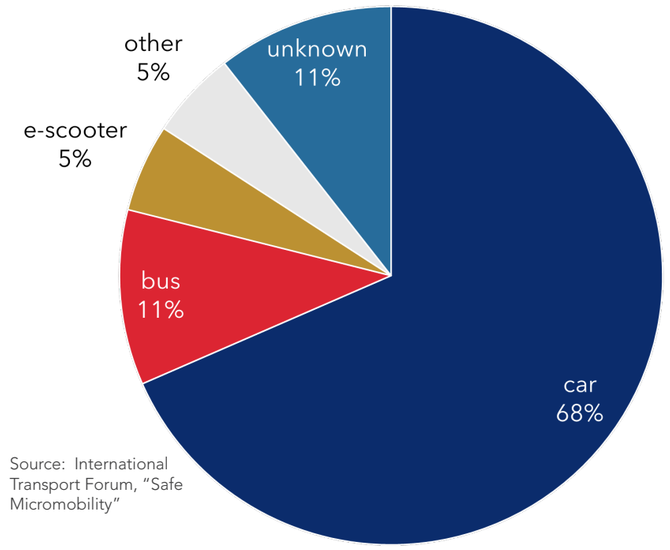
Micromobility safety data is currently not robust due to under-reporting and the lack of standardization in micromobility incident reporting. Current practices for collecting injury data include:

Police reports — not a consistent method for tracking injuries. People are not motivated to file police reports because insurance claims in the case of scooter, which are often motivation for filing in car crashes, are infrequent and do not require police reports.

Emergency medical services (EMS) and hospital records — the best method available. However, this is still an incomplete data set because it excludes injuries which weren't treated by EMS or in a hospital. Additionally, the lack of standardization in coding for micromobility incidents causes some injuries to be missed.

Community surveys — the least reliable but can provide interesting qualitative information.

Exhibit 133. *Object with which the Rider Collided in Fatal e-Scooter Crashes in the U.S., May 2018 to October 2019*



Source: International Transport Forum, "Safe Micromobility"

Tension Between Stakeholders

Users of micromobility depend on bicycle and pedestrian paths and sidewalks for safe travel. New forms of mobility can compete with the automobile for right-of-way. Non-users of micromobility may resent this reallocation of right-of-way as it reduces capacity for autos and potentially increases congestion. Misuse of micromobility vehicles creates negative consequences for public space[16].

Two major infrastructure challenges face micromobility users: parking and operation in high-traffic corridors. Municipalities can create designated parking areas for dockless micromobility to lower the likelihood that these vehicles clutter the public right-of-way and create tension between varying stakeholders. The locations of these designated parking areas can be reinforced with geofencing. Physical design of these parking zones can include bike/scooter racks, bollards, and/or paint to indicate the appropriate placement and orientation of the vehicles (see examples on page 24 for more information). This infrastructure change is relatively inexpensive and easy to implement.

Exhibit 134. *Improper scooter parking causes disruption on sidewalks.*

Source: CNN

Equity

While micromobility can help counter equity issues caused by cars and increase connectivity for disadvantaged populations, it can also create its own equity issues. When prices are not regulated by the municipality, prices of shared micromobility continue to increase - average e-scooter and e-bike trip costs doubled from 2018 ($3.50) to 2021 (around $7)[17]. Requirements for equity efforts should be established in the permitting program. Discounted fare structures, equitable distribution of micromobility devices, and connection to public transportation can help advance transportation equity via micromobility.

Dockless micromobility can be an unreliable form of transportation for someone going to work or necessary appointments. The decision to purchase an e-bike or e-scooter translates into a more reliable, long-term solution for their transportation needs. Another equity issue arises with respect to shared micromobility: rental companies' business models rely on on-demand workers who are needed daily to collect, re-charge, and replace shared scooters from the streets.

Additionally, some people may be physically unable to ride traditional standing scooters or bikes and may require adaptive devices. These can include seated scooters, Segways with handles, powered cycles that attach to wheelchairs, or others. Shared micromobility permits can include requirements for a certain number of vehicles deployed to cater to these populations and expand ridership.

Peer Review of Policies and Programs for Micromobility

Kansas City, Missouri

Kansas City, Missouri, on the border of Missouri and Kansas, has a population of 505,958[18]. The Kansas City Chamber of Commerce's main initiative is "Making Kansas City America's Most Entrepreneurial City". Since 2011, this goal has been embraced by the community and is a point of pride for Kansas City residents. The city's response to incoming shared micromobility is reflective of this shared goal and can serve as an example for other communities who wish to use shared micromobility as a source of economic development.

In 2018, Kansas City and Bird negotiated an interim operating agreement, where 100 e-scooters were deployed within the city. The agreement required Bird to revenue share (to benefit the city's Bike Plan), to distribute the scooters equitably, and to share their data with the city so they could monitor e-scooter operations.

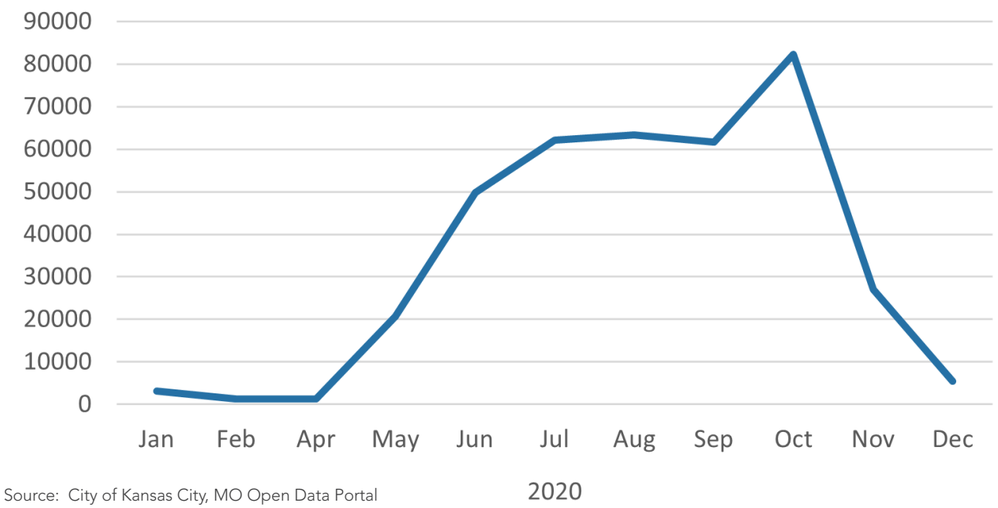
In 2020, there were 377,875 total rides on shared e-scooters and e-bikes within Kansas City (Exhibit 136).

The City's openness to innovation in the way of shared micromobility allowed Kansas City residents access to the new form of transportation while maintaining some control over the operations and gaining more information. The slow, controlled growth of scooter-share in the city meant that residents could become familiar with the vehicles, increase proficiency, and provide feedback before there was an all-out implementation of the technology.

Innovative shared miromobility policies helped futher Kansas City's high-level goal of being an entrepreneurial city.

Source: VisitKC

Exhibit 135. *e-Scooter and e-Bike Trips in Kansas City, 2020*



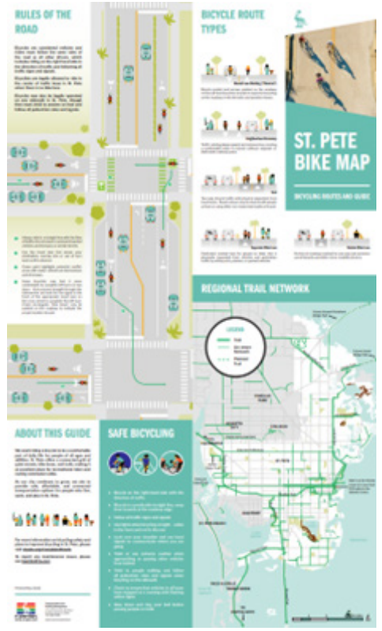
Source: City of Kansas City, MO Open Data Portal

St. Petersburg, Florida

Known as "The Sunshine City," St. Petersburg is home to 258,308 people, with a 5.5% growth in population from 244,769 in 2010. The city's micromobility services are currently emerging and growing, with partnerships from micromobility companies like Lime and Veo providing hundreds of e-bikes and e-scooters across the city. This move toward clean alternatives to car ownership will increase equity and provide access to a wider range of user groups since it is also more affordable.

Partnering with the City of St. Pete Beach, Lime, a leading company in the micromobility industry, has released a fleet of 300 e-bikes for use across the city, hoping to promote residents and visitors to use micromobility to conveniently access the city. St. Pete Beach boasts a rich network of Lime bikeshare locations and a connected web of bike trails and lanes (Exhibit 137), giving users more incentive to employ micromobility.

Exhibit 136. *St. Petersburg Bike Network Map*



Source: St. Petersburg Parks & Recreation

St. Petersburg Ordinance 2021-24 proposes a set of boundaries and regulations that the micromobility network and its users must follow. The ordinance lists definitions, general provisions, and requirements that micromobility devices must abide by to ensure safety for all transportation types and users. The initiative taken by implementing these measures intended to improve facilities for micromobility shows acceptance and the important role that micromobility plays in today's transportation network.

San Antonio, Texas

San Antonio, home of the Alamo and the second-largest city in Texas, with a population of 1,434,625 people, is facing a challenge as it experiences a growing population of residents and visitors while trying to implement more "Complete Streets." The city is currently met with a noticeable increase in trail users and recreational and commuting bicyclists. As cities plan and design their urban cores centered around people rather than vehicles, policies must also be updated to address the growing population of users.

Cosmo seated e-scooter by Veo
Source: Veo

One of the micromobility companies contracted by San Antonio, Veo, supplies improved seated scooters that provide riders with more comfort over longer rides versus a standing scooter. In efforts to appeal to more users, a model that has been specifically designed for seated use was released ( ); average rides on the new model measured twice as long as average rides on typical upright scooters. Because of the improved performance and ease of use of the seated scooter, it opens up micromobility to a wider range of users including those with an accessibility impairment which may make them reluctant to ride a stand-up scooter.

To address this growing network, San Antonio Code of Ordinances (Chapter 19) explains the definitions, limitations, and exclusions surrounding dockless vehicle transportation. There are also agreements in place with the contracting companies which may limit access areas that these vehicles have available, such as restricted access near the River Walk or weakened throttle response near large crowds of people. Also, restrictions exist that control where e-scooters may be parked while not in use, so that they are not interfering with fellow pedestrian and micromobility traffic on the sidewalks/roadways. Current policies are more effective at reducing e-scooters and other micromobility means from becoming a nuisance compared to previous policies in place.

Texas has relaxed e-scooter laws, with no state-wide regulations on speed limit, minimum age, helmet requirements, or where to ride.

Austin, Texas

Austin is the capital city of Texas and has experienced rapid growth since 2010; its population has grown by 23% (from 782,149 to 958,202 persons)[19]. Residents of Austin are more likely to travel using alternative modes of transportation than people in other areas; just 57% of workers in Austin drive to work alone in a car, compared to 71% of workers in the state of Texas[20].

As a part of the continual implementation of their mobility plans, the City of Austin regularly administers surveys for micromobility users. In their 2019 Dockless Mobility Community Survey Report, the City of Austin reported that the top 5 reasons someone might be more likely to use dockless micromobility were:

1. More infrastructure, such as a connected bicycle facility or shared use pathway to where they need to go
2. Expanded service areas where dockless providers can operate
3. Clearer delineations on where bikes and scooters should be parked
4. Easier and more reliable connections to public transit
5. More available electric scooters

An interesting business model for shared e-scooters is being tested by FlashParking and Bird in Austin. FlashParking, an Austin-based private mobility company, provides docked Bird e-scooters at select parking garages for round-trip use. This helps people with first- and last-mile trips and allows for easy access to micromobility right where they parked. The goal of this model is to create a complete and connected mobility system, from home to destination and back. Because the scooters are rented and returned in the same place, an organized charging dock in a parking garage, they do not negatively impact walkways or bike lanes when not in use. This also eliminates the need for vans or trucks to collect, charge, and return the scooters. However, this does little toward the goal of reducing car dependency, as the business model is targeted to car drivers.

Peer Review Evaluation Matrix

City	Population (2021)	Shared Micromobility Providers	Key Takeaway
Kansas City, MO	508,090	RideKC Bird Spin	Interim operating agreements can allow for controlled deployment of shared micromobility. A slow introduction of the new service allows users to gain familiarity with the vehicles before they are all-out launched.
Austin, TX	965,872	Bird Lime LINK Wheels MetroBike Austin Spin	Various networks supporting micromobility along with an accommodating infrastructure offer a plentiful selection of shared e-scooters and micromobility with ample space for them to be used within the city. However, micromobility users are still competing with motorists.
St. Petersburg, FL	258,354	Lime Veo	Pilot programs and pre-existing network facilities allow for smooth integration of micromobility networks. Strategic positioning of Lime hubs and a fairly connected existing micromobility network provides a good basis for introducing these new modes of transport.
San Antonio, TX	1,434,625	Bird Veo	The City of San Antonio partnered with Bird and Veo to bring shared micromobility to the area with easy-to-use services. Veo offers a more accessible micromobility vehicle which can accommodate longer rides; partnered with policy, these micromobility networks are helping to turn more users away from cars while not interrupting existing bike/pedestrian networks.

Recommendations

1. Create a dedicated Active Transportation Committee

It is crucial to be proactive about deployment of micromobility systems. Historically, because of the rapid adoption of micromobility, new and established companies are eager to employ their vehicles onto the streets without proper regulation. Cities should anticipate this and have the policies in place to ensure a proactive response when considering adoption of micromobility services. The Active Transportation Committee could meet regularly to discuss issues related to micromobility. Among the responsibilities of this committee would be to:

- Collect and review ridership data
- Make recommendations to municipalities
- Ensure that accommodations for micromobility are included in future transportation projects
- Assist in the pursuit of funding for micromobility infrastructure and services
- Regularly review the status of permits and Micromobility Program
- Facilitate coordination between municipalities in and around the Corinth service area
- Create and distribute information materials on micromobility operation best practices

2. Update permitting requirements for shared micromobility providers.

Permits allow municipalities to regulate the deployment of shared e-scooters and e-bikes and outline clear performance standards. Permits should be relatively short term (6-12 months) to ensure continued compliance and should require providers to re-apply at the end of each term. All requirements should be clear and measurable. Best practices for permitting requirements:

- Deployment location - Where providers collect, charge and redistribute vehicles has significant ripple effects. Vehicles should be evenly distributed throughout the service area to avoid both cluttering the public right-of-way and having gaps in their service area. Cities can help mitigate transportation equity issues by requiring providers to place vehicles in underserved areas (if demand exists).
- Mandated response time to requests - Providers must be reachable by both users and local officials when action is required, like when vehicles are improperly parked or broken. Users should be provided with contact information in the case of vehicle issues including misplacement or failure to operate.
- Maintenance protocols and production standards - Safety issues are of utmost importance. Without regular maintenance, shared bikes and scooters can become hazardous. According to the Consumer Product Safety Commission, there were at least 208 fire or overheating incidents with micromobility vehicles between January 1, 2021 and November 28, 2022, resulting in at least 19 fatal injuries. Both private and shared micromobility users must only operate vehicles with up-to-standard production. Longer lasting vehicles also reduce environmental waste caused by retired scooters and bikes. NACTO (National Association of City Transportation Officials) suggests that each vehicle should be inspected at least once a month.
- Fleet size and redistribution - Creating this cap on fleet size is important for managing the amount of space allocated toward shared micromobility and helps avoid crowding on streets or sidewalks.
- Data sharing – Data collected by shared micromobility providers is invaluable to decision makers because it indicates who, what, when, how, and where people are using micromobility. This has obvious implications for micromobility decision making, but it can also reveal things about the transportation system as a whole. Additionally, because there are often conflicting interests among stakeholders, using data to support your decisions helps stakeholders reach consensus and leverage support.
- User education - The online interfaces from which users rent micromobility vehicles are a critical space for user education.
- Fee structures - Through the permitting process, cities can require shared micromobility companies to pay various fees, the revenue from which can be allocated to programs that contribute to the city's goals, such as plan implementation or sustainability programs. This money can serve to counter the negative effects of the new mode of transportation through implementation of any local bike/pedestrian plan or sustainability programs. Examples of fees can include removal, impoundment, or relocation fees; fees for misuse; permit application fees; permit renewal fees; abandonment fees; and fees for each vehicle on the street.
- Affordability programs - To increase accessibility and promote equity, cities can require providers to offer a reduced fee payment plan, non-smartphone plan, and/or a cash option. Many established companies already have similar programs (see Exhibit 138 on page C-10).
- Miscellaneous:
  - Vendor must have the appropriate up-to-date insurance
  - Vendor must incur costs associated with complying with the permit, including recovering lost or broken vehicles and repair of damage to the public right of way caused by the vehicles
  - Vendor must have the appropriate staffing for the city or area. This includes, at a minimum, an area manager and several employees who collect, charge, and redistribute the fleet daily.

Exhibit 137. *Affordability Programs for Common Micromobility Providers*

Provider	Affordability Program	Eligibility	Details
Bird	Bird Access	Enrollment in or eligibility for a state-sponsored program for low-income individuals including, but not limited to, CalFresh, Medicaid, SNAP or discounted utility bills	Five 30-minute rides per day for $5 a month. After your fifth ride in a single day, standard pricing will apply.
Lime	Lime Access	Reasons for eligibility may include, though are not limited to, being unemployed, or receiving support from the government, such as a discounted public transport pass, or universal credit	Lime-S (e-scooters) and Lime-E (e-bikes): 50 cents to unlock, 7 cents per minute (50% discount) LimeBike: 5 cents for every 30 minutes (95% discount)
LINK	LINK-Up	Enrollment in an income-based government assistance program	Discount varies by location. Most riders receive a discount of 70% or more.
Wheels	Wheels for All	Enrollment in a city, state, or federal assistance program such as Medicaid, EBT, SNAP, or a discounted utility bill	Discount varies by location. Most riders receive a discount of 50%.
Blue Duck	Access Program	Individuals who qualify for local, state, or federal assistance programs. Examples of eligible documents to prove enrollment: a photo or scan of your card, proof of secondary education financial aid, discounted utility bill, insurance or reduced fare card (including Medicaid, LIHEAP, SNAP, WIC, EBT, etc.)	50% discount

Exhibit 138. *Suggested Guidelines for Micromobility Operation*

Vehicle	e-Bike			Pedal bike	e-Scooter	Kick scooter	Other - Skateboard, e-Skateboard, Onewheel, Hoverboard, Segway
	Class 1	Class 2	Class 3				
Operational Speed	20 mph or less	20 mph or less	28 mph or less	15 mph	15-20 mph	10 mph	Typically 20 mph or less
Speed Limit	15 mph	15 mph	15 mph	15 mph	15 mph	15 mph	15 mph
Helmet Use	Only for users age <16	Only for users age <16	Always	Only for users age <16	Only for users age <16	Only for users age <16	Only for users age <16
Where to ride	Roads with a speed limit of 30 mph or less, or bike lane (where available)	Roads with a speed limit of 30 mph or less, or bike lane (where available)	Roads with a speed limit of 35 mph or less, or bike lane (where available)	Roads with a speed limit of 35 mph or less, or bike lane (where available)	Roads with a speed limit of 30 mph or less, or bike lane (where available)	Sidewalk	Sidewalk or bike lane (where available)

Adapted from Pedestrian and Bicycle Information Center, "E-Scooter Management in Midsized Cities in the United States"; NACTO "Guidelines for Regulating Shared Micromobility"; Transportation for America, "Shared Micromobility Playbook"; Kevin Fang, Asha Weinstein Agrawal, and Ashley M. Hooper, "How and Where Should I Ride This Thing? 'Rules Of The Road' for Personal Transportation Devices"

3. Work with municipalities to create and modify ordinances concerning the proper use of micromobility vehicles.

One tool that local governments can use to create and enforce guidelines for proper use of micromobility is the passage of ordinances. The following are several recommendations for guidelines to ensure the safe and effective operation of micromobility in Corinth. Exhibit 139 on page C-11 shows suggested guidelines for proper operation of various micromobility vehicles. A sample ordinance for the Corinth area is included on page 28.

- Speed - Micromobility vehicles should generally go with the flow of traffic where they are being ridden. Higher speeds are associated with more frequent and severe injuries to users[21]. High-speed micromobility, like throttle e-bikes, should be operated slower than their maximum speed. A speed limit of 15 miles per hour should be in place.
- Helmet laws – It is recommended that helmets be required only for users below 16 or below 18 years old or if operating a Class 3 e-bike due to their higher speeds.
- Where to ride – Most classes of micromobility should be operated in dedicated bicycle lanes when possible. Otherwise, most micromobility should be operated on-street where the speed limit for all vehicles does not exceed 25-35 miles per hour and ridden as far right on the street as reasonable.
- Parking - Scooters or bikes left in streets, in bike lanes, or blocking sidewalks can create safety and accessibility issues and creates a negative image of micromobility for non-users. Many cities have adopted parking zones to limit this issue, which should be outlined on the Preferred Micromobility Network Map and communicated to the user via the app. In the absence of dedicated parking zones, micromobility should be parked in or around bike racks only in an effort to consolidate the vehicles and utilize existing bicycle infrastructure.

Exhibit 139. *Scooter Parking Zones Installation in Austin, TX*

Source: City of Austin Transportation Department

4. Create a Preferred Micromobility Network Map to encourage locationally appropriate shared micromobility use.

Geofencing is an emerging but valuable technology for policymakers attempting to control where and how users operate the vehicles. Scooters can be remotely slowed or even stopped remotely based on their location if they cross invisible boundaries set by the service provider. Preferred Micromobility Network Maps outline various zones to be used as a guide for shared e-scooter companies to set geofencing boundaries within the area. This ensures that all providers are held to the same requirements and that vehicles are operated safely. The geofenced zones can also be altered for special events if needed.

Micromobility Zones:

- No ride – Areas with high car traffic and a lack of micromobility infrastructure such as bike lanes or sufficiently wide sidewalks should be prohibited. Users must walk their vehicle in these spaces.
- No park – Users should not be able to park their vehicles in crowded areas wherein they will encroach on the public right-of-way.
- Slow zone – Slow zones should be enacted in certain areas where e-scooter or e-bike operation is safe only at slow speeds and where conflicts between micromobility users and cyclists or pedestrians is likely. A speed limit of 8-12 mph is recommended.
- Preferred parking – Preferred parking areas (typically around 25 square feet) are usually on sidewalks and give the user a pre-approved place to leave their scooter or bike. These parking areas can be created and designated using only paint or with cones, bollards, etc.

Exhibit 140. *Example of a Geofencing Map, Cheyenne, WY*

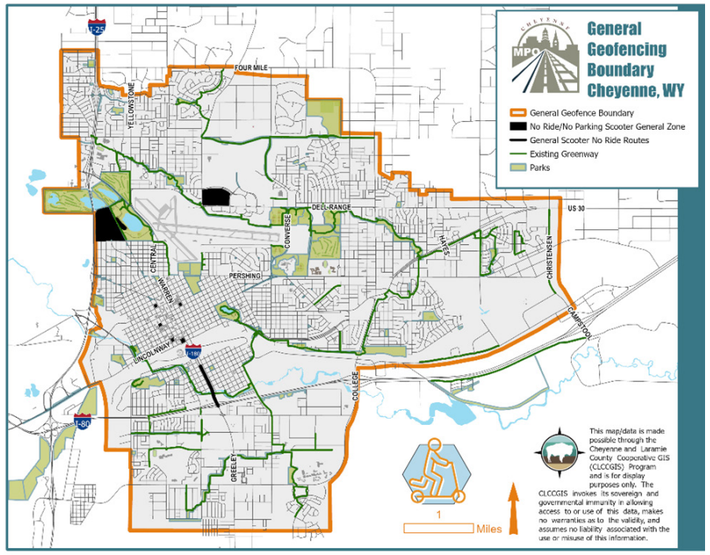
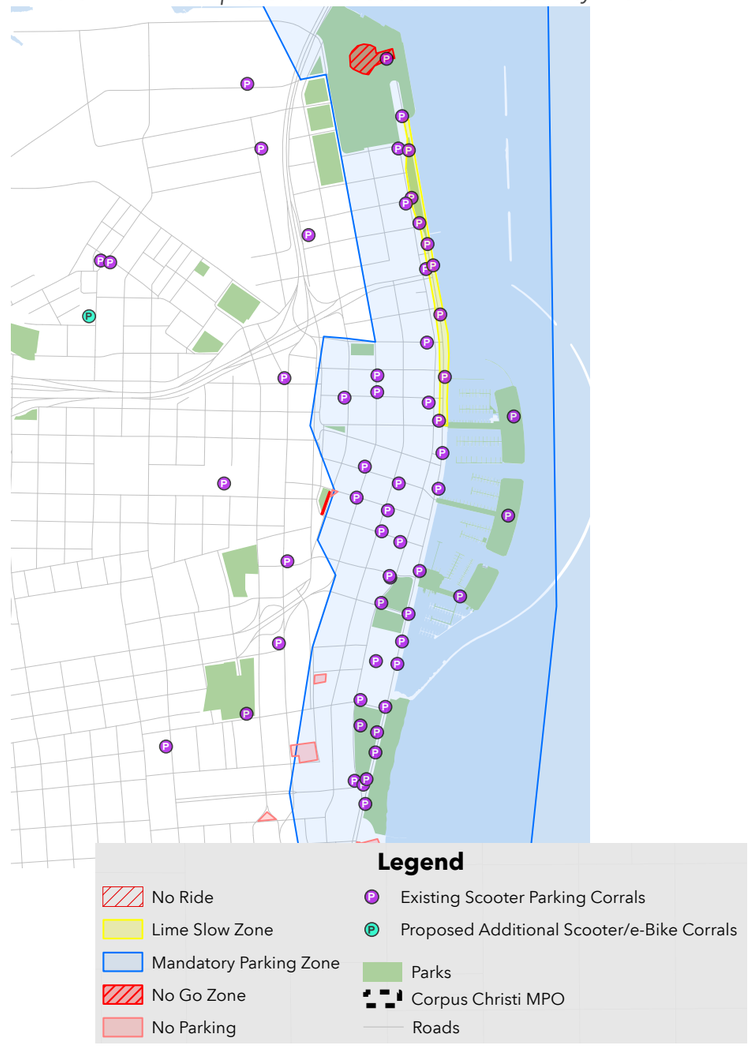


Exhibit 142 shows one example of a Preferred Micromobility Network for the Corpus Christi MPO. Key locations near popular destinations have been identified as opportunities for expansion of micromobility.

Exhibit 141. *Example of a Preferred Micromobility Network*



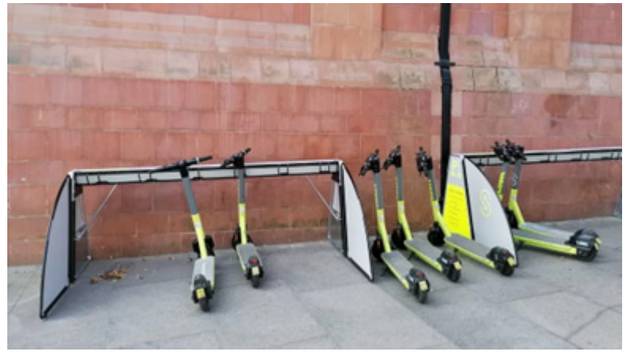
Suggested Guidelines for the Placement of Scooter Corrals

When adding or moving shared scooter corrals, several factors must be considered to ensure the vehicles do not encroach on the public right-of-way negatively. Below are considerations for the placement of e-scooter corrals.

- The safety of all users should be the primary concern for corral placement.
- Corrals should be demarcated with signage, planters, flexible delineators, and/or pavement markings to increase visibility and safety.
- Corrals must be on a level, well-marked, paved surface with sufficient drainage to prevent pooling/flooding. Where heat is a concern for users, shade structures may be used.
- Parking lanes or street/curb extensions are the preferred locations for corrals. Parking lanes should be at least 8' to accommodate corrals.
- Corrals must be in a well-lighted location that is highly visible.
- Corrals must be connected to existing bicycle and pedestrian networks.
- Corrals must be easily visible and accessible from the street so operators may collect them for recharging and redistribution. Operator parking must be permitted adjacent to corrals.
- There should be no more than 50-80 corrals per square mile.
- Corrals should be spaced no more than 650 feet apart.
- A minimum 6' clear path for pedestrians is required for all sidewalk corral locations.
- Corrals should be placed 5'-15' away from fire hydrants, mailboxes, bus stops, ticketing stations, and driveways for emergency service vehicles.
- Corrals must not interfere with parking for personal bicycles and e-scooters.
- Corrals should not impede curbside delivery for adjacent businesses.
- Avoid placing corrals in areas with high pedestrian access/egress or near splash pads, pools, fountains, and bridges.
- Micromobility parking restrictions may be supplemented with geofencing.

Examples of Dockless e-Scooter Parking

Exhibit 142. *Scooter Parking Racks, Nottingham*



Source: BBC News

Exhibit 143. *Marked Location on Sidewalk, Atlanta, GA*

Source: NACTO

Exhibit 144. *Scooter and Bike Combined Parking in the National Mall, Washington, D.C.*

Source: DC Department of Transportation

Exhibit 145. *Scooter Corral with Bollards in On-Street Car Parking Space, Santa Monica, CA*

Source: Santa Monica Daily Press

Model Micromobility Ordinances

Municipalities have the authority to adopt ordinances for proper operation of micromobility vehicles and ordinances for shared micromobility providers. Both are important for a successful, safe transportation system with micromobility. Ordinances allow cities to create and enforce restrictions and to continually monitor and update them.

Example ordinances for shared micromobility users and providers are shown in Exhibit 147.

Exhibit 146. *Model Micromobility Ordinances (continued on following pages)*

TITLE x. - USE OF STREETS AND PUBLIC PROPERTY.
CHAPTER x. - TRAFFIC OR SIDEWALK OBSTRUCTIONS.
ARTICLE 2. SHARED DOCKLESS VEHICLE OPERATING PERMIT

ARTICLE 2. SHARED DOCKLESS VEHICLE OPERATING PERMIT

Section A. DEFINITIONS

The following definitions apply to the terms used in this Article:

(A) Applicant means the person who submits for a permit or license with the City, who will own, control, or operate the proposed shared dockless vehicle service.

(B) *City* means the City of Corinth, Texas, together with all its governing and operating bodies.

(C) *City Manager* means the person authorized to operate and manage the daily functions, services, and departments of the City. The City Manager may delegate tasks and as such, the term includes the City Manager's designee.

(D) *Director* means the director of the department designated by the City Manager to enforce and administer this Article and includes representatives, agents, or department employees designated by the Director.

(E) *License* means a license granted by the City under the terms and provisions of this Article authorizing the licensee to obtain a permit to operate a shared dockless vehicle.

(F) *License Holder* means a person that has been authorized by the City to operate a shared dockless vehicle and maintain any necessary shared dockless vehicle services.

(G) *Operator* means an individual or company that has been issued an operating authority permit under this Article.

(H) *Rebalance* means moving shared dockless vehicles from an area of low demand to an area of high demand.

(I) *Right-Of-Way* means the surface of, and the space above and below, any street, road, highway, freeway, lane, path, trail, drainage way, channel, bridge, tunnel, fee interest, public way or place, sidewalk, alley, boulevard, parkway, drive, or other easement now or hereafter held by the City or over which the City exercises any rights of management or control and shall include, but not be limited to, all easements now held, or hereafter held, by the City. The public right-of-way includes the entire area between the boundary lines of every right-of-way.

(J) *Shared Dockless Vehicle* means a bicycle, an electric bicycle pursuant to the definition set forth in Texas Transportation Code Section 664.001, as amended, or a motor-assisted scooter, pursuant to the definition set forth in Texas Transportation Code, Section 551.351, that is intended to be rented or leased to different users.

(K) *Shared Dockless Vehicle Service* means a service to rent, lease, or sell shared dockless vehicles in the public right-of-way for the purpose of transportation or conveyance.

(L) *Traffic Engineer* means the person authorized to oversee the City's engineering functions, programs, and services pertaining to traffic, vehicular circulation, and pedestrian safety.

(M) *Vendor* means any person who engages in the business of selling, offering for sale, renting or offering for rent and delivering from stock at or near the time of sale or rental any goods or services from any vehicle, cart, stand, or other equipment or electronic device or from their person, from, in or upon any public street, alley, sidewalk, park, beach or any other public way or premises or from, in or upon any private premises; and outside a permanent, established structure.

The following rules of construction apply to this Article:

Page 1 of 8

(A) The term “shall” is mandatory.

(B) The term “may” is discretionary.

(C) The singular includes the plural and the plural includes the singular where indicated by the context.

Section B. GENERAL AUTHORITY AND DUTY OF DIRECTOR

(A) The Director may issue an operating authority permit to a shared dockless vehicle service for use of the public right-of-way to sell, rent, lease, or exchange, offer to sell, rent, lease, or exchange, or take order for the use of shared dockless vehicles.

(B) The Director shall implement and enforce this Article and may by written order establish rules or regulations, consistent with this Article and state or federal law, as the Director determines necessary to discharge their duty under, or to affect the policy of this Article to achieve a safe, orderly, equitable, and multi-modal transportation system.

(C) The Director may include rules or regulations regarding:

(1) The hours of operation;

(2) The appropriate number of Operators to be permitted;

(3) The number of shared dockless vehicles that may be placed in the public right-of-way;

(4) Rebalancing requirements; and

(5) Data-sharing requirements.

(D) The Director may contract with vendors to assist with data collection and analysis and to collect and store shared dockless vehicles deployed or parked in violation of this Article.

(E) The City Manager shall not issue a license under this Article unless the Traffic Engineer has reviewed the request for a license and determines that the proposed location:

(1) Have been approved by the Texas Department of Transportation, if the location involves a right-of-way covered by a state-city maintenance agreement;

(2) Has been the site of fewer than 14 motor vehicle accidents during the 12-month period immediately preceding the application date;

(3) Has a turnout, curbside parking, or other parking space available that may be used to transact a sale;

(4) Is not expected to cause excessive vehicle delays, vehicle surges, or lane changes;

(5) Has customary street traffic volumes that do not significantly impede the flow of vehicular traffic;

(6) Complies with the provisions of the Section 552.007 (Solicitation by Pedestrians) of the Texas Transportation Code and Section 42.03 (Obstructing Highway or Other Passageway) of the Texas Penal Code;

(7) Is not expected to cause or significantly contribute to sidewalk congestion or make access to abutting private property unreasonably inconvenient or hazardous; or

(8) Is not expected to impede the flow of pedestrian traffic to make the use of a sidewalk unreasonably inconvenient or hazardous.

(D) The Director shall review the license request and determine that the following criteria have been met in addition to other criteria as established by this Article that:

(1) A unit placement plan (Section 0 City-Wide Placement Plan) has been submitted;

(2) The submitted unit placement plan complies with the provisions of Texas Transportation Code Section 552.007 (*Solicitation by Pedestrians*) and Section 42.03 (*Obstructing Highway or Other Passageway*) of the Texas Penal Code;

(3) Activity is not expected to cause or significantly contribute to sidewalk congestion or to make access to abutting private property hazardous;

(4) Activity is not expected to impede the flow of pedestrian traffic or to make the use of a sidewalk unreasonably inconvenient or hazardous;

(5) The License Holder provides anonymized data reporting as required to ensure best management of public right-of-way and improve associated infrastructure, safety, and associated planning;

(6) The Vendor meets determined minimum liability insurance, both per occurrence and in the aggregate, as well as providing a performance bond per unit (to serve as security deposit); and

(7) Units physically display contact information of vendors to provide people ability to call with complaints;

A. The Director may modify a license or reduce the number of authorized units placed in the right-of-way, based on the total number of units concentrated within a specific area.

B. Each license shall be valid for no more than twelve (12) months from date of issuance.

C. The Director shall ensure that license applications are approved only for Operators in compliance with City laws and in good financial standing with the City once an Operator files a permit application and pays the permit fee. Companies can restore good standing if they take the following actions:

(1) Remove dockless devices from the public right-of-way;

(2) Cease operations until they secure a license;

(3) Reimburse the City for any and all costs associated with the company's noncompliance; and

(4) Other requirements as determined by the Director.

Section C. CONDITIONS OF LICENSE.

A person who applies for a license under this Article must:

(A) Agree to comply with the terms of the license agreement;

(B) Pay the annual ground rent fee prescribed by ordinance, based on the Traffic Engineer's determination of the vendor's square-foot encroachment on the right-of-way; and

(C) Carry and display a right-of-way license verification card.

Section D. CITY-WIDE DOCKLESS TRANSPORTATION UNIT PLACEMENT PLAN.

(A) An Applicant for a city-wide dockless transportation license shall provide the Director a plan that shows the number of units to be deployed in specific areas of the City.

(B) The Director may reduce the number of authorized units placed in the right-of-way, based on the number of units concentrated within a specific area.

Section E. APPLICATION FOR OPERATING AUTHORITY PERMIT.

(A) To obtain an operating authority permit, an Applicant shall submit an application on the form and in the manner prescribed by the Director.

(B) An Applicant shall file with the Director a verified application statement, to be accompanied by a non-refundable application fee, containing the following, in addition to the information needed under Subsection (C):

(1) The form of business of the Applicant and, if the business is a corporation or association, a copy of the documents establishing the business and the name and address of each person with a twenty percent (20%) or greater ownership interest in the business;

(2) The verified signature of the Applicant;

(3) The address of the fixed facilities to be used in the operation, if any, and the address of the Applicant's corporate headquarters, if different from the address of the fixed facilities;

(4) The name of the person designated by the Applicant to receive on behalf of the Applicant any future notices sent by the City to the Operator, and that person's contact information, including a mailing address, telephone number, and email or other electronic address;

(5) Documentary evidence from an insurance company indicating that such insurance company has bound itself to provide the Applicant with the liability insurance required by this Article;

(6) Documentary evidence of payment of ad valorem taxes on property within the city, if any, to be used in connection with the operation of the proposed shared dockless vehicle service;

(7) Documentary evidence from a bonding or insurance company or a bank indicating that the bonding or insurance company or bank has bound itself to provide the Applicant with the performance bond or irrevocable letter of credit required by this article;

(8) The number and types of shared dockless vehicles to be operated;

(9) An agreement to indemnify the City; and

(10) Three references from North American municipal bodies where the Applicant is currently operating.

(C) The Director shall review the application for an operating authority permit and determine if the following criteria have been met, in addition to other criteria that the Director may establish by rule or regulation the Operator's:

(1) Effort to educate users and ensure compliance by its users with applicable laws;

(2) Capacity to comply with this article, rules and regulations issued by the director, and all other state or federal laws or regulations;

(3) Experience operating shared dockless vehicle services, including the operator's compliance with applicable laws; and

(4) Efforts to increase access to shared dockless vehicle service to low-income and non-English speaking users.

(D) An operating authority permit may be renewed following the process in this Section.

(E) The initial application for an operating authority permit must be accompanied by an application fee of $1,000 and the appropriate vehicle fee as specified in Section I. VEHICLE FEE AND RIDE FEE. Applications to renew an operating authority permit must be accompanied by an application fee of $500 and the appropriate vehicle fee as specified in Section I. VEHICLE FEE AND RIDE FEE.

Section F. LICENSE AMENDMENT, SUSPENSION, OR REVOCATION.

(A) The Director may suspend, amend, or revoke a license for a violation of federal, state, or local law, or if the License Holder does not meet the requirements under this Section.

(B) In addition to the grounds described in Subsection (A) above, the Director may also suspend or revoke a license if the:

(1) License Holder fails to maintain correct and current information with the City regarding the information or operations in the right-of-way required by the license;

(2) License Holder provides false or misleading information to the director or any officer, employee, or contractor of the City;

(3) License Holder files bankruptcy, is insolvent, or fails to meet financial obligations on a timely basis (30 days late of posted payment date), or is unable to obtain or maintain the financial resources needed to properly maintain facilities or provide adequate service;

(4) License Holder fails to provide the Director regular reports (at least quarterly);

(5) License Holder engages in fraudulent, unfair, misleading, deceptive, or anti-competitive practices or unlawful discrimination;

(6) License Holder is operating more shared dockless vehicles than is authorized by the operating authority permit;

(7) License Holder operates a shared dockless vehicle service with a suspended operating authority permit;

(8) After consultation with the City Manager, the Director determines that the Operator's shared dockless vehicle service constitutes an imminent threat to public safety;

(9) License Holder shows a pattern of not responding to inquiries by the Director or customer complaints in a timely fashion (less than 1 week);

(10) A federal, state, or local registration, certification, or license of the License Holder is suspended; or

(11) License Holder, a person controlling the license, or principal employed by the License Holder, is convicted of a felony or any crime involving theft, fraud, or deceit related to the License Holder's service.

(C) The cease of operations by suspension or revocation notice shall meet the conditions below.

(1) Upon receiving an emailed notice by the Director that its operating authority permit has been suspended or revoked, an Operator must stop providing shared dockless vehicle services within 12 hours and must remove its shared dockless vehicles from the public right-of-way within 24 hours.

(2) If the Operator fails to retrieve all its shared dockless vehicles within 24 hours of receipt of notice the Director may remove the shared dockless vehicles from the public right-of-way without notice or consent of the Operator.

(3) The Operator is responsible for the cost of removal and storage of its shared dockless vehicles, and the Operator will be assessed a fee to retrieve any of its shared dockless vehicles that are removed and stored.

(4) The Director shall provide notice via email and certified mail to the addresses provided under Section 0.

Section G. REFUSAL TO ISSUE OR RENEW OPERATING AUTHORITY PERMIT.

A. The Director shall refuse to issue or renew an operating authority permit if:

(1) The License Holder intentionally or knowingly makes a false statement as to a material matter in an application for a permit or permit renewal;

(2) Issuance would result in activity that is expected to cause significant sidewalk congestion or make accessing abutting property hazardous;

(3) Issuance would result in activity that is expected to impede the flow of pedestrian traffic or make the use of sidewalks hazardous.

(4) The License Holder has had an operating authority permit revoked within two (2) years of the application date; or

(5) License Holder is providing shared dockless vehicles services without an operating authority permit.

(B) If the Director recommends permit denial, then the Director shall notify the Applicant or Operator in writing that the application is denied. and include in The notice shall include the specific reason(s) for denial and a statement informing the Applicant or Operator of the right to appeal the decision.

Section H. INSURANCE REQUIREMENTS

(A) An Operator shall procure and keep in full force and effect no less than the insurance coverage required by this Section through a policy or policies written by an insurance company that:

(1) Is authorized to do business in the State of Texas;

(2) Acceptable to the City; and

(3) Does not violate the ownership or operational control prohibition described in Subsection (E) of this Section.

(A) The insured provisions of the policy must name the City and its officers and employees as additional insureds, and the coverage provisions must provide coverage for any loss or damage that may arise to any person or property by reason of the operation of a shared dockless vehicle.

(B) An Operator shall maintain the following insurance coverages:

(1) The commercial general liability insurance must provide single limits of liability for bodily injury (including death) and property damage of $1 million for each occurrence, with a $2 million annual aggregate.

(2) If an Operator will utilize motor vehicles in its operations, the business automotive liability insurance must cover owned, hired, and non-owned vehicles, with a combined single limit for bodily injury (including death) and property damage of $500,000 per occurrence.

(3) Worker's compensation insurance with statutory limits.

(4) Employer's liability insurance with the following minimum limits for bodily injury by:

(A) Accident, $500,000 per each accident; and

(B) Disease, $500,000 per employee with a per policy aggregate of $500,000.

(5) Cyber/technology network liability and risk insurance, inclusive of information security and privacy with minimum limits of $1 million per claim.

(D) Insurance required under this Section must:

(1) Include a cancellation provision in which the insurance company is required to notify the director in writing not fewer than 30 days before cancelling the insurance policy (for a reason other than non-payment) or before making a reduction in coverage;

(2) Include a cancellation provision in which the insurance company is required to notify the director in writing not fewer than 10 days before cancelling for non-payment;

(3) Include an endorsement to waive subrogation in favor of the City and its officers and employees for bodily injury (including death), property damage, or any other loss.

(4) Cover all shared dockless vehicles during the times that the vehicles are deployed or operating in furtherance of the Operator's business;

(5) Include a provision requiring the insurance company to pay every covered claim on a first-dollar basis;

(6) Require notice to the Director if the policy is cancelled or if there is a reduction in coverage; and

(7) Comply with all applicable federal, state, and local laws.

(E) No person who has a twenty percent (20%) or greater ownership interest in the Operator shall have an interest in the insurance company.

(F) An Operator shall not be self-insured.

(G) Any insurance policy required by this Section must be on file with the City within 45 days of the issuance of the initial operating authority permit, and thereafter within 45 days of the expiration or termination of a previously issued policy.

Section I. VEHICLE FEE AND RIDE FEE.

(A) An Operator shall pay an annual vehicle fee of $35 for each permitted shared dockless vehicle with $5 from the annual vehicle fee dedicated to equity programs.

(B) An Operator shall pay a right-of-way rental fee of $0.20 for each ride a customer takes on a shared dockless vehicle.

(C) The Director may establish a program, subject to City Council approval, to rebate or waive fees under this Section to encourage equity in the distribution of shared dockless vehicles throughout the city.

(D) City Council must review the fees in this Section each year.

Section J. PERFORMANCE BOND OR IRREVOCABLE LETTER OF CREDIT.

Before issuance of an operating authority permit, the Operator shall provide the Director a performance bond or irrevocable letter of credit approved by the City Attorney.

(A) A bonding or insurance company authorized to do business in the State of Texas and acceptable to the City must issue the performance bond.

(B) A bank authorized to do business in the State of Texas and acceptable to the City must issue the irrevocable letter of credit.

(C) The performance bond or irrevocable letter of credit must list the Operator as principal and be payable to the City.

(D) The performance bond or irrevocable letter of credit must remain in effect for the duration of the operating authority permit.

(E) The amount of the performance bond or irrevocable letter of credit must be at least $10,000.

(F) Cancellation of the performance bond or irrevocable letter of credit does not release the Operator from the obligation to meet all requirements of this Section and the operating authority permit. If the performance bond or irrevocable letter of credit is cancelled, the operating authority permit shall be suspended on the cancellation date and the Operator shall immediately cease operations until the Operator provides the Director with a replacement performance bond or irrevocable letter of credit that meets the requirements of this Section.

(G) The City may draw against the performance bond or irrevocable letter of credit or pursue any other available remedy to recover damages, fees, fines, or penalties due from the Operator for violation of any provision of this Section or the operating authority permit.

Section K. OFFENSE AND PENALTY.

(A) A person commits an offense if the person operates without a permit or license as required by this Article.

(B) A person commits an offense if the person fails to display the person's right-of-way license verification card to a peace officer or authorized City employee during the time the person is operating at the permitted location.

(C) An offense under this Article is a Class C misdemeanor.

ARTICLE 1. GENERAL PROVISIONS.

Section A. DEFINITIONS.

In this Chapter:

(A) *Child* means a person younger than 18 years of age who has not been married or had the disabilities of minority removed for general purposes.

(B) *Director* means the director of the department designated by the City Manager to enforce and administer this Article and includes representatives, agents, or department employees designated by the Director.

(C) *Bicyclist* means a person operating a bicycle.

(D) *Blockface* means the linear distance of lots along one side of a street between the two nearest intersecting streets. If a street deadends, the terminus of the dead-end street will be treated as an intersecting street.

(E) *Electric Bicycle*:

(1) Has the meaning assigned by Section 664.001 of the Texas Transportation Code, as amended;

(2) The term does not include:

A. A motorized mobility device, as defined by Section 552A.0101 of the Texas Transportation Code, as amended;

B. An electric personal assistive mobility device, as defined by Section 551.201 of the Texas Transportation Code, as amended; or

C. A neighborhood electric vehicle, as defined by Section 551.301 of the Texas Transportation Code, as amended.

(F) *Helmet* means a properly-fitted bicycle helmet that:

(1) Is not structurally damaged; and

(2) Conforms to current standards of the American National Standards Institute, the American Society for Testing and Materials, the Snell Memorial Foundation, or any federal agency having regulatory jurisdiction over bicycle helmets.

(G) *Motor Assisted Scooter* has the meaning assigned by Section 551.351 of the Texas Transportation Code, as amended.

(H) *Parent* means the natural or adoptive parent or court-appointed guardian or conservator of a child.

(I) *Passenger* means any person riding upon or attached to a motor assisted scooter who is not the primary operator of the vehicle.

(J) *Pedestrian Zone* means the portion of the street that accommodates non-vehicular activity, it extends from the face of the building or edge of the property line to the face of the curb.

(K) *Rider* means a person operating a bicycle or a micromobility device.

(L) *Shared Micromobility Service* means a publicly offered transportation service that enables a person to obtain short-term access to a micromobility device on an as-needed basis.

(M) *Sidewalk Clear Zone* means the portion of the pedestrian zone that is specifically reserved for pedestrian travel.

(N) *Shared Dockless Vehicle* means a bicycle, an electric bicycle pursuant to the definition set forth in Texas Transportation Code Section 664.001, as amended, or a motor-assisted scooter, pursuant to the definition set forth in Texas Transportation Code, Section 551.351, that is intended to be rented or leased to different users.

(O) *Slow Ride Zone* means an area where shared dockless vehicles may not exceed 10 miles per hour or the speed limit otherwise posted.

(P) *Traffic Control Device* means traffic control signs, signals, devices, and markings previously placed or erected by the police department or department of transportation, or any predecessor department, and now in use for the purpose of regulating, warning, or guiding traffic.

(Q) *Traffic Engineer* means the person authorized to oversee the City's engineering functions, programs, and services pertaining to traffic, vehicular circulation, and pedestrian safety.

(R) *Trail* means a pathway for pedestrian circulation, alternative transportation, and recreational uses that is designed and constructed in compliance with standards and specification adopted and maintained by the city.

(S) *Wearing A Helmet* means that a helmet is properly attached to a person's head with the chin straps of the helmet securely fastened and tightened.

The following rules of construction apply to this Article:

(A) The term "shall" is mandatory.

(B) The term "may" is discretionary.

(C) The singular includes the plural and the plural includes the singular where indicated by the context.

Section B. APPLICABILITY.

This Chapter applies when a rider operates a micromobility device or bicycle on a street or sidewalk.

ARTICLE 2. MICROMOBILITY DEVICE AND BICYCLE TRAFFIC REGULATIONS.

Section A. APPLICABILITY OF VEHICLE TRAFFIC RULES.

A rider shall comply with the requirements of this Chapter imposed on a driver of a vehicle, to the extent that the requirements may be applied to operation of a micromobility device or bicycle.

Section B. OBEDIENCE TO TRAFFIC-CONTROL DEVICES.

(A) A rider shall obey the instruction of official traffic signals, signs, and other traffic-control devices applicable to vehicles, unless otherwise directed by a City of Corinth police officer.

(B) Unless a bike lane is specifically designated otherwise, a rider travelling in a bike lane shall not travel in the opposite direction of adjacent motor vehicles in the roadway.

(C) A rider shall obey traffic signs that prohibit a right, left, or "U" turn, except when the rider dismounts from the micromobility device or bicycle to make the turn. A rider who dismounts shall obey regulations applicable to pedestrians.

(D) Every motor assisted scooter and electric bicycle must be equipped with a lamp on the front that emits a white light that is visible at a distance of not less than 500 feet and a red reflector on the rear that is visible from a distance of not less than 600 feet when directly in front of lawful lower beams of head lamps on a motor vehicle.

Section C. OPERATION ZONES

(A) The Traffic Engineer is authorized to designate zones where the operation of motor assisted scooters is prohibited and slow ride zones for motor assisted scooters and electric bicycles. Slow ride zones are in the areas where, in the professional judgment of the traffic engineer:

(1) Congested pedestrian or non-motorized traffic is present;

(2) Without a speed limit, a significant speed differential would exist between pedestrians or non-motorized traffic and motor assisted scooters and electric bicycles; and

(3) Without a speed limit, the presence of motor assisted scooters and electric bicycles could endanger public safety.

(B) A rider shall comply with the requirements of this Chapter imposed on a driver of a vehicle, except those by which their nature can have no application, unless directed by a City of Corinth police officer.

(C) Unless a bike lane is specifically designated otherwise, a rider traveling in a bike lane may not travel in the opposite direction of adjacent motor vehicles in the roadway.

(D) A person commits an offense if the person:

(1) Operates or rides a motor assisted scooter or an electric bicycle at a speed greater than:

(A) 20 miles per hour;

(B) The designated speed limit in a designated slow ride zone; or

(C) The posted speed limit on a public street or trail.

(2) Transports any passenger on a motor assisted scooter or electric bicycle while in the public right-of-way or public park or public plaza within the city, unless the device is equipped with a seat and a set of foot rests for the passenger;

(3) Fails to yield the right-of-way to any pedestrian while operating a motor assisted scooter or an electric bicycle;

(4) Operates a motor assisted scooter on a trail where riding is prohibited or during the hours that riding is prohibited on the trail; or

(5) Operates a motor assisted scooter or electric bicycle on public landscaping or art or on public amenities in a manner that is contrary to the intended use of the amenity.

(E) Except as provided in Sections B and C, a person may ride a micromobility device or bicycle on a sidewalk in a reasonable and prudent manner.

(F) Riders shall operate on sidewalks in a manner consistent with the Americans With Disabilities Act and that does not endanger or hinder the movement of persons with limited mobility or other sidewalk users.

Section D. EXITING FROM ALLEY, DRIVEWAY, OR BUILDING.

A rider exiting from an alley, driveway, or building shall yield the right-of-way to a pedestrian on a sidewalk or sidewalk area, or to a vehicle on a roadway.

Section E. PARKING.

(A) A person shall not park a micromobility device or bicycle:

(1) In a manner that obstructs pedestrian or vehicle traffic;

(2) In a space designated as a vehicle parking place or between two designated vehicle parking places, unless otherwise marked;

(3) On any part of an accessibility ramp for persons with disabilities, or in any manner that would restrict the movement of persons with disabilities;

(4) In designated and marked special use zones, including, but not limited to, commercial service zones, passenger loading zones, customer service zones and valet zones;

(5) On or near railroad or light rail tracks or crossings;

(6) In a manner that obstructs street furniture that pedestrians access, including, but not limited to, benches and parking pay stations;

(7) On any private property without the permission of the owner

(8) Within 10 feet of an intersection or crosswalk, unless that area is a space designated by the city for the parking of motor assisted scooters or electric bicycles;

(9) On a roadway unless that area is a space designated by the City for the parking of motor assisted scooters or electric bicycles;

(10) On a sidewalk or public path in such a way as to obstruct traffic that prevents the free passage over any part of the sidewalk or public path, including in the sidewalk clear zone or pedestrian zone;

(11) Along a Blockface where the combined width of the sidewalk clear zone and buffer/furnishing/ curb zone is less than eight feet;

(12) Within, against, or adjacent to a public transit shelter or public transit stop, in a manner which restricts the use of the shelter or stop by pedestrians who are waiting for public transportation;

(13) In a manner that obstructs fire suppression appurtenances, building entryways or exits, or vehicular driveways; or

(14) In a public park or plaza unless that area is a space designated by the City for the parking of motor assisted scooters or electric bicycles.

(B) A person shall not attach or secure a micromobility device or bicycle to public or private property in a manner that may damage, impair, or render the property unusable.

(C) A person shall park a micromobility device or bicycle:

(1) On concrete or other non-porous surface;

(2) In designated spaces marked for such use;

(3) In a manner which does not obstruct a roadway, path, sidewalk, crosswalk, or other pedestrian-way;

(4) In a manner which does not obstruct building entrances, exits, fire exits, delivery areas, or alleyways;

(5) In a manner which does not obstruct travel and movement in violation of the Americans with Disabilities Act; or

(6) In a manner which does not trespass on or obstruct private property, unless authorized by owner.

(7) In the pedestrian zone if it is fully contained in the buffer/furnishing/curb zone; or

(8) Fastened to a bicycle rack in the right-of-way, if the device includes a locking mechanism.

Section F. RIDING RESTRICTIONS.

(A) Except as otherwise directed by a Traffic Control Device or a City of Corinth police officer, a rider shall ride in accordance with state law.

(A) A rider shall not operate a micromobility device or bicycle between vehicles traveling or standing in the same direction within marked lanes of a roadway or contrary to established traffic control devices.

Section G. RIDING ON RESTRICTED OR PROHIBITED STREETS.

A rider may not operate a micromobility device or bicycle on a street or sidewalk where riding is prohibited or on a street during the hours that riding is prohibited on the street.

Section H. RIDER DUTIES.

A rider who causes injury to a person or damage to property shall immediately stop the micromobility device or bicycle and:

(A) Provide any injured person reasonable assistance;

(B) Give the injured person or owner of damaged property the rider's name, address, and phone number; and

(C) If the damaged property is unattended, the rider must leave in a clearly visible way, or securely attached in a visible way to the property, a written notice with the rider's name, address, and phone number.

ARTICLE 3. SAFETY EQUIPMENT.

Section A. HELMET REQUIRED.

(A) Except as permitted by Section C HEALTH CONDITION EXEMPTION a child shall not operate or ride a micromobility device or a bicycle, sidecar, trailer, child carrier, seat, or other device attached to a micromobility device or bicycle unless the child is wearing a helmet.

(B) Except as permitted by Section C HEALTH CONDITION EXEMPTION a parent shall not permit a child to operate or ride a micromobility device or a bicycle, sidecar, trailer, child carrier seat, or other device attached to a micromobility device or bicycle unless the child is wearing a helmet.

(C) Under this Section, a helmet must:

(1) Be properly fitted and securely fastened to the child's head with the straps securely tightened;

(2) Not be structurally damaged; and

(3) Conform to the standards of the United States Product Safety Commission.

Section B. APPROVAL OF STANDARDS.

The City Council approves the bicycle helmet standards promulgated by the United States Consumer Product Safety Commission.

Section C. HEALTH CONDITION EXEMPTION.

(A) A child is not required to wear a helmet if the child has in its immediate possession a health exemption identification prescribed by this Section.

(B) The City Manager shall provide a health exemption identification to a child with a written statement:

(1) from a licensed physician that states the child's health condition and explains why the condition prevents the child from wearing a helmet; and

(2) that is approved by Denton County Public Health.

(C) The city manager shall establish procedures to implement this section.

Section D. MULTIPLE RIDERS PROHIBITED.

A rider shall not operate a micromobility device or bicycle with another rider or occupant, unless the device or bicycle is specifically manufactured and designed to accommodate multiple riders.

Section E. PENALTY; ENFORCEMENT.

(A) A person commits an offense if the person performs an act prohibited by this Article or fails to perform an act required by this Article.

(B) A culpable mental state is not required for the commission of an offense under this Article.

(C) A separate offense is committed each time an offense occurs.

(D) Prosecution for an offense under this Article does not prevent the use of other enforcement remedies or procedures applicable to the person charged with the conduct or involved in the offense.

(E) An offense under this Article is a Class C misdemeanor punishable by a fine not to exceed:

(1) $20 on a first conviction; and

(2) $40 on a subsequent conviction.

(F) The municipal court may dismiss a charge against a person for an offense under Section 12-2-31 (*Helmet Required*) on receiving proof that the defendant acquired a helmet for the child who was operating or riding a micromobility device or bicycle in violation of Section 12-2-31 (*Helmet Required*) on or before the 30th day after the citation was issued.

(G) A City of Corinth police officer or officer designated by the Director may issue a citation for any violation of this Chapter.

Endnotes

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3 Stefan Gössling, “Integrating e-scooters in urban transportation: Problems, policies, and the prospect of system change” (2020) https://doi.org/10.1016/j.trd.2020.102230
4 FHWA, “Shared Micromobility and Equity”
5 Shunhua Bai and Junfeng Jiao “Toward Equitable Micromobility: Lessons from Austin E-Scooter Sharing Program” (2021) https://journals.sagepub.com/doi/10.1177/0739456X211057196
6 Anastasia Loukaitou-Sideris, Robin Liggett, and Hyun-Gun Sung “Death on the Crosswalk: A Study of Pedestrian-Automobile Collisions in Los Angeles” https://doi.org/10.1177/0739456X06297008
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11 International Transport Forum “Safe Micromobility” (2020) https://www.itf-oecd.org/safe-micromobility
12 Insurance Institute for Highway Safety (IIHS) “Fatality Facts 2021” https://www.iihs.org/topics/fatality-statistics/detail/state-by-state
13 International Transport Forum “Safe Micromobility” (2020) https://www.itf-oecd.org/safe-micromobility
14 International Transport Forum “Safe Micromobility” (2020) https://www.itf-oecd.org/safe-micromobility
15 City of Austin “Dockless Mobility Community Survey Report” (2019) https://www.austintexas.gov/sites/default/files/files/Transportation/Dockless_Mobility_Community_Survey_Report_2-28-19.pdf
16 Sylvaine Tuncer and Barry Brown, “E-scooters on the Ground: Lessons for Redesigning Urban Micro-Mobility” (2020) https://dl.acm.org/doi/10.1145/3313831.3376499
17 NACTO, “Shared Micromobility Snapshot” (2022) https://nacto.org/wp-content/uploads/2022/12/2020-2021_shared_micro_snapshot_Dec7_2022.pdf
18 American Community Survey 2022 5-Year Estimate, Table S0101: Age and Sex
19 American Community Survey 2022 5-Year Estimate, Table S0101: Age and Sex
20 American Community Survey 2022 5-Year Estimate, Table S0802: Means of Transportation to Work by Selected Characteristics
21 International Transport Forum “Safe Micromobility” (2020) https://www.itf-oecd.org/safe-micromobility

Corinth Active Transportation Plan

Appendix D: Funding Opportunities

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Local and Federal Funding

Funding sources for active transportation, complete streets and micromobility projects that Corinth may leverage to enhance their active transportation efforts are available at the local, state and federal level.

Local Funding Opportunities

Source	Description
Crowd Funding	Through crowd funding, community members raise money to fund certain projects. This approach can raise awareness of community needs on pedestrian and bicycle infrastructures, which may help gather public support on future projects. It may also help attract potential donors for future projects.
Impact/Developer Fee	Impact/Developer fees can be used to fund infrastructure improvement projects such as pedestrian and bicycle amenities. Cities charge such fees to ensure the costs of maintaining the local transportation system are shared by developers who bring new growth into the area.
Local Capital Improvement Programs (CIPs)	Capital Improvement Programs (CIPs) outline upcoming capital projects, including streets and pedestrian and cyclist infrastructures. These projects are funded using local sources including property and sales taxes.
Municipal Bonds	A city is able to finance a project by acquiring debt that must be paid with interest over a specified amount of time.
Park Land Dedication Ordinances	Park Land Dedication Ordinances consist of park land dedication and development fees. This funding source can be used to acquire new park land and construct walking and biking trails.
Partnership	Cities can partner with local and regional businesses, non-profits and other public agencies to acquire additional funding sources. These partnerships may be able to receive funds from development grants targeting pedestrian and bicycle improvements.
Private Donations	A donation program is established to receive contributions from the community.
Property Taxes	Cities can use property taxes to help fund infrastructure improvements if their policies permit. It is generally the major source of local revenue and can be increased with voter approval.
Revenue Bonds	Financed debt to fund a project that is paid for by the revenue of the project.
Sales Taxes	Sales taxes consist of both local and statewide sales taxes. Cities can use sales taxes to fund pedestrian and bicycle infrastructure improvements. Sales taxes can be increased with voter approval.
Special Assessments	Cities can use special assessments to fund infrastructure improvements when the cost is directly controlled by people who benefit from the project. Neighborhoods can coordinate to use their property taxes to fund pedestrian or bicycle improvements in their area. Tax-increment financing districts and public improvement districts are common examples of special assessments.
User Fees	User fees are paid by people who use certain public utilities or services, such as water and sewer facilities, parks and transportation systems. Cities can charger user fees for people who use off-road facilities and recreational trails.
Utility Bill Contributions	To help fund projects small contributions can be made via a utility bill.

State Funding Opportunities

Souce	Description
Transportation Alternatives Set-aside (TA) Program	TxDOT administers TA funds for locally sponsored bicycle and pedestrian infrastructure projects in communities across the state. In large urbanized areas with populations over 200,000, TA funds are also distributed directly to Metropolitan Planning Organizations (MPO) to administer according to their needs. MPOs and TxDOT are responsible for selecting projects independently of one another.
Subrecipient Monitoring and Compliance Program	The FHWA requires TxDOT requires to monitor their Subrecipients for compliance with Title VI and the ADA. TxDOT recently developed an online Subrecipient Compliance Assessment Tool. Upon completion, Subrecipients will be identified as having a satisfactory or unsatisfactory status. This assessment is a first step for TxDOT to determine Subrecipient compliance, help Subrecipients understand their ADA/504 and Title VI responsibilities and assist TxDOT in planning future training and technical assistance.
Traffic Safety Grants	Traffic Safety Grants are funded by the NHTSA and administered through TxDOT. Educational institutions, local governments, nonprofit organizations, and state agencies can submit traffic safety proposals for funding consideration with TxDOT. Projects can include increased enforcement, traffic safety training, driver behavior education, and outreach programs to reduce fatalities, injuries and crashes on Texas roadways.
Local Government Assistance Program (LGAP)	Section 201.706, Transportation Code, requires TxDOT to provide a minimum amount of materials to assist counties with the repair and maintenance of county roads and bridges. Materials may include surplus materials already possessed by TxDOT or new materials.
Recreational Trails Grants	Texas Parks and Wildlife Department (TPWD) administers the National Recreational Trails Fund in Texa. Funds can be spent on both motorized and non-motorized recreational trail projects such as the construction of new recreational trails, to improve existing trails, to develop trailheads or trailside facilities, and to acquire trail corridors.
Local Parks Grant Program (LPGP)	LPGP consists of 5 individual programs that assist local units of government with the acquisition and/or development of public recreation areas and facilities throughout the State of Texas. The Program provides 50% matching grants on a reimbursement basis to eligible applicants. All grant assisted sites must be dedicated as parkland in perpetuity, properly maintained and open to the public.

Federal Funding Opportunities

Source	Description
Active Transportation Infrastructure Investment Program (ATIIP)	A competitive federal grant to provide safe access to active transportation facilities with an emphasis on connecting the community.
Community Development Block Grant Program (CDBG)	CDBG funds can be used to support projects that improve and revitalize streetscape, such as constructing and repairing sidewalks and bike lanes.
Section 108 – Loan Guarantee Program	Section 108 provides CDBG recipients with the ability to leverage their annual grant allocation to access low-cost, flexible financing for economic development, housing, public facility, and infrastructure projects.
Disaster Relief Fund	FEMA can authorize direction, coordination, management, and provide funds to help with eligible emergencies.
Highway Safety Improvement Program (HSIP)	HSIP aims to support projects that reduce conflicts between vehicles and pedestrians or cyclists. Section 405 (National Priority Safety Program) of HSIP specifically provide funds for safety enhancement and education programs related to pedestrians and bicycles.
Land and Water Conservation Fund (LWCF)	LWCF aims to support projects that create and maintain high-quality recreation resources. Projects that improve trail networks may be eligible for this funding.
National Highway Performance Program (NHPP)	The NHPP funding, which is administrated by TxDOT, can fund projects that construct new facilities on the National Highway System (NHS). This includes bicycle lanes, bicycle parking and shared use paths.
Surface Transportation Block Grant Program (STPBG)	STPBG funding can be used for nearly all types of transportation projects. Local, regional, and state governments can use this funding source to pay for pedestrian and bicycle improvement projects.
Surface Transportation Block Grant Program Set-aside (STPBG Set-aside)	STPBG Set-aside funding replaces the Transportation Alternative Program (TAP) and includes the Recreation Trails Program (RTP). This source can fund projects that promote alternative transportation modes as well as trail constructions and improvements. Previously TAP-eligible pedestrian and bicycle projects remain eligible in the STPBG Set-aside. The Texas Parks & Wildlife Department (TPWD) administrates the RTP funding for trail-related projects.
TIGER Discretionary Grants Program	This program provides fundings for road, rail, transit and port projects that achieve critical national objectives such as environmental sustainability and livability. Projects with an active transportation focus are eligible for the fund.
Urban Park and Recreation Recovery Grant (UPARR)	URAPP fund helps economically distraught communities to restore desired recreation facilities. Projects that repair and upgrade park and trail may be eligible for the grant.
Federal Transit Administration Programs (FTA)	FTA provides annual formula grants to transit agencies nationwide as well as discretionary funding in competitive processes. Currently there are 13 formula and 37 competitive grants available.
Transportation Infrastructure Finance and Innovation Act (TIFIA)	TIFIA provides credit assistance for qualified projects of regional and national significance. Many large-scale, surface transportation projects - highway, transit, railroad, intermodal freight and port access - are eligible for assistance. Eligible applicants include state and local governments, transit agencies, and others.

Corinth Active Transportation Plan

Appendix E: Survey Results

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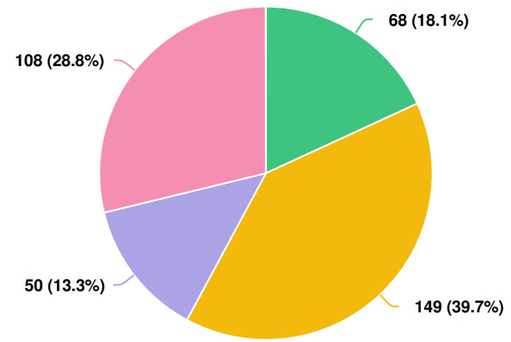
Public Engagement Survey Results

The following is the full results of the public engagements survey conducted by the City of Corinth for the Active Transportation Plan. For discussion of the survey results, please see Chapter 3: Issues, Needs, and Opportunities.

Q1 How often do you ride a bike on public roads or sidewalks?

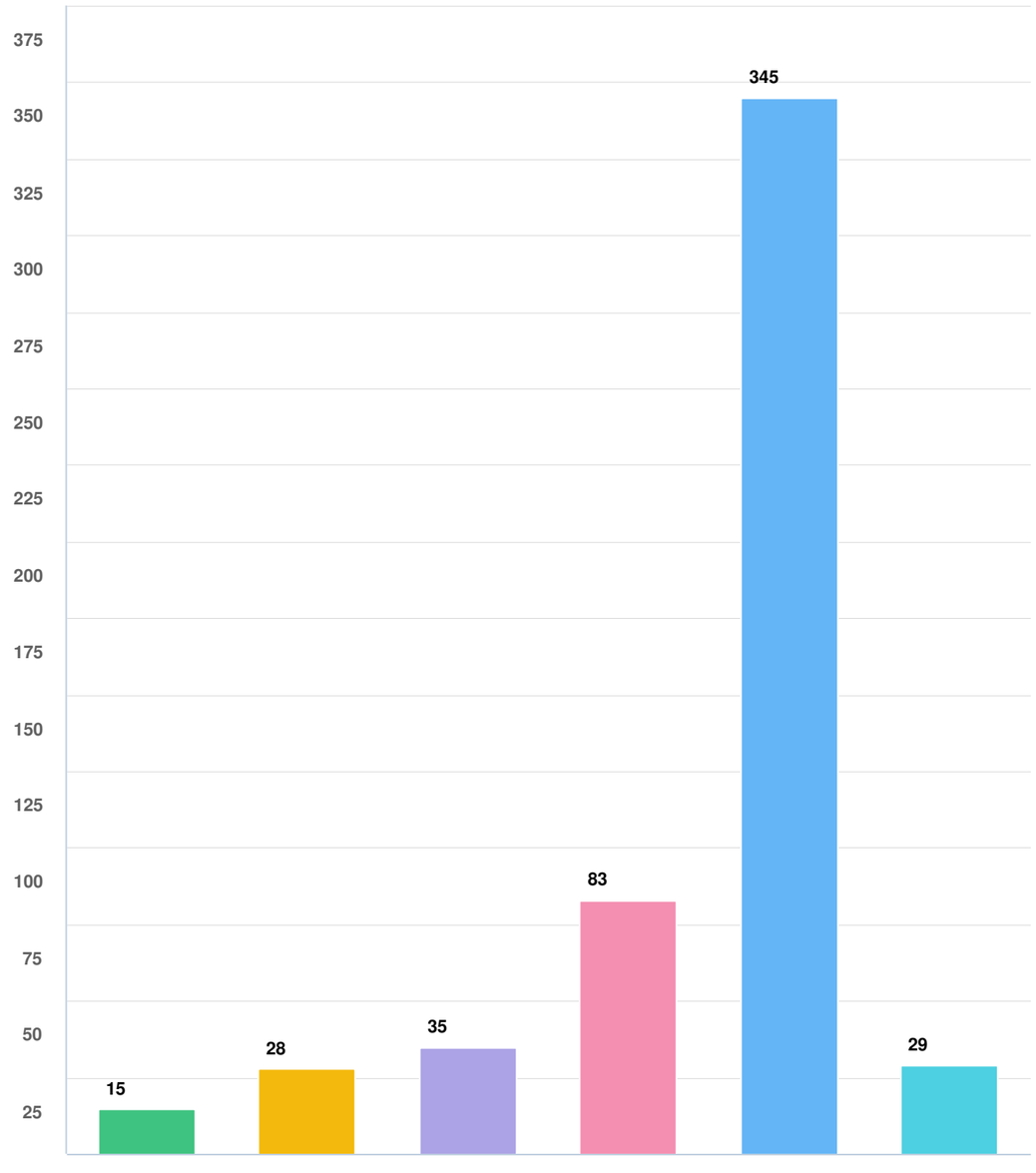


Question options

Daily Weekly Monthly Rarely

Mandatory Question (375 response(s))
Question type: Radio Button Question

Q2 Where do you travel to on a bike?

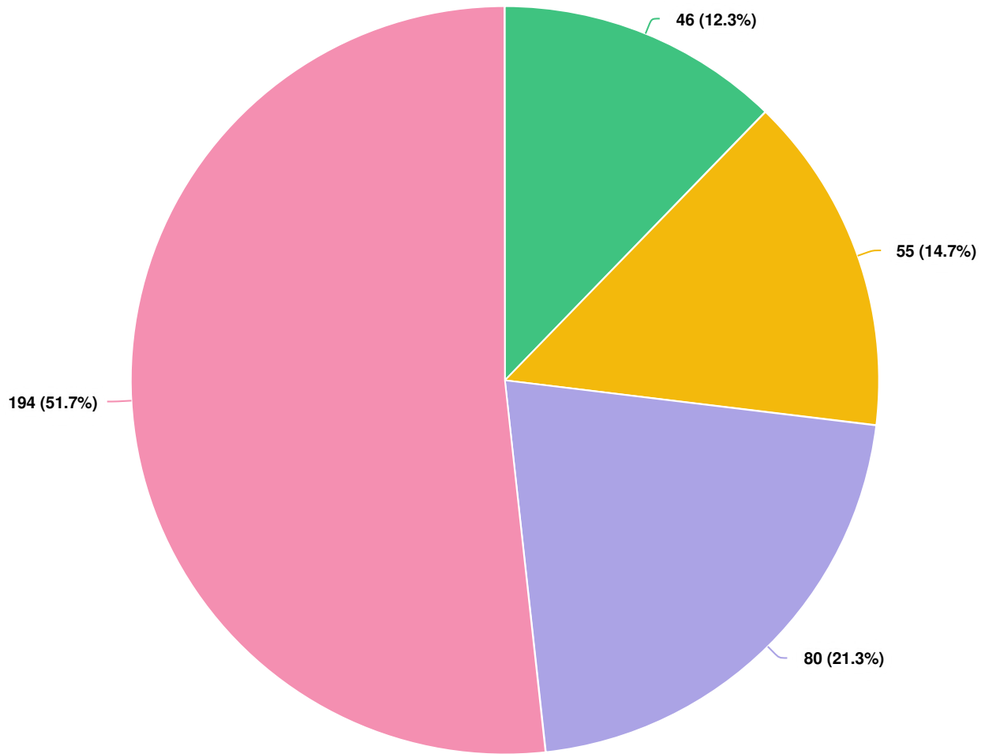


Question options

School Work Shopping Social Activity Exercise/Recreation Other (please specify)

Mandatory Question (375 response(s))
Question type: Checkbox Question

Q3 On average, how long are your trips (total round trip in miles)

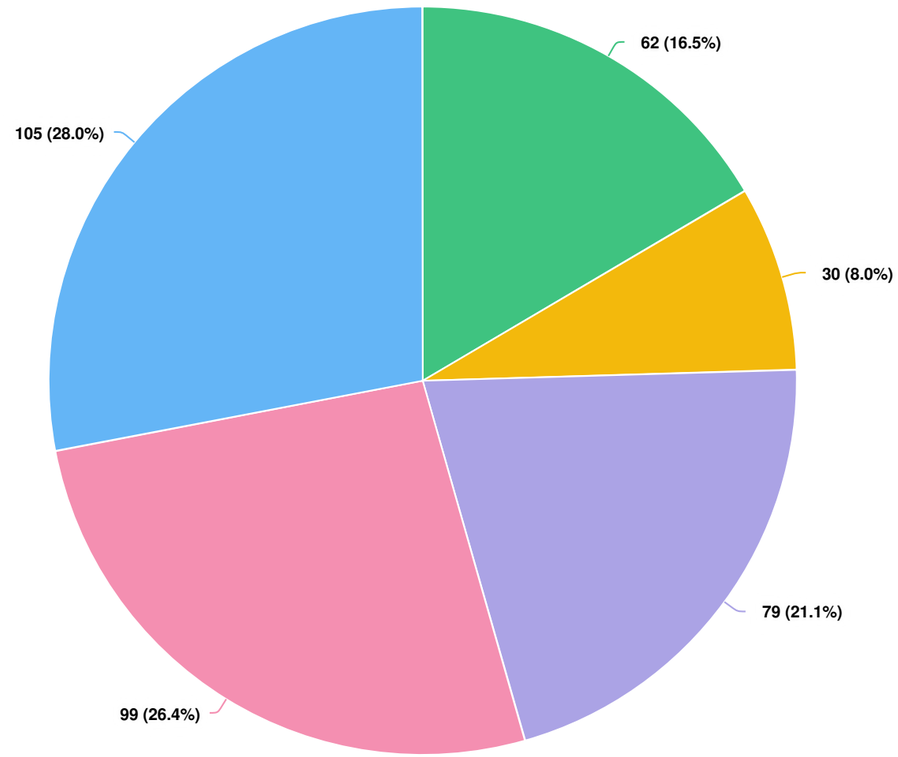


Question options

Less than 1 mile · Between 1 and 2 miles · Between 2 and 5 miles · Greater than 5 miles

Mandatory Question (375 response(s))
Question type: Radio Button Question

Q4 Please indicate your level of agreement with the following statement: "The City needs to prioritize bicycle transportation even if that means redirecting resources/funds from other transportation needs."

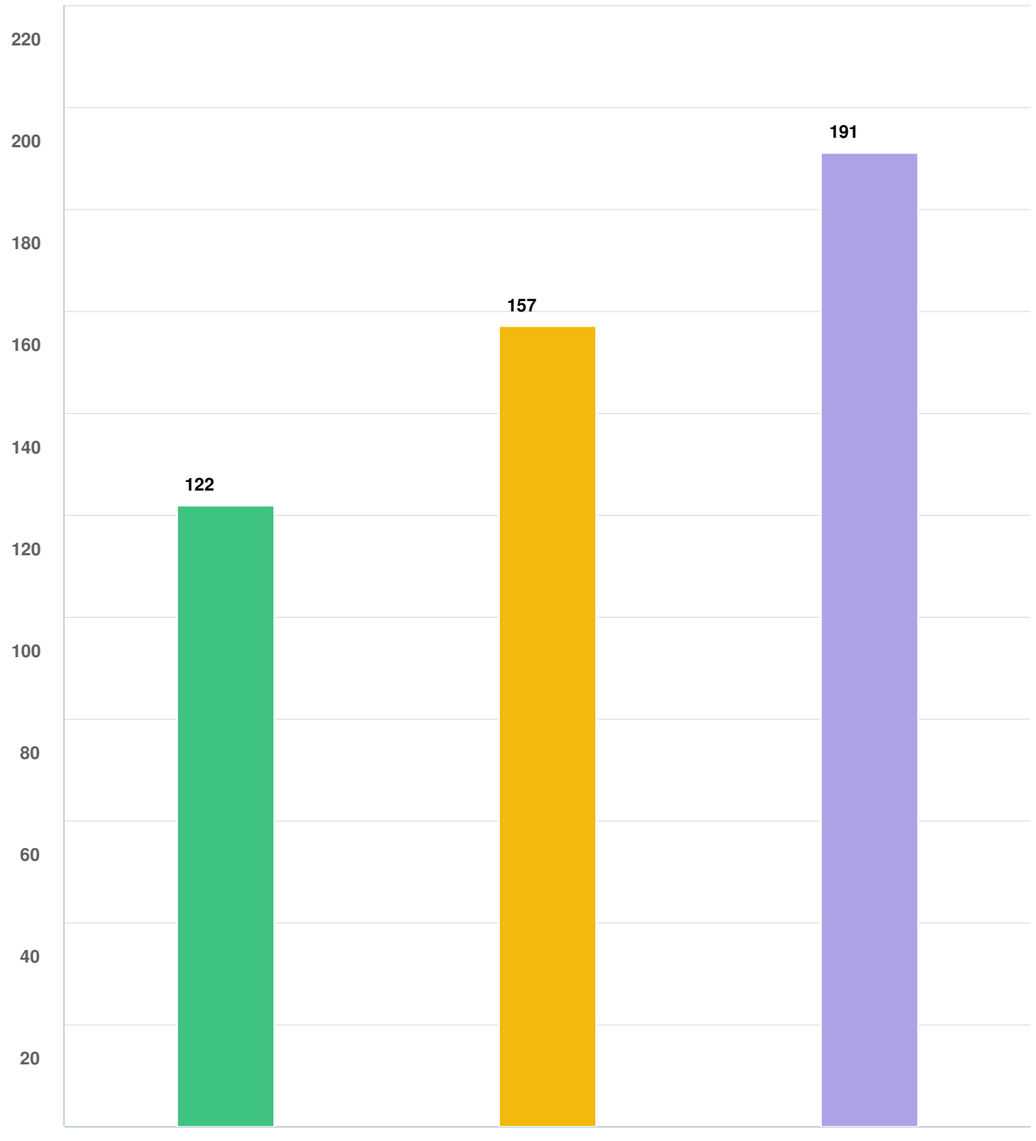


Question options

Strongly Disagree · Disagree · Neutral · Agree · Strongly Agree

Mandatory Question (375 response(s))
Question type: Radio Button Question

Q5 How should the City prioritize bicycle transportation design?



Question options

- Complete the most amount of routes with existing funding and resources.
- Prioritize bike lanes that have the least impact to motor vehicle drivers.
- Prioritize the experience and safety of the bicyclist.

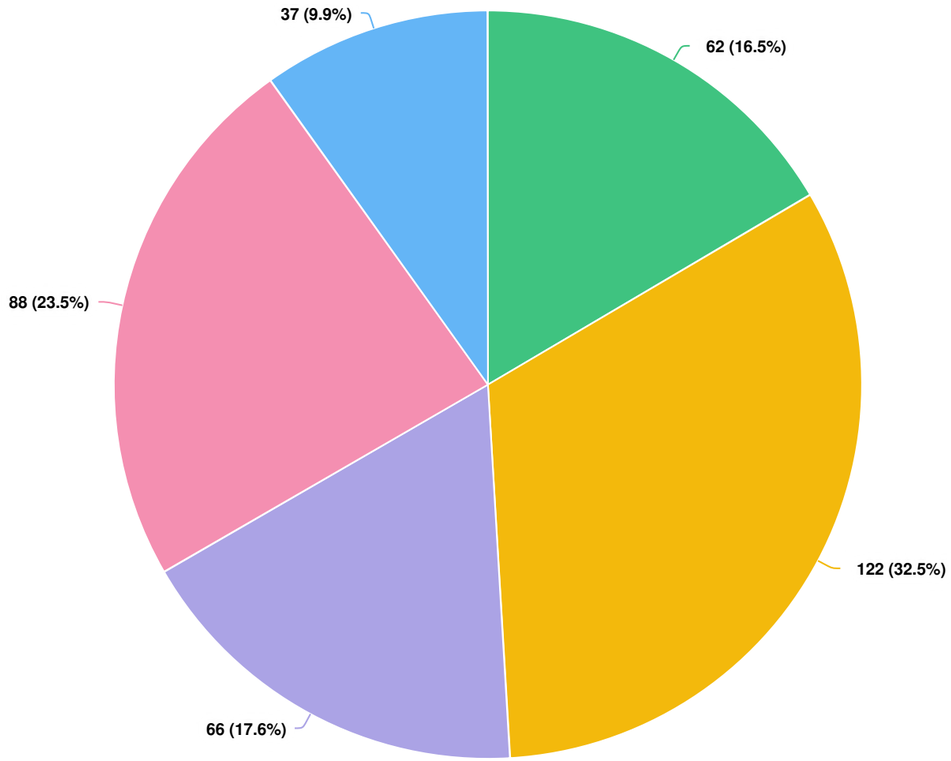
Mandatory Question (375 response(s))
Question type: Checkbox Question

Q6 If the City were to increase bicycle transportation investments, please list the following improvements in order of priority with your highest priority at the top and lowest priority at the bottom

OPTIONS	AVG. RANK
Shared use paths: 10-12-foot wide paved pathways typically along a corridor separate and not parallel to a motorized roadway	1.81
Protected Bike Lanes: Separation between moving motor vehicle traffic and the bike lane. (Ex. bollards, curbs, plastic posts, parked cars.	1.95
Shared Painted Lanes: painted lanes alongside motor vehicle travel lanes that can accommodate active transportation modes.	2.23

Mandatory Question (375 response(s))
Question type: Ranking Question

Q7 How safe do you feel while using bike transportation in your neighborhood.

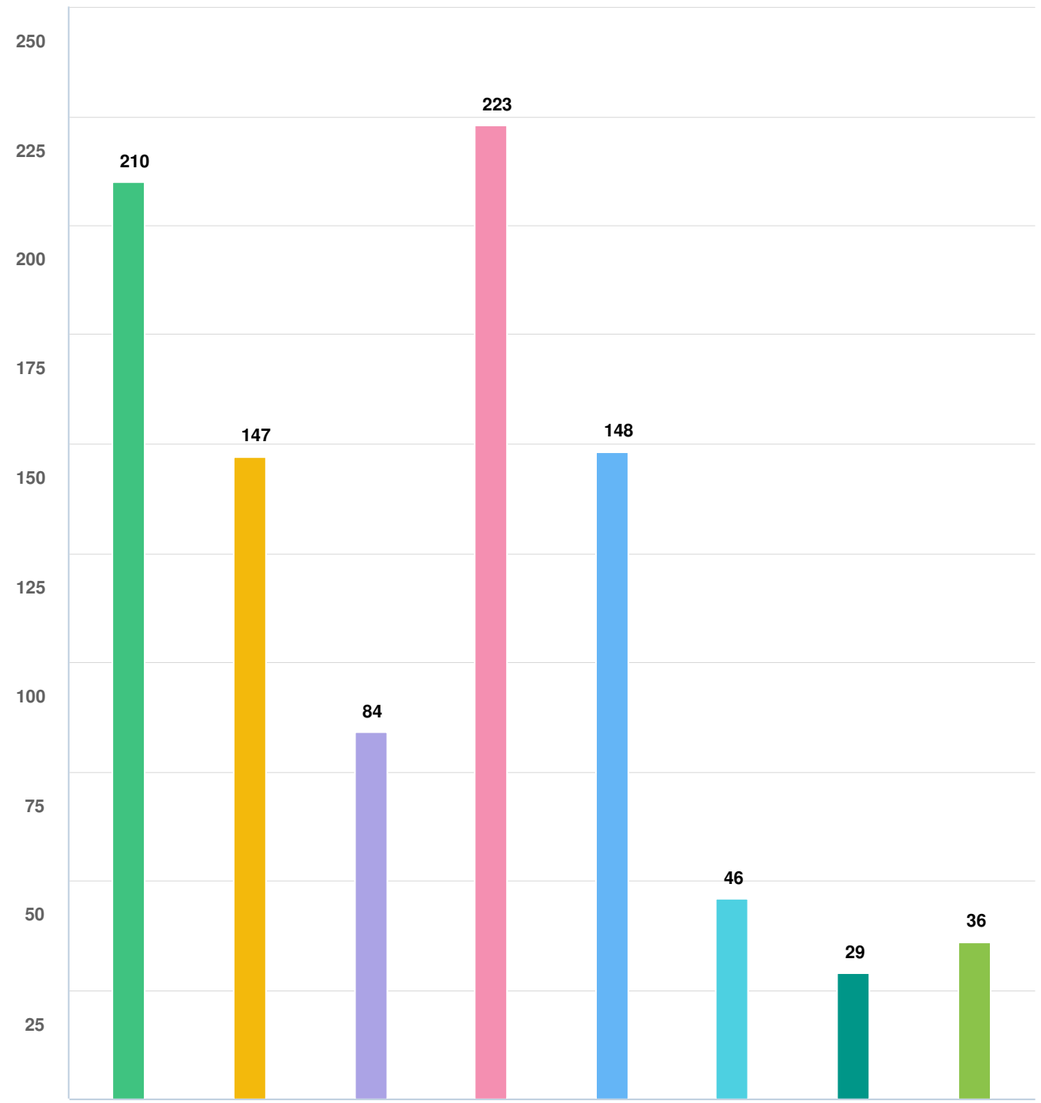


Question options

Very safe · Somewhat safe · Neutral · Somewhat unsafe · Very unsafe

Mandatory Question (375 response(s))
Question type: Radio Button Question

Q8 What are top 3 safety concerns where you travel?



Question options

Lack of bike lanes · Poor pavement conditions · Inadequate signage/pavement markings · Recurring driver behavior issue · Inadequate sidewalks · Inadequate crosswalks · Inadequate or missing ADA-accessible curb ramps · Other (please specify)

Mandatory Question (375 response(s))
Question type: Checkbox Question

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Active Transportation Plan

City of Corinth, Texas
Adopted June 5th, 2025

FREESE AND NICHOLS

CORINTH
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