



City of

 **Dallas**

COMPLETE STREETS DESIGN MANUAL
~DRAFT

ACKNOWLEDGEMENTS

Dallas City Council

- Mayor Mike Rawlings
- Mayor Pro Tem Tennell Atkins, District 8
- Deputy Mayor Pro Tem Monica Alonzo, District 6
- Scott Griggs, District 1
- Adam Medrano, District 2
- Vonciel Jones Hill, District 3
- Dwaine R. Caraway, District 4
- Rick Calahan, District 5
- Carolyn R. Davis, District 7
- Sheffie Kadane, District 9
- Jerry R. Allen, District 10
- Lee M. Kleinman, District 11
- Sandy Greyson, District 12
- Jennifer S. Gates, District 13
- Philip T. Kingston, District 14

Council Transportation and Trinity River Project Committee

- Vonciel Jones Hill, Chair
- Lee M. Kleinman, Vice Chair
- Monica Alonzo, Deputy Mayor Pro Tem
- Tennell Atkins, Mayor Pro Tem
- Sheffie Kadane
- Sandy Greyson

Dallas City Plan Commission

- Joe Alcantar, Chair, District 15
- Richard Davis, District 1
- Liz Wally, District 2
- Michael Anglin, District 3
- Betty Culbreath, District 4
- Emma Rodgers, District 5
- Tony Hinojosa, Jr., District 6
- Ann Bagley, District 7
- Myrtil M. Lavallaisaa, District 8
- Gloria Tarpley, District 9
- John Shellene, District 10
- Bruce Bernbaum, District 11
- Sally Wolfish, District 12
- Michael Schwartz, District 13
- Paul E. Ridley, District 14

City Plan Commission Transportation Committee

- Ann Bagley, Chair
- Richard Davis, Vice Chair
- Myrtil Lavallaisaa
- Steve Stoner
- Gary Lawler
- Terry Watson

City Management

- A.C. Gonzalez, Interim City Manager
- Ryan S. Evans, Interim First Assistant City Manager
- Jill A. Jordan, P.E., Assistant City Manager
- Forest Turner, Assistant City Manager
- Joey Zapata, Assistant City Manager
- Charles Cato, Interim Assistant City Manager
- Theresa O'Donnell, Interim Assistant City Manager

Sustainable Development and Construction Department

- David Cossum, Interim Director
- Peer Chacko, Assistant Director
- Shilpa Ravande, Senior Planner, (Co-Project Manager)
- David Schleg, Senior Planner
- Luis Tamayo, Senior Planner

Public Works Department

- Keith Manoy, Assistant Director
- Tanya Brooks, Chief Planner (Co-Project Manager)

Funding Partner Agencies

Texas Department of Transportation

- Wes McClure, Dallas District Program Engineer
- Polita Fleming, Transportation Funding Specialist

North Central Council of Governments

- Karla Weaver, Principal Planner
- Deborah Humphreys, Transportation Planner

Technical Committee

City Staff

- Alan Hendrix, Public Works
- Thomas Morris, Public Works
- Chiamin Korngiebel, Public Works
- Henry Nguyen, Public Works
- Raj Guntnur, Public Works
- Jared White, Public Works, Transportation Planning
- Elizabeth Ramirez, Transportation Operations
- Steve Cherryholmes, Transportation Operations
- David Whitley, CityDesign Studio
- Arturo Del Castillo, CityDesign Studio
- Lloyd Denman, Engineering
- Max Kalhammer, Transportation Planning

- Cesar Baptista, *Dallas Water Utilities*
- Chad Kopecki, *Dallas Water Utilities*
- Abidur Khan, *Dallas Water Utilities*
- Ben Stephenson, *Dallas Water Utilities*
- Bonnie Meeder, *Real Estate*
- John Rogers, *City Attorney Office*
- Arthur Hudman, *City Attorney Office*
- Dorcy Clark, *Trinity River Corridor*
- Michael Hellman, *Parks Department*
- Esmeralda De La Cruz, *Housing Department*
- Karl Stundins, *Office of Economic Development*
- Hammond Perot, *Office of Economic Development*
- Sue Hounsel, *Office of Economic Development*
- Phil Erwin, *Building Inspections*
- Debra Carlin, *Fire Department*
- Lt. Simmeana Westbrook, *Fire Department*
- Ivan Gunner, *Police Department*

External Agencies

- Karla Weaver, *NCTCOG*
- Johnathan Toffer, *Dallas County*
- Jack Wierzenski, *DART*
- Steve Biba, *DART*
- Wes McClure, *TxDOT*

Private Sector

- John Hollingsworth, *AT & T*
- Larry Hamilton, *Hamilton Properties*
- Kristian Teleki, *Matthews Southwest*
- Paris Rutherford, *Catalyst Urban Development*
- Rachel Hayden, *Hayden Consultants*
- Luis Salcedo, *Salcedo Group Inc.*
- Steve Stoner, *DeShazo Group Inc.*

Community Focus Group

- Gregory Tomlin, *The University of North Texas at Dallas*
- John Martin, *The University of North Texas at Dallas*
- Gail Terrell, *Runyon Springs Neighborhood Association*
- Kourtney Garrett, *Dallas Downtown Inc*
- Dustin Bullard, *Downtown Dallas Inc.*
- David Allen, *Bryan Place Neighborhood Association*
- Bruce Bradford, *North Dallas Chamber of Commerce*
- Houyong Kim, *Greater Dallas Asian American Chamber of Commerce*
- Michael Amonett, *Old Oak Cliff Conservation League*
- Pam Conley, *Old Oak Cliff Conservation League*
- Phillip Leven, *Old Oak Cliff Conservation League*
- Bob Stimson, *Oak Cliff Chamber of Commerce*
- Evan Beattie, *Vickery Place Neighborhood Association*

- Selena Urquhart, *Vickery Place Neighborhood Association*
- Marc Andres, *Andres Properties*
- Kevin Hickman, *Knox-Henderson Public Improvement District*
- Frank Nucherino, *Vickery Meadow Public Improvement District*
- Angelina Avalos, *Vickery Meadow Public Improvement District*
- Jo Sutton, *Old Lake Highlands Neighborhood Association*
- Rebecca Range, *Lake Highlands Public Improvement District*
- James Frye, *Skillman Corridor Tax Increment Finance District*
- Deborah Carpenter, *Fort Worth Avenue Tax Increment Finance District*
- Sherman Roberts, *Citywide Community Development Corporation*
- Diane Ragsdale, *Inner City Community Development Corporation*
- Dr. Shirley King, *Pleasant Grove Mission Impossible*
- Jean Schobert, *North Dallas Neighborhood Alliance*
- Warren Casteel, *Bike Plan Advisory Committee*
- Shelli Stephens Stidham, *Dallas Area Pedestrian Safety Coalition*
- Susan J. Williams, *AARP*
- Crispin Lawson, *Dallas Homeowners League*
- Linda Brown, *Southern Dallas Task Force*

- Linda McMahon, *The Real Estate Council*
- Macey Davis, *The Real Estate Council*
- Brent Brown, *CityDesign Studio*
- Harvey Spears, *Reach of Dallas*
- Mary Grinsfelder, *Dallas Community Transportation Network*
- Cyndy Lutz, *Dallas Habitat for Humanity*
- Lynder Ender, *The Senior Source*
- Beverly Mitchell-Brooks, *Urban League of Greater Dallas and North Texas*

Consultant Team

- Kimley-Horn and Associates, Inc. (KHA)
- Toole Design Group (TDG)
- Moore Iacofano Goltsman (MIG)
- Collective Strength
- Team Better Block

Portions of Chapter 4, 5, and 6 were derived from the Boston Complete Streets Guidelines, prepared by the City of Boston Transportation Department, with permission.



TABLE OF CONTENTS

Adoption Resolution	vi
---------------------	----

Introduction	3
--------------	---

Dallas Complete Streets Goals and Objectives	4
<i>Benefits of Complete Streets</i>	4
<i>Community Aspirations</i>	6
<i>Survey Results</i>	6
Foundation	8
<i>forwardDallas!</i>	8
<i>National Trends</i>	9
<i>County, NCTCOG, and State Initiatives</i>	10

Chapter 1 - How To Use This Manual	15
------------------------------------	----

Complete Streets Tools Summarized	16
<i>Complete Streets Vision Maps</i>	16
Getting Started	17
Thoroughfare Plan Functional Classification	18
Complete Streets Initiative Improvement Process	20
Project Types	21
<i>Street Improvement Projects</i>	21
<i>Complete Streets Improvement Process</i>	23
<i>Development-Related Projects</i>	24
<i>Implementing Complete Streets through Private Development</i>	24
<i>City Department Roles and Responsibilities</i>	25
Detailed Complete Streets Design Review Process	27
<i>Corridor Planning</i>	28
<i>Conceptual Design</i>	29
<i>Engineering Design</i>	29
<i>Construction Management</i>	30
<i>Developing a Maintenance Plan</i>	30
Existing Manuals and Standards	31
<i>Relevant Manuals And Standards by Project Phase</i>	31
<i>Corridor Planning Documents and Standards</i>	32
<i>Conceptual Design Documents and Standards</i>	33

<i>Engineering Design Documents and Standards</i>	34
<i>Federal and State Design Manuals</i>	37

Chapter 2 - The Dallas Complete Streets Vision	43
--	----

Complete Streets Context and Development Policy	44
Classifying Complete Streets	46
Mixed-Use Streets	46
Commercial Streets	50
Residential Streets	54
Industrial Streets	58
Parkways	62
Dallas Complete Streets Vision Maps	66
<i>How the Vision Map was Developed</i>	69

Chapter 3- Complete Streets Policy Framework	73
--	----

General Complete Streets Policy Guidance	74
Intersection Zone Policy Guidance	75
The Pedestrian Zone Defined	76
Pedestrian Zone Policy Guidance	77
The Street Zone Defined	78
Street Zone Policy Guidance	79
Trade-offs in Limited Right-of-Way	80
Street Elements Widths	82
Complete Streets Design Elements	84
Design Element Priorities Chart	85
Incorporating Bicycle and Transit Facility Network Within Streets	86
Street Cross Sections For Various Street Types and Rights-Of-Way Examples	88
Mixed Use Street Examples	88
Commercial Street Examples	91
Residential Street Examples	93
Industrial Street Examples	95
Parkway Examples	97
Design Controls	99
Target Speed Defined	100

Design Factors That Influence Target Speed	102
Design Vehicle	104
Speed Management	105
Existing Speed Management Tools	107
Access Management	107
Knox Street Demonstration Experience	108
Monitoring and Evaluation	110
Making Adjustments	110

Chapter 4 - Pedestrian Zone Design Elements 115

Wider Sidewalks	116
Trees and greenscape.	116
Street furniture	117
Seating	117
Bicycle Racks.	119
Bicycle Shelters	120
Bollards	121
Parking Meters and Pay Stations	122
Recycling Bins and Garbage Cans.	123
Newspaper Racks	123
Transit Stops	124
Bus Stops	124
Bus Shelters	125
Driveways and Curb Cuts.	126
Urban Open Spaces	127
Plazas, Pocket Parks and Parklets	127
Sidewalk Cafés	129
Pedestrian Lighting	131
Signage	132
Informational Kiosks.	132
Wayfinding.	133
Utilities	133

Chapter 5 - Street Zone Design Elements 139

Traffic Calming Elements	140
Safe Speeds	140
Road Diets	141
One-way/Two-way Street Conversions.	142
Slip Streets	143

Center Medians/Islands.	144
Mid-Block Curb Extensions (Neckdowns).	145
Bikeways.	146
Bike Lanes	148
Cycle Tracks	149
Shared Lane Markings.	150
Bicycle Boulevards.	151
Paved Shoulders	151
Bicycle Route Signage.	152
On-Street Parking	152
Transit Lanes.	153
Shared Streets	154
Chicanes.	155
Speed Tables	156
Street Lighting	157
Trees and Greenscape	159

Chapter 6 - Intersection Design Elements 163

Multimodal Intersections	164
Intersections at Slip Streets	165
Intersection Controls	166
Uncontrolled Intersections.	166
Mid-block Crossings	166
Stop-Controlled Intersections	166
Signalized Intersections.	167
Signal Timing.	167
Modern Roundabouts and Traffic Circles	168
Key Geometric Design Guidance	170
Curb Radii.	170
Curb Ramps	171
Curb Extensions	172
Crossing Islands	174
Diverters.	174
Key Pedestrian Treatments	176
Crosswalk Design.	176
Crosswalk Markings At Uncontrolled Locations	177
Special Paving Treatment	179
Advance Yield Markings and Signs	180
In-street YIELD TO PEDESTRIAN Signs	181
Special Pedestrian Signals	182

<i>Rectangular Rapid-Flash Pedestrian Beacons</i>	182
<i>Pedestrian Signal Heads</i>	183
<i>Accessible Pedestrian Signals (APS)</i>	184
<i>Signal Phases for Pedestrians</i>	186
<i>Signalization Strategies to Reduce Conflicts</i>	187
Key Bicycle Treatments	189
<i>Bicycle Lanes at Intersections</i>	189
<i>Bicycles at Signalized Intersections</i>	190
<i>Bicycle Boxes</i>	191
<i>Cycle Tracks at Intersections</i>	192
Key Transit Treatments	193
<i>Bus Stop Location</i>	194
<i>Transit Prioritization at Intersections</i>	195
<i>Bus Bulbs</i>	197

Chapter 7 - Green Streets 201

General Policy Guidance	202
<i>Integrated Stormwater Management (iSWM)</i>	202
Benefits of Green Street Elements	203
Integrated Site Design Practices	204
Pavement	207
<i>Porous/Permeable Pavement</i>	207
Permeable Asphalt/Concrete	208
<i>Permeable Brick Pavers</i>	209
Landscaping	209
<i>Bioretention</i>	209
<i>Infiltration Trenches</i>	210
<i>Planter Boxes</i>	211
<i>Enhanced Swales</i>	212
<i>Landscaping in Medians</i>	212
<i>Underground Detention</i>	213
<i>Pavement Design Considerations</i>	213

Appendix 215

Complete Streets Design Review Checklist	216
Implementation Plan	219
Knox street demonstration evaluation	223
Proposed Major Thoroughfare Plan Change Priorities	229
Potential Revisions to Manuals	230

photo credits 239

ADOPTION RESOLUTION

- To be provided by the City of Dallas





INTRODUCTION



A successful Complete Street creates an environment in which diners, pedestrians, bicyclists and transit users feel safe sharing the corridor right-of-way with cars, transit, goods and services vehicles.

INTRODUCTION



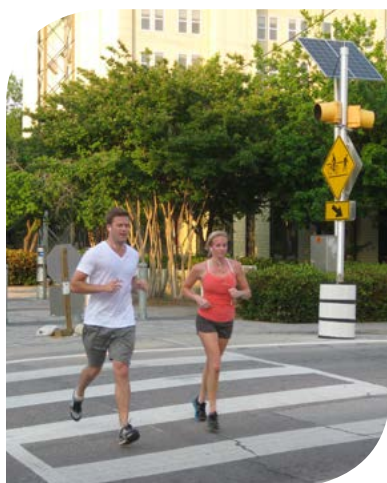
Sidewalk cafe in West Village

WHAT ARE COMPLETE STREETS?

The vision of the Dallas Complete Streets Initiative is to build streets that are safe and comfortable for everyone: young and old; motorists and bicyclists; walker and wheelchair users; bus and train riders alike.

The City launched the Complete Streets Initiative in June 2011 with the goal of instituting a new approach to designing and building streets. *Complete Streets* is a relatively new term for an idea from decades past. Long before regulations and requirements promoting rapid automobile movement began dictating street design, streets were built and developed to serve the destinations surrounding them. Some of the greatest streets in America still maintain this centuries-old character. New great streets – built to evolving standards – are being built throughout the country through Complete Streets programs.

Complete Streets make it easy to cross the street, walk to shops, and bicycle to work. They help buses run on time and make it safe for people to walk to and from train stations.



Runners on the Katy Trail



DART transit center



Vibrant street life



Complete Streets are designed with all users in mind, not just drivers.

DALLAS COMPLETE STREETS GOALS AND OBJECTIVES

Dallas Complete Streets Initiative has been guided by goals embraced in past City Council policy directives. The goal of Dallas Complete Streets is to design streets that

- enhance the public realm rather than serve as mere traffic conduits;
- provide for multiple transportation modes—pedestrian, bicycle, transit, and automobile—and include environmentally sustainable solutions appropriate for the situations;
- reflect that all streets are not the same;
- use design solutions that are specific to the context;
- support flexibility to accommodate changing needs, and allow change to occur incrementally.

The following objectives have driven the development of this manual as a means towards achieving the above-stated goals:

- Establish a new street design process, policies, and standards that integrate Complete Streets and Integrated Stormwater Management (ISWM) principles
- Provide effective and timely opportunities for community stakeholder input on the design priorities, costs, benefits, and trade-offs of proposed street improvements
- Develop a strategy for systematic and phased implementation over time through both public and private improvements

Benefits of Complete Streets

Complete Streets drive both infrastructure and cultural changes. Shifting demographic trends show more people are choosing to live in walkable urban areas and desire access to several modes of transportation. This gives an increasing number of people the option not to use automobiles for everyday travel.

With over 40 percent of the trips made in the U.S. being less than two miles, and roadway congestion growing despite a continual investment in infrastructure, the demand for alternative ways to move around the City is increasing. In a random phone survey of Dallas citizens' perception and use of transportation, 54 percent of respondents expressed interest in using transit; 12 percent indicated they would be interested in walking or biking, if it was more convenient; 68 percent of residents believed that being able to walk or bike to destinations would be better for the economy; and 88 percent would accept a five-minute longer drive time if it meant more convenient walking and biking. Given these responses from Dallas residents, it is obvious that providing safe and healthy

alternatives to our current transportation system is critical.

The Complete Streets design also encourages a shift in the City's modal split, increasing the use of transit, biking, and walking. By diversifying modes of transportation, like transit and rail, more people can move through a corridor other than by solely using motor vehicles. Another critical benefit is the incorporation of *green* features. These design elements can improve the visual impact of the roadway, assist in stormwater management, combat pollution from emissions, reduce exposed pavement, and lead to a decrease in the City's heat island effect.

Complete Streets benefit the city in the following ways:

- Promote public safety
- Create increased social, civic, and economic activity on streets
- Increase the overall capacity of the transportation network while offering options to avoid traffic
- Provide incentives for economic revitalization by reducing transportation costs and travel time while increasing property values and job growth
- Reduce the demand on existing infrastructure by incorporating stormwater management into street designs
- Improve the return on infrastructure investments by integrating sidewalks, bike lanes, transit amenities, and safe crossings into the initial design of a project, sparing the expense of later retrofits
- Improve the quality of place by creating vibrant, livable centers through increased walking and bicycling, and by promoting suitable denser development patterns
- Improve safety by designing and accommodating for all modes—bicyclists, pedestrians, drivers, and transit users—thus reducing the incidence of crashes
- Create more walking and bicycling opportunities to address our City's obesity epidemic; streets that provide room for bicycling and walking can help encourage children to be more physically active and to gain independence
- Provide environmental benefits from reduced congestion, alternative transportation options, and increased stormwater management
- Enhance the everyday quality of life for Dallas residents by providing safe, comfortable space for public activities



Complete Streets is not a new idea—Dallas' streets once hosted greater diversity in modes of transportation.





Community input was sought throughout all stages of the Complete Streets Initiative.



Complete streets foster economic development.

Community Aspirations

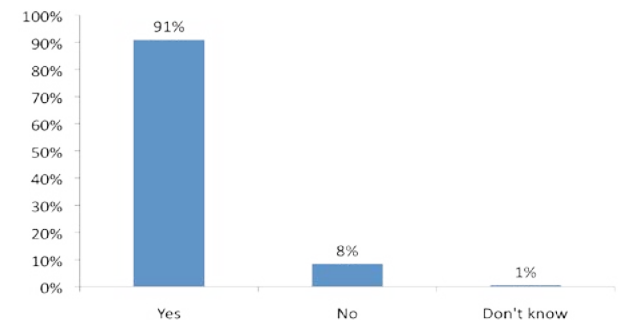
Citizens from across the City participated in a random phone survey about their perception and use of transportation in Dallas. Residents also attended workshops and participated in focus groups and interviews to discuss how they would like to see their streets designed in the future. The following statements reflect the desires expressed by Dallas citizens:

- Dallas citizens broadly support sustainable economic development that fosters neighborhoods that have more transportation choices; are closer to shops, schools, and jobs; and are more energy efficient
- Complete Streets encourage citizen safety, health, and economic viability by promoting pedestrian safety, maintaining existing streets, and providing public transportation options.
- Both the public and private sectors are encouraged to participate in promoting Complete Streets throughout the City through public-private partnerships and by aggressively implementing Complete Streets
- While the primary form of transportation continues to be personal vehicles, the Complete Streets Initiative recognizes that safer streets, an improved economic environment, and enhanced walking and biking conditions are essential considerations in future roadway investments.

Survey Results

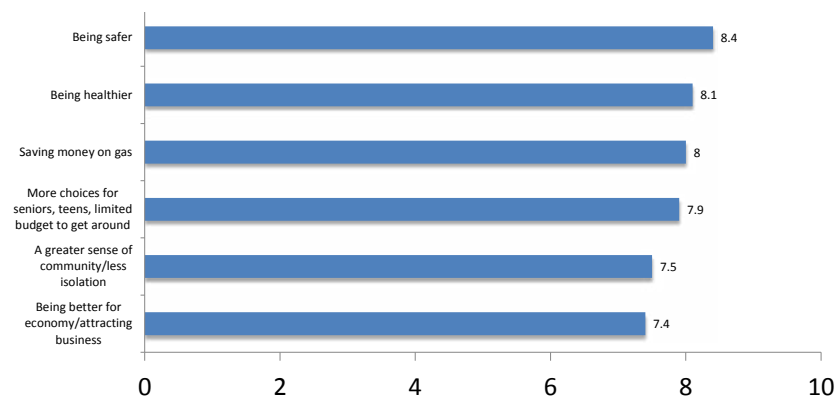
The following are highlights of the survey questions:

1. A *sustainable community* is defined as a neighborhood that has more transportation choices; is closer to shops, schools, and jobs; is more energy efficient; and helps protect our air and water. Do you want your elected officials to work towards more sustainable communities?



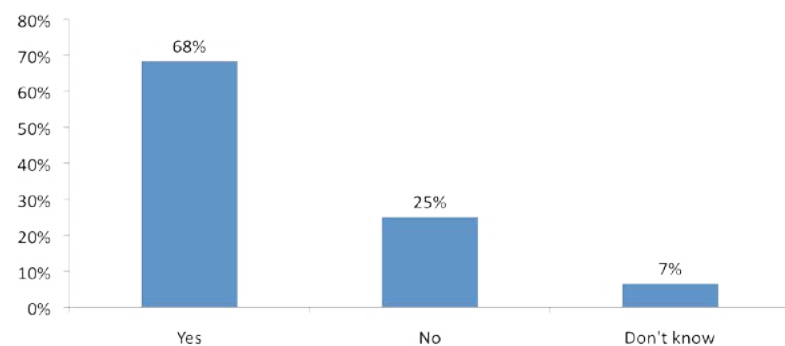
The vast majority of respondents want elected officials to work towards sustainable communities.

2. On a one to ten scale, where one is not at all important and ten is extremely important, how important to you are the following reasons for giving up some street space for walking and biking?



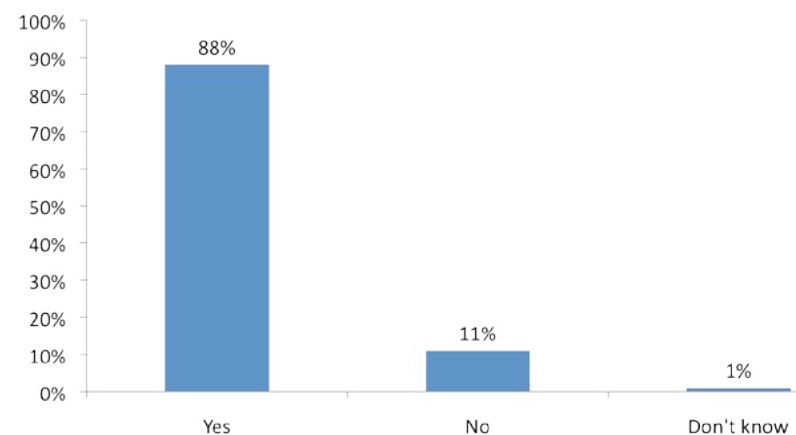
According to Dallas citizens, safety, health, and saving money are all strong motivators for implementing Complete Streets.

3. Do you feel that kids being able to walk or bike to school, and adults being able to walk or bike to places to shop and eat would be better for the Dallas economy than it is now?



Most residents agree that being able to walk or bike would be better for the economy.

4. Would you be willing to accept your drive time taking five more minutes than it does now on City streets if it meant more convenient walking and biking?



A majority of residents agree that the benefit gained from Complete Streets by having more convenient opportunities to walk and bike to destinations is worth a slightly longer drive time.





The Complete Streets concept takes development patterns and the community's needs and desires into account and applies these considerations to the design, construction, reconstruction, or rehabilitation process to create streets that are multifaceted rather than single purpose. Complete Streets programs use many features like the context and character of an area, future goals for a corridor, and the future need for different modes of transportation to create a realistic and compatible roadway design.

FOUNDATION

forwardDallas!

The *forwardDallas! Comprehensive Plan* adopted by the City Council in 2006 envisions a new multimodal Dallas that encourages a thriving urban downtown, employment opportunities, and a more visually-pleasing urban design for thoroughfares.

The Vision for Dallas, mapped out by Dallas citizens during the *forwardDallas!* process, discusses how the City of Dallas will look, function, and feel over the next quarter century. The policies in the *forwardDallas! Guiding Vision* and *Comprehensive Plan* are the starting point for creating the economy, housing, transportation choices, parks, and open spaces that the citizens of Dallas desire. The *forwardDallas! Strategic Plan* establishes the first steps for implementing Complete Streets and recommends the development of policies and guidelines for Dallas.

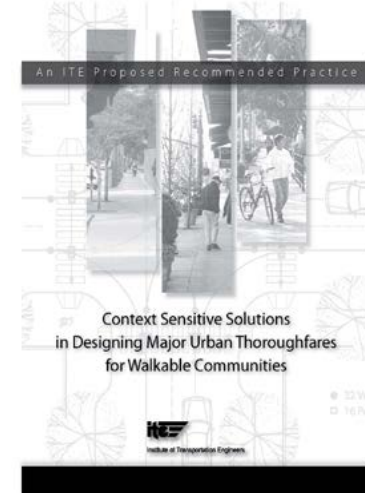
The *forwardDallas! Vision* places an emphasis on coordinating transportation facility design with the land uses and the context they serve. Like many American cities, Dallas' transportation system has historically been built to support automobile-oriented land development transportation. Looking forward, cars will likely remain the predominant mode of transportation for Dallas citizens. However, during the extensive public input process conducted while developing this Complete Streets Initiative, significant support was expressed for expanding the range of transportation options, as well as for land development forms that are walk- and bike-friendly and easily served by transit.

National Trends

Locally and across the nation recent trends in development have changed the approach to roadway planning, allowing for greater flexibility in thoroughfare design which better complements surrounding land uses. This emerging practice is based upon the principles of context sensitive roadway design. The *Context Sensitive Solutions (CSS) Design Manual*, written by the Institute of Transportation Engineers and the Congress for the New Urbanism, provides a guide on how this emerging practice can be implemented during the thoroughfare planning process. Opportunities for multimodal corridors that advance economic development and create a safer, more efficient transportation system arise when the context of a roadway is taken into account during the planning and design processes.

People who live in cities and towns throughout the country have a strong interest in ensuring that transportation investments provide for the safe travel of everyone using the road. Across the country, Complete Streets policies have been gaining traction as more communities have realized the benefits of safe, accessible, and healthy streets. Of all the trips within the U.S., 40 percent are less than two miles; of these, 99 percent are made by automobile. Nationwide, people are open to using viable transportation alternatives, if available. Trends also show that vibrant bike- and transit-friendly cities attract youth and the creative class—those people who are integral to building tomorrow's workforce.

In 2011, 125 jurisdictions adopted a Complete Streets policy, up from 80 that committed to Complete Streets in 2010. In total, as of 2011, 330 regional and local jurisdictions, 26 states, the Commonwealth of Puerto Rico, and the District of Columbia have made a commitment to Complete Streets implementation.



Context Sensitive Solutions (CSS) Design Manual



McKinney Avenue streetcar



Lively, vibrant street life enhances the livability of a city for all citizens.

County, NCTCOG, and State Initiatives

Dallas County recently celebrated the completion of a sustainable solution for a complicated five-leg approach intersection (Belt Line Road, Eastgate Drive, and Pioneer Road) in Balch Springs. Instead of a complicated, traditional at-grade intersection with a multiphase traffic signal, the County, the City, and adjacent property owners worked together to implement the first modern multi-lane roundabout in Dallas County.

The North Central Texas Council of Governments (NCTCOG) is in the process of developing a Regional Complete Streets Policy Statement, which when adopted, will provide guidance to implement Complete Streets. The NCTCOG's policy statement will:

- Apply to both new and retrofit projects as identified in the Transportation Improvement Program and the Metropolitan Transportation Plan
- Provide local governments assistance with the implementation of the NCTCOG Complete Streets Policy Statement

On March 23, 2011, the Texas Department of Transportation (TxDOT) issued a memorandum stating the following: "TxDOT is committed to proactively plan, design, and construct facilities to safely accommodate bicyclists and pedestrians. It is critical that bicycle and pedestrian accommodations be considered and discussed as the need and purpose of a project is defined during the National Environmental Policy Act (NEPA) process, taking into consideration existing and anticipated bicycle and pedestrian facility systems and needs." The memo provides guidance for both urbanized and rural settings, and shows that TxDOT is committed to a Complete Streets policy.

With such a large portion of Dallas' land area developed as roadways, these public spaces provide one of the greatest opportunities to enhance the City's urban design and livability for all citizens.



Provides a variety of experiences.

Fortunately, Dallas has a robust transit system and a street network. In many areas, there is a significant amount of available capacity which will allow streets to be transformed into high performance, multimodal transportation environments. **In essence, the notion of Complete Streets offers the promise of an economically vibrant, safe, multimodal, and sustainable Dallas. This manual lays out a process and policy framework to lead Dallas along a pathway from our existing auto-oriented roadway system towards the pedestrian-, bicyclist-, and transit-sensitive roadway system of Dallas' future.**



1. HOW TO USE THE MANUAL



Complete Streets create increased social, civic, and economic activities.

1. HOW TO USE THIS MANUAL



Greenville Avenue



Outdoor dining area

This Complete Streets Design Manual provides policies and design best practice guidelines to City agencies, design professionals, private developers, and community groups for the improvement of streets and pedestrian areas throughout Dallas. The manual promotes higher quality street designs that create safe, multimodal streets for all users. This manual is intended to direct transportation planners and engineers to routinely design and operate the entire right-of-way to enable safe access for all users, regardless of age, ability, or mode of transportation.

This manual is intended to work alongside the Dallas Thoroughfare Plan and the Dallas Development Code to provide the policy framework for the design and use of Dallas' roadway network. Through the use of this manual early in the design process, street improvement plans will consider the context of the roadway, community design priorities, and the roadway's functional classification. This manual will also serve as a policy guide for private development projects and community-driven initiatives that involve physical improvements within the public right-of-way.



Urban reserve



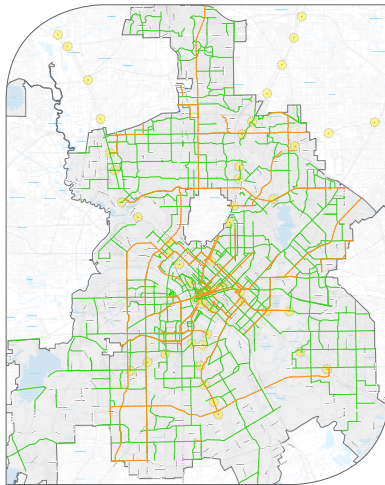
West End Station

COMPLETE STREETS TOOLS SUMMARIZED

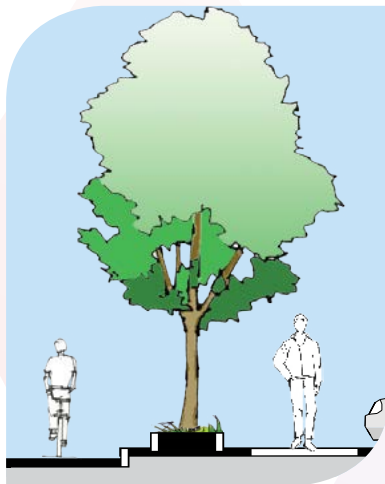
The Complete Streets Initiative provides a series of new guidelines and best practices to use in planning for roadway improvements. The following tools are provided to support implementation of Complete Streets in Dallas.

Complete Streets Typology:

A new classification system for streets that takes into account the street context and the future vision for accommodating all modes of travel—including pedestrians, cyclists, public transit, the movement of services and goods, and private vehicles—is provided. These street types include mixed use, commercial, residential, industrial, and parkway and are described starting on page 46 of Chapter 2.



Complete Streets vision maps are displayed in Chapter 2.



Example cross sections are illustrated in Chapter 3.

Complete Streets Vision Maps

- **Contextual Overlay:** The vision map designates the City's thoroughfares as one of five new Complete Streets types. This map provides a way to envision the future role of Dallas' street network in serving their adjoining neighborhoods, and is a starting point in determining how a particular street should be designed in the future. The vision map is provided on page 67 in Chapter 2.
- **Bike and Transit Network Overlay:** This overlay map shows streets that are designated on the 2011 Dallas Bike Plan, as well as transit streets, which have enhanced bus service, street cars, and passenger rail or transit stations. This overlay map shows streets that should be designed with particular consideration given to bike or transit facilities. The overlay map is provided on page 68 in Chapter 2.

Green Streets and iSWM™

Coordination: Chapter 7 promotes coordination between the City's integrated stormwater management and this Complete Streets Manual.

Flexible Requirements: Page 75 in Chapter 3 provides flexible lane widths for a variety of Complete Streets elements. These are shown by street type, so that flexibility is maintained when balancing competing goals in areas with limited right-of-way.

Complete Streets Design Elements:

The charts provided in Chapter 3 offer policy guidance on design priorities. The "Design Element Priorities Chart" on page 85 provides a quick reference for prioritization of key design elements. The "Bike and Transit Network Facility Priorities Chart" on page 87 provides general policy guidance for selection of appropriate bike and transit facility types for bike and transit network streets.

Example Cross Sections:

Chapter 3 also shows how to apply varying elements in corridors with limited right-of-ways.

Best Practices for All Parts of the Street and Sidewalk:

- Sidewalk zone best practices are provided in Chapter 4
- Street zone best practices are provided in Chapter 5
- Intersection best practices are provided in Chapter 6

Pilot Projects: As part of the Complete Streets Initiative, the City produced 15 pilot projects throughout the City. Conceptual plans and cross sections are shown in the Appendix.

GETTING STARTED

Initial assumptions driving the implementation program include the following:

- The Complete Streets Initiative reflects a shifting mind-set for some citizens in favor of gradual transition of streets to accommodate multiple users.
- Not all streets are appropriate or feasible candidates for transformation—many streets will not change significantly, or will change slowly over time.
- Cost of enhancements and maintenance of new amenities as well as trade-offs are key factors that must be considered when weighing the benefits of Complete Streets.

Street improvement projects are initiated in many ways, and have a wide range of purposes and a variety of stakeholders. Street projects may be initiated by either the public or private sector. Projects may include new streets in new locations, or reconstruction projects. Reconstruction projects may be resurfacing (or rehabilitation), underground utility upgrades that require replacing the pavement surface afterwards, or complete reconstruction projects. Projects may be funded 100 percent by a capital improvement program, financed from the enterprise fund of the particular utility, or a combination of both public funding sources. Projects may be the result of a public-private partnership in which private funds are matched by state, federal, or local funds. Finally, projects may be financed 100 percent by the private sector.

Who initiates and sponsors a Complete Streets project determines the initial review and approval process by the City of Dallas. Not all street projects will be appropriate for Complete Streets treatment, and those that are can vary

greatly in the type and scope of improvement that may be suitable at any given time. For example, short segments of streets that are reconstructed as part of a utility repair process would most likely not be appropriate for an application of Complete Streets elements. Streets that need to be reconstructed because of utility emergencies are not practical for Complete Streets implementation. Similarly, a number of Dallas roadways are functioning well within their physical context and do not need special enhancements to be high-performing, safe streets. In addition, highways do not fall under the purview of the City's thoroughfare plan or this Complete Streets Manual. Complete Streets improvements may occur as large capital projects along an entire roadway segment, incrementally on portions of a roadway along with private developments, or through small neighborhood initiatives.

Regardless of the manner in which a project is initiated, we would encourage professional planners and designers, private developers and property owners, and community and neighborhood organizations to consider this Design Manual a primary guide to a successful project.



Complete Streets foster economic development, not just transportation.



Our roadways belong to all of us, no matter how we choose to travel them.

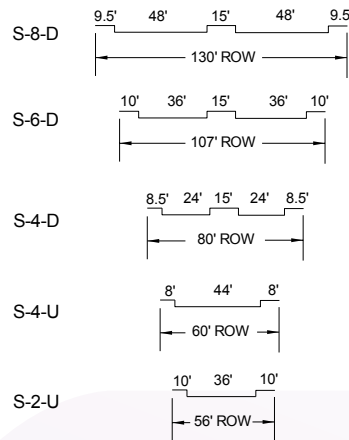
THOROUGHFARE PLAN FUNCTIONAL CLASSIFICATION

The **Dallas Thoroughfare Plan** provides the basis for classifying streets based on projected traffic volumes on the road. This functional classification has guided the design of most of Dallas' thoroughfares, resulting in conventional, separate-use building blocks. This type of street design does not account for other types of non-motorist facilities on the road or sidewalk, and favors automobile mobility over the convenience and safety of other modes of transportation. The Dallas Thoroughfare Plan generally defines roadways based on motorist needs as follows:

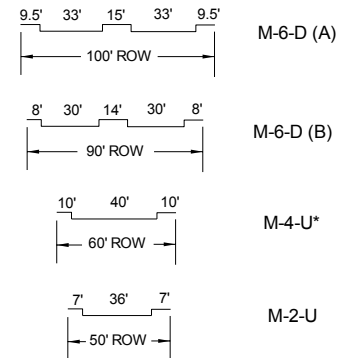
Arterial Roads

Arterial roads deliver traffic from collector roads to freeways, and between urban centers, with minimal delay to motor vehicles. They typically carry high volumes of motor vehicle traffic operating at higher speeds. As a result, arterial roads are unfriendly to pedestrians and bicyclists.

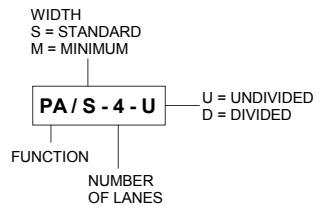
STANDARD ROADWAY SECTIONS



MINIMUM ROADWAY SECTIONS



*M-4-U can be striped and operated as 2 or 4 lanes.



PROPOSED FUNCTION

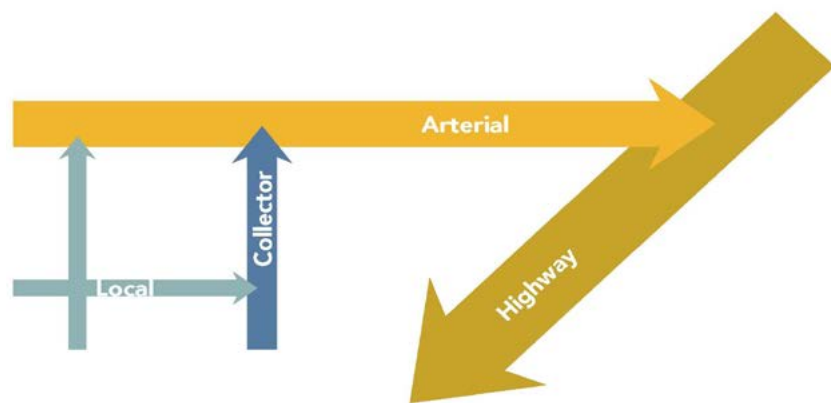
- PA - PRINCIPAL ARTERIAL
- MA - MINOR ARTERIAL
- C - COMMUNITY COLLECTOR
- RC - RESIDENTIAL COLLECTOR
- FURTHER STUDY
- FUTURE OPTIONS

Map by Transportation GIS
Revised: July 2004

Dallas Thoroughfare Plan minimum and standard roadway sections

Collector Roads

Collector roads have a moderate capacity and serve to move traffic from arterial roads to local streets. Unlike arterial roads, collector roads provide access to residential properties, parks, schools, and other neighborhood amenities. They often have limited consideration for surrounding neighborhood character.



Functional hierarchy of roadways

Local or Minor Streets

Local streets, which are not designated on the **Thoroughfare Plan**, carry low volumes of motor vehicle traffic at lower speeds and provide direct access to residential property. Chapter 51A of the Dallas Development Code, as amended, and the resulting applied zoning districts, establish the right-of-way—and in some instances, design criteria—for minor streets.

	Street Classification	Pavement Width	ROW Width	Minimum Alley Required	Center line Radius
Zoning	L-2-U(B)	26'	50'	YES	150'
	L-2-U(A)	33'	53'	NO	200'
	S-2-U	36'	56'	NO	230'
R-1 thru R- 7.5	L-2-U(A)	33'	53'	YES	200'
	S-2-U	36'	56'	NO	230'
R-5,MH, D,TH-1 , TH-2	L-2-U(A)	33'	53'	YES	200'
	S-2-U	36'	56'	NO	230'
TH-3, CH, Multifamily	S-2-U	36'	56'	NO	230'
All non-residential districts except PDDs, and WR Districts in Article XIII	S-2-U	36'	56'	NO	280'

Chapter 51A of the Dallas Development Code:
Requirements for Minor Streets

COMPLETE STREETS INITIATIVE IMPROVEMENT PROCESS

The Complete Streets Process uses the current public and private processes as a base and enhances them with specific coordination, planning, and conceptual design in order to improve the efficiency of the process, balance user needs up front, and anticipate short- and long-term associated costs. This process produces improved outcomes that create an environment that addresses the needs of all users. This manual is intended to supplement and reference rather than replace existing engineering and environmental standards and requirements, including but not limited to the City's design manuals, *Texas Manual on Uniform Traffic Control Devices (TMUTCD)*, and *AASHTO Policy on Geometric Design of Highways and Streets ("Green Book")*. In a city with many varied and complex conditions, designs must be tailored for the particular needs and opportunities created by the local context, uses, and dimensions of streets. This section describes the Complete Streets Process for public street projects as well as for development-related projects.

The Complete Streets Roadway Design Process requires that both traditional information as well as the contextual environment inform the roadway design team. Designers of Complete Streets must balance roadway characteristics, the context and land use of an area, priority elements, and the construction, operation, and maintenance costs associated with the improvements. Some factors to consider in roadway design include:

Roadway Characteristics and Needs

- Thoroughfare plan designation and the roadway's functional classification
- Existing and proposed right-of-way
- Multimodal traffic counts
- Auto speeds
- Congestion and capacity
- Planned infrastructure projects

Context and Land Use

- forwardDallas! Vision
- Local area plans
- Existing land uses and form
- Existing zoning
- Development proposals
- Complete Streets Vision

Priority Elements

- Design priorities chart - Page 85
- Variable lane width chart
- Community input and user needs and preferences
- Major destinations
- Desired connections
- Under-performing districts
- Regional plans

Funding Sources

- Construction
- Operation and maintenance

PROJECT TYPES

There are several ways in which Complete Streets can be implemented but the nature and scope of the improvements will depend on the type of project. There are two broad types of projects that can result in implementation of Complete Streets: Street Improvement Projects and Development Related Projects.

Street Improvement Projects

Street Improvement Projects are typically initiated by a City department or other public agency, such as Dallas County. These public projects are primarily focused on the public right-of-way and may be one of the following types, depending on their scope or impetus:

- Roadway construction/reconstruction projects
- Utility replacement projects
- Street resurfacing and restriping projects

The "Complete Streets Improvement Process" later in this chapter describes the recommended approach to ensure integration of Complete Streets Design Standards in the typical street improvement process.

Roadway Construction and Reconstruction Projects

Roadway projects may be public works reconstruction of existing facilities or new roadway construction. These projects are typically publicly initiated by being placed on the City's need inventory for prioritization. The scope of these projects are usually large enough to provide the opportunity for more comprehensive implementation of Complete Streets elements, and may provide for changing the number and width of lanes, expanding sidewalks, or introducing new features.

Utility Replacement Projects

Utility replacement projects are large scale infrastructure projects that are initiated to replace water, sewer, and utility lines. In these cases, entire segments of roadways are torn up and replaced. These projects are placed on the utility needs inventory and coordinated with City departments. Utility replacement projects are prioritized based on the service levels and operational criteria and are funded through the utility funds. In some instances, the repairs are in small areas and would not trigger a Complete Streets evaluation. Other projects cover multiple blocks and allow for consideration of planning and potential implementation of Complete Streets elements.

Street Resurfacing and Restriping Projects

The Streets or Public Works Departments initiate resurfacing and restriping projects to maintain existing streets within their current lane configurations. Since these improvement programs may be discontinuous segments based on the current condition of the roadways, they may not always be appropriate for consideration for Complete Streets elements. In some situations these projects may provide an opportunity to make changes in lane configuration based on Complete Streets considerations, such as implementing the bike plan or introducing new multimodal features. The most likely of these types of projects to be implemented as Complete Streets include resurfacing or restriping projects that connect significant origins and destinations and have a source of funding such as a Tax Increment Financing District (TIF) or Public Improvement District (PID), or other public-private mechanism.



Lancaster corridor - existing condition

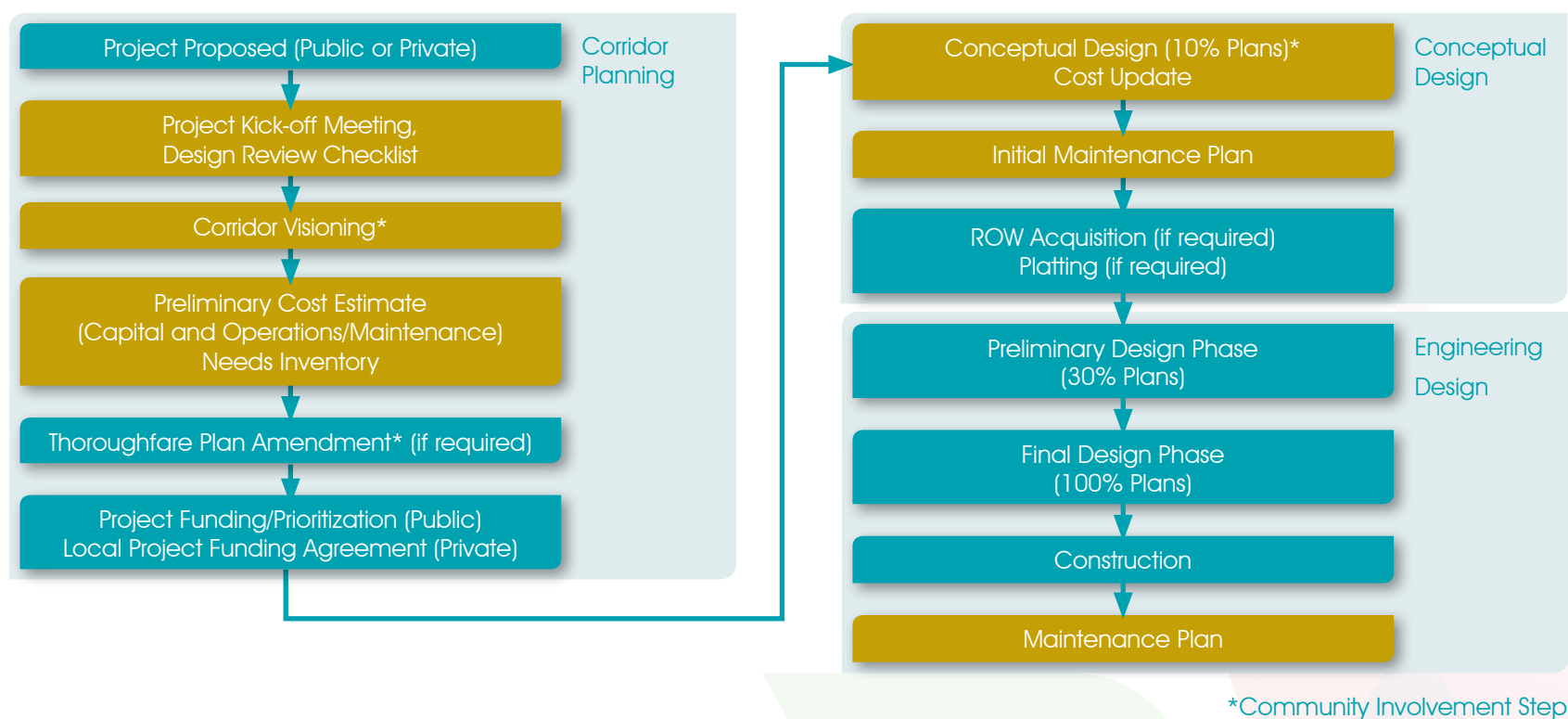


Photo simulation of a Complete Streets improvements on Lancaster

Complete Streets Improvement Process

The following chart shows the typical street improvement process in blue, with steps that are critical for integration of Complete Streets considerations highlighted in gold. This process also highlights key steps for community involvement during planning and design so that projects progress efficiently within a transparent framework.

COMPLETE STREETS IMPROVEMENT PROCESS



Development-Related Projects

Development-related projects are typically initiated by a property owner or developer. They include one of two types of projects, both of which are initiated through services provided by the Office of Sustainable Development and Construction. The Dallas Development Guide details the City's development process.

Development Projects with Thoroughfare Frontage

Private development projects on thoroughfares may include large, multiblock projects or incremental development. Development projects may be on streets that are built to thoroughfare plan standards or on streets that are not currently built to standard. For properties on thoroughfares that are not built to standard, or where the developer wishes to amend the thoroughfare plan, development projects may trigger the need to work through the City's platting process to ensure adequate right-of-way dedication. In addition to thoroughfare plan and platting requirements, zoning will also have important bearing on the street design in terms of sidewalk and streetscape standards. Besides planned development districts that may have special sidewalk and streetscape standards, other zoning districts default to the minimum standards in the development code.

Developments with Minor/Local Street Frontage

Private developments may front on residential or nonresidential local streets. Local street design is governed by zoning and platting requirements rather than through the Thoroughfare Plan for right-of-way and pavement widths, as well as sidewalk and streetscape standards. In addition, private streets contained entirely within private developments must also follow local street standards.

Implementing Complete Streets through Private Development

In initial interviews with members of the development community, developers indicated that Complete Streets benefited their developments economically, and the majority of those interviewed expressed desire to be able to integrate their developments into lively, safe, and walkable communities. These developers expressed an interest in the greater predictability that Complete Streets will bring to future development. The street design policies and standards contained in this manual are intended to influence private development projects in the following ways:

- The Complete Streets Vision Maps establish expectations for various street types in terms of sidewalk and streetscape design guidelines, as well as how developments should interact with the street to support alternative modes of transportation. These Vision Maps are intended to inform all planning and development processes that affect street design and make it easier for consistent developments to obtain approvals.
- The Design Elements Priorities Chart in Chapter 3 prioritizes elements by street type—providing guidance to developers on how to design and build their infrastructure improvements.
- The Complete Streets Design Manual should be used as guidelines in City decision-making for development proposals involving zoning before the Plan Commission and City Council.
- The Complete Streets Design Manual should also be used as a basis for requiring streetscape enhancements for developments seeking tax increment financing or other public incentives or support.
- Development projects with thoroughfare frontage may involve some improvements within the public right-of-way that may trigger new Complete Streets infrastructure standards related to sidewalks and streetscape.
- The Complete Streets Design Manual should also be used as a guide for considering future code amendments to introduce new sidewalk and streetscape standards for developments within existing zoning districts.
- As small area and special area plans are prepared, Complete Streets principles should be incorporated to guide future infrastructure plans associated with development.
- As development pressures occur in potentially changing areas, the City may initiate corridor studies to gain property owner input and support for a unified corridor vision that can be implemented incrementally as development occurs.
- Finally, the Complete Streets Design Manual supports a more flexible approach to handling improvements along the pedestrian zone that straddles the public and private realm. This guidance is intended to be used in future code amendments to make it easier for private developments to invest in street improvements that contribute to a more Complete Street.

City Department Roles and Responsibilities

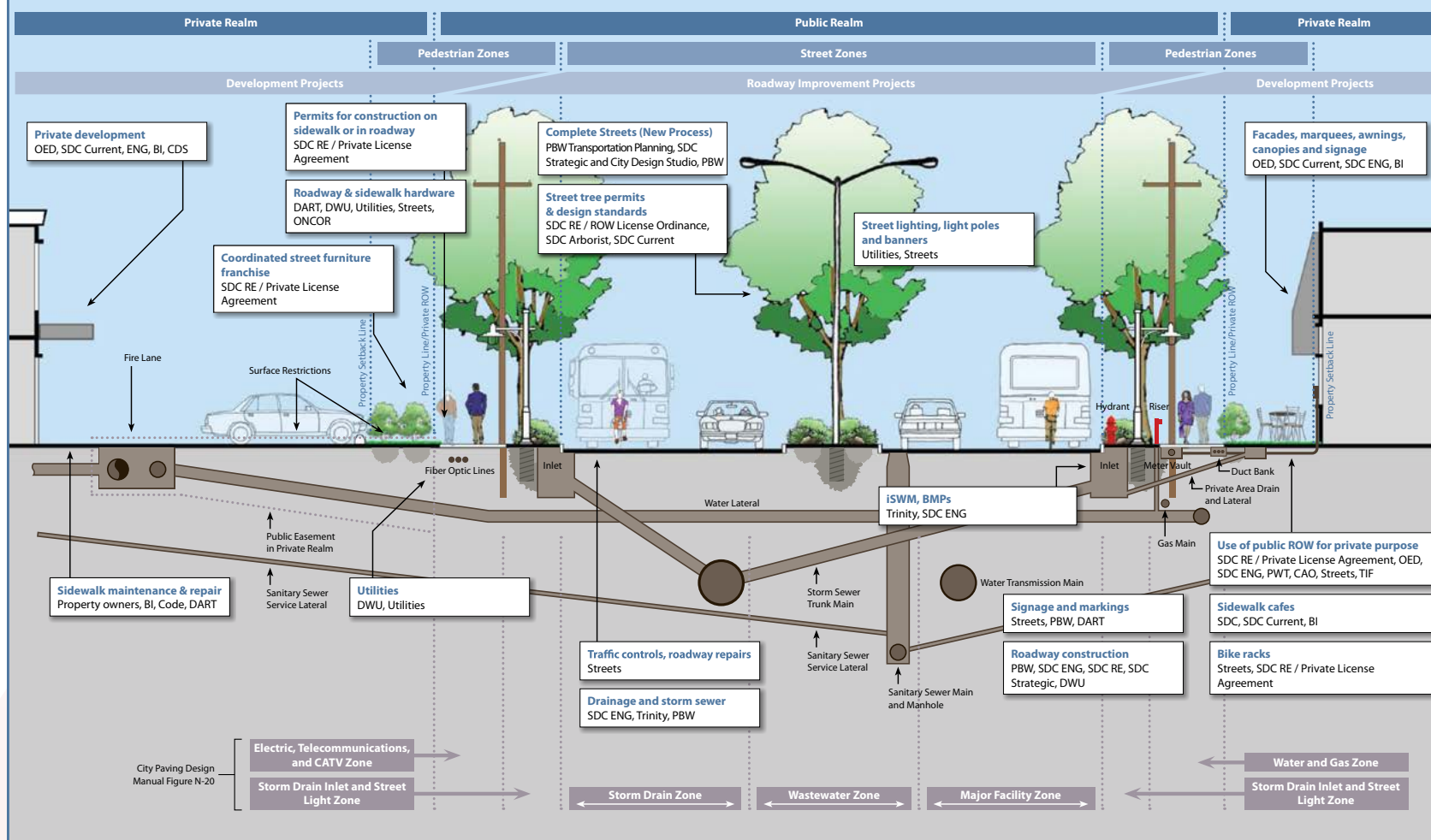
Street design and development involves many departments and agencies from several jurisdictions. The "Agency Roles on the City's Streets" graphic on the next page shows a typical street cross-section, above and below grade, and illustrates the various agencies, departments and entities that have authority in the public right-of-way. This graphic should be used to communicate and coordinate on the complex and overlapping issues and the required reviews and approvals. The table on this page names the agencies, authorities and other organizations that are frequently involved in the design of streets in the City of Dallas. This list is provided as a reference tool for informational purposes only, and is not an exhaustive list.

Because so many departments and agencies are involved in road building, implementation of a Complete Streets program will require effective leadership and coordination of resources and responsibilities across departments. Strategies include assigning a leadership and ombudsman role to one group or department, establishing team responsibilities to include coordination of all aspects of Complete Streets policy implementation, and providing ongoing staff training to institutionalize Complete Streets design practices.

Department/Agency Involved in Roadway Planning & Construction

CAO	City Attorney's Office
CDS	City Design Studio
Code	Code Compliance
DART	Dallas Area Rapid Transit
DWU	Dallas Water Utilities
Fire	Dallas Fire Rescue
Housing	Housing and Community Services
OED	Office of Economic Development
OED TIF	Tax Increment Financing District (as applicable)
Parks	Park and Recreation
PBW	Public Works
PBW Coord	Intergovernmental Coordination
PD	Dallas Police Department
SDC	Sustainable Development & Construction
SDC Arborist	Sustainable Development & Construction – Arborist
SDC BI	Sustainable Development & Construction – Building Inspection
SDC Current	Sustainable Development & Construction – Current Planning
SDC ENG	Sustainable Development & Construction – Engineering
SDC RE	Sustainable Development & Construction – Real Estate Division
SDC RE / PLA	Sustainable Development & Construction – Real Estate Division (for Private License Agreement)
SDC Strategic	Sustainable Development & Construction – Strategic Planning
Streets	Street Services
TWM	Trinity Watershed Management
Utilities	Utilities: Atmos, Verizon, ATT, ONCOR

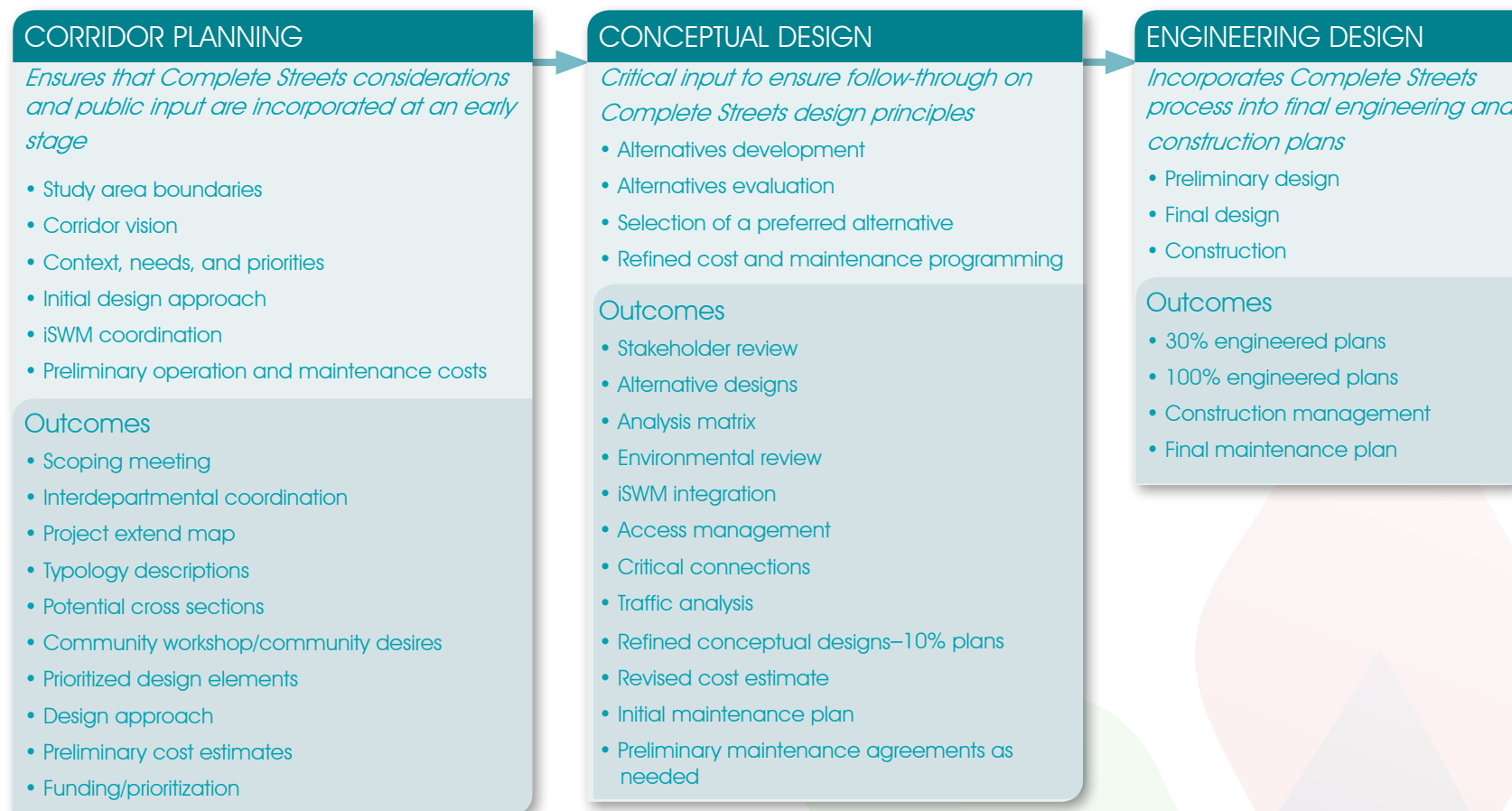
Agency Roles on the City's Streets



DETAILED COMPLETE STREETS DESIGN REVIEW PROCESS

The Complete Streets process evaluates the many conditions and factors affecting the roadway design, and uses a three-phase process to develop projects: corridor planning, conceptual design, and engineering. This section describes the three phases and then reviews the steps in each of the three phases.

THREE-PHASE DEVELOPMENT PROCESS





Right-of-way space is allocated in the corridor planning process.

Corridor Planning

Corridor planning is essential for resolving Complete Streets issues related to allocation of right-of-way space for various functions, prioritization of design elements, and preliminary definition of costs and approaches to maintenance. The corridor planning process builds on the tools provided in this Manual, including the Vision Map, street type characteristics, priority charts, lane width charts and the best practices examples.

Kick-Off Meeting

The project kick-off meeting ensures that all agencies involved in the implementation are brought into the process at the onset. A coordinated kick-off meeting to discuss the information presented in the Complete Streets Design Review Checklist (see Appendix A), and determine critical issues and steps forward must be scheduled. Projects initiated by the City must have a pre-application meeting with the following departments represented:

- Public Works
- Sustainable Development and Construction
- Street Services
- Dallas Water Utilities
- Economic Development
- Park and Recreation
- Trinity Watershed Management
- Others as appropriate

The first step in initiating and planning for a Complete Street is to fill out as thoroughly as possible the Complete Streets Design Review Checklist developed for this manual.

The Checklist requests a range of information about existing and proposed conditions, project information, street operations, iSWM and environmental conditions, and the *Paving Design Manual* requirements. The purpose of this checklist is to help identify the issues associated with the proposed street construction and ensure that appropriate City and agency representatives are at the table to facilitate the design and construction of the desired project.

Key process and decision points in the corridor planning and project initiation phase include:

- Develop project scope
- Identify agency lead and review departments
- Identify adjacent and overlapping projects
- Integrate surrounding land use, environmental, social, and historical context
- Review related plans (City or institutional)
- Engage community stakeholders in developing a corridor vision
- Estimate project costs
- Propose design and construction timeline
- Identify design and construction funding sources
- Amend the thoroughfare plan if necessary, based on preliminary design concepts

Conceptual Design

Concept designs are typically developed through extensive community and interagency review. Designs must adhere to the Dallas Complete Streets policies and design guidelines. The conceptual design phase should explore and present detailed design considerations to ensure that proposed elements are feasible. Key process and decision points in the conceptual design phase include:

- Complete traffic and operations analysis/impact/modeling as needed
- Develop design alternatives and select a final alternative based on community stakeholder input
- Propose a roadway and urban design plan with alignment and dimensions of sidewalks; lane functionality for motor-vehicles, bicycles, parking and transit; proactive accommodation for the disabled; street furniture; and intersection geometry
- Programming
- Integrate green features to promote sustainability, and *smart* features to maximize technological advances, into the design
- Flag potential right-of-way issues, easements, area-ways, and conflicts with major utility lines
- 30% design
- Develop preliminary cost estimate

Engineering Design

Engineering design involves extensive review by City agencies to ensure that all technical standards are being met. Applicable state and federal agency requirements may need to be followed, particularly if they are funding the project. Detailed requirements and review processes are customized project-by-project in contract documents.

Key steps in the design development and review process include:

- Street and sidewalk surveys and inventory
- Sub-surface investigation
- Design submission and approvals to progress from 25% design to 75% design with public process plan
- Right-of-way plans coordinated with abutters
- Utilities plans coordinated with utility companies
- 100% design and PS&E
- Finalization of maintenance agreements

Approvals and/or detailed review are required from the following agencies:

- Transportation Planning
- Dallas Public Works Department (including Lighting Division)
- Commission for Persons with Disabilities, Architectural Access Board
- Dallas Redevelopment Authority
- Dallas Water Utilities
- Dallas Park and Recreation Department
- Dallas Fire Department
- TxDOT district office (if necessary)

Based on location and design features additional review may be required by the Coordinated Street Furniture Program, the Dallas Groundwater Trust, Dallas Conservation Commission, Dallas Landmark Commission, and the Dallas Arts Commission.



Grand Avenue – existing condition

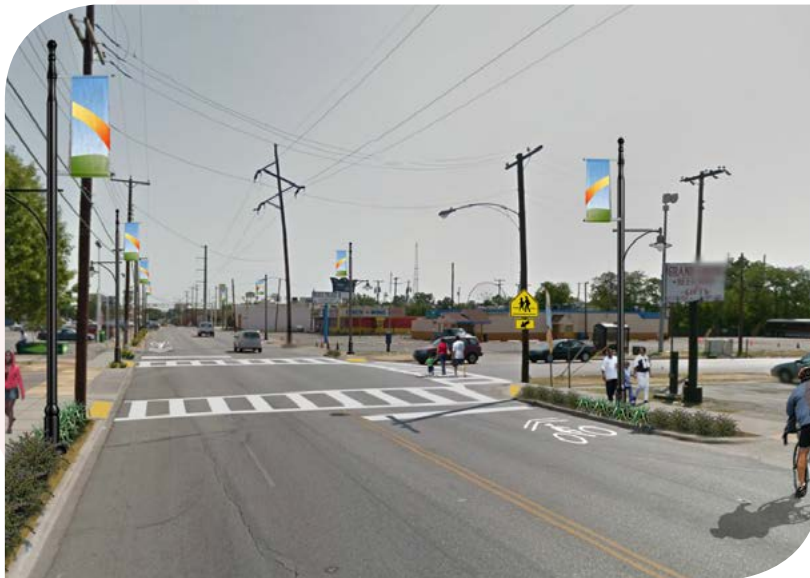


Photo simulation of Grand Avenue as a Complete Street

Construction Management

Construction will be managed by a resident engineer typically appointed by the Dallas Public Works Department, or by TxDOT for state and federal funded projects.

Key steps to steer the project to completion include:

- Construction bids, contractor selection and award
- Preparation of Construction Management Plan (CMP) (SDC and PWB approval)
- Development of a public notification plan and designation of a point of contact for the public
- Monitoring of construction to ensure quality standards are met, change-orders are reviewed, and community impact mitigation commitments are honored
- Punch list
- Accept equipment, installation, and materials

Developing a Maintenance Plan

An important consideration for a successful Complete Streets project is the determination of cost and responsible entities to maintain the various elements. A partial list includes the following:

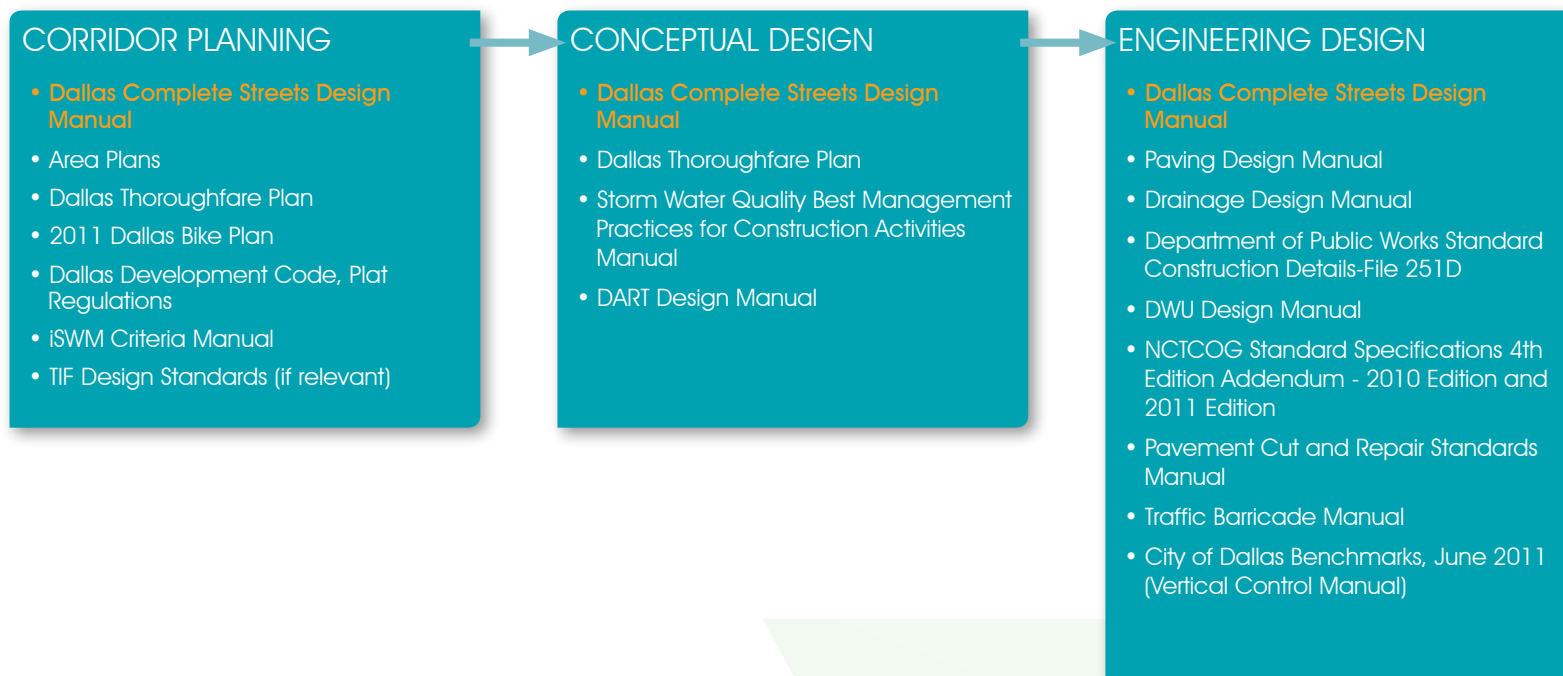
- Maintenance and Indemnification Agreements
- Tree inspection during warranty
- Update of databases/asset management
 - Tree database
 - Pavement markings plan
 - Signal timing plan
 - Street cleaning schedule
 - Trash collection routes
- Plan for pruning, seasonal plantings, lighting and decorating, and abutter responsibilities
- Plan for power washing, drain clearance, and recharge basin silt removal
- Source list for all materials

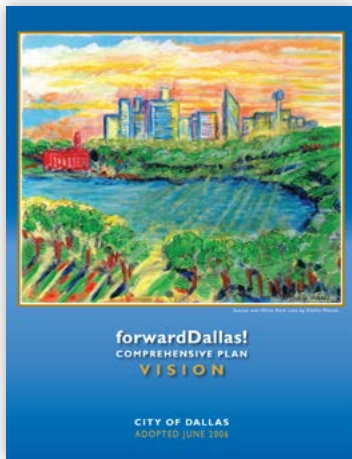
EXISTING MANUALS AND STANDARDS

Designing a Complete Street entails the use of new tools in this manual in combination with all of the traditional design tools and guidelines available to plan and design a safe transportation project that meets all of the current design standards. The *Complete Streets Design Manual* provides a road map for the corridor planning and conceptual design process. The diagram below lists many of the resources that must be considered

in a Complete Streets project. These documents range from planning documents to regulatory documents to required engineering standards. These resources are provided by phase of street development.

Relevant Manuals And Standards by Project Phase





Corridor Planning Documents and Standards

forwardDallas! Comprehensive Plan

The *forwardDallas! Comprehensive Plan*, adopted in 2006, provides a consensus vision for Dallas that is based on the ideals and goals residents have for Dallas' future. The *forwardDallas! Policy Plan* provides the overall policy framework to guide decisions over time toward achieving the Vision. The Policy Plan guides decisions made in regard to land use, housing, transportation, neighborhoods, environment, economic development, and urban design. The Transportation and Urban Design Elements set policy for achieving more walkable and pedestrian-friendly development throughout Dallas.

Dallas Thoroughfare Plan

The *Thoroughfare Plan* provides a detailed discussion of the history, purpose, approach, and goals of the thoroughfare system within Dallas and details the current functional and dimensional classifications of the thoroughfares in the City. The plan provides descriptions of designated routes and minimum and standard pavement cross sections.

2011 Dallas Bike Plan

The primary purpose of and impetus for the *2011 Dallas Bike Plan* is to provide an update to the *1985 Dallas Bike Plan*. The *2011 Bike Plan* update provides a master plan and an implementation strategy for a new bicycle network—the Dallas Bikeway System—which will be made from designated on-street and off-street facilities. This document also provides recommendations for supporting policies and the identification of bicycle-related programs to be recognized, sponsored, or supported under the Plan. The guiding principles for the *2011 Dallas Bike Plan* provides an overarching mission and vision, in addition to goals and objectives. The guiding principles form the basis for the identified programs, specifications for the Dallas Bikeway System Master Plan, and the implementation strategy. Ultimately, the *2011 Bike Plan* is structured around creating actions to implement the goals and objectives.

Dallas Development Code

The Dallas Development Code, Chapter 51A provides the regulations governing zoning and platting that define streetscape standards associated with private development as well as minor street standards. Paving infrastructure requirements for developments in the City of Dallas are provided in this code. Additional relevant Chapter 51A articles that should be consulted include Article V, Flood Plain and Escarpment Zone Regulations, and Article IX, Thoroughfares. The *Dallas Development Guide* details the development process.

iSWM Criteria Manual

The purpose of this manual is to provide design guidance and a framework for incorporating effective and environmentally sustainable stormwater management into the site development and construction processes and to encourage a greater regional uniformity in developing plans for stormwater management systems that meet the following goals:

- Control runoff within and from the site to minimize flood risk to people and properties
- Assess discharges from the site to minimize downstream bank and channel erosion
- Reduce pollutants in stormwater runoff to protect water quality and assist communities in meeting regulatory requirements

Note: The *Drainage Design Manual* is intended to be incorporated into the *iSWM Criteria Manual* when adopted.

Following the criteria provided in the manual will help projects meet sustainable development goals for public roadways as well as private development by integrating appropriate green infrastructure elements within the street cross-section. There are many ways that sustainable development may be achieved while following

these criteria. For example, a development that reduces individual lot imperviousness and a development that has high lot density in one area and a large open space in another can both meet sustainability requirements.

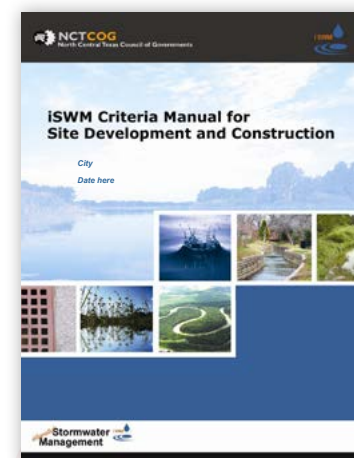
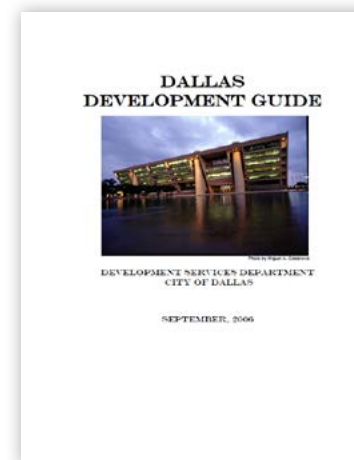
Conceptual Design Documents and Standards

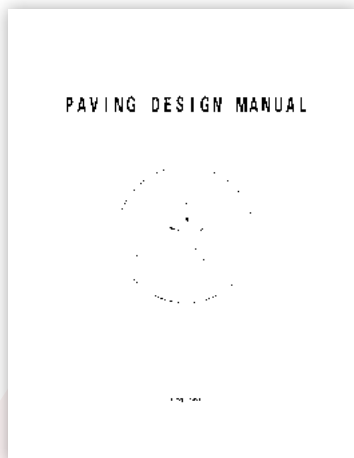
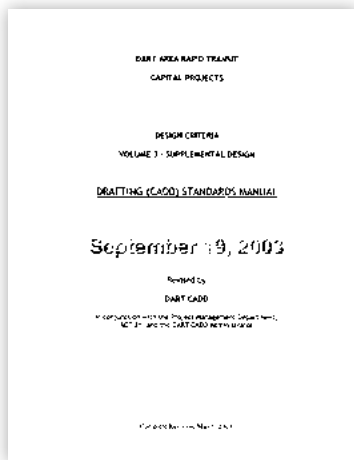
Thoroughfare Plan

(Described above under Corridor Planning)

The Storm Water Quality Best Management Practices For Construction Activities Manual

The *Storm Water Quality Best Management Practices for Construction Activities Manual* provides the guidelines, criteria, and standard details for the design of storm water pollution prevention plans which may be required on City construction projects.





DART Design Manual

The *Dallas Area Rapid Transit Light Rail Project Design Criteria Manual* provides design standards and criteria for future development and expansion of the system. The purpose of this manual is to establish a standard to maintain the safety, image, and efficient function of the transit system. The design characteristics covered in this manual include standards for the vehicles, traction electrification, signal system, communications, the control center and supervisory system, fare collection, corrosion control, system grounding and raceways, operations, reliability and maintainability, and systems safety.

Engineering Design Documents and Standards *Paving Design Manual*

The purpose of the *Paving Design Manual* is to provide guidelines for designing streets and thoroughfares and preparing construction plans in the City of Dallas. These guidelines will be used by the Department of Public Works, other City departments, Consulting Engineers employed by the City for street and thoroughfare improvement projects, and engineers for private developments in the City of Dallas. The standards set forth in this document are the minimum criteria permitted by the City of Dallas to be used in paving design. Unusual circumstances or

conditions may arise which require variance from the standards. Any variances from the standards set forth in this manual must be accompanied by prior written approval from the Director of Public Works.

The scope of this *Paving Design Manual* includes the various design elements, criteria, standards, and instructions required to prepare paving plans for the Department of Public Works. Included in the manual is the classification of the various streets according to the City Thoroughfare Plan. Geometric design standards to be used on the various classifications and criteria for design of pavement structures are also presented. These guidelines should result in the construction of safe, economical, comfortable riding streets, and thoroughfares carrying acceptable traffic volumes while providing for pedestrian traffic as well.

In the *Complete Streets Design Manual*, design speed is replaced by target speed which is based on the functional classification, thoroughfare functional classification, thoroughfare type and context, whether the ground floor land uses fronting street are predominantly residential or commercial. Target speed then becomes the primary control for determining the following geometric design values:

- Minimum intersection sight distance
- Minimum sight distance on horizontal or vertical curves; and
- Horizontal and vertical curvature

Drainage Design Manual

The purpose of the *Drainage Design Manual* is to provide guidelines for designing facilities in the City of Dallas. This manual is for use by the Department of Public Works (DPW), other City departments, consulting engineers employed by the City, and engineers for private development in the City. It is not intended to limit the design capabilities or engineering judgment of the design professional, nor to limit the use of new technical developments in engineering. Special problems may require special methods. Unusual circumstances or special designs requiring variance from standards within this manual may be approved by the Director of Public Works. The *Drainage Design Manual* is intended to be incorporated into the *iSWM Criteria Manual* when adopted.

The guidelines contained in this manual have been developed from a comprehensive review of basic design technology as contained in various engineering publications, and through the experience of individual engineers who have contributed to the content. This manual addresses storm drainage situations which are generally relative to the City of Dallas and its immediate geographical area. Accepted engineering principles are applied

to these situations in detailed procedures. The documentation is not intended to limit initiative, but rather is included as a standardized format to aid in design, and as a record source for the City. Additional information on the City of Dallas regarding drainage design can be found in the Development Code under the Floodplain, Escarpment, Platting Regulations, and in adopted Floodplain Management Plans.

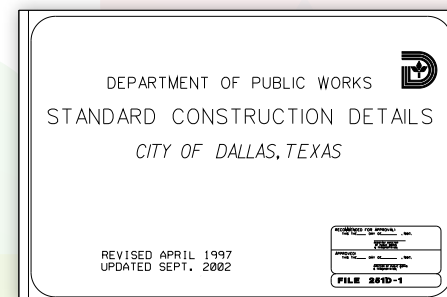
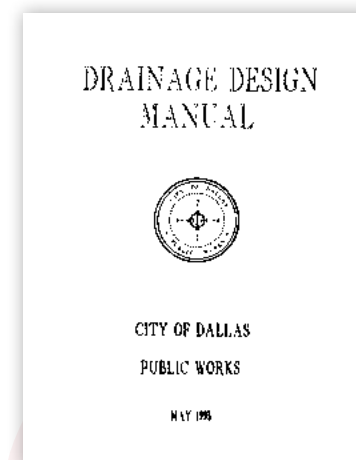
The Drainage Design manual will be incorporated into the iSWM Criteria Manual when it is adopted.

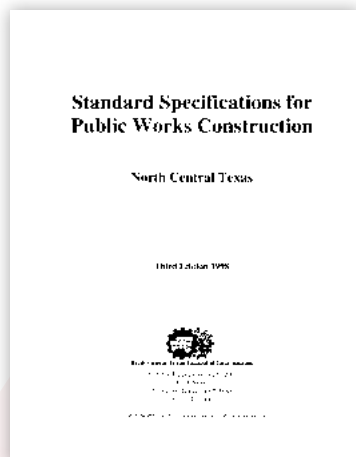
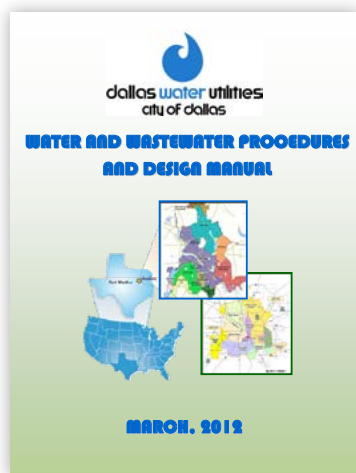
Standard Construction Details - File 251D

The Standard Construction Details provides standard detailed paving, drainage, traffic control, and related facility drawings showing construction items and features to be used with paving plans provided for the City of Dallas.

Paving plan designs prepared for the City shall be consistent with the Standard Construction Details, as currently amended. Specific details have specific functions and uses, and this set of standard details must not be considered a catalog from which to choose. Special situations will require the designer to develop special details for approval from the Director of Public Works.

This document is presently being updated to include revised cross-sections and details. Coordination of this update with the measure contained within this manual is recommended.





Water and Wastewater Procedures and Design Manual

This manual is provided for use in the design and construction of water, wastewater and reclaimed water mains owned and operated by Dallas Water Utilities (DWU). DWU provides water, wastewater and reclaimed water services to customers within the City of Dallas and other adjacent communities.

NCTCOG Standard Specifications for Public Works Construction

The North Central Texas Council of Government (NCTCOG) *Standard Specifications* provides a framework for public works construction. These standards strive to decrease construction costs while allowing the implementation of new technologies, materials and methods. The standards recorded in the document list the materials and construction methods supported by NCTCOG. The construction method standards include provisions for erosion and sediment control, pavement systems, water distribution, wastewater collection, and stormwater drainage.

These regional provisions are recommended by the Public Works Advisory Committee. Modifications to these standards must be developed under the supervision and seal of a registered professional engineer and the program manager of the Public Works Department.

NCTCOG Standard Specifications for Public Works Construction, 3rd & 4th Editions Addendum

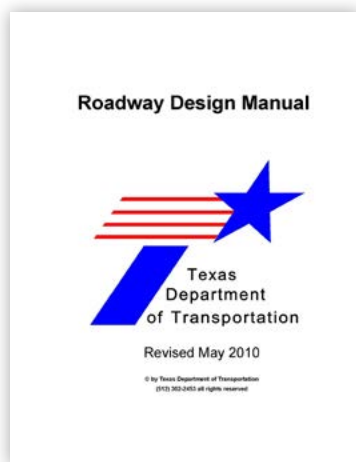
(Described above under NCTCOG Standard Specifications)

The Addenda to the *3rd & 4th Editions* set forth exceptions and requirements of the City of Dallas Public Works Department, and are consequently the most current standards to be followed. These specifications take precedence over existing requirements and conditions listed in previous standards.

Pavement Cut and Repair Standards Manual

The Pavement Cut and Repair Standards Manual provides a reference for the repairs, excavations, installations, restorations and other operations to streets within the Dallas area. The standards detailed in the manual are set as the current methods to be utilized, with the provision that new methods and technologies may be employed as well. Engineering, technical, and

other criteria and standards to be improved upon must be approved by the Director of the Public Works Department. However, it is the responsibility of the permit holder to make certain that current standards are being used. The purpose of this manual is to ensure the safe and durable construction of roadways.



TxDOT Roadway Design Manual

The *TxDOT Roadway Design Manual (RDM)* applies only to state highways and bikeways within local jurisdictions. If cities deviate from the minimum widths and geometric criteria for bikeways spelled out in Chapter 6, they are advised to follow the exemption process or experimental process as applicable. The *RDM* does not establish legal standards for designing local streets.

MUTCD and TMUTCD

The *Manual on Uniform Traffic Control Devices (MUTCD)* and the Texas version of the *MUTCD (TMUTCD)* provide standards and guidance for the application of all allowed traffic control devices including roadway markings, traffic signs, and signals. The Federal Highway Administration oversees application of the *MUTCD*.

The rules and requirements for the use of traffic control devices are different than for street design criteria. Local agencies have limited flexibility to deviate from the provisions of the *TMUTCD* in the use of traffic control devices due to the relationship between the *TMUTCD* and state law. The *TMUTCD* does provide flexibility within its general provisions for items such as application of standard traffic control devices, use of custom signs for unique situations, traffic sign sizes, and sign placement

specifics. In contrast, agencies do not generally have the flexibility to develop signs that are similar in purpose to signs within the manual while using different colors, shapes, or legends. Agencies are also not authorized to establish traffic regulations that are not specifically allowed by, or are in conflict with, state law. The provisions of the *TMUTCD* and related state laws thus make it difficult to deploy new traffic control devices in Texas. This can result in complications, especially in the areas of speed management, pedestrian crossings, and bikeway treatments.

The State of Texas and the Federal Highway Administration have procedures that allow local agencies to experiment with traffic control devices that are not included in the current *TMUTCD*.

Both the *MUTCD* and *TMUTCD* are amended through experimentation. After one or more experiments have shown benefit, the new devices are sometimes adopted into these manuals. In Texas, the Vehicle Code must be changed first if it prevents use of the new device.

The *MUTCD* and *TMUTCD* establish warrants for the use of some traffic control devices. For example, stop signs, traffic signals, and flashing beacons are expected to meet minimum thresholds before application. These thresholds include such criteria as number of vehicles, number of pedestrians or other uses, distance to other devices, crash history, and more. These warrants often prevent local engineers from applying devices that, in their opinion, may improve safety. For example, pedestrian crossings on a busy, high-speed, wide arterial street may need signals for user safety, but may not meet the warrants.

As with street design guidelines, cities may establish their own warrants or modify those suggested by the *TMUTCD* to suit their context in order to use some traffic control devices. In special circumstances that deviate from their own warrants, cities need to document their reasons for the exception. As an example, they may say the trail crossings or school crossings qualify for certain traffic control devices.

Texas Fire Code

The Texas Fire Code can impede street design in limited circumstances. The state legislature has adopted the National Fire Code. The National Fire Code is written by a private agency and has no official legal standing unless states or municipalities adopt it, as has been done in Texas. The primary barrier caused by this adoption is the requirement for a minimum of 20 feet of an unobstructed clear path on streets. In order to comply, streets with on-street parking on both sides must be at least 34-feet wide. This prevents municipalities from designing “skinny” and “yield” streets to slow cars and to make the streets safer, less land consumptive, and more hospitable to pedestrians and bicyclists.

There are ways around this requirement. If the local jurisdiction takes measures such as installing sprinklers and adding extra fire hydrants, or the adjacent buildings are built with fire retardant materials, it may be able to get the local fire department to agree to the exception.

Alternatively, the state legislature could repeal its adoption of the 20-foot clear path requirement due to

- The arbitrary and unresearched nature of the provision
- The safety problems associated with the resulting excessively wide streets
- The contradiction that this provision causes with properly researched guidelines and standards by ITE, CNU, AASHTO, and others for streets under 34 feet wide

It is likely that the state legislature was unaware of these issues when it adopted the code in its entirety.

Texas Streets and Highways Code and Texas Vehicle Code

The Texas Streets and Highways Code and the Texas Vehicle Code include laws that must be followed in street design. These are embodied in the *TMUTCD*. Changes to the Streets and Highways Code and the Vehicle Code may cause the *TMUTCD* to change.



2. THE DALLAS COMPLETE STREETS VISION



market street



Complete Streets provide an opportunity to improve the return on infrastructure investments by integrating sidewalks, bike lanes, transit amenities, and safe crossings into the initial design of the project, which spares the expense of retrofits later.

2. THE DALLAS COMPLETE STREETS VISION

The Dallas Complete Streets Vision is to build streets that are safe and comfortable for everyone; young and old, motorists and bicyclists, walkers and wheelchair users, and bus and train riders alike. A key element of the Complete Streets Vision is to incorporate a green approach to the roadway design process in order to reduce the impacts on the stormwater system and create an environment where safe, comfortable, and healthy streets are the preferred design choice.

This chapter describes a new Complete Streets Typology that takes into account a range of street contexts and all modes of travel, and establishes Complete Streets Vision Maps that overlay these street types on the City's thoroughfare system.



Bicycle and public transit



Multimodal thoroughfare



Conventional, Separate-Use:

Large shopping centers represent a typical conventional, separate-use development. The *forwardDallas!* Plan calls for these areas to become more like town centers, with transit enhancements as well as landscape buffers from the street including sidewalks and street trees.



Walkable, Mixed-Use:

This West Village sidewalk cafe provides a great example of a walkable, mixed-use development—outdoor seating and retail on the lower floors, and residential living on the upper stories.

COMPLETE STREETS CONTEXT AND DEVELOPMENT POLICY

The Complete Streets approach designs streets for all modes of travel including pedestrians, cyclists, public transit, and freight and private vehicles. This approach also designs streets to suit the surrounding neighborhood character, as well as the capacity needs for all modes of transportation, with emphasis given to varying modes, depending on the type of street. The different types of Complete Streets proportionally take into account the context or types of uses within an area to then determine the most appropriate design for the use of the right-of-way.

Along with the more flexible functional classification design standards, the street context—or the character of the area adjacent to the roadway—plays an important role in the way a street looks. One type of street design will not satisfy all of the different needs within the City and, therefore, it is important that the design standards offer flexibility to allow for these distinctions. There is no “one size fits all” in the framework of street design.

The *forwardDallas!* plan identifies two overall categories of contextual building blocks: Conventional, Separate-Use and Walkable, Mixed-Use. These building blocks, shown in the *forwardDallas!* Vision Illustration, provides an important basis for identification of the Complete Street types in the Complete Streets Vision Map shown later in this chapter. Historically, Dallas has been developed in the Separate-Use context, but recent trends see widespread desire to implement more Walkable, Mixed-Use development in many parts of the City.

Conventional, Separate-Use Contexts are areas that follow a development pattern of defining distinct areas for housing, jobs, and shopping. These areas are typical of post-war, suburban cities and are inherently more dependent on the automobile. They are characterized by large parking lots and faster-moving arterial traffic. Opportunities for walking and bicycling tend to be limited and, for the most part, are confined to quieter residential areas.

Walkable, Mixed-Use Contexts are areas where a healthy balance of housing, jobs, and shopping exist in proximity with one another, allowing residents to live, work, shop, and play all in the same neighborhood. Public transit, bicycling, and walking are priorities in these areas, though cars continue to play an important role. These areas have slower moving traffic, and the average car trip is shorter. This Manual is a key tool in implementing the *forwardDallas!* mixed-use building blocks.



Example of a residential street

CLASSIFYING COMPLETE STREETS

The Complete Streets approach promotes designing streets for all—including pedestrians, bicyclists, transit users, and motorists—while taking into consideration both the context and the functional classification. This approach assumes that all streets present opportunities to be *complete*, although each will need different priority design elements depending on the context. Complete Streets typology considers context, location, and use to guide appropriate design of streets. The following section presents detailed descriptions and preferred elements for each of the Complete Streets types:

- Mixed-Use streets
- Commercial streets
- Residential streets
- Industrial streets
- Parkways

MIXED-USE STREETS

Downtown streets and other main streets are examples of mixed-use streets. These streets encompass a variety of types of streets and land use contexts, from downtown to small Main Street locations. Buildings are usually close to the street and offer a vibrant blend of opportunities to live, work, shop, and play. In their present form, these streets already have some pedestrian and bicycle activity. In some locations, they carry heavy traffic. On Mixed-Use Streets, the focus is on slower traffic speeds and a greater emphasis on pedestrian, bicycle, and transit choices. This street type is the most flexible and has a multipurpose use of street space.

On-street parking is common along Mixed-Use Streets. Often there are large parking areas and other auto-oriented land uses located at the edges of commercial areas. The design of Mixed-Use Streets is targeted for pedestrians, bicyclists, and transit users with the goal of reducing motor vehicle speeds and creating a more desirable environment for people.

A range of street types are identified in the *Downtown Dallas 360 Plan* that further define streets and uses in the City Center, and additional information can be found in the *CBD Comprehensive Transportation Plan*.



Mixed-Use street

Key Features

- Higher pedestrian activity
- Reduced motor vehicle speeds
- Bike lanes or shared use of travel way
- Pedestrian-oriented development, street furniture, and lighting
- Mix of commercial, residential, and civic uses oriented to the street
- Maximized on-street parking
- Higher transit accessibility

MIXED-USE STREET EXAMPLES



Main Street at Akard Street—two-lane thoroughfare with on-street parking



Greenville Avenue at Alta Avenue—two-lane local road (Main Street)



State Street at Allen Street—two-lane street with on-street parking, buffer, and sidewalk



State Street at Ellis Street—two-lane street with on-street parking, buffer, and sidewalk



Knox Street at Cole Avenue—four-lane thoroughfare with head-in parking and combination of adaptive re-use and new buildings



Preston Road between Wentwood and Northwest Highway—four- and five-lane thoroughfare with head-in parking



Commercial street

COMMERCIAL STREETS

These streets serve mostly commercial or institutional areas with low densities. Buildings are likely set back from the road and do not feature on-street parking. These streets are often multi-lane and serve faster moving traffic and provide regional connections. However, there are many opportunities for improving walking, biking, and transit between destinations in this street type.

Adjacent land uses function as service and job destinations, with buildings located on separate parcels. Land uses include offices, restaurants, and a range of retail and commercial uses. Adjacent land uses may also include multifamily housing in low- to mid-rise apartment buildings.

Commercial Streets should be designed to accommodate pedestrians while still maintaining vehicle traffic flow. This objective may be inherently unpleasant for pedestrian, bicycle, and transit users, however, the safety of such users—particularly at intersections—is a paramount concern.

Key Features

- Emphasis on travel lanes and automobile capacity
- Access management with the use of landscaped median or two-way left turn lane
- Usually serve faster moving traffic
- Less use of on-street parking
- Lower pedestrian activity, but provide safe opportunities for use with wider landscaped buffers and sidewalks

COMMERCIAL STREET EXAMPLES



Lovers Lane at Devonshire Drive—four- and five-lane thoroughfare



Preston Road at Sherry Lane—four- and five-lane thoroughfare with off-street parking adjacent to roadway with sidewalk and buffer



Montfort Drive at Belt Line Road—four-lane divided with sidewalk and buffer



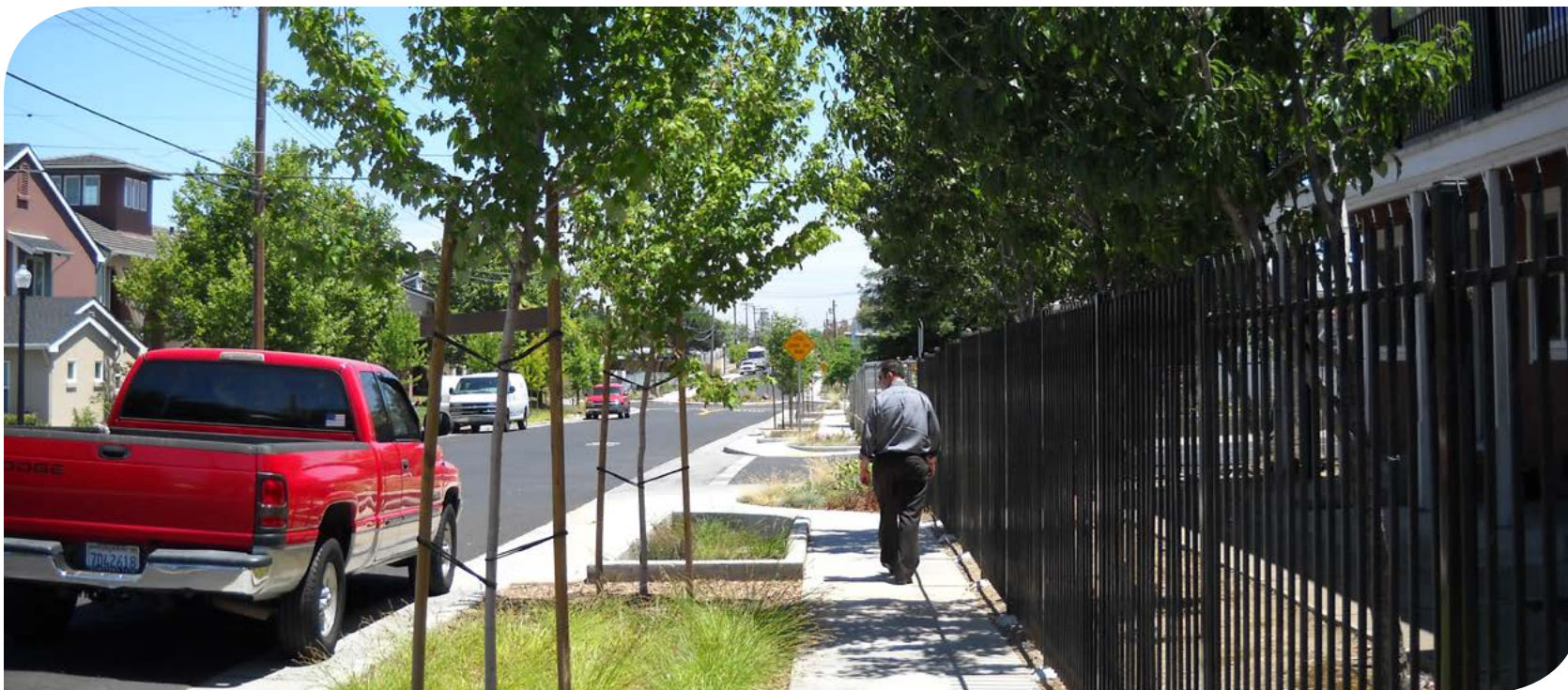
Garland Road at Buckner Boulevard—six-lane divided thoroughfare with bus stops, sidewalk, crosswalks, and planting zone



North Haskell Avenue at Capitol Avenue—six-lane divided thoroughfare with planting zone and sidewalks in a shopping strip environment



Preston Road at Weldon Howell Parkway—four- and five-lane thoroughfare with sidewalk, buffer, and off-street parking adjacent to commercial in a slip street format



Residential street

RESIDENTIAL STREETS

These streets serve residential land uses as well as schools, churches, and businesses within residential neighborhoods. Residential streets can vary from serving high volumes and fast moving traffic to serving moderate traffic volumes and lower speeds, depending on the surrounding neighborhood context. However, the dominant land use is single family. This type of street will likely also have pedestrian, bicycle, and transit activity to connect important neighborhood destinations.

Residential Streets are designed to reduce motor vehicle speeds and place an emphasis on intersection safety for pedestrians, bicyclists, and transit users.

Key Features

- Safety for pedestrians and bicyclists
- Medians on major facilities
- Increased sidewalk buffering from traffic through on-street parking, bicycle lanes, and landscaping

RESIDENTIAL STREET EXAMPLES



Winnetka Avenue at Temple Drive—two directional local road with historic single family homes



North Bishop Avenue at West Canty Street—four-lane thoroughfare with bike lane



West Colorado Boulevard at North Oak Cliff Boulevard—two-lane local road with single family homes, sidewalks, and wide buffer



Florence Street at Texas Street—two-directional local road



Montfort Drive at Preston Oaks Road—four- and five-lane thoroughfare with multi-family dwellings



Northwest Highway at Thackery Street—six-lane divided thoroughfare with single family homes on south side, multifamily with slip street on north side



Industrial street

INDUSTRIAL STREETS

Industrial Streets serve industrial corridors. They are built with wide lanes and intersections to accommodate trucks and other large vehicles. Industrial streets are located within large areas of land with a mix of low- and medium-density industrial buildings and industrial yards. They often have large surface parking lots for cars and trucks, and should have quality access. Due to the need for freight rail access, industrial streets are often linked to rail lines.

Transit, sidewalks, and pedestrian amenities are typically limited in these areas. However, industrial streets may serve as through-routes to adjacent land uses, and thus should provide for the safety of all modes. Pedestrian provisions should not be overlooked on industrial streets if residential or transit facilities are in the vicinity.

Key Features

- Emphasis on managing large truck traffic
- Ability to safely mix industrial traffic with vehicular and pedestrian traffic

INDUSTRIAL STREET EXAMPLES



Alberta Drive at Newberry Street—two-lane divided



North Cockrell Hill Road at Adler Drive—six-lane divided thoroughfare



Manor Way at Cedar Springs Road—two-lane street



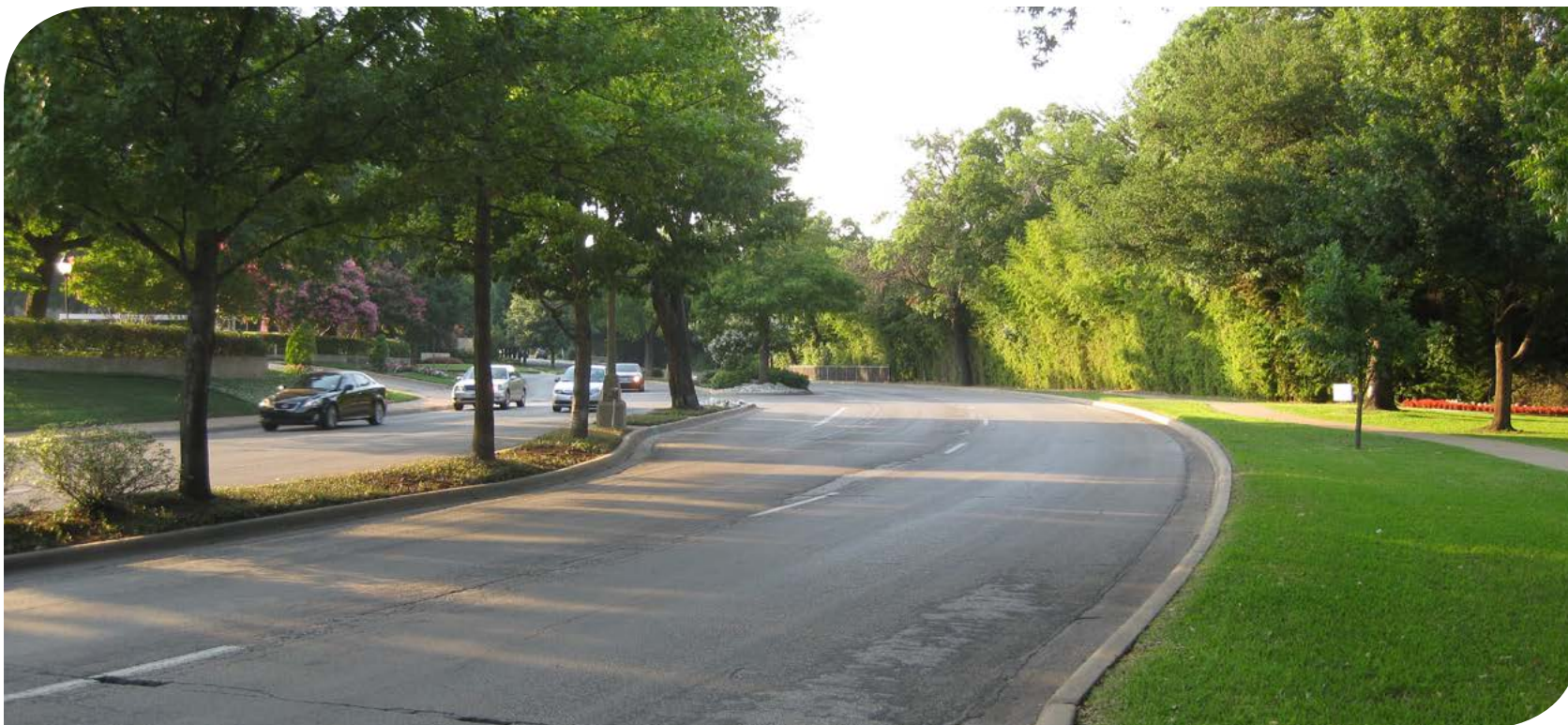
Manor Way at Cedar Springs Road—two-lane street



Rock Quarry Road at North Cockrell Hill Road—four-lane local road



Royal Lane at Luna Road—six-lane divided



Parkway

PARKWAYS

Parkways extend through natural areas (such as lakes, rivers, floodplains, streams, and parks) where there is a desire to maintain or create a park-like feel to the roadway. Parkway serve sensitive areas—such as White Rock Lake, the Escarpment, and the Great Trinity Forest—and may be elevated over these areas. Design elements may include wide landscaped medians, structures with natural materials, and shared use paths alongside the roadway in lieu of sidewalks.

The primary objective of a parkway is to reduce motor vehicle speeds and provide safe intersections for pedestrians, bicycles, and transit users.

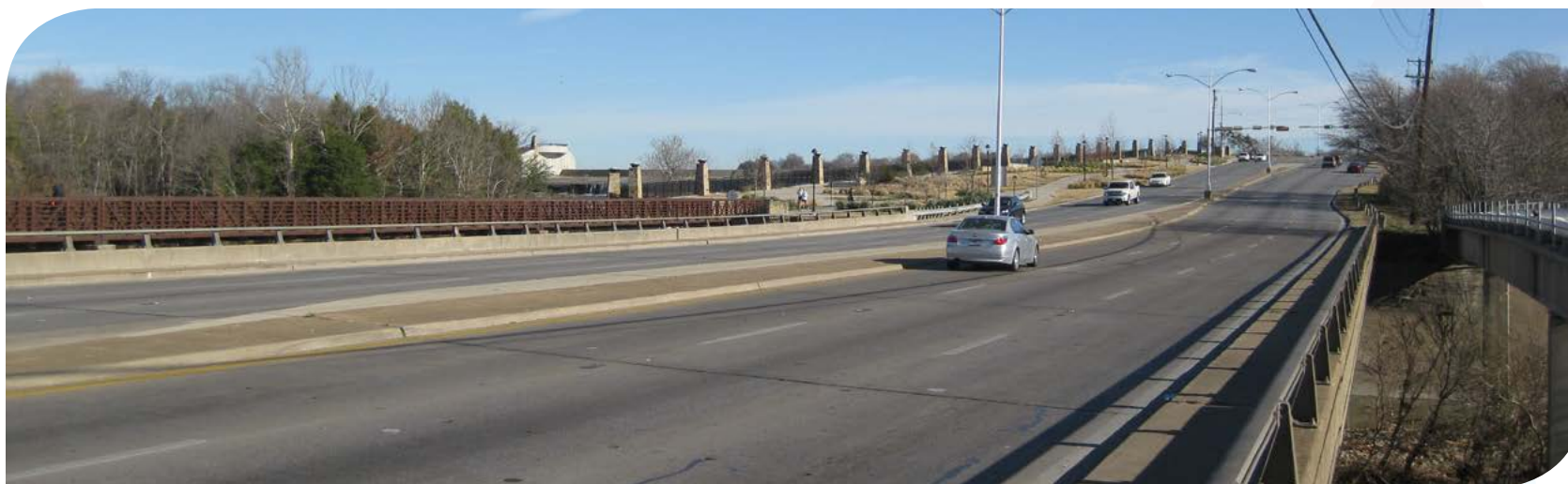
Key Features

- Emphasis on pedestrian, bike, and vehicle access to natural areas
- Shared use travelways
- Landscaped medians and edges

PARKWAY EXAMPLES



Turtle Creek Boulevard at Hall Street—six-lane divided thoroughfare



Garland Road at White Rock Lake spillway—six-lane divided thoroughfare



East Lawther Drive—two-directional local road with adjacent trail



Meriman Parkway at Fair Oaks Avenue—two-directional local road with adjacent trail



Mockingbird Lane at White Rock Lake Dog Park—six-lane divided thoroughfare



East Lake Highlands Drive at North Buckner Boulevard—six-lane divided thoroughfare

DALLAS COMPLETE STREETS VISION MAPS

The Complete Streets Vision Maps designate thoroughfares (excluding highways) throughout the entire City into contextual street types and bike or transit network street types. These designations are intended to serve as overlays on the Thoroughfare Plan functional and dimensional classification system. For example, a four-lane, divided arterial may be a Mixed-Use Street and also a Bike or Transit Network Street.

Contextual Street Types Overlay

The Contextual Street Types Overlay Vision Maps identify five contextual street types: mixed-use streets, commercial streets, residential streets, industrial streets, and parkways. These designations, discussed in more detail in following sections, are shown on the Complete Streets Vision Map and provide the first step in determining how a particular street should be initially designed, as well as the enhancement elements potentially needed given the use, capacity, and context of the area.

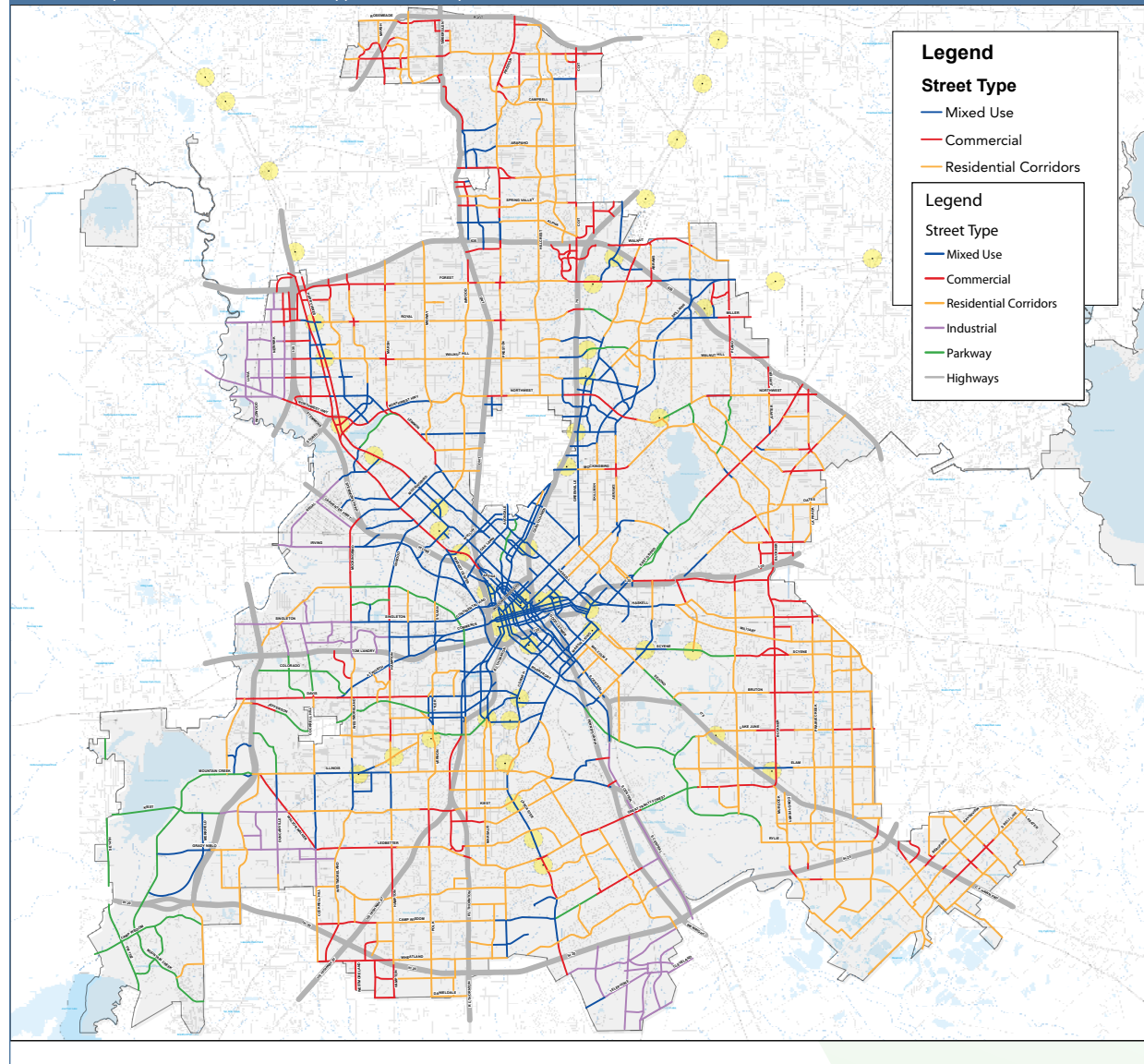
Bike Network Streets

The Bike Network Streets Overlay identifies thoroughfares with designated bike facilities based on the *2011 Dallas Bike Plan*. The *2011 Bike Plan* provides proposed cross sections for retrofit projects and should be consulted for all minor projects and resurfacing. During new construction, the cross section will be considered to provide a high level of accommodation for bicycles, if needed.

Transit Network Streets

Transit Network Streets are streets that serve high levels of transit activity such as fixed rail, streetcars, bus rapid transit, or other enhanced transit service. This category is not intended to encompass all streets where transit exists, rather, the more transit-intensive streets.

Vision Map: Contextual Street Types Overlay



This vision map is intended to be incorporated into the Thoroughfare Plan and periodically updated through the Thoroughfare Plan amendment process.

This map is intended to be overlaid on the Thoroughfare Plan functional and dimensional classification map. It is intended to serve as the point of reference for applying the relevant design guidance for each street based on the identified contextual street type.

This classification reflects predominant land use patterns along street frontages rather than site-specific delineation of uses.

This map is intended as the starting point in the planning and design process, and should be further informed by site-specific considerations and public input. Particular site specific consideration should be given to points of transition from one street type to another.

Highways are shown here for reference only. They do not fall under the City's purview for design standards.

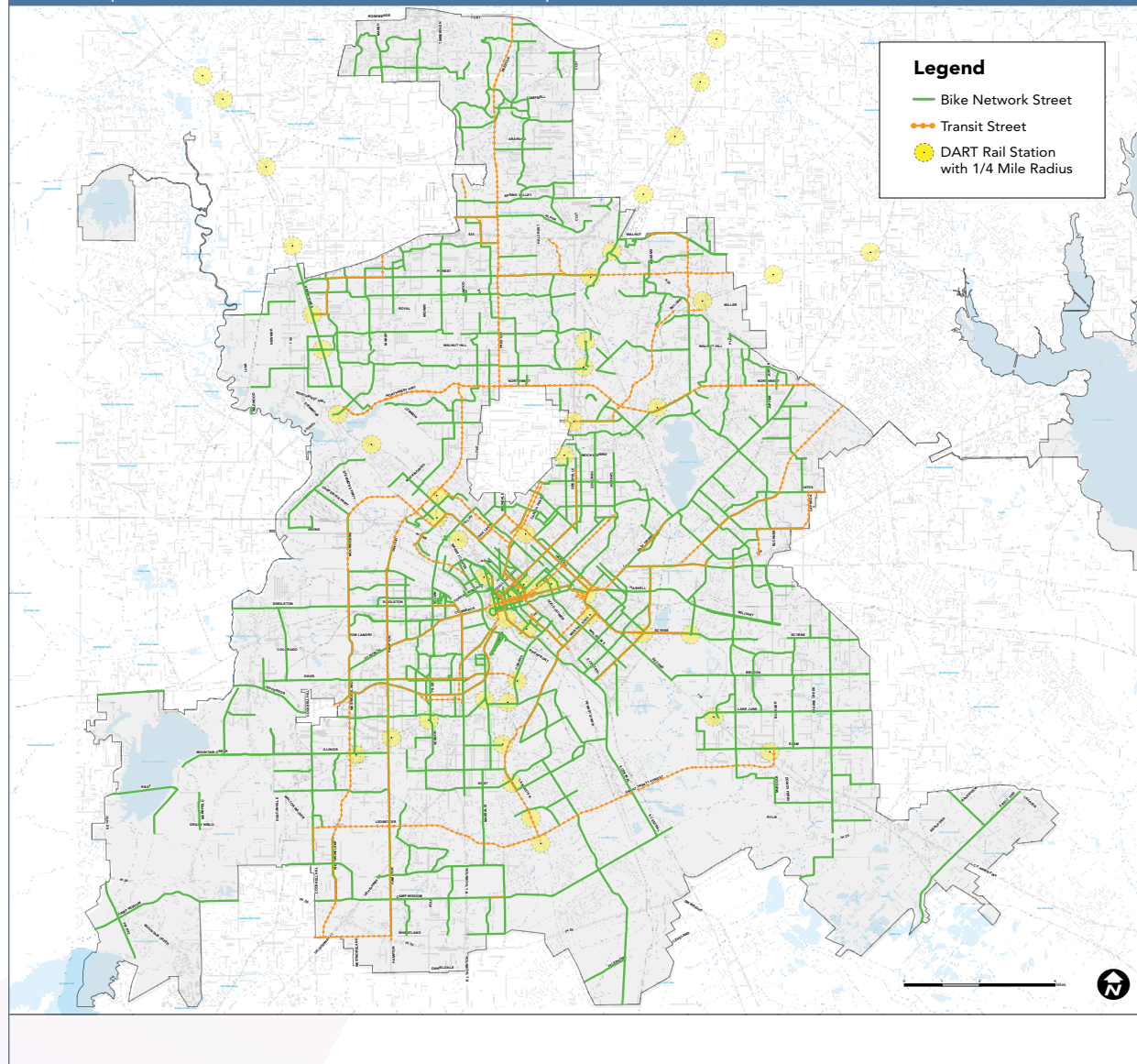
This map is intended to be overlaid on the Thoroughfare Plan functional and dimensional classification map in addition to the Contextual Street Types Overlay Map.

The bike network overlay includes thoroughfares designated as bike routes on the *2011 Dallas Bike Plan*.

The transit network overlay includes thoroughfares with light rail lines, street car lines, express bus lines, and other enhanced transit service lines identified in the DART System Plan as amended and approved by the City. When designing these streets, extra consideration should be given to the design elements for transit facilities highlighted in Chapters 4, 5, and 6.

In addition, a 1/4 mile (5-minute walk) radius is shown around all DART light rail stations to highlight areas within which special consideration should be given to pedestrian, bike, and transit feeder linkages. All streets within these zones should follow the guidance for Mixed-Use Streets.

Vision Map: Bike Network and Transit Network Overlay

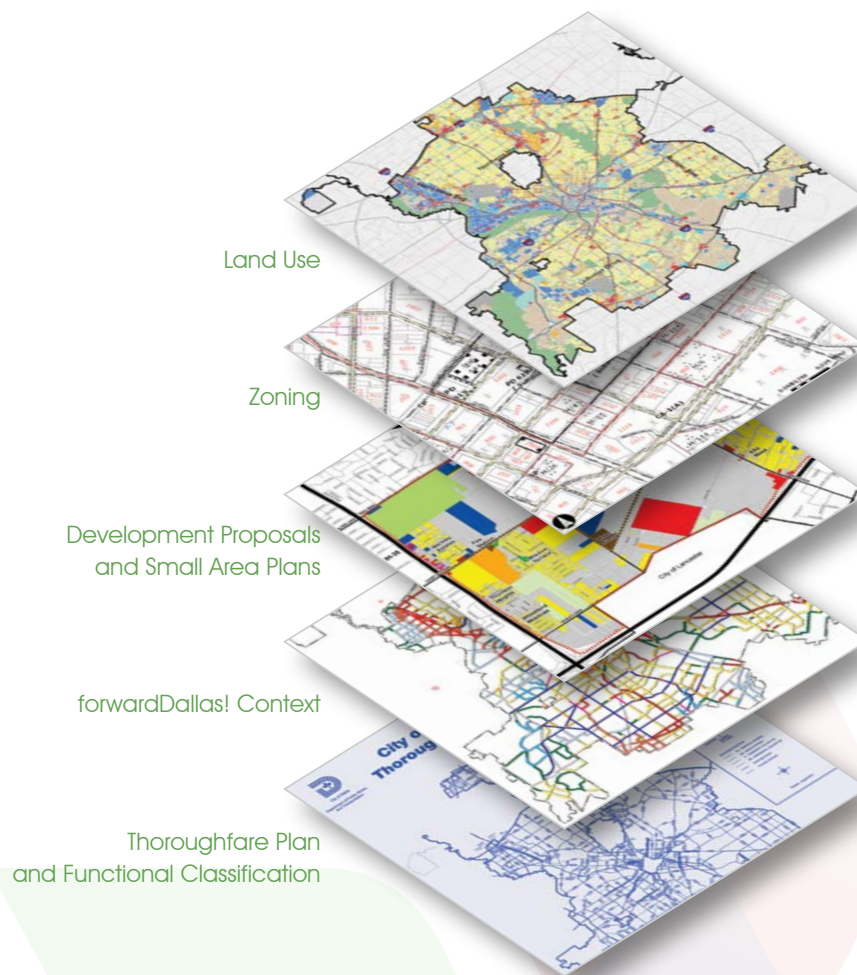


This vision map is intended to be incorporated into the Thoroughfare Plan and periodically updated through the Thoroughfare Plan amendment process.

How the Vision Map was Developed

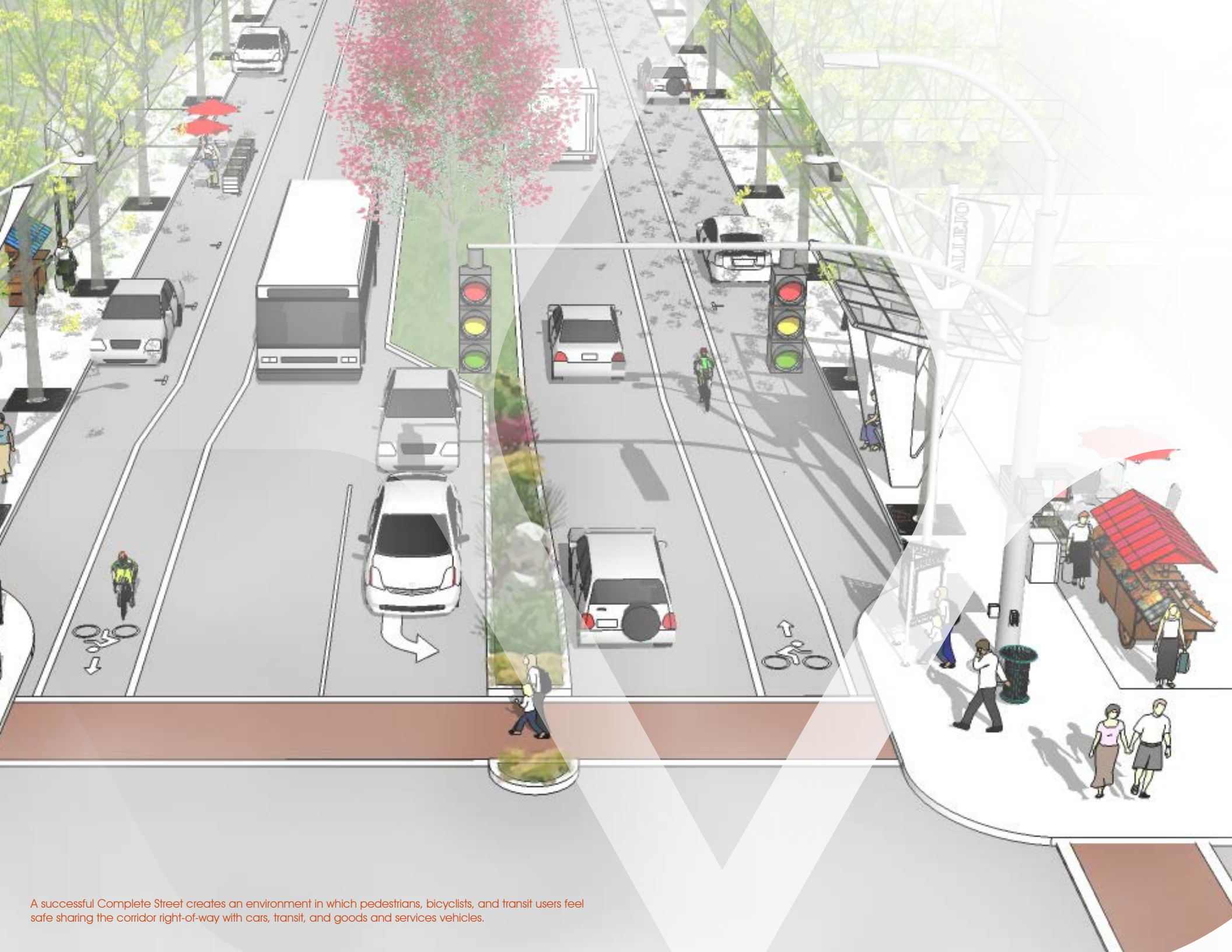
The approach to applying the typologies to particular thoroughfares reflects the future development vision based on the *forwardDallas!* Plan. It takes into account existing land use patterns where the transition to future development patterns are anticipated to be long-term, and reflects the prevailing patterns of use along a corridor, rather than site-specific uses.

The Vision Map was created by starting with the City's Thoroughfare Plan and functional classification system and looking at future street type needs based on both the current context and built form, and the future land use context, as proposed in the *forwardDallas!* Plan. In addition, development proposals, small area plan recommendations, and zoning and surrounding land use were considered. Using this information, along with thoroughfare operational characteristics, initial typologies were designated for each thoroughfare on the Thoroughfare Plan.





3. COMPLETE STREETS POLICY FRAMEWORK



A successful Complete Street creates an environment in which pedestrians, bicyclists, and transit users feel safe sharing the corridor right-of-way with cars, transit, and goods and services vehicles.

3. COMPLETE STREETS POLICY FRAMEWORK



Complete Streets public outreach



Greenville Avenue crosswalk

Many agencies and regulations provide guidance in evaluating and weighing the trade-offs of the physical, operational, and multimodal characteristics needed to design Complete Streets in a variety of contexts. Currently, City guidance in designating the dedication and use of right-of-way is provided by the Thoroughfare Plan and Chapter 51A of the Development Code. Complete Streets expands the factors influencing the use of the City's right-of-way, and provides guidance on designing roadways in constrained conditions.

This chapter establishes a policy framework for designing Complete Streets in order to guide decision making during the planning and design process on how to weigh the trade-offs encountered in an urban area. This chapter establishes the key principles that guide the Complete Streets design approach; defines various functional zones within the street, clarifying their roles and relationships to each other; and provides the over-arching design policy guidance associated with the development of walkable urban streets.



Bus/bike shared lane



Walnut Hill DART Station and local connector routes

GENERAL COMPLETE STREETS POLICY GUIDANCE

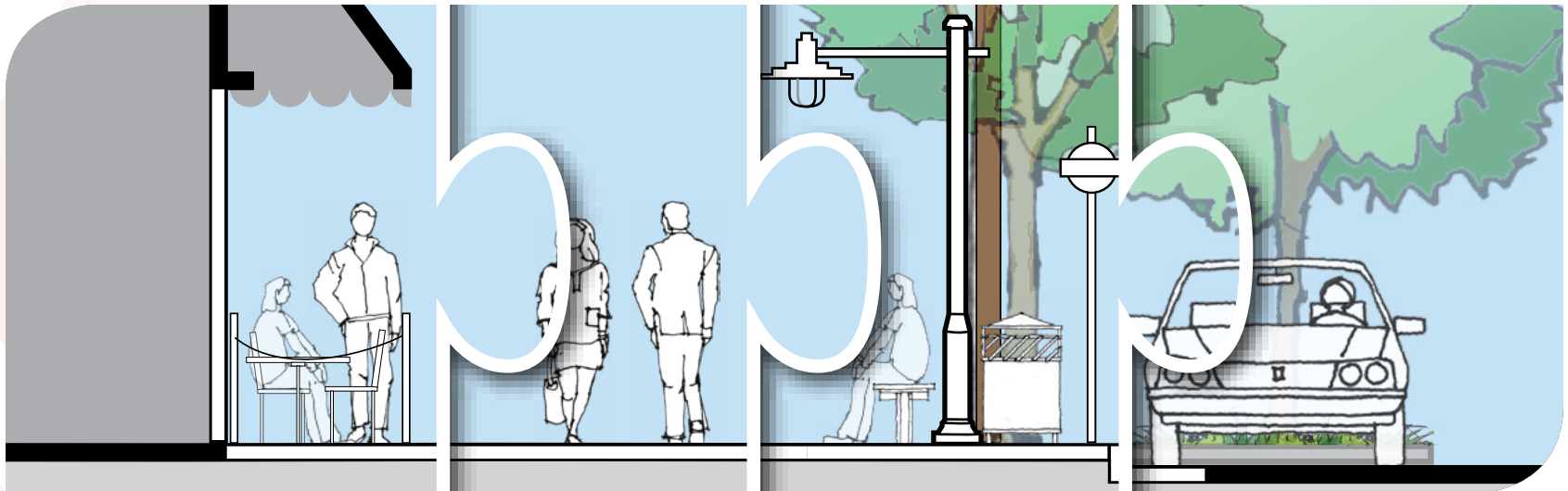
The following principles address the City's priority for the design of streets that are safe, multimodal, and green. These principles will guide the planning and construction of privately and publicly funded roadways. Five new street types implement these principles: mixed-use, commercial, residential, industrial, and parkway. These street types will supplement the existing Thoroughfare Plan street classification system. The new street types reflect the varying conditions of Dallas' streets and land uses and help ensure that streets are multimodal.

- Dallas' roadway design has traditionally been focused on auto speeds and vehicular movement through the City. The new Complete Streets approach expands this focus to better accommodate additional modes including walking, bicycling, and transit.
- Streets are designated and planned in context with the surrounding land uses and cultural and environmental considerations. Streets add to the vibrancy of the City and enhance Dallas' public spaces.
- Complete Streets optimize the street space and right-of-way to balance the needs of pedestrians, bicyclists, transit riders, and motorists, with emphasis placed on different modes, depending on the type of street and adjacent land uses.
- Complete Streets take advantage of opportunities to reallocate

roadway space once reserved for motor vehicle use to wider sidewalks, bikeways, on-street parking, and green spaces where possible.

- Roadway design integrates green street elements that support policies adopted by the City to reduce and filter stormwater runoff.
- Street design is based on an evaluation of network capacity along with multimodal level of service considerations.
- To ensure safety for all roadway users, streets are designed to limit excessive speeds, and reflect limits for the street type and context of surrounding land uses.

Policy guidance for the Intersection Zone, the Pedestrian Zone, and for the Street Zone is provided on the following pages.



INTERSECTION ZONE POLICY GUIDANCE

1. **Maximize Safety**—Safe and accessible designs for all modes of transportation are the driving principles for intersection design in Dallas. Intersections should be designed to minimize conflicts, reinforce the message that drivers and bicyclists should slow down, and respect the needs of pedestrians. National guidelines for accessible design in the public right-of-way should be followed with a commitment to achieving the best outcome for all users within the constraints of each site.
2. **Improve Access, Mobility, and Connectivity**—
A dense network of intersections should distribute traffic amongst different routes and prioritize users based on the surrounding context and land uses connecting people to work, goods, and services. Intersections should efficiently move traffic, reducing delay and travel times. New developments should offer a mix of land uses and aim to minimize block lengths.
3. **Design for Predictable Movements**—Intersection designs should facilitate predictable movements by all modes, and encourage everyone to obey traffic laws.
4. **Reclaim Space**—Intersection and roadway design has been traditionally oriented toward automobile traffic. Undefined and underutilized areas of pavement not necessary for the efficient movement of motor vehicles should be used to reclaim street space for pedestrians, transit users, and bicyclists.
5. **Minimize Signal Cycle Lengths**—Signal cycle lengths should be kept to a minimum to reduce delay for all users. For coordinated signal corridors, consideration for pedestrian movements should be factored into the timing plans. As technology advances, traffic signalization should move towards a system that passively detects all modes in order to become more efficient, reducing delay and improving safety.
6. **Reduce Footprint and Improve Sustainability**—Intersection designs should strive to live within the current right-of-way and incorporate green, sustainable street elements wherever possible to reduce impervious surfaces, treat stormwater at the source, and reduce the heat island effect.
7. **Reduce or Eliminate**—Free right-turn movements and configurations should be reduced or eliminated where possible.

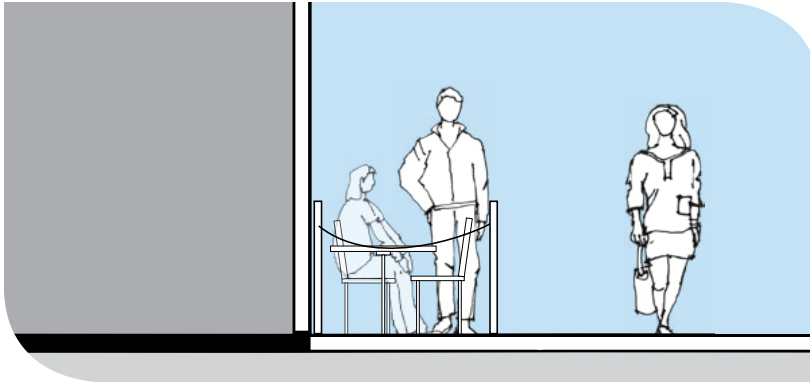


Under-utilized areas of pavement should be reclaimed for pedestrian use.



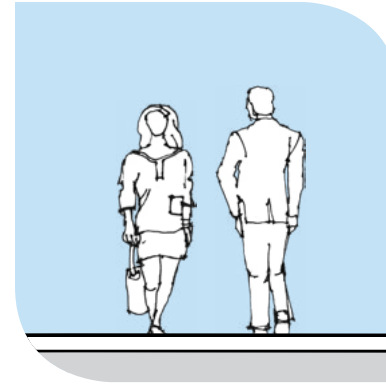
Safe and accessible designs for all modes of transportation must guide intersection design.

THE PEDESTRIAN ZONE DEFINED



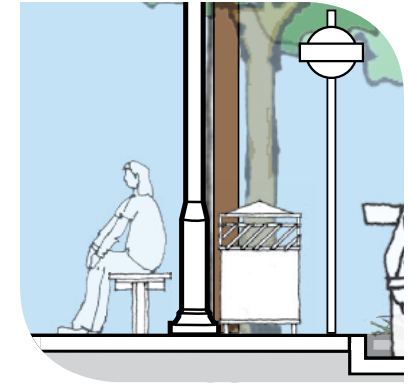
The Frontage Zone

The frontage zone is defined as the area between the face of the adjacent building and the sidewalk clear zone. This zone is ideally located on private property in the building setback area where design standards are controlled by zoning. In existing dense urban situations such as Downtown and Old Main Street corridors, frontage zone design elements may need to extend into the public right-of-way. Given the variety of development patterns in Dallas, the frontage zone will vary from buildings with narrow or no setbacks to buildings with large setbacks. For buildings with narrow setbacks, the frontage zone provides a place for sidewalk cafés, outdoor retail displays, and landscaping, among other things. It is important that these elements do not infringe on the sidewalk clear zone.



Sidewalk Clear Zone

The sidewalk clear zone is the portion of the pedestrian zone that is specifically reserved for pedestrian travel. It should be well-lit and meet ADA accessibility guidelines. This zone should be free of any physical obstructions to allow for continuous pedestrian movement. Materials used in the pedestrian zone should be consistent, and should not vary from block-to-block. Utility poles, signal boxes, street furniture, and vegetation should not encroach into the sidewalk clear zone.



The Buffer/Furnishing/Curb Zone

The buffer/furnishing/curb zone is the area between the curb and the sidewalk clear zone that provides separation and protection from moving vehicle traffic. The buffer zone also provides space for the placement and organization of street elements such as landscaping, street furniture, and above and below ground utilities. Where parking is allowed, the buffer zone creates space between the curb and vertical elements for proper clearance from moving vehicles or to allow car doors to open, and motor vehicle drivers to access the sidewalk. It also allows space for driveway aprons to ramp down from the grade of the sidewalk to the street in order to maintain a level sidewalk clear zone. In constrained areas, or where utilities are required, landscaping may be shifted to the frontage zone.

THE PEDESTRIAN ZONE

The Pedestrian Zones involve the portion of the street that accommodates non-vehicular activity—walking as well as the business and social activities—of the street. These zones extend from the face of the building or edge of the private property to the face of the curb. Streets are the most extensively used civic spaces in the community. The Pedestrian Zones are comprised of three functional elements:

- The Frontage Zone
- The Sidewalk Clear Zone
- The Buffer/Furnishing/Curb Zone

PEDESTRIAN ZONE POLICY GUIDANCE

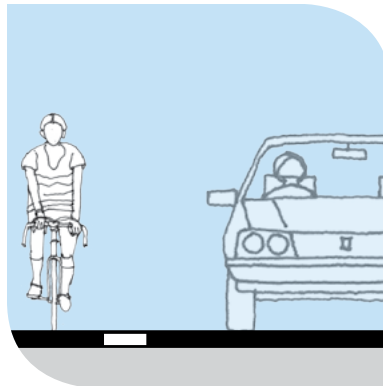
1. **Maximize Safety**—Sidewalks should be located on both sides of all streets to reduce the need for pedestrians to cross the street in order to access a safe walking area. Driveways and other elements should be minimized and designed to enhance pedestrian safety.
2. **Provide a Comfortable Walking Environment**—Roadway design should strive to maximize the buffer between pedestrians and adjacent motor vehicle traffic. On-street parking provides an excellent buffer and is encouraged. Street trees and planting strips or furnishing zones also make excellent buffers. Sidewalks should only be placed at the back of the curb in extremely constrained conditions.
3. **Promote Active and Inviting Building Frontages**—Ground-level land uses and building frontages should encourage foot traffic. Building entrances should be visible and easily accessible from the sidewalk. The transparency of building frontages should be maximized (e.g., fences and blank facades in mixed-use commercial areas should not be allowed) and elements such as sidewalk cafes, parklets, landscaping, and shading devices should be encouraged.
4. **Buffer Parking Areas**—Off-street parking should cover no more than 25 percent of the property frontage facing the street. Parking should generally be placed behind or underneath buildings or in structures. Where structures face the street, they should incorporate ground-floor uses that activate the pedestrian zone. In commercial areas, landscaping or small-scale commercial uses such as food vendors or kiosks should be provided to buffer parking from the pedestrian zone.
5. **Provide for Universal Access and Continuity**—The pedestrian zone should meet all applicable accessibility guidelines. The sidewalk should provide a smooth, stable, and slip-resistant surface. Surface materials and design should be consistent along street corridors. Users of all ages should be able to safely move within and across streets.
6. **Provide a Direct Route**—Sidewalks should align with crosswalks at intersections, and curves in the sidewalk should always serve a purpose. In most cases, sidewalks should be straight and follow the alignment of the roadway. It may be desirable in some locations for a sidewalk to curve to form a more direct route to an intersecting walkway, to preserve significant trees, or to provide a greater degree of separation between the sidewalk and the roadway for a distance.
7. **Provide Connectivity**—Convenient, safe, and comfortable pedestrian access linkages between adjacent land uses and the pedestrian zone should be addressed through the site planning process. Access should be provided to primary and secondary building access points, should maintain good sight lines, and should incorporate lighting where necessary. Pedestrian crossings at driveways and drive aisles should be minimized.
8. **Enhance Green Infrastructure**—The pedestrian zone should incorporate green infrastructure elements such as planting strips, street trees, and rain gardens. In physically constrained urban environments, there is a need for creative solutions such as pervious pavement and/or vegetated stormwater management features, stormwater planters, and tree box filters. The goal is to minimize impervious surfaces to reduce runoff and the heat island effect.
9. **Provide Pedestrian-Friendly Amenities**—The pedestrian zone should incorporate some pedestrian-friendly amenities such as including public art, street furniture, etc., that encourage pedestrians to linger and lends character to the street. This policy promotes the provision of these amenities through a combination of public and private investment.
10. **Maintenance**—Newly-constructed pedestrian facilities such as sidewalks, curb extensions, and plazas should be constructed with ease and efficiency of maintenance in mind. Maintenance of features within the pedestrian zone such as landscaping, street furniture, and pedestrian lighting should be achieved through public-private partnerships utilizing mechanisms such as Business Improvement Districts.
11. **Promote a Cohesive and Legible Walking Environment**—While street and land use character and conditions may change from block to block and require context-sensitive design solutions, unifying elements such as sidewalk material and joint pattern, street trees and landscaping, street furniture, and wayfinding signage help to create a cohesive and comfortable walking environment.
12. **Coordination with Land Use Decisions and Designations**—Provision of sidewalks should be made a priority, no matter the land use designation of adjacent properties.

THE STREET ZONE DEFINED



The Parking Zone

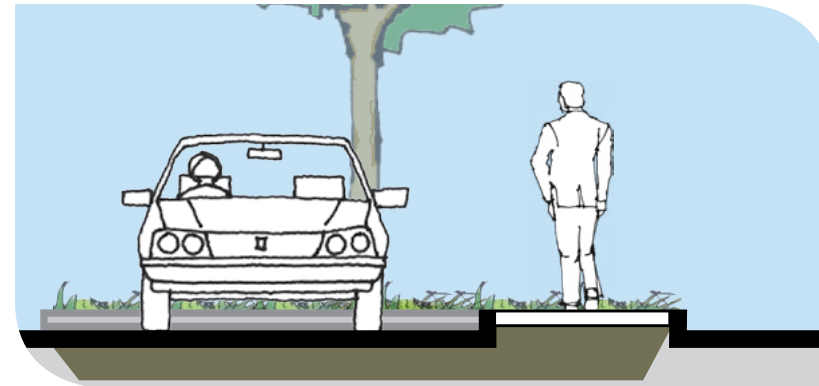
The parking zone is adjacent to the curb and may be parallel, perpendicular, angled, or back-in diagonal parking, which is preferred when adjacent to bike lanes. The presence of on-street parking increases street activity, meets the parking needs of adjacent uses, and protects pedestrians from moving traffic. On-street parking increases pedestrian comfort by providing a buffer between pedestrians and moving traffic; slows traffic, making pedestrian crossing safer; and increases the economic activity of a street. The parking zone may double as a travel lane at peak hours in high traffic areas or be dedicated for parking through the use of bulb outs. The parking zone is not an essential component of all streets as on-street parking may not be appropriate or necessary on some streets.



The Travelway Zone

The travelway zone is the portion of the street that is reserved for vehicular travel, including transit, bicycle, and other two wheelers. Speed and width are important in designing the travelway in walkable contexts. Because of the pedestrian-oriented nature of these areas, the target speed should be kept low (25–30 miles per hour). Lower speeds improve the user's perception of the street, creates a safer environment, accommodates parking maneuvers, and is consistent with restricted sight distances encountered in urban places.

The width of the travelway affects users' perceptions of the speed and volume of the street. Wide travelways may be perceived as a barrier to crossing where frequent crossings are desired and encouraged.



The Median Zone

Medians are the center portion of a street that separates opposing directions of travel. Medians vary in width and purpose and can be raised with curbs or painted and flush with the pavement. Medians on low-speed urban thoroughfares are used for access management, accommodation of turning traffic, safety, pedestrian refuge, and landscaping. Well-designed and landscaped medians can serve as a focal point of the street or an identifiable gateway into a community, neighborhood, or district. Medians can be used for landscaping, lighting, and urban design features.

Wider medians provide pedestrian refuge at long intersection crossings and midblock crossings. Medians are not an essential element for all streets. They are specified in the Thoroughfare Plan if considered necessary for thoroughfares.

THE STREET ZONE

The Street Zones support adjacent land uses and should be designed to balance the efficiency of motor vehicle travel with considerations for pedestrians, bicyclists, and transit users. The Street Zones encompass the areas between the curbs and include the portion of the street that accommodates vehicular activity—transit, bicycle and motor vehicles. The Street Zones are comprised of three functional elements:

- The Parking Zone
- The Travelway Zone
- The Median Zone



The safety of vulnerable users is particularly important, as they are at greater risk when crashes occur.

STREET ZONE POLICY GUIDANCE

1. **Multimodal Streets**—The design of the traveled way should include considerations for every mode. Street space will be optimized to balance the needs of pedestrians, bicyclists, transit riders, and motorists, and will not be dominated by cars.
2. **Safety is a Paramount Concern**—Even if one mode is given priority within a street type, the design cannot compromise the safety of any mode for the benefit of another. The safety of vulnerable users is particularly important, as they are at greater risk when crashes occur.
3. **Design for Slower Speeds**—The safety and comfort of pedestrians and bicyclists is negatively impacted by fast motor vehicle traffic. For street types oriented to pedestrian and bicycle travel, motor vehicle speeds should be slower. A wide variety of roadway design strategies can help to reduce motor vehicle speeds without causing undue frustration for drivers. These are discussed later in this chapter.
4. **Street Design Should Reinforce Adjacent Land Uses**—The design of the traveled way should complement and reinforce adjacent uses. This approach can help to increase property values and foot traffic to local businesses.

TRADE-OFFS IN LIMITED RIGHT-OF-WAY

A primary goal of the corridor planning stage of the Complete Streets improvement process described in Chapter 1 is to define conceptual cross sections of the street to include the desired design elements within the available right-of-way. The majority of streets in Dallas serve already developed areas. Acquisition of additional right-of-way to accommodate a new design will typically be the option of last resort.

The Design Priorities Chart is provided to help clarify the relative importance of each zone and sub-zone in the right-of-way.

Designing streets in constrained rights-of-way necessarily involves balancing priorities for various design elements. Higher priority design elements are those that enable the street to meet the context sensitive community vision. Establishing design priorities requires re-cycling through the steps of the design process, potentially requiring a review of the community vision for the context and street relationship.

Often the width of the public right-of-way varies along existing streets, making the job of the designer more challenging. When identifying priorities for design elements in the context of street segments with varying right-of-way widths, it is advisable to explore conceptual cross-section options that address the priorities for the typical range of widths available, and to understand the issues that arise at the transition points from one cross-section to another.

If the vision for the corridor is long range, then the necessary right-of-way for a more desired cross section may be acquired over time as the adjacent property redevelops. Under these circumstances, the optimal roadway width may be phased in over time, beginning with a functional minimum design in the initial phase, where most of the higher priority elements can be accommodated within the predominant right-of-way width available. Consideration may also be given in these circumstances to the possibility of some design elements being incorporated into developments on private property as they occur. Examples of these include additional sidewalk width beyond the minimum, and elements within the frontage zone such as landscaping or sidewalk cafes.

The chart on the following page provides policy guidance for allocation of space between competing design elements within constrained right-of-way. The community should be engaged in setting street design priorities using the guidance in this chart as a starting point during the corridor planning phase of the Complete Streets design process. This chart should be used in conjunction with the Lane Width Chart to guide width choices for various design elements. It should also be used to guide decisions to relinquish lower priority design elements in some situations. It should also be used in conjunction with the Design Element Priorities Chart to guide appropriate use of design elements in various contexts.

PRIORITIES CHART FOR TRADE OFFS IN LIMITED RIGHT-OF-WAY

	Pedestrian Zone			Street Zone		
Contextual Street Types and Functional Classifications	Frontage Zone (private)	Sidewalk Clear Zone	Buffer/Furnishing/Curb Zone	Parking Zone	Travelway Zone	Median Zone
Mixed Use Streets						
Principal Arterial		1	2	5	4	3
Minor Arterial		1	2	3	4	5
Collector		1	2	3	4	5
Minor/Local		1	2	3	4	5
Commercial Streets						
Principal Arterial		1	3	5	1	4
Minor Arterial		1	4	5	2	3
Collector		1	3	4	2	5
Minor/Local		1	4	3	2	5
Residential Streets						
Principal Arterial		1	2	5	3	4
Minor Arterial		1	4	2	5	3
Collector		1	4	2	3	5
Minor/Local		1	4	2	3	5
Industrial Streets						
Principal Arterial		2	3	4	1	5
Minor Arterial		2	3	4	1	5
Collector		2	3	4	1	5
Minor/Local		2	3	4	1	5
Parkways						
Principal Arterial		2	4	5	3	1
Minor Arterial		2	4	5	3	1
Collector		2	4	5	3	1
Minor/Local		5	1	4	3	2

High Priority
Medium Priority
Low Priority

General Notes:

1. The numbers rank various zones between 1 and 5, with one being the highest priority and 5 being the lowest. The priority level is intended to guide width choices (low priority means minimum width, high priority means desired width).
2. Refer to the On-Street Bike and Transit Facility Priorities Chart later in this chapter for additional guidance on the travelway zone.
3. The Parking and Median Zones are not essential on all streets. A low priority ranking for these zones implies that they may be eliminated. A high priority implies that it is desirable to include them even if minimum dimensions are used.
4. The Frontage Zone priorities shown in this chart reflect the importance of using the public right-of-way for this zone. A low priority implies that the Frontage Zone should be incorporated on private property. A high priority implies that allowing this zone to expand into the right-of-way is an important consideration.
5. For streets within a 1/4 mile radius of train stations as shown on the Vision Maps, the Sidewalk Clear Zone and the Buffer/Furnishing Zone should be given a High Priority.
6. This chart is intended to be used as a starting point for engaging the community in setting design priorities during the corridor planning stage of the Complete Streets process.

STREET ELEMENTS WIDTHS

The Recommended Width Chart for Dallas Complete Streets Elements presents proposed guidelines by street type in the City of Dallas. The widths shown in the chart should be considered minimums in new construction, major reconstruction, and retrofit street design. A design exception may be required for some values on federal or state-funded projects.

Engineering judgment is necessary to make final determinations regarding widths. In response to specific conditions on a given street, such as constrained right of way or specific types of uses, widths that are different from those in the chart may be required. The City of Dallas will make the final determination on appropriate widths on a project-by-project basis.

General Notes:

- Consult the *DART 2030 Transit System Plan* for locations of existing and future transit lanes and facilities.
- Consult the *Dallas Bike Plan* for proposed locations and types of bicycle facilities.

Specific Notes:

1. Local streets are also covered by the subdivision code.
2. Where ranges are shown for preferred width, the width should be based on anticipated volumes.
3. Widths for the Frontage Zone are not included in this chart. Frontage Zone widths are controlled by local zoning.
4. For all streets within a 1/4-mile of transit stations, regardless of street type, a minimum six foot clear pedestrian through zone must be provided.
5. Street trees are preferred on thoroughfare streets. In locations where there is insufficient width for street trees, these minimum values apply.
6. Additional width in the curb zone beyond six inches should be calculated as a part of the Buffer/Furnishing Zone.
7. Decisions regarding parking lane width when adjacent to bicycle lanes should consider parking turnover rates. In areas with higher turnover rates, such as on Mixed-Use street types, consider providing a door zone buffer or wider bicycle lanes.
8. Back-in angled parking is preferred to front-in angled parking due to safety benefits for pedestrians and bicyclists.
9. Flex lanes are parking lanes that convert to travel lanes during peak hour commuting times. Twelve-feet is the minimum width of a flex lane to accommodate bicycles and parked vehicles during off-peak times.
10. Minimum width is suitable only in locations with low truck traffic,

typically less than eight percent.

11. In locations where insufficient widths do not provide room for separate bicycle facilities, roadways must be shared by bicyclists, motor vehicle drivers, and transit vehicles. Shared lane markings can be installed on lanes of any width, in locations with and without parking. However markings should not be provided on roadways with speeds greater than 35 mph. Specific details on placement are provided in the latest edition of the MUTCD.
12. 12 Shared travelways on local streets generally do not use centerlines. Local streets are also covered by the subdivision code.
13. 13 This may include street trees.

RECOMMENDED WIDTH CHART FOR DALLAS COMPLETE STREETS ELEMENTS

	Mixed-Use Streets		Commercial Streets		Residential Streets ¹		Industrial Streets		Parkways	
Recommended Designation	Min	Pref	Min	Pref	Min	Pref	Min	Pref	Min	Pref
Pedestrian Zone²										
Frontage zone: ³										
Frontage zone ³	-	-	-	-	-	-	-	-	-	-
Sidewalk clear zone: ⁴										
Sidewalk clear zone	6'	8'-15'	5'	6'-10'	5'	5'-10'	5'	5'-7'	5'	8'-10'
Buffer/furnishing zone:										
Buffer with street tree	6'	8'	6'	10'	6'	10'	6'	10'	6'	20'
Buffer (adjacent to on-street parking) ⁵	2'	6'	2'	6'	2'	7'	2'	7'	-	-
Buffer (adjacent to travel lane, on-street parking not permitted) ⁵	5'	8'	5'	10'	5'	10'	5'	7'	5'	20'
Curb zone: ⁶										
Curb zone width ⁶	6"	1'-2'	6"	1'-2'	6"	1'-2'	6"	1'-2'	6"	1'-2'
Street Zone										
Parking zone: ⁷										
Parallel parking	7'	8'	-	-	7'	8'	7'	8'	-	-
Back-in angled parking ⁸	15'	22'	-	-	15'	22'	15'	22'	-	-
Flex lane ⁹	12'	15'	-	-	-	-	-	-	-	-
Travelway zone—lanes on thoroughfares:										
General purpose inside travel lane ¹⁰	10'	11'	10'	11'	9'	10'	11'	12'	10'	11'
Inside travel lane (adjacent to bicycle lane and parking lane)	10'	10'	-	-	10'	10'	11'	12'	-	-
Inside travel lane (adjacent to bicycle lane and curb, parking not permitted)	10'	10'	10'	11'	10'	10'	11'	12'	10'	12'
Left-turn lane	9'	10'	10'	10'	9'	10'	10'	11'	10'	10'
Two-way left turn lane	10'	12'	10'	12'	9'	12'	11'	12'	-	-
Shared use lane (adjacent to on-street parking, includes streetcars) ^{10, 11}	10'	12'	-	-	10'	10'	11'	12'	-	-
Shared use lane (adjacent to curb, parking not permitted,) ^{10, 11}	10'	12'	10'	12'	10'	10'	11'	12'	10'	12'
Travelway zone—lanes on local (non-thoroughfare plan) streets: ¹²										
Two-directional two-lane roadway (curb to curb width, parking permitted)	26'	26'-36'	-	-	26'	26'	36'	36'	-	-
Two-directional two-lane roadway (curb to curb width, parking not permitted)	18'	18'	20'	20'	18'	18'	22'	22'	18'	18'
Travelway zone—bicycle facilities: ²										
Paved shoulder (with curb)	-	-	-	-	5'	8'	5'	8'	5'	8'
Paved shoulder (without curb)	-	-	-	-	4'	8'	4'	8'	4'	8'
Bicycle lane (parking permitted)	5'	6'	5'		5'	6'	5'	6'	-	-
Bicycle lane (parking not permitted, curb and gutter present)	5'	5'	5'	6'	5'	5'	5'	5'	5'	6'
Bicycle lane/paved shoulder (parking not permitted, no curb and gutter)	-	-	4'	8'	4'	5'	4'	5'	4'	8'
Buffered bicycle lane (includes buffer)	7'	9'	7'	12'	7'	12'	7'	12'	7'	12'
Cycle track (one-way, includes buffer)	8'	10'	8'	10'	8'	10'	8'	10'	8'	13'
Cycle track (two-way, includes buffer)	11'	13'-18'	13'	13'-18'	13'	13'-18'	13'	13'-18'	13'	13'-18'
Travelway zone—transit lanes:										
Bus-only lanes	11'	12'	11'	12'	11'	12'	11'	12'	11'	12'
Bus and bicycle-only lanes	11'	14'-16'	11'	14'-16'	11'	14'-16'	11'	14'-16'	11'	14'-16'
Median zone:										
Pedestrian refuge	6'	-	6'	-	6'	-	6'	-	6'	-
Continuous with landscaping ¹³	6'	15'	6'	15'	6'	15'	10'	15'	6'	20'
Continuous without landscaping	4'	15'	4'	15'	4'	15'	4'	15'	4'	20'



Shared lane markings and wayfinding signage along Martin Luther King, Jr. Boulevard

COMPLETE STREETS DESIGN ELEMENTS

A variety of design elements may be considered for inclusion on specific streets in order to achieve the design character and target speed that is appropriate to the street context. The following Design Element Priorities Chart provides a quick reference for prioritization of key design elements to be considered in the Pedestrian, Street, and Intersection Zones according to Complete Streets type. The design elements are organized in this chart according to sections in Chapters 4, 5, and 6 where more detailed design guidance is provided for each design element.

DESIGN ELEMENT PRIORITIES CHART

	Pedestrian Zone												Street Zone								Intersection Zone																	
	Wide Sidewalks	Shared Use Paths	Trees and Greenscape (Buffer Zone)	Seating	Bicycle Parking Facilities	Bollards	Newspaper Racks	Recycling/Garbage Cans	Transit Stops	Limited Curb Cuts and Driveways	Plazas/PocketParks/Parklets	Sidewalk Cafes	Pedestrian Lighting	Information Kiosks	Pedestrian Signage	Bicycle Signage	Slip Streets	Couplets	Shared Streets (Woonerfs) ⁴	Trees and Greenscape (Median)	On-street Parking	Road/Lane Diet ⁵	Chicanes	Midblock Pedestrian Crossings	Special Pavement Treatment/Speed Tables ⁴	Street Lighting	Multimodal Intersection Design	Curb Extensions/Bulbouts	Modern Roundabouts	Traffic Circles	Crossing Islands ²	Special Pavement Treatment/Speed Tables	Special Pedestrian Signals	Special Bicycle Treatments ³	Special Transit Treatments			
Contextual Street Type Overlays																																						
Mixed-Use Streets	■			■	■	■	■	■		■	■	■	■	■	■	■		■	■			■	■	■	■	■	■	■		■	■	■	■	■				
Commercial Streets	■	■		■	■	■					■		■					■		■		■		■	■	■	■	■	■	■	■	■	■	■	■			
Residential Streets	■			■								■	■					■	■			■		■		■	■		■		■	■	■	■	■			
Industrial Streets	■		■		■							■	■							■	■		■		■	■	■	■		■	■	■	■	■	■			
Parkways	■	■	■	■	■						■	■						■				■					■		■					■				
Bike and Transit Network Overlays																																						
Bike Network Overlay					■				N/R	■							■						■				■								■	N/R		
Transit Network Overlay ¹	■	N/R	■						■			■	■	■	■	N/R			■				■	■	■			■			■				N/R			

General Notes:

- Guidance for choice of bicycle facilities and transit facilities within the travelway based on Complete Street type is provided in the Bike and Transit Network Facility Priorities Chart.
- The guidance in this chart for Bike Network and Transit Network Streets should be considered in conjunction with the underlying contextual street types on which they are overlaid.
- More detailed design guidance on each design element is provided in Chapters 4, 5, and 6.
- Incorporation of Green Street and ISWM techniques to reduce stormwater run-off and improve energy efficiency are a primary consideration for all street types in all zones.

Primary Consideration
Secondary Consideration
Optional Consideration
Not Desirable
N/R Not Relevant

Specific Notes:

- The guidance in this chart for transit network streets also applies to all street types that are located within a 1/4-mile radius of DART rail stations.
- The guidance in this chart assumes that crossing islands are only relevant on divided roadways.
- Note that bicycle boxes as a special bike treatment at intersections are a primary consideration on streets with dedicated bike facilities and more than two lanes of traffic. See Chapter 6 for more detailed guidance.
- Shared Streets and Special Pavement Treatments may be appropriate on streetcar corridors.
- Road diets require a traffic impact analysis to assess the impacts on the roadway network.



Bicycle and transit facilities—when integrated—typically exist in a symbiotic relationship. That is, each mode generates additional usage for the other mode.

INCORPORATING A BICYCLE AND TRANSIT FACILITY NETWORK WITHIN STREETS

The Vision Map titled “Bike Network and Transit Network Overlay” identifies streets where bike facilities and transit facilities are envisioned to be priorities based on the *Dallas Bike Plan* and long range transit system planning efforts by DART and the City of Dallas. These networks are generally intended to provide continuous bike and transit connectivity across the city. They typically extend along long street stretches that may have a variety of Complete Streets types. It is anticipated that there will be opportunities during the corridor planning stage for proposed Complete Streets improvement projects to consider and refine the choice of bike and transit facility types to be included within the travelway zone of these streets.

The following chart provides general policy guidance for selection of appropriate bike and transit facility types for Bike and Transit Network streets based on the contextual street type and functional classification. It is intended to be used in conjunction with the other charts in this chapter to engage the community in defining the key conceptual design components and priorities for specific street improvement projects, and to help make trade-offs for use of limited right-of-way space in constrained situations. It should be noted that besides the Bike and Transit Network streets identified in the Vision Map, all city streets may be designed to accommodate bikes and transit, albeit without dedicated facilities.

BIKE AND TRANSIT NETWORK FACILITY PRIORITIES CHART									
Contextual Street Types and Functional Classification	Bike Network Facilities						Transit Network Facilities		
	Signed Route Only (No Lane Markings)	Paved Shoulders (Signed Route)	Bike Boulevards	Shared Bicycle Lane Markings ²	Bicycle Lanes	Buffered Bicycle Lanes / Offset Bicycle Lanes ⁴	Cycle Track (One-Way or Two-Way) ⁵	Shared Lanes ³	Priority Transit Lanes ⁶
Mixed Use Streets									
Principal Arterial									
Minor Arterial									
Collector									
Minor/Local									
Commercial Streets									
Principal Arterial									
Minor Arterial									
Collector									
Minor/Local									
Residential Streets									
Principal Arterial									
Minor Arterial									
Collector									
Minor/Local									
Industrial Streets									
Principal Arterial									
Minor Arterial									
Collector									
Minor/Local									
Parkways									
Principal Arterial									
Minor Arterial									
Collector									
Minor/Local									

	Preferred
	Acceptable
	Need Site Specific Review
	Not Desired

General Notes:

- This chart is intended as a quick reference during the corridor planning stage to guide choices of bike and transit facility types within the travelway zone for Complete Streets projects on streets included in the Bike Network and Transit Network Overlay Vision Map.
- This chart should be used in conjunction with the Priorities Chart for Trade-Offs in Limited Right of Way.
- The guidance in this chart is based on the recommended target speed ranges for each contextual street type and functional class identified in the Target Speed Chart. Note that the Operational Speed must also be considered in situations where the desired target speed is not achievable through design measures within the scope of a street improvement project.
- Refer to the *Dallas Bike Plan* for facility type recommendations for specific bike network streets.
- Refer to Chapter 5 and the *Dallas Bike Plan* for definitions and design guidance for the various bicycle and transit facility types included in this chart.

Specific Notes:

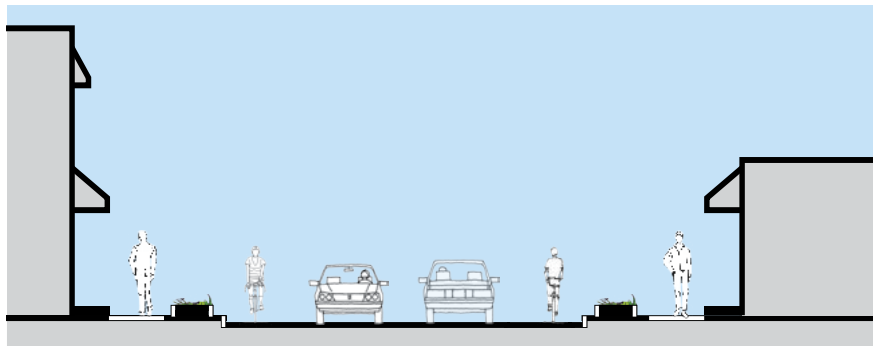
1. Bike Network Facilities may also include shared use paths that would typically be located within the pedestrian zone. Refer to the Design Element Priorities Chart for guidance on shared use paths based on Complete Streets type.
2. Shared Bicycle Lane Markings are not desirable on streets with target speeds exceeding 30 mph or on Shared Lanes with rail transit. Shared Lane Markings on two-lane roadways require special site-specific review relative to traffic volume and speeds.
3. Shared Lanes for buses may also include Shared Bicycle Lane Markings if the target speed does not exceed 30 mph.
4. Buffered Bicycle Lanes or Offset Bicycle Lanes are preferred in situations where bicycle lanes are provided adjacent to designated on-street parking.
5. Cycle Tracks are preferred for bike routes on heavily-travelled roadways with target speeds exceeding 40 mph and where space is available to provide a physical separation.
6. Priority Transit lanes are not desirable on two-lane roadways.

STREET CROSS SECTIONS FOR VARIOUS STREET TYPES AND RIGHTS-OF-WAY EXAMPLES

The following cross section examples illustrate how the Priorities Chart for Trade-Offs in the Public Right-of-Way on page 81 can be used to configure Complete Streets in different situations. The cross sections do not represent specific streets for specific situations.

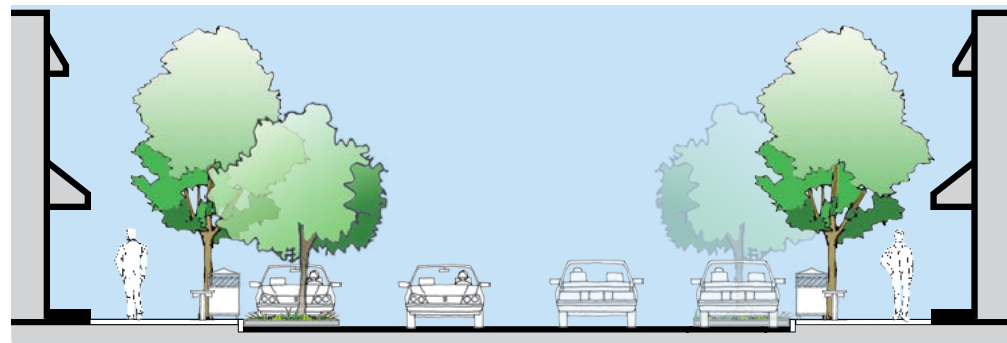
MIXED-USE STREET EXAMPLES

EXAMPLE MIXED-USE TYPOLOGY CROSS SECTION: 50' ROW



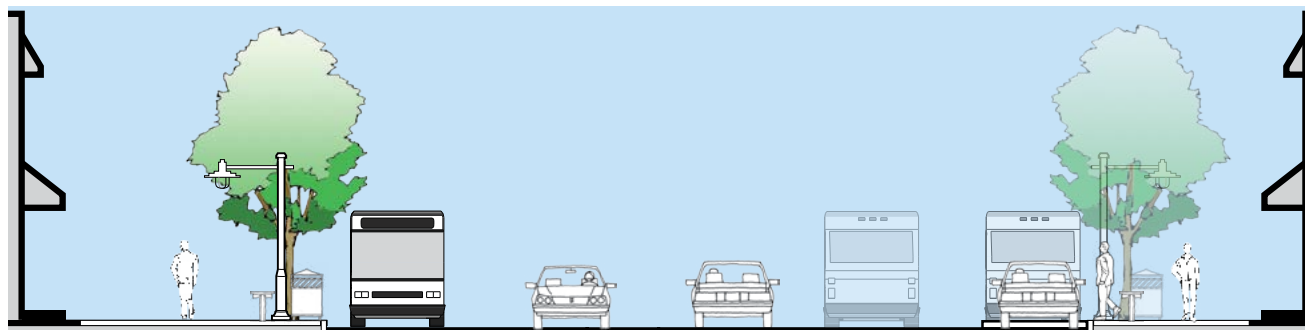
Private Property	Sidewalk	Buffer	Bike Lane	Travel Lane	Travel Lane	Bike Lane	Buffer	Sidewalk	Private Property
	5'	5'	5'	10'	10'	5'	5'	5'	
Total Width: 50'									
	Min.	Min.	Pref.	Min.	Min.	Pref.	Min.	Min.	

EXAMPLE MIXED-USE TYPOLOGY CROSS SECTION: 60' ROW



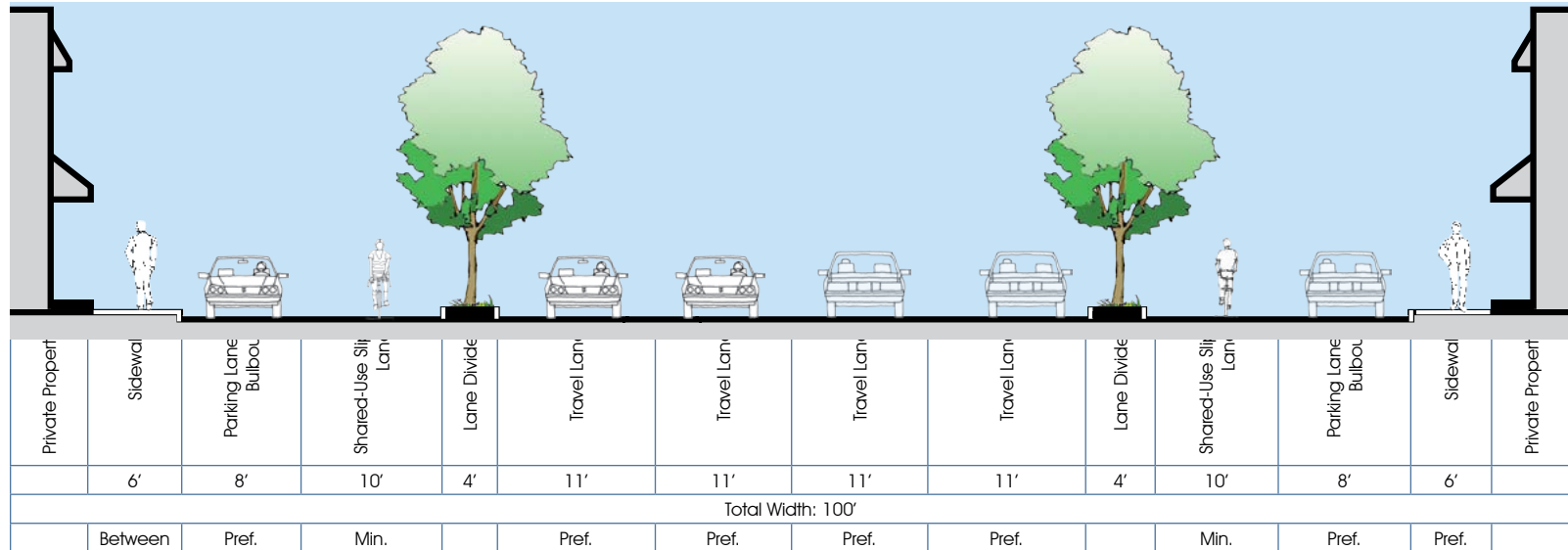
Private Property	Sidewalk	Street Trees and Streetscape Furniture	Parallel Parking with Planted Bulb	Travel Lane	Travel Lane	Parallel Parking	Buffer	Sidewalk	Private Property
	5'	6'	8'	11'	11'	8'	6'	5'	
Total Width: 60'									
	Min.	Pref.	Pref.	Pref.	Pref.	Pref.	Pref.	Min.	

EXAMPLE MIXED-USE TYPOLOGY CROSS SECTION: 80' ROW

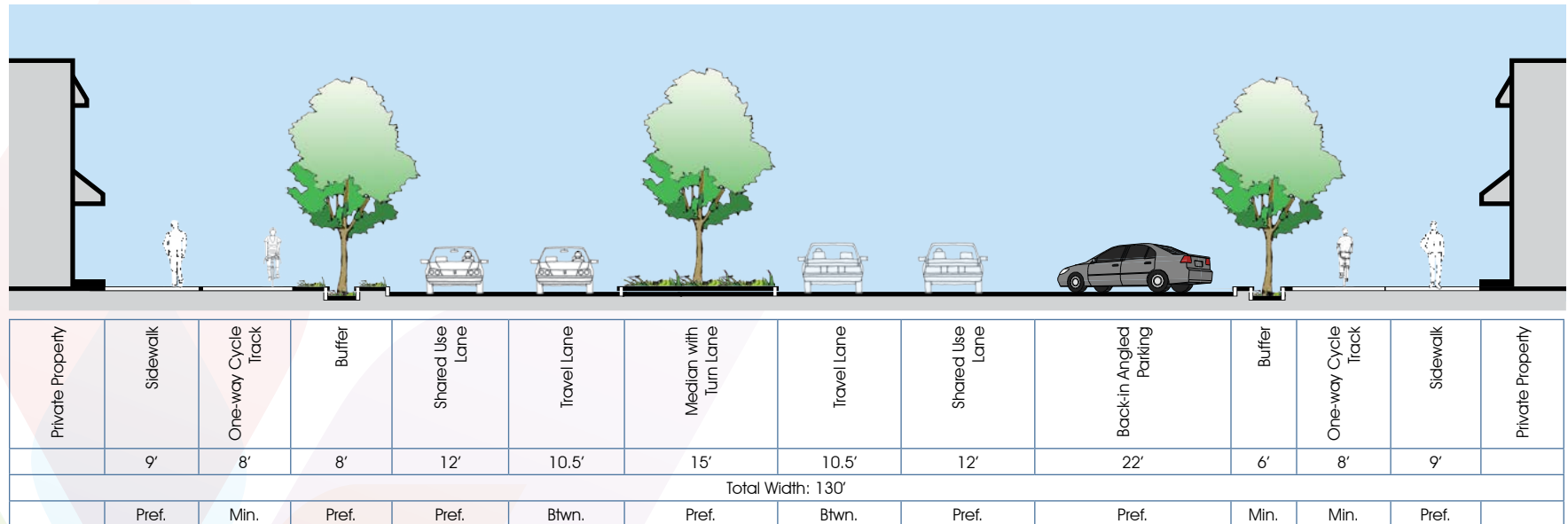


Private Property	Sidewalk	Landscaping and Furniture	Transit-only Lane	Travel Lane	Travel Lane	Transit-only Lane	Parallel Parking/Transit Stop	Landscaping and Furniture	Sidewalk	Private Property
	8'	8'	12'	11'	11'	12'	8'	4'	6'	
Total Width: 80'										
	Pref.	Pref.		Pref.	Pref.		Pref.	Min.	Pref.	

EXAMPLE MIXED-USE TYPOLOGY CROSS SECTION: 100' ROW

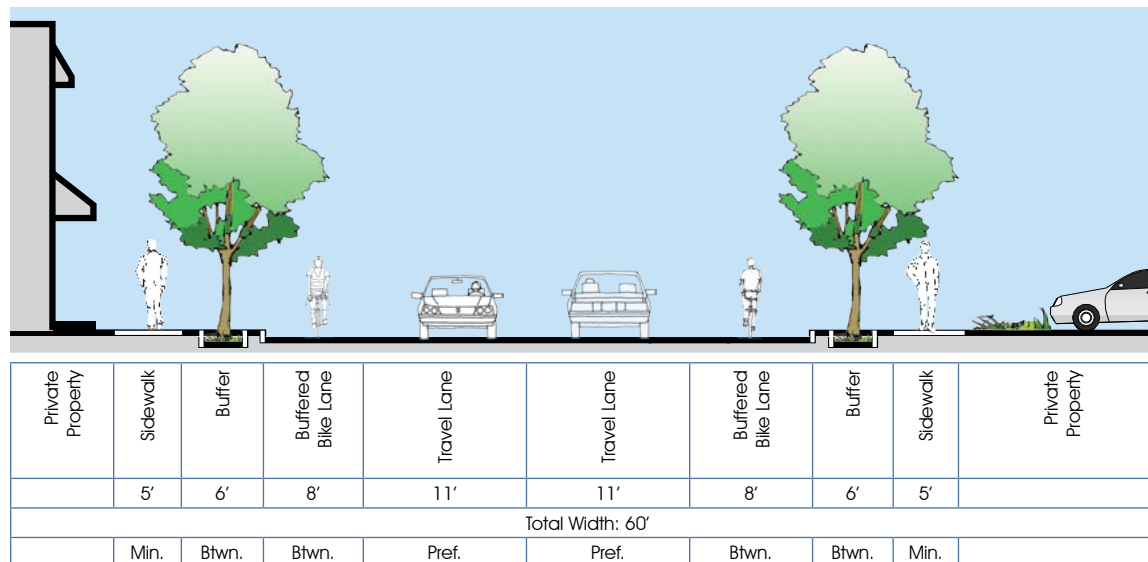


EXAMPLE MIXED-USE TYPOLOGY CROSS SECTION: 130' ROW

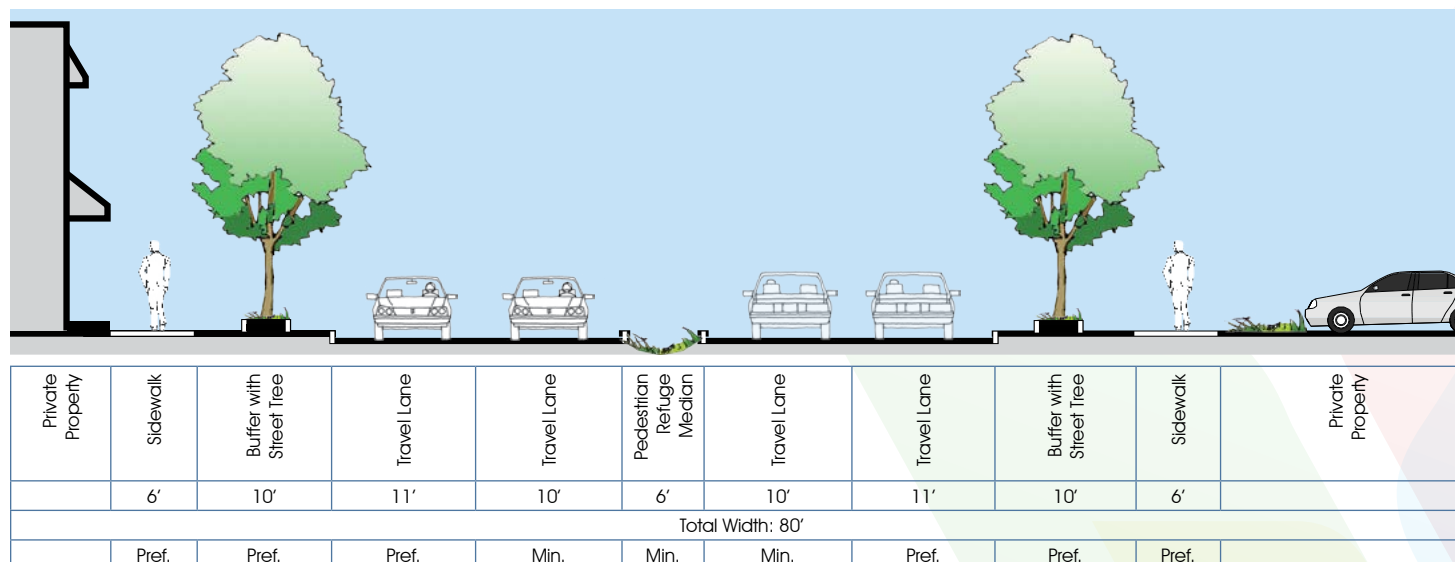


COMMERCIAL STREET EXAMPLES

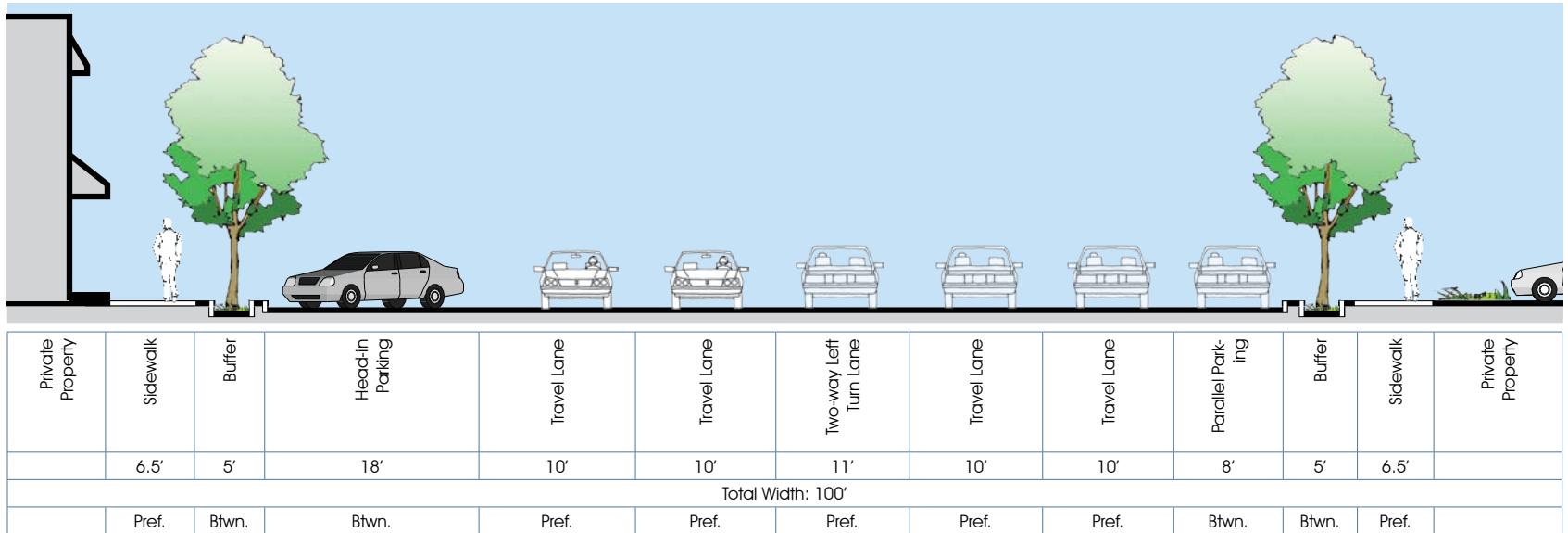
EXAMPLE COMMERCIAL TYPOLOGY CROSS SECTION: 60' ROW



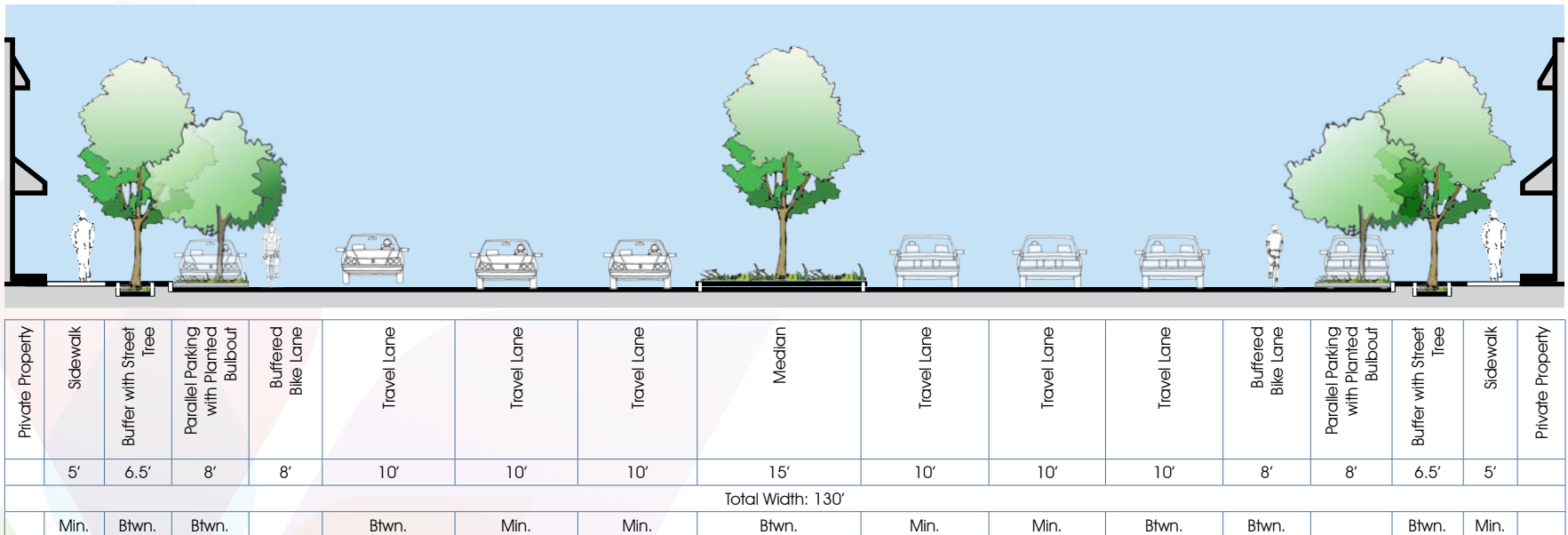
EXAMPLE COMMERCIAL TYPOLOGY CROSS SECTION: 80' ROW



EXAMPLE COMMERCIAL TYPOLOGY CROSS SECTION: 100' ROW

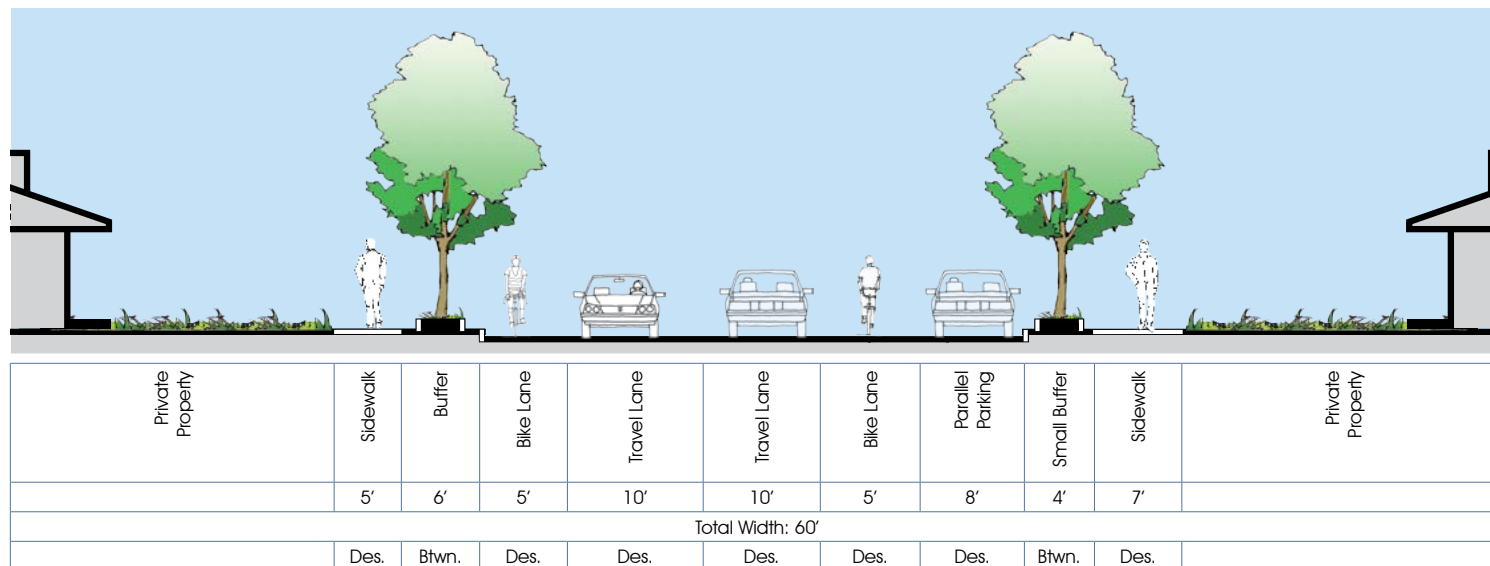


EXAMPLE COMMERCIAL TYPOLOGY CROSS SECTION: 130' ROW

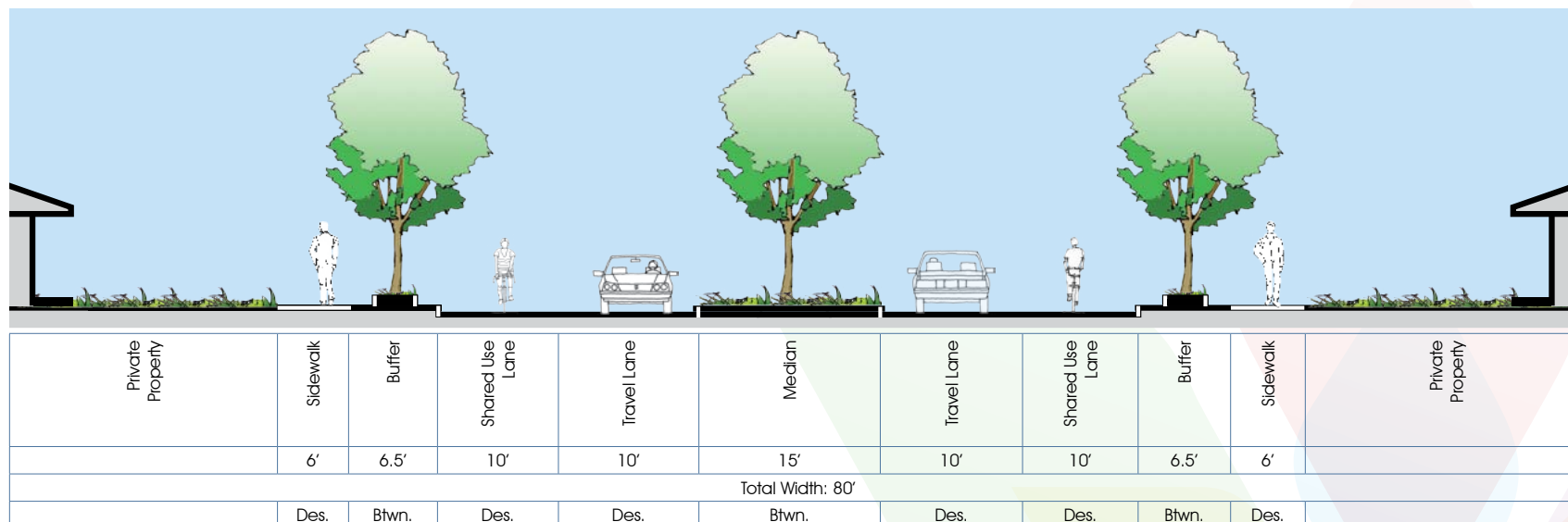


RESIDENTIAL STREET EXAMPLES

EXAMPLE RESIDENTIAL TYPOLOGY CROSS SECTION: 60' ROW



EXAMPLE RESIDENTIAL TYPOLOGY CROSS SECTION: 80' ROW



EXAMPLE RESIDENTIAL TYPOLOGY CROSS SECTION: 100' ROW



Private Property	Sidewalk	Buffer	Buffered Bike Lane	Travel Lane	Travel Lane	Median	Travel Lane	Travel Lane	Buffered Bike Lane	Buffer	Sidewalk	Private Property
	5'	7'	8'	10'	10'	15'	10'	10'	8'	7'	10'	
Total Width: 100'												
	Des.	Btwn.	Btwn.	Des.	Des.	Des.	Des.	Des.	Btwn.	Des.	Des.	

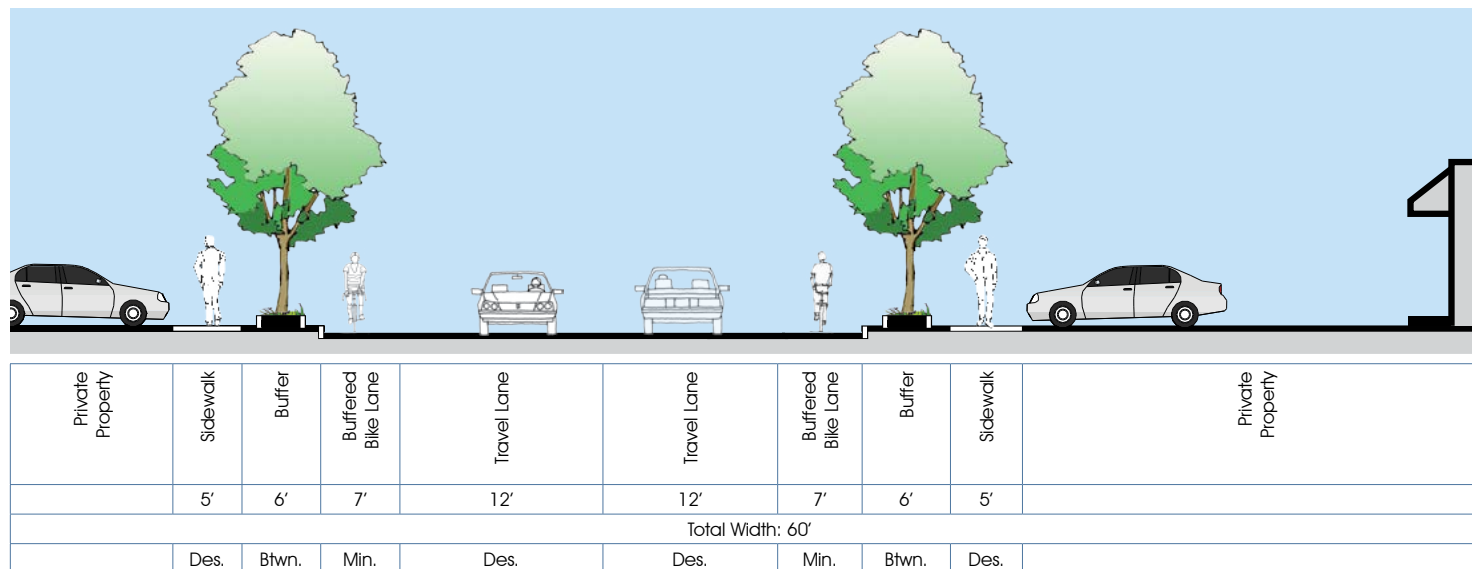
EXAMPLE RESIDENTIAL TYPOLOGY CROSS SECTION: 130' ROW



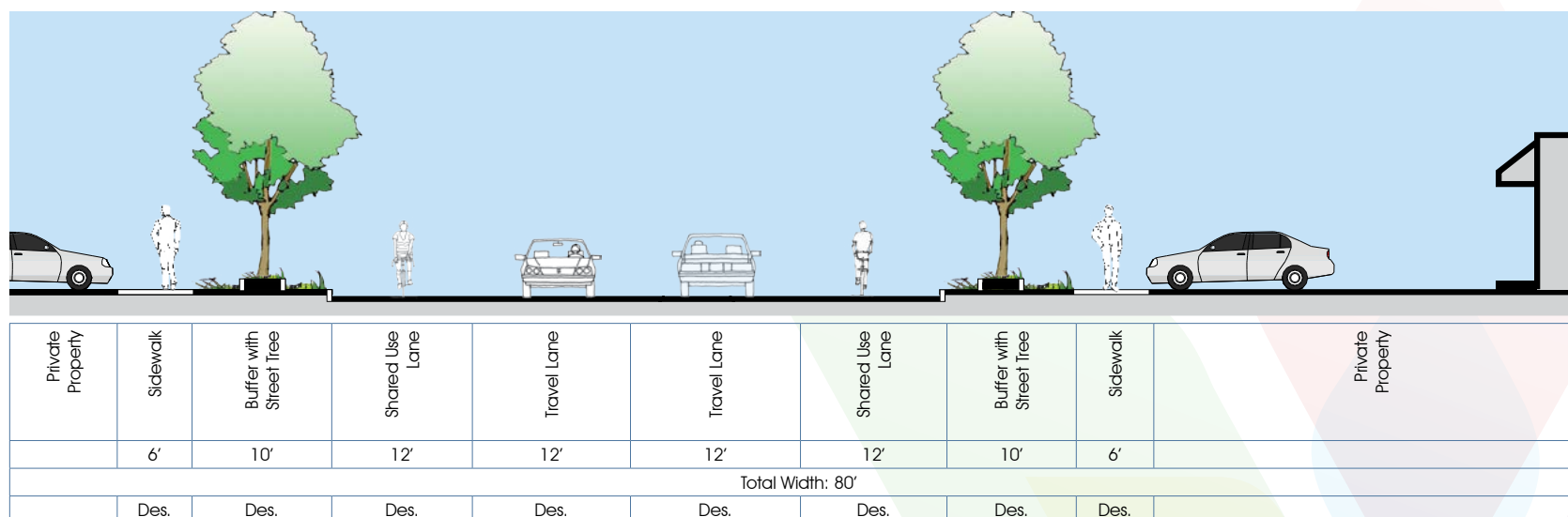
Private Property	Sidewalk	Buffer	Back-in Angled Parking	Buffered Bike Lane	Travel Lane	Travel Lane	Median	Travel Lane	Travel Lane	Buffered Bike Lane	Back-in Angled Parking	Buffer	Sidewalk	Private Property
	6.5'	8'	18'	8'	10'	10'	15'	10'	10'	8'	18'	7'	6.5'	
Total Width: 130'														
	Des.	Des.	Des.	Des.	Des.	Des.	Des.	Des.	Des.	Des.	Des.	Des.	Des.	

INDUSTRIAL STREET EXAMPLES

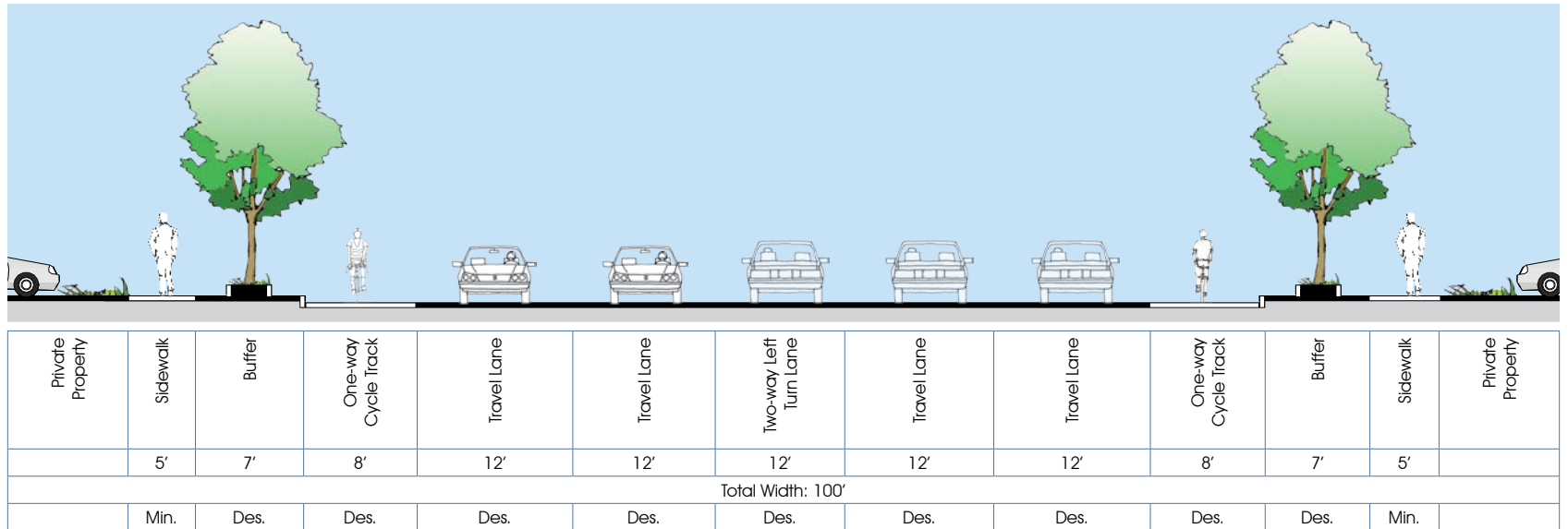
EXAMPLE INDUSTRIAL TYPOLOGY CROSS SECTION: 60' ROW



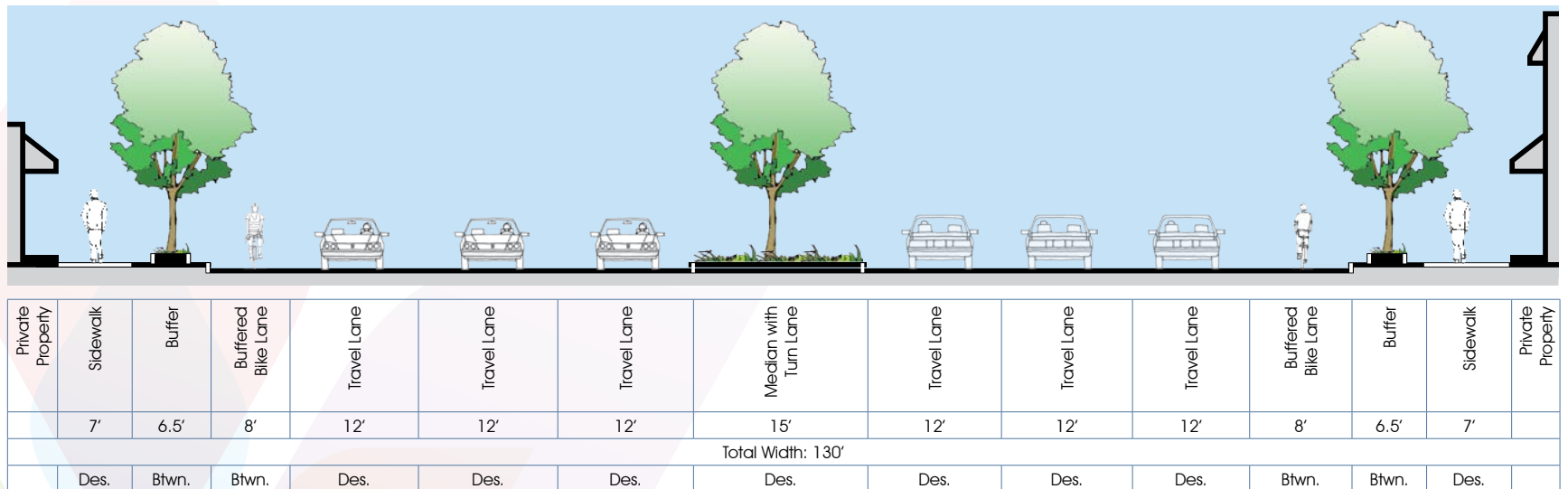
EXAMPLE INDUSTRIAL TYPOLOGY CROSS SECTION: 80' ROW



EXAMPLE INDUSTRIAL TYPOLOGY CROSS SECTION: 100' ROW

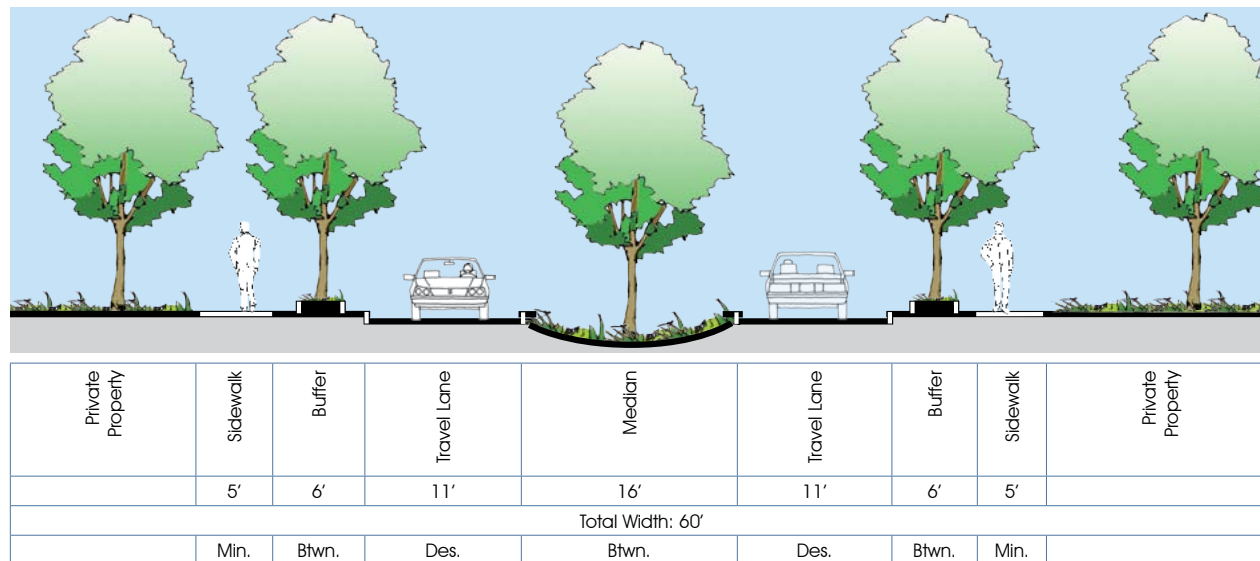


EXAMPLE INDUSTRIAL TYPOLOGY CROSS SECTION: 130' ROW

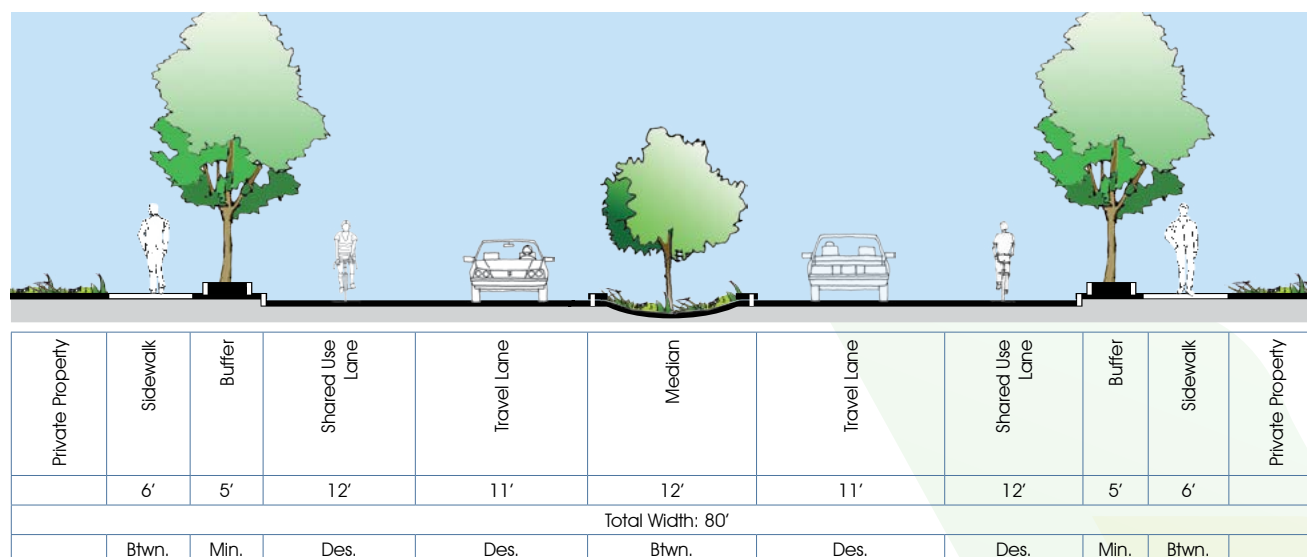


PARKWAY EXAMPLES

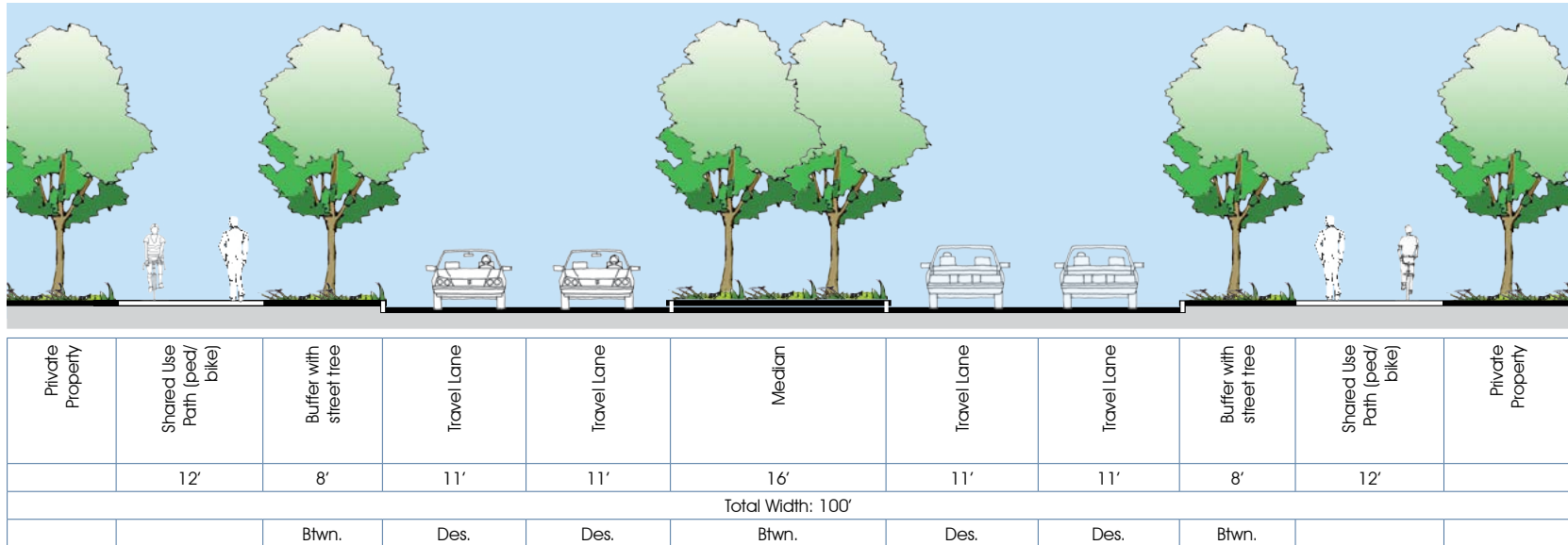
EXAMPLE PARKWAY TYPOLOGY CROSS SECTION: 60' ROW



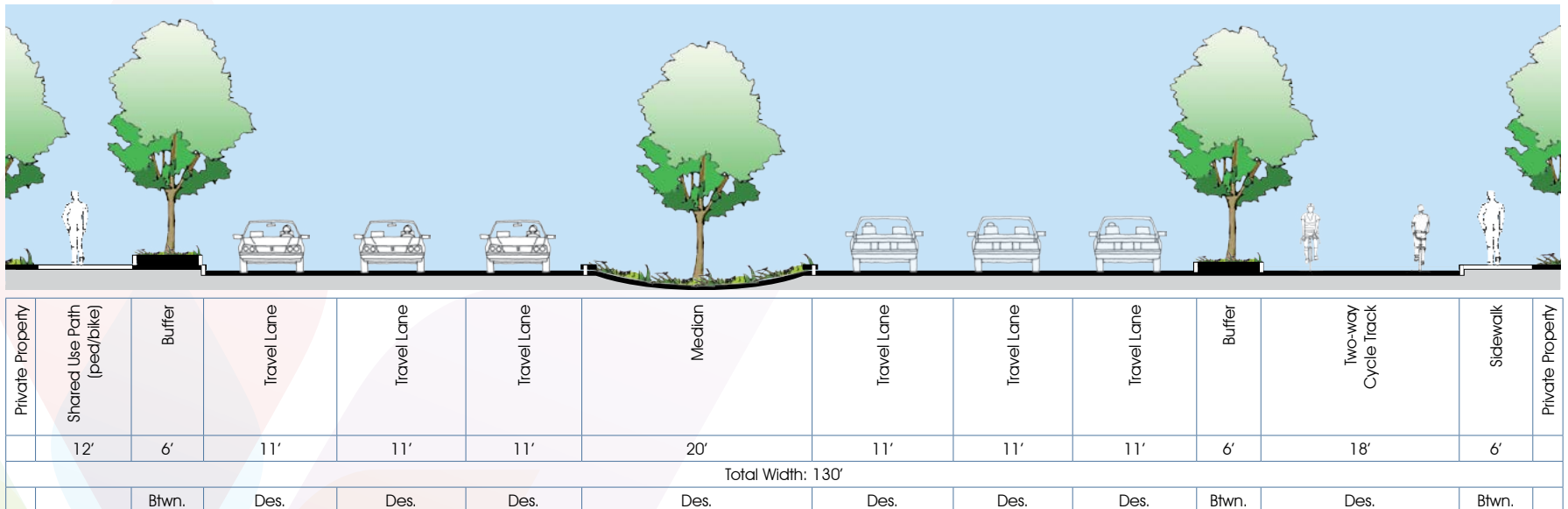
EXAMPLE PARKWAY TYPOLOGY CROSS SECTION: 80' ROW



EXAMPLE PARKWAY TYPOLOGY CROSS SECTION: 100' ROW



EXAMPLE PARKWAY TYPOLOGY CROSS SECTION: 130' ROW



DESIGN CONTROLS

An important resource in developing a successful Complete Street is the Institute of Transportation Engineers' *Designing Walkable Urban Thoroughfares: A Context Sensitive Approach*. It describes the physical, operational, policy, and multimodal characteristics that should be considered when selecting the design criteria that will affect the speed of vehicles.

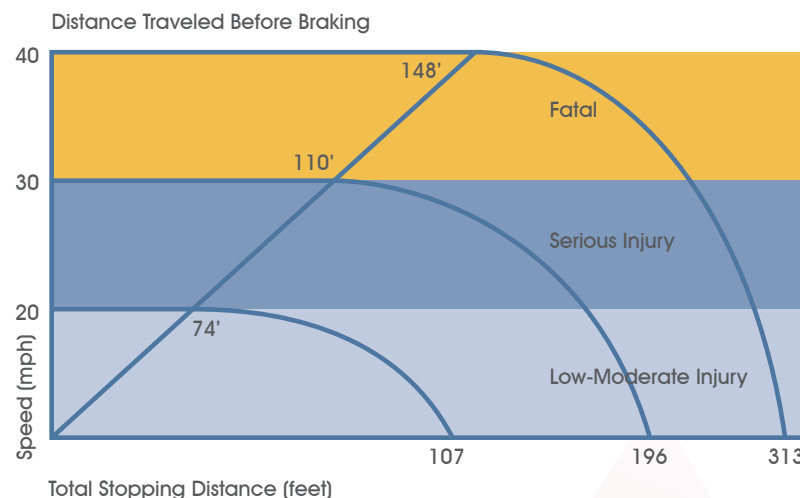
Design controls are the primary criteria used to guide the design of roadways. When designing walkable urban thoroughfares, it is important to carefully consider a broad range of design controls. Some design controls are fixed—such as terrain, climate and certain driver performance characteristics—but most controls can be influenced in some way through design and are determined by the roadway designer.

The American Association of State Highway and Transportation Officials' (AASHTO) *A Policy on Geometric Design of Highways and Streets (Green Book)* and *A Guide for Achieving Flexibility in Highway Design* identify design controls and establish design criteria. AASHTO identifies a number of design controls that have varying degrees of influence on thoroughfare design:

- Design vehicle
- Vehicle performance (acceleration and deceleration)
- Driver performance (age, reaction time, driving task, guidance and so forth)
- Functional classification
- Traffic characteristics (volume and composition)
- Speed
- Capacity and level of service
- Access control and management
- Pedestrian and bicycle facilities
- Safety
- Environment

AASHTO recognizes the influence that context has on driver characteristics

and performance, and how design controls respond to these influences. The *Green Book* defines the environment, or context, as “the totality of humankind’s surroundings: social, physical, natural, and synthetic,” and states that full consideration to environmental factors should be used in the selection of design controls.



The relationship between speed and pedestrian crash severity illustrates the benefit of reduced speeds in walkable urban places.

Source: Derived from Anderson, McLean, Farmer, Lee and Brooks, *Accident Analysis & Prevention* (1997).



Thoroughfare design should influence actual operating speeds.

TARGET SPEED DEFINED

AASHTO identifies functional classification and design speed as primary factors in determining highway design criteria. Although design speed used to be defined as the “maximum safe speed,” FHWA’s Flexibility in Highway Design recommends that design speed take into account topography, anticipated operating speed, adjacent land use, and functional design. Currently AASHTO defines operational speed as the speed at which drivers are observed operating their vehicles during free-flow conditions.

Design controls in the application of Complete Streets principles that may be used differently than in the conventional design process include speed, location, design vehicle, and functional classification. The Institute of Transportation Engineers (ITE) recommends replacing design speed with *target speed*. Target speed is the highest speed at which vehicles should operate on a thoroughfare in a specific context, consistent with the level of multimodal activity generated by adjacent land uses, to provide both mobility for motor vehicles and a safe environment for pedestrians, bicyclists, and public transit users. The target speed is intended to be designed as the posted speed limit. Traditionally, the speed limit is established based on the operational speed of the roadway defined as the 85th percentile speed. The posted speed limit is generally 5-10mph less than the design speed or equal to or less than the operational speed. Therefore, it is important for the design of the thoroughfare to encourage actual operating speeds that are equal to the target speed.

In this manual, design speed and operational speed are replaced with target speed, which becomes the primary control for determining the following geometric design values:

- minimum intersection sight distance,
- minimum sight distance on horizontal and vertical curves, and
- horizontal and vertical curvature.

Target speed ranges from 25 to 40 mph for the primary thoroughfare types described in this manual. A lower target speed is an essential characteristic of thoroughfares in walkable, mixed-use urban areas.

TARGET SPEED BY STREET TYPOLOGY AND FUNCTIONAL CLASSIFICATION

Contextual Street Types and Functional Classification	Thoroughfare Plan			Complete Streets Policy
	ROW	Number of Lanes	Volumes	Target Speeds
Mixed Use Streets				
Principal Arterial	60'-130'	4-8 Lanes	> 3,500 v/l/d	25-35 mph
Minor Arterial	50'-107'	2-6 Lanes	2,500-5,000 v/l/d	25-30 mph
Collector	50'-80'	2-4 Lanes	1,250-3,500 v/l/d	25-30 mph
Minor/Local	50'-56'	2-4 Lanes	< 1,250 v/l/d	20-30 mph
Commercial Streets				
Principal Arterial	60'-130'	4-8 Lanes	> 3,500 v/l/d	25-40 mph
Minor Arterial	50'-107'	2-6 Lanes	2,500-5,000 v/l/d	25-40 mph
Collector	50'-80'	2-4 Lanes	1,250-3,500 v/l/d	25-30 mph
Minor/Local	50'-56'	2-4 Lanes	< 1,250 v/l/d	25-30 mph
Residential Streets				
Principal Arterial	60'-130'	4-8 Lanes	> 3,500 v/l/d	25-35 mph
Minor Arterial	50'-107'	2-6 Lanes	2,500-5,000 v/l/d	25-30 mph
Collector	50'-80'	2-4 Lanes	1,250-3,500 v/l/d	20-25 mph
Minor/Local	50'-56'	2-4 Lanes	< 1,250 v/l/d	20-25 mph
Industrial Streets				
Principal Arterial	60'-130'	4-8 Lanes	> 3,500 v/l/d	25-45 mph
Minor Arterial	50'-107'	2-6 Lanes	2,500-5,000 v/l/d	25-40 mph
Collector	50'-80'	2-4 Lanes	1,250-3,500 v/l/d	25-35 mph
Minor/Local	50'-56'	2-4 Lanes	< 1,250 v/l/d	25-30 mph
Parkways				
Principal Arterial	60'-130'	4-8 Lanes	> 3,500 v/l/d	25-45 mph
Minor Arterial	50'-107'	2-6 Lanes	2,500-5,000 v/l/d	25-30 mph
Collector	50'-80'	2-4 Lanes	1,250-3,500 v/l/d	25-30 mph
Minor/Local	50'-56'	2-4 Lanes	< 1,250 v/l/d	25-30 mph

NOTE: The goal is to achieve a 25 mph target speed on street segments within 1/4-mile of rail transit stations.



Textured paving materials notify drivers of the possible presence of pedestrians.

DESIGN FACTORS THAT INFLUENCE TARGET SPEED

Establishing a target speed that is artificially low relative to the design of the roadway will only result in operating speeds that are higher than desirable and difficult to enforce. Consistent with AASHTO, this manual urges sound judgment in the selection of an appropriate target speed based on a number of factors and reasonable driver expectations. Factors in urban areas include transition from higher- to lower-speed roadways, terrain, intersection spacing, frequency of access to adjacent land, type of roadway median, presence of curb parking, and level of pedestrian activity. AASHTO's *A Guide for Achieving Flexibility in Highway Design* (2004c) summarizes the selection of speed in urban areas:

- Context-sensitive solutions for the urban environment often involve creating a safe roadway environment in which the driver is encouraged by the roadway's features and the surrounding area to operate at lower speeds.

Urban thoroughfare design for walkable communities should start with the selection of a target speed.

The target speed should be applied to those geometric design elements where speed is critical to safety, such as horizontal and vertical curvature and intersection sight distance. The target speed is not set arbitrarily, but rather is achieved through a combination of measures that include the following:

- Setting signal timing for moderate progressive speeds from intersection to intersection
- Using narrower travel lanes that cause motorists to naturally slow their speeds
- Using physical measures such as curb extensions and medians to narrow the traveled way
- Using design elements such as on-street parking to create side friction
- Minimal or no horizontal offset between the inside travel lane and median curbs
- Eliminating super elevation
- Eliminating shoulders in urban applications, except for bicycle lanes
- Smaller curb-return radii at intersections and elimination or reconfiguration of high-speed channelized right turns
- Paving materials with textures (e.g., crosswalks, intersection operating areas) detectable by drivers as a notification of the possible presence of

pedestrians

- Proper use of speed limit, warning, advisory signs, and other appropriate devices to gradually transition speeds when approaching and traveling through a walkable area

Other factors widely believed to influence speed include a canopy of street trees, the enclosure of a thoroughfare formed by the proximity of a wall of buildings, and the striping of edge lines of bicycle lanes or parking lanes. These are all elements of walkable, mixed-use urban areas but should not be relied upon as speed-reduction measures until further research provides a definitive answer.

The practitioner should be careful not to relate speed to capacity in urban areas, avoiding the perception that a high-capacity street requires a higher target speed. Under interrupted flow conditions, such as on thoroughfares in urban areas, intersection operations and delay have a greater influence on capacity than speed. The *Highway Capacity Manual* (TRB 2000) classifies urban streets (Class I through IV) based on a range of free-flow speeds. The thoroughfares upon which this report focuses have desired operating speeds in the range of 25 to 35 mph (Class III and IV based on the *Highway Capacity Manual*). Level of service

C or better is designated by average travel speeds ranging from 10 to 30 mph. Therefore, adequate service levels can be maintained in urban areas with lower operating speeds. Capacity issues should be addressed with highly connected networks and sound traffic operations management such as coordinated signal timing, improved access management, removal of unwarranted signals, and the accommodation of turning traffic at intersections.



On-street parking creates side friction and reduces vehicle speeds.



The design vehicle influences many roadway characteristics.

Design Vehicle

The design vehicle—the vehicle that the road is designed for—influences the selection of design criteria such as lane width and curb-return radii.

Some practitioners will conservatively select the largest design vehicle (WB 50 to WB 67) that could use a thoroughfare, regardless of the frequency. Consistent with AASHTO, this manual emphasizes an analytical approach in the selection of a design vehicle, including evaluation of the trade-offs involved in selecting one design vehicle over another.

In urban areas, it is not always practical or desirable to choose the largest design vehicle that might occasionally use the facility; the impacts to pedestrian crossing distances, speed of turning vehicles, and other design criteria that may be inconsistent with the community vision, goals, and objectives for the thoroughfare. In contrast, selection of a smaller design vehicle in the design of a facility regularly used by large vehicles can invite frequent operational problems. The practitioner should select the design vehicle that will use the facility with considerable frequency (for example, bus on bus routes and semi-tractor trailer on primary freight routes or accessing loading docks). Two types of vehicles are recommended:

Design vehicle—This is the vehicle that must be regularly accommodated without encroachment into the opposing traffic lanes. A condition that uses the design vehicle concept arises when large vehicles regularly turn at an intersection with high volumes of opposing traffic (such as a bus route).

Control vehicle—This vehicle's infrequent use of a facility must be accommodated, but encroachment into the opposing traffic lanes, multiple-point turns, or minor encroachment into the street side is acceptable. A condition that uses the control vehicle concept arises when occasional large vehicles turn at an intersection with low opposing traffic volumes (such as a moving van in a residential neighborhood or once-per-week delivery at a business) or when large vehicles rarely turn at an intersection with moderate to high opposing traffic volumes (such as emergency vehicles).

In general, the practitioner should obtain classification counts to determine the mix of traffic and frequency of large vehicles, should estimate how this mix will change as context changes, and should keep consistent with the community's long-range vision. If there are no specific expectations, the practitioner may consider the use of a single-unit truck as an appropriate design vehicle.

Speed Management

Under the conventional design process, many arterial thoroughfares have been designed for high speeds and traffic volumes. As the context of these thoroughfares change over time—which would include walkable, compact mixed-use areas—the speed encouraged by the design becomes a matter of concern. Further, municipalities establishing speed limits based on the measured 85th percentile speed are finding they are required to establish higher speed limits than the community desires for the area. In these cases, traffic engineers are tasked with identifying methods to reduce arterial speeds. This section identifies research and the practical experience of agencies in managing arterial speeds.

It is popularly held that higher operating speeds result in higher crash rates and higher severity of crashes. Research on the effect of actual operating speed on crash rate is inconclusive (TRB 1998). However, research shows that higher operating speeds do result in higher crash severity, higher percentages of injury, fatality crashes, and more serious property damage. Therefore, lower vehicular traffic speeds are beneficial when collisions occur with other vehicles or pedestrians.

Speed management is an approach to controlling speeds using enforcement, design, and technology applications. While “traffic calming” is a type of speed management usually used on local residential streets, speed management can be used on all types of thoroughfares.

Speed management methods can use technologies that provide feedback to the motorist about their speed, or designs in which the motorist perceives the need for a lower speed. These techniques include signage, signalization, enforcement, street designs, and built environments that encourage slower speeds. Other methods include physical devices that force drivers to slow down, such as roundabouts, raised intersections, narrowed sections created by curb extensions, and raised medians. Physical devices are generally more effective at changing driver behavior, but may be more costly to implement and may not be appropriate on all thoroughfares. Speed management is often a multidisciplinary decision because it requires input from emergency services, engineering, street maintenance departments, law enforcement, and transit service providers. The process of implementing a speed management program benefits from public involvement to understand how the community

uses thoroughfares and how it perceives various speed management methods. Bicycle and pedestrian advocacy groups should also be involved in the process. Effective speed management requires knowledge of the existing traffic patterns, both quantitative and qualitative. Quantitative measures of traffic counts, intersection turn movements, and speeds help to determine the existing condition and the need. Qualitative information, often gathered from the public or through observation, can explain behavioral issues. Implementation of speed management should be examined along corridors and across jurisdictions. It is important for a corridor to have a consistent speed through different jurisdictions if the character and context also remain constant.



Speed management methods can use displays that provide feedback to motorists.



Roundabouts are a way to maintain traffic flow and control speeds.

The following is a list of speed management measures commonly used in the United States on thoroughfares designated as arterials or collectors.

Active Measures

- Roundabouts, particularly when used within a “roundabout corridor”
- Road diets (reducing the number of lanes by adding medians, converting travel lanes to parking, or adding bike lanes)
- Lateral shifts or narrowing (curb extensions with a center island or other techniques that require vehicles to move out of a straight path or create neck downs)
- Smaller curb-return radii to slow turning vehicles, and the elimination of free-flow channelized right-turn lanes
- Provision of on-street parking where adjacent land uses and activities will generate demand
- Speed humps and speed tables (not widely used on arterials and lack support of emergency service providers)
- Speed cushions or speed platforms (less impact on emergency vehicles than hump and tables)
- Narrowed travel lanes
- Raised crosswalks combined with curb extensions to narrow street
- Speed actuated traffic signals where a vehicle traveling at excessive speeds will trigger the signal to change to red

Passive Measures

- Synchronized signals to create progression at an appropriate speed
- Radar trailers/speed feedback signs flashing
- “SLOW DOWN” message when speed exceeds a preset limit (most effective when coupled with enforcement)
- Visually narrowing road using pavement markings
- Visually enclosing street with buildings, landscaping, and street trees
- Variable speed limits (using changeable message signs based on conditions)
- Speed enforcement corridors combined with public education
- Flashing beacons on intersection approaches to slow traffic through the intersection
- Speed limit markings on pavement
- Mountable cobblestone medians or flush concrete bands delineating travel lanes for visual narrowing
- Shared streets using signs and pavement markings (such as bicycle boulevards)
- Automated speed enforcement (including red-light enforcement)

Existing Speed Management Tools

Dallas has six traffic management techniques available that are designed to address speed and cut through traffic in residential areas. These implementation items are for alleys, local roadways, and in two instances, collectors. They must be initiated by petition with a consensus from area residents. The available tools include:

- All-way stops
- Road Humps
- Alley Rumble Strips
- Residential Parking Districts
- Residential Parking Only
- Street Closures

Given the limitations of these elements to residential locals and collectors, it is important to explore additional, broader traffic management techniques to calm roadways and create the desired Complete Streets environment.

Access Management

Description

Access management reduces the potential for conflicts between vehicles, bicyclists, and pedestrians. Managing access also improves the traffic flow of a street and provides more capacity. Improved traffic flow may also reduce the need for road widening, allowing part of the right-of-way to be

recaptured for other users. A major challenge in street design is balancing the number of access points to a street, as most conflicts between users occur at intersections and driveways. The presence of multiple driveways, in addition to the necessary intersections, has the potential to create several conflicts between vehicles entering or exiting, bicyclists, and pedestrians. When possible, new driveways should be minimized, old driveways should be eliminated or consolidated, and raised medians should be placed to limit left turns in and out of driveways.

Application

Access management through limiting driveways, providing for shared access, and providing raised medians should be implemented when conceptually planning a corridor. Property owners should be involved from the outset to ensure that solutions do not have adverse impacts on access to their properties, and to facilitate a consensus solution that works for all owners.

Considerations

- Access management reduces the number of conflict points, especially by replacing center-turn lanes with raised medians, as left turns by motorists account for a higher number of crashes with bicyclists and

pedestrians.

- Pedestrian crossing opportunities are enhanced with a raised median.
- Universal access for pedestrians is easier, as the sidewalk is less frequently interrupted by driveway slopes.

The following possible negative effects of management should also be considered:

- Streamlining a street may increase motor vehicle speeds and volumes, which can be detrimental to other users.
- Reduced access to businesses may require out-of-direction travel for all users, including walkers and bicyclists.
- Concrete barriers and overly-landscaped medians act as barriers to pedestrian crossings. Medians should be designed with no more than normal curb height, and with landscaping that allows pedestrians to see to the other side.

Careful, site-specific access management solutions developed with property owners will minimize potential negative impacts.



Pedestrian volumes are one method used to gauge the effectiveness of Complete Streets policies.



Knox Street demonstration project installed and monitored the operation of a two-way cycle track.

KNOX STREET DEMONSTRATION EXPERIENCE

Under special circumstances it can be desirable to test Complete Streets concepts prior to implementing them permanently. These tests, or demonstration projects, can be extensive, held over 30 to 90 days, and at a significant expense; or they can be short-term, lasting a day, several days, or weeks with a minimal cost. With creativity, any number of Complete Streets features may be tested on a temporary basis, including road diets which explore adding bike lanes, on-street parking, enhanced cross walks, bulb-outs, medians, turn lanes, or other roadway features.

In September 2012 the City of Dallas authorized a four-day demonstration project on Knox Street from North Central Expressway to the Katy Trail. The project was intended to reduce Knox street from four to three vehicle lanes, install a two-way cycle track on the north side, and restripe all head-in parking on the south side of the street to 60-degree angle parking. This demonstration would allow testing the feasibility of combining a road diet, exclusive bicycle facility, and new parking in a narrow and congested retail corridor.

The project was monitored and evaluated to confirm whether a reduced number of lanes could function adequately to warrant implementing the demonstrated cross-section on a permanent basis. In order to implement the demonstration project, the following objectives were anticipated:

- Construct a temporary cross-section with traffic signs, barricades and pavement marking tape and test it for a total of four days (two weekdays and two weekend days).
- Create a Traffic Control Plan (TCP) approved by the City of Dallas that utilizes temporary construction barricades and devices and meets budget constraints.
- Develop and execute a TCP that encourages an appropriate vehicle speed, minimizes delays and congestion, accommodates high turnover of on-street parking, and is robust enough to provide a safe separation between vehicular and bicycle traffic.
- Create a more walkable and bikeable street than currently exists.

The project was a success in terms of creating a safe and durable roadway environment for pedestrians and bicyclists. Traffic volumes through the corridor and at major intersections were approximately the same before, during, and after the demonstration. However, congestion increased during each peak period which was confirmed by the Level of Service analysis. Adjacent retailers and restaurateurs indicated that their patrons were disappointed by the level of congestion. The following Lessons Learned are catalogued by category.

Design Concept

- For high turnover angle parking, extra maneuvering room is desirable.
- All signs and pavement markings should conform to MUTCD.
- Provide adequate advance warning for a lane drop.
- Bulbouts were useful to direct drivers and minimize street crossing distances.
- Set stop bars back from the intersection to accommodate turning vehicles.
- Converting from 90-degree to angle parking loses a few parking spaces.

- A yellow delineator placed at the ends of the cycle track provided a visible and positive delineation.
- Existing utility poles and concrete bases are a barrier.
- Lower, water-filled traffic barriers would have been more than adequate to protect the bicyclists and pedestrians and not obstruct sight distance.

Installation

- Black-out tape or paint to cover up existing pavement markings is a necessity.
- Tape stands up to rain and normal traffic, but not to turning and parking maneuvers.
- Be vigilant and flexible—we created a temporary bulbout to direct drivers safely.
- Restriping of parking requires additional surface cleaning and care.
- Installation during off-peak vs. peak traffic periods is preferable.
- The weather forecast is critical and determines what materials you use.
- Four-foot bike lane (eight-foot cycle track) next to a gutter is tight.

- The east terminus of the cycle track had confusing signs and markings for bicyclists.
- Start the design as early as possible and work with the contractor to minimize costs.

Conclusions

- Demonstrations can model permanent Complete Streets installations for a reasonable cost.
- Demonstrations can ensure input from all stakeholders.
- Knox Street can technically be converted to a three-lane section and accommodate the existing vehicle demand.
- The allocation of space in the existing ROW would still need to be perfected during the detailed design phase.

Demonstration projects are valuable in giving residents, property owners, and City staff an opportunity to understand the impact on operational changes that may occur.



The Knox Street demonstration used blackout tape to temporarily cover up existing pavement markings.



The Knox Street demonstration tested the installation of an eight-foot cycle track.

Monitoring and Evaluation

In order to determine the success or failure of new Complete Streets policies, the City of Dallas should refer back to the initial livability goals and principles. Well-documented public outreach and continued engagement through the implementation stages will make for a smoother experience. A monitoring program should:

- measure the impacts and effectiveness of the Complete Streets Initiative over time;
- establish benchmarks based on multimodal levels of service. (For instance, transit quality of service, pedestrian safety, and vehicle delay);
- develop a multimodal travel counts process to monitor the actual corridor performance versus the pre-established benchmarks; and
- establish operations policies to better link street maintenance, utilities, and rehabilitation with bicycle lanes and pedestrian improvements.

Making Adjustments

Through public surveys, the City can continue to monitor customer satisfaction, ease of use, and behavior adjustments. A business activity and satisfaction survey should be conducted after three months to gauge effectiveness of policies. These results can be



The Knox Street Demonstration project provided a two-cycle track from the Katy Trail crossing on Knox Street to McKinney Avenue.

compared with results from public surveys. In the end, there may still be unsatisfied customers. However, through documentation of the publicly-established goals for the community, the strategies selected to achieve those goals, as well as the indicators for success, can be used to help explain why the policy changes were necessary and what they have accomplished. Maintaining an open communication platform is important; take time to respond to emails and answer phone calls about the policy changes.

Some examples of evaluation measures include local business activity, pedestrian and vehicle volumes, average time spent searching for a parking space (determined through public surveys), number of people biking or walking to work, adoption of commuter benefits to promote alternatives to solo driving, and customer satisfaction. If these indicators are showing little-to-no improvements, the Complete Streets strategies need to be re-evaluated with new strategies selected to reach target goals.

Driving will continue to be the primary mode of transportation for many people in the region, but it must be evaluated as one part of a comprehensive multimodal transportation system that includes walking, biking, and transit.



Portions of Chapter 4 were derived from the Boston Complete Streets Guidelines, prepared by the City of Boston Transportation Department, with permission.

4. PEDESTRIAN ZONE DESIGN ELEMENTS

POST
APARTMENT HOMES



Streets are the most extensively used civic spaces in the community.

4. PEDESTRIAN ZONE DESIGN ELEMENTS



Good sidewalks provide a clear, unobstructed path for pedestrians.

A safe pedestrian zone is an essential component of a well-designed street. The pedestrian zone is composed of several elements, including the sidewalk, the spaces between the sidewalk, the roadway on one side, and the building front on the other side. In addition to the provision of a basic sidewalk, the walking experience is affected by numerous elements that are contained within this pedestrian zone such as driveways, utilities, transit stops, furnishings, and public art.

Though Dallas currently has many streets with sidewalks, many of these sidewalks are not continuous, or do not feel comfortable due to specific design issues. There are also locations in Dallas where the pedestrian zone provides for excellent walking conditions such as Flora Street, McKinney Avenue, and Bishop Avenue.

This chapter covers the essential design elements of the pedestrian zone that ensure that people can safely and comfortably walk along streets throughout Dallas. It provides a menu of components and specific guidance to make the pedestrian experience more welcoming and safe.



Senior citizens depend on sidewalks for mobility and exercise.



Pedestrian zone



A comfortable walking environment encourages car-free short trips.



Universal access enhances quality of life for all citizens.

WIDER SIDEWALKS

The minimum recommended sidewalk widths are shown in the Lane Width Chart, however, there are many locations where a wider sidewalk is necessary to accommodate anticipated pedestrian volumes. Where these volumes are known or can be reasonably estimated, the Highway Capacity Manual should be used to determine the appropriate sidewalk width.

Wider sidewalks should be provided as a matter of course along school and university properties and key school walking routes, along streets with frequent transit service, all streets within 1/4-mile radius of DART rail stations, along all mixed-use streets, and in any location where the sidewalk is likely to be shared between pedestrians and bicyclists. Other factors to consider when determining sidewalk widths include materials, placement of trees and landscaping, ensuring continuous walking surfaces, and transitioning between different street types and between the sidewalk and building entrances. In addition, the sidewalks should be designed in coordination with the placement of utilities to minimize potential obstructions.

TREES AND GREENSCAPE

Trees and other greenscape plantings have a variety of functions. They can provide shade, buffer pedestrians from passing vehicles, and provide aesthetic enhancements. Trees and other plantings must conform to Article X of the Dallas Development Code, The Landscape and Tree Preservation Ordinance. When placing trees, consideration should be given to the placement and interaction of pedestrian lighting, utilities, and street furniture. Tree and plant selection is very important to ensure selection of climate-appropriate trees and plants (see Article X and the NCTCOG's iSWM guidelines). Another consideration is the tree's anticipated mature canopy height, which will affect the clearance for pedestrians, buses and utilities. With proper considerations all of these elements can function together efficiently.

STREET FURNITURE

Well-designed street furniture makes the sidewalk realm more comfortable. Benches provide places to rest, catch-up with neighbors, or have lunch. Properly distributed trash receptacles help to keep the street clean and presentable. Appropriately located bicycle racks and shelters are easier to use than improvising with meters and fences. In addition to providing amenities, street furniture can also provide a buffer from the noise and commotion of vehicles in the street.

Street furniture that is not thoughtfully laid out can result in obstructions and clutter in the sidewalk environment. This section provides design guidelines for street furniture frequently located in the pedestrian zone, including bicycle parking, seating, and waste receptacles. Street furniture is normally installed in the buffer/furnishing zone, although it can also be installed in the frontage zone, on curb extensions, and on medians.

A key goal of these guidelines is to organize the City's street furniture in a way that maximizes safety, comfort, and function for all users. In addition to location considerations, the design of street furniture should be simple and compatible with the existing environment. Street furniture should be durable, maintenance-free, and should utilize green material (recycled plastics and metals) whenever possible. Ultimately, City staff will review and approve all proposals for the placement of street furniture in the public right-of-way, and may request the addition of street furniture for some projects.

Seating

Description

Providing a place to sit is a basic necessity, particularly for mixed-use streets in Dallas. Seating gives pedestrians a place to rest, wait, or simply to relax and enjoy street life. Providing comfortable, inviting places to sit can transform a sidewalk into a gathering area and enhance its role as a public space. Providing a shaded seating area is particularly important during hot weather. Seating is also important to provide for seniors who may be walking between transit and their destination.

Application

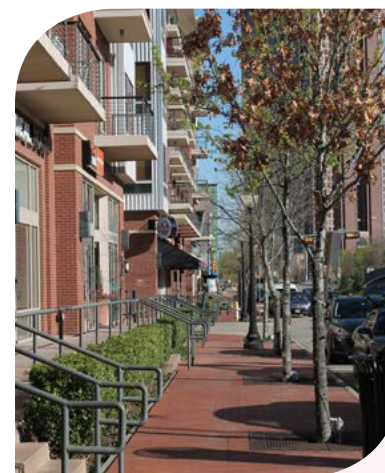
Seating comes in a variety of temporary and permanent forms, such as chairs, benches, seating walls, steps, monuments, planters, and raised tree beds. People enjoy watching others move about, and the design and location of seating should respond to how the surrounding space is used. Where possible, seating should be arranged to define social spaces.

The following considerations apply to seating areas in the public right-of-way.

- Seating should be affixed in such a way that it is not easily damaged or removed. Care should be exercised to ensure that seating does not interfere with entrances to buildings, heavily used loading zones, parked vehicles, access to fire hydrants, and other potential conflicts.
- Seating should accommodate a minimum of two people. Seating can be integrated into buildings and building frontages.



Space for sidewalk cafés should not come at the expense of pedestrian zone width.



On-street parking and trees create a pedestrian buffer that enhances comfort.



Street furniture should be illuminated at night and shaded during the day.



A place to sit is a basic necessity, especially for the very young and old.

- Seating should be situated to enable pedestrians to view street activity while being outside of the immediate flow of pedestrian traffic, and should be buffered from noise and vehicle exhaust whenever available. Where possible, seating should provide a sense of protection to the person seated.
- Benches at bus stops with no shelter should be located at the back of the sidewalk and should face the street.
- The following clear widths must be maintained when installing benches:
 - 3' minimum on either side of the bench
 - 5' minimum from fire hydrants
 - 2' recommended clearance from all utilities and utility appurtenances
 - 5' minimum, ideally 6' clear path in front of the bench when located at the back of the sidewalk, facing the curb
 - Where the back of the bench abuts a building, wall, or other obstruction, a one-foot minimum clear width should be provided for maintenance and debris removal.

Considerations

Seating should be provided with and without armrests if possible. Armrests provide stability for those who require assistance sitting and standing. Armrests in the middle prevent sleeping while still allowing access from the side. Seating without armrests allows a person in a wheelchair to maneuver adjacent to seating or to slide on easily.

Climatic conditions should be taken into consideration when seating materials are determined. Bare metal and other heat absorbing materials should not be used.

Movable seating allows the flexibility for an individual to control the amount of sun exposure or an allowance for groups to determine their desired seating arrangement. Movable seating may be most appropriate for plazas, street parks, or in association with certain retailer groups where activities may spill out into streets. Movable seating, however, requires a commitment to continually maintain and replace elements that become damaged or stolen.

Bicycle Racks

Description

Providing ample, well-designed bicycle parking is a key component of the City's strategy to increase bicycling. When bike parking is provided, bicyclists are less likely to lock their bikes to sign posts, trees, or railings, which can do damage or create obstructions. Bicycle parking has been installed as part of the DART Station Access Program, and bicycle parking is identified as an implementation project in the Dallas Bike Plan. The City of Dallas issues licenses for private installation of bicycle racks in the right-of-way. Other relevant requirements related to bicycle parking (in addition to these guidelines) are provided in the Dallas City Code, Chapter 43.

Application

The following guidelines cover the design of bicycle racks in the public right-of-way. They can be sculptural or utilitarian, and hold one or multiple bicycles. Good bicycle parking designs maximize capacity while maintaining an orderly appearance. Bicycle rack designs should meet the following criteria:

- The rack should be affixed to a paved surface.
- The rack should support the frame of the bicycle at two points (in consideration of different frame sizes and styles).
- The rack should be simple and easy to use.
- The rack should allow easy locking of the frame and, preferably, both wheels.
- The rack should be placed so that bicycles park parallel to the curb or building frontage, or angled if there is additional space available while still meeting the minimum clearances.
- The rack should meet ADA guidelines to be detected with a cane.

Some bicycle rack designs that are available commercially do not meet these criteria, and therefore should not be used. The dimensions that follow represent the recommended minimum clearance between the nearest element of an unoccupied bicycle rack and the adjacent object. Racks should be installed so that parked bicycles do not obstruct the pedestrian through zone or access to fire hydrants.



Seating design and location should relate to how the surrounding space is used.



The design of bike racks and street furniture can complement each other.



Street furniture can turn the pedestrian realm into an urban “living room.”



Bicycle shelters should be located close to building entrances.

Supplement “Location of a Bicycle Parking Device” (Dallas City Code Sec. 43-125)

- 3’ from back of curb
- 3’ from building or building frontage while maintaining a five-foot minimum pedestrian clear path
- 10’ from a building doorway
- 3’ from all street furniture or fixed objects including trees and vegetation, light poles, benches and other bike racks
- 5’ from a marked crosswalk
- 10’ from a fire hydrant, fire call box, police call box or other emergency facility
- 5’ from a driveway
- 3’ from the front and 15’ from behind a designated bus stop sign post
- Place bicycle racks within 50’ of the target building entrance so that bicyclists are not tempted to use other objects that are closer to the entrance

Considerations

In-street bicycle parking should be considered where there are space constraints on the sidewalk and high bike parking demand. 8-10 bicycles may be parked in the space of one motor vehicle. When placed close to an intersection, in-street bicycle parking can work as a curb extension to lessen the distance pedestrians must cross the street.

Bicycle Shelters

Description

Bicycle shelters are structures that provide secure, covered areas for bicycle parking. DART has installed a number of shelters at transit stations. These guidelines encourage the use of additional covered shelters on City streets that accommodate numerous bikes for short- and long-term parking needs. Street types such as mixed-use with wide sidewalks are appropriate to consider for bicycle shelters. Ideally, they are within sight distance or close proximity to significant building entrances or transit stops. Where possible, bicycle parking shelters should provide weather protection for as many parked bicycles as possible. Installation footings must meet all structural and loading requirements.

Application

Bicycle shelters should be:

- Located within 50’ of the main entrance to the building or transit station to encourage use of the shelter
- A minimum of 8’ wide and a minimum of 7’ from floor to ceiling (if a bicyclist is expected to enter the shelter to lock the bike to a rack); the length of the shelter depends upon the number of bicycle racks the shelter is designed to accommodate
- Placed so that, when occupied, bicycles do not intrude into the pedestrian through zone

Considerations

- Bicycle shelter installation on pavers requires approved footing.
- Bicycle shelters should be located in well-lit areas. Passive detection lighting should be provided in areas of low ambient light.
- Signs should be used to help direct bicyclists to shelters.

Bollards

Description

Bollards are permanent or temporary posts or objects used to create an unobtrusive boundary between different modes of transportation and realms of the street. Their main functions are to protect pedestrians, bicyclists, buildings, and specified areas from vehicular access and to highlight traffic calming measures. On streets without curbs (shared streets), bollards can delineate the edge of the roadway. Bollards can also provide a location for installation of low-level lighting.

Bollards can be fixed, flexible, or removable; they can be designed to withstand heavy impacts, or give way on impact. Breakaway bollards are intended to deter vehicle access, but allow emergency vehicles access. Bollards come in all forms, from metal posts to concrete blocks and planters.

Application

The most important design feature when using bollards is visibility. Bollards must be clearly visible in all lighting conditions for all users, particularly pedestrians and motor vehicles. Reflective material, lighting, and colors that provide contrast to the surrounding environment should be used. Proper size and spacing should balance restricting vehicular access and providing a clear pedestrian path free from obstructions.

Bollards can be used to

- Restrict vehicular access to car-free zones, pedestrian malls, plazas, etc.
- Prevent delivery trucks from using sidewalks in downtown commercial and mixed-use areas
- Provide security measures for buildings and infrastructure such as government and financial institutions
- Narrow turning radii to reduce vehicular speeds around corners
- Create protected space for street furniture
- Protect stormwater management features such as rain gardens, stormwater planters, and green curb extensions
- Direct traffic flow and highlight traffic calming measures such as chicanes on shared streets
- Separate the roadway from the pedestrian realm on streets without grade separation or curbs

Considerations

- Bollards require proper maintenance when damaged due to accidents or deterioration from environmental wear. When not maintained they can create hazards for pedestrians.
- Removable bollards should be considered if restricting access is only needed during part of the day or during special events.



Bicycle shelters have been installed at DART rail stations.



Bollards define and protect a pedestrian space by restricting vehicular access.



Parking meters and pay stations



Recycling bins along mixed-use trails make it easy to recycle plastic water bottles.

Parking Meters and Pay Stations

Description

In many parts of the city where on-street parking is present, motorists are required to pay at meters or pay stations. Dallas, like many other cities, is moving towards smart parking technologies, which enhance parking information, achieve desired turnover levels, optimize parking space occupancy, consolidate single parking space meters to multispace pay stations, improve operational efficiency, and reduce maintenance costs. Dallas is working to consolidate single space parking meters to multispace pay stations in the Downtown core to reduce streetscape clutter and to achieve the objectives above.

Application

- All meters and pay stations should be located in the greenscape/furnishing zone at a minimum of 18" from the curb; meters may not be placed in the pedestrian zone. A clear path should provide access to and from parked cars to the pay station.
- Typically, one pay station should be provided for every 8 to 10 parking spaces, centered in the middle of these spaces. This spacing typically puts pay stations no greater than 80 to 100' from the farthest parking space. In some cases, such as where there are fewer than 16 spaces on a block face, it is possible to only provide one pay station in the middle or two pay stations placed equidistant from each corner of the block. Street trees, utilities, and other street furniture elements may also dictate where pay stations can be installed.
- Sensors can be programmed to convey occupancy rates to a centralized system that can collect, store, and analyze the data over time, making it possible to identify patterns in how parking spaces are utilized and develop new management programs. Parking spaces that are underutilized should be identified. Usage rates can be used to develop or adjust pricing schemes. Sensors can report time violations to parking enforcement officers and help increase efficient use of parking spaces. Sensors can also be useful for documenting and publishing actual real-time usage and availability rates.

Considerations

- On-street parking rates should be on par with rates of private and public lots and garages
- Pay stations should be solar powered where possible. Solar panels should be strategically placed to reduce visual clutter on the street.
- When removing individual parking meters to install multispace meter kiosks, installing bicycle racks, street trees, benches, and other sidewalk amenities should be considered.
- The use of smartphone apps should be considered for remote payment at meters. Smartphone apps can also convey parking availability in real-time to drivers, however this can also lead to distracted driving. The benefits of such applications should be weighed against safety concerns
- If individual spaces are demarcated, information on usage can be collected per space. However, striping parking spaces can limit the number of spaces utilized, particularly with the growing popularity of smart cars, scooters, and motorcycles.

Recycling Bins and Garbage Cans

Description

Providing receptacles for trash and recycling is important to prevent the spread of litter while demonstrating the City's commitment to waste reduction through recycling. In order to ensure a minimum five-foot pedestrian through zone is maintained, receptacles for trash and recycling should be placed in the buffer/furnishing zone. Where a furniture zone is not present, placement of receptacles should adhere to the clearance requirements listed below. Otherwise, other street types can accommodate trash receptacles where space is available such as at high-use transit stops.

Many on-street garbage cans are owned and maintained by DART. DART's guidelines state that a bench or shelter must be present for placement of a trash can. Alternatively, a trash can may be placed as part of DART's Adopt-A-Can program. Under this program, the entity that requested the trash can is required to maintain it.

Application

The following clearance requirements apply to the placement of trash receptacles:

- 5' minimum from fire hydrants
- 1' minimum from any in ground obstruction, i.e., manhole, tree pit etc.
- 3' minimum from other street furniture
- 5' minimum, ideally 6', pedestrian through zone

Newspaper Racks

Description

Streetscape projects should provide the option of consolidated distribution newspaper racks. In Dallas, news racks are licensed and their number and placement per block is determined on a case-by-case basis.

Application

In districts with special design standards, news racks must conform to the district standards. Distributors are determined by lottery for each block face. Proposed sidewalk extensions are ideal locations for newspaper boxes.

Considerations

- See Chapter 51A of the Dallas City Code for additional detailed guidance
- Place racks near transit stops and other street furniture where people may be waiting or sitting
- Annual licenses for both free-standing and attached news racks are available through the City Office of Sustainable Development and Construction



Garbage cans can be designed to coordinate with other pedestrian zone elements.



Free standing newspaper racks are typically clustered together.



Amenities may include shelter, schedule information, and wayfinding signage.



Signage can help define a bus stop and give passengers a good first impression.

TRANSIT STOPS

Sidewalks provide access to transit and locations for transit stops. Transit stops are typically located in the buffer/furnishing zone. They should provide adequate space for people who are waiting without crowding the pedestrian through zone. This area should be paved to provide an accessible pathway to the door of the transit vehicle. Where space permits, shelters should be added to transit stops to make them more comfortable and inviting. Transit stops may also be located on curb extensions and floating islands.

Information for travelers should also be provided at transit stops. This should include, at a minimum, schedule information and real-time arrival information where possible. Bus stops can also be locations for local area maps and wayfinding information. All transit stops should be fully ADA accessible for passengers.

Bus Stops

Description

Bus stops are the most basic transit stop and should be comfortable, safe, and accessible. Bus stop accommodations improve operations, ridership, and the value of transit to the community. They can include benches, trash and recycling receptacles, shelters, lighting, bicycle racks, bus schedules, maps, real-time next bus arrival information, newspaper boxes, and public art.

Stops should be visible, providing a clear sight line between bus operators and users of the system. Simple stops without shelters are appropriate for lower volume routes. Installation of amenities should be done in consultation with DART and the City of Dallas, as most amenities will require maintenance agreements.

Application

The length of the stop depends on the length of the vehicle as well as the placement of the stop, (i.e., nearside, farside, or midblock) and should be determined in consultation with DART. DART buses are up to 40' in length. In general, bus stops should be a minimum of 60' in length (80' long if midblock).

The pedestrian through zone of the sidewalk should extend to the curb at stops so that passengers may access the sidewalk directly from the bus doors.

The area on the sidewalk where passengers load and unload at bus doors is called the landing pad. The landing pad at the front of the bus stop must provide a clear zone 5' long, parallel to the curb, and a minimum of 8' deep. The landing pad should consist of ADA accessible surface materials such as concrete or asphalt.

Trees should not be planted within landing pad and door zones of a bus stop. When street trees are desired near or within bus stops, DART should be consulted.

Bus stops should be set back a minimum of 5' from crosswalks. Where feasible, a 10' setback is preferred.

Where possible, trash and recycling receptacles should be placed to the front of the bus stop, at a minimum of 18" from the landing pad, a minimum of 3' away from benches, and in the shade. They should also be anchored to the pavement to deter theft.

Considerations

Curb extensions can provide additional pedestrian space and improve bus travel time by reducing the time needed for loading and unloading. The width of the curb extension is determined by the width of the adjacent parking lane, and the length should be long enough to allow passengers to board and exit at all doors of the bus. Be aware that curb extensions can delay through traffic (since the bus essentially stops in the travel lane and does not pull over).

Bus Shelters

Description

Well-designed transit stops can help make transit use more comfortable and convenient. Transit shelters in Dallas are currently provided and installed by DART. Transit shelters should be provided on all key bus routes if sidewalk space allows. The I-STOP program installs solar-powered bus shelters with lighting at all new bus shelter locations. When providing a bus shelter, the bus stop must be ADA compliant with a 5' long (parallel to the curb) by 8' deep landing pad and a 4' minimum clear path.

Shelter placement must allow for unobstructed loading, unloading and unimpeded pedestrian through movements on the sidewalk.

Application

The following minimum clear widths for shelter placement must be maintained:

- 1' from the building face
- 4' from the back of curb
- 15' from crosswalks at nearside bus stops for visibility.
- 1' from any ground obstruction (i.e., manhole, tree pit, sign)
- 10' from fire hydrants
- 3' from the landing pad (maximum 25' to the right of the landing pad)



Stops should provide a clear sight line between operators and passengers.



Attractive, well-shaded bus stops encourage transit use.



Bus Rapid Transit (BRT) stops typically feature an array of passenger amenities.



Bus bays allow a bus to pull out of travel lanes; typically at park-and-ride facilities.

Considerations

Bus shelters should be prioritized and installed based on ridership, with the goal of benefitting the largest number of riders. Special consideration should be given to areas where high numbers of transfers are expected, where waiting times for riders may be longer, or where stops are close to facilities such as schools, medical centers, rehab centers, or high density housing and senior centers. Other considerations include the physical constraints of bus stop sites, preferences of adjacent property owners, bus stop requests by riders, and construction costs.

DRIVEWAYS AND CURB CUTS

Description

Driveways cross through the pedestrian zone and put vehicles in direct conflict with people who are walking. Therefore, driveway design and the number of driveways has a considerable influence on pedestrian safety and comfort. Generally, the frequency of driveways should be minimized and access should be provided via alleys, where possible. Driveway consolidation should be evaluated where driveway spacing is less than 50 feet.

Vehicles entering the right-of-way are required to yield to all cross traffic, including pedestrians. It is important to convey this requirement through design of the driveway/sidewalk interface. Driveways should be designed to look like driveways, rather than like roadway intersections.

Application

Different roadway types require different driveway treatments depending on the adjacent property use, the relationship between the property and the street, and the type of vehicles using the driveway. The following guidelines should be applied:

- The sidewalk should be clearly delineated across the driveway and maintain the grade, slope, and material of the adjacent sidewalk on either side of the driveway.
- Driveway design should meet current ADA guidelines.
- Maintain a 5' minimum sidewalk across driveways with no more than a 2% cross slope.
- The driveway apron should be contained within the buffer/furnishings zone to avoid a cross slope on the sidewalk. Where no buffer/furniture zone is present, the sidewalk approaches and crossing of driveway should be pulled back to ensure no more than a 2% cross slope.

Considerations

- Place driveways a minimum of 20' from crosswalks to provide good sight lines between vehicles and pedestrians and so that vehicles do not block the visibility of pedestrians.
- Consolidate driveways whenever possible to minimize the number of conflict points along the sidewalk. Planners, designers and engineers should follow the guidance for driveway spacing provided in the City of Dallas Off-Street Parking and Driveways Handbook (2004) prepared by the Department of Development Services.

URBAN OPEN SPACES

Urban Open Spaces are places within a city where people gather to partake in a wide variety of activities: to celebrate, to demonstrate, to shop, to meet friends, and to relax. They are important to civic life, and serve as public living rooms for City events. Urban open spaces can be a variety of sizes and dimensions, from pocket parks like the Bexar Street Clock Tower Plaza to public plazas like Main Street Garden. Urban open spaces also include linear pedestrian malls such as Stone Place. Urban open space should be seamlessly integrated with the sidewalk and adjacent buildings.

Plazas, Pocket Parks, and Parklets

Description

Plazas are typically hardscaped open spaces that adjoin the sidewalk in the frontage zone. Plazas may be of various sizes and their design should take into account the human scale or “social field of vision.” As a general rule of thumb, plazas should be no wider than 200 feet to encourage interaction between people. Plazas may be designed to accommodate active uses such as temporary markets or street performances, or passive activities such as sitting.

Pocket parks are small areas that may adjoin the sidewalk (typically in the frontage zone), or be visually and/or physically connected to the sidewalk. Pocket parks may provide additional green space, gardens, play areas for children, or other public amenities. Pocket parks can be included in building developments or within the right-of-way where underutilized space is available.

Parklets are small extensions of the pedestrian zone that occupy former parking spots and include amenities such as plantings, seating and sidewalk cafés. They are a low-cost solution to expanding the pedestrian zone in areas where existing sidewalk widths cannot accommodate pedestrian amenities. They can be temporary or long-term.

The following guidelines suggest ways to design urban open spaces that encourage pedestrian activity.



Urban open spaces break up the concrete monotony of a city.



Urban open spaces should encourage pedestrian activity and interaction.



Landscape materials should be as sustainable as possible to reduce maintenance costs.



A mix of sun and shade is preferred in open space settings.

Application

- Locate urban open space adjacent to areas with high pedestrian activity throughout the day such as near transit stations or other pedestrian generators to encourage use throughout the day.
- Consider environmental elements that will make the plaza comfortable throughout the year. A mix of sun and shade is preferred. During the summer months, shade, water elements, and reduced hardscape help to reduce heat. In the winter, sun exposure and wind protection makes a plaza more inviting.
- Reclaim odd-shaped parklets, especially in high density areas, to provide interesting open spaces.
- Look for opportunities to reclaim odd space. By creating a pleasant and inviting area out of small areas of transition, utilization of these odd spaces can be increased.
- Make the transition between the sidewalk and plaza as broad and seamless as possible in order to make it inviting, visible, and easy to enter.
- Landscaping designs should be as sustainable as possible and take into consideration the level of maintenance that can practically be achieved in the space over the long run. The proportion of landscaping to paving should take long-term maintenance needs into account.
- Look for opportunities to make stormwater management a visible amenity. Trees and planters should be designed to provide shade, manage stormwater, and create visual interest. Porous materials may be used to reduce runoff. The use of cisterns is an optional method of capturing water for landscape irrigation during the summer months.
- Within plazas, provide a variety of seating options, some of which should be movable. Seating can be incorporated into building edges, walls, and landscaping containers; seating along plaza edges is encouraged because people tend to gather and feel comfortable at edges. A good rule of thumb is to dedicate at least 10% of a plaza's open-space to seating. Movable chairs provide ultimate flexibility for a public space and allow for endless variation in arrangements to suit personal preference, to capture sun or shade, or to sit in a group or alone.
- Open spaces are important to develop and maintain, especially in high density, urban areas, where they provide social gathering places and support the lifestyles of urban dwellers.

Considerations

- Install temporary or permanent public art to energize the space, and to highlight local artists.
- Consider roadway surface treatments to delineate slow zones adjacent to public open spaces.
- Adjacent businesses can share responsibility as caretakers of the space.
- Designate locations for movable vending carts or stalls as part of the design. Vending configurations should take into consideration maintenance of a clear pedestrian path and the potential for supplying power or water to stalls or carts.
- Program the space with performances or activities at times when pedestrian activity is greatest.
- Offer public Wi-Fi, if possible.

Sidewalk Cafés

Description

Sidewalk cafés are outdoor areas in the public right-of-way with seating and tables at which patrons of adjacent restaurants can dine. Sidewalk cafés should be encouraged because they add interest, and enliven the sidewalk area.

Sidewalk cafés are encouraged along Mixed-Use Street where commercial activities occur. Careful attention must be given to the design and layout of sidewalk cafés to maintain sidewalk functionality and the quality of the public environment.

Where sidewalk cafés are proposed within the public right-of-way, proposals must be approved by the City Council, which must grant a license by ordinance before any sidewalk café can be installed. The submission requirements and regulations for permitting are available in Dallas City Code Section 43-115. The following guidelines focus specifically on the impact of sidewalk cafés on the pedestrian environment.

Application

- All sidewalk cafés must comply with American with Disabilities Act (ADA) guidelines. This applies to all aspects of the design, including maintaining of access on the sidewalk adjacent to the café, access into the café from the restaurant or the street, compliance of barriers around the dining area for detectability and railing height, overhead clearance, service aisle design, and wheel chair access to tables.
- A clear pedestrian path of at least 5' must be maintained on the sidewalk. This is measured from the outside edge of the sidewalk café to the first obstacle such as a bicycle rack, light pole, tree pit, etc. In areas with high pedestrian traffic, a clear pedestrian path of 6' or more should be maintained. This clear path can include a portion of the furnishing zone but cannot direct pedestrians onto a non-ADA compliant surface. The clear path should be a straight line of travel. Pedestrians in the through zone should not be required to walk around any part of the sidewalk café or be required to navigate around obstructions in the pedestrian through zone.
- Required size, location, and set-backs for sidewalk cafés include the following:
 - 5' from alleys entrances
 - 5' from parking meters, kiosks, traffic signs, and utility poles, fire hydrants, bike racks, and other street furniture except planter boxes.
 - 10' from pedestrian street crossing
 - Cafés can be as little as 6' deep (e.g., a single row of movable tables and chairs).
 - Sidewalk cafés can be placed in the buffer/furnishing zone instead of the frontage zone, as long as the pedestrian through zone is maintained and a 3' buffer between the curb and seating is maintained.
 - Whether placed within the frontage zone or adjacent to a curb, sidewalk cafes should not interfere with the loading and unloading of transit vehicles, handicap parking, or commercial vehicles (where there is designated curb side space provided).



Sidewalk furniture should be durable, free-standing, and matching.



A clear pedestrian path must be maintained on the sidewalk.



Minimum vertical clearances must be adhered to in cases of planter installations.

If alcohol is served, the State of Texas requires that there be an enclosure. Barriers must be attached to the ground, but can be made of fence, rope, chains, or live plants and be no higher than 3'. Permanent anchors may be installed as long as the barrier is removable, and the anchor is flush with the ground and ADA compliant. Fully enclosed sidewalk cafés are discouraged because they are less effective at activating the sidewalk.

- Furniture should be durable, free-standing, and matching.
- Awnings and/or umbrellas are desirable but may not extend into the pedestrian clear zone unless they are 7' or higher above the sidewalk but no more than 10' high. Heat lamps must meet fire codes.

Considerations

In locations where the sidewalk is not wide enough for sidewalk cafés, or where additional seating is desired, consider the use of motor vehicle parking spaces for movable decking to extend the pedestrian environment.

The City will consider providing permits for "tables and chairs" only. This permit allows businesses to apply for seating to be used by patrons, but the seating is also available for the public to use. Table service is not permitted, nor is service of alcoholic beverages.



New pedestrian lighting is required to be dark-sky compliant.

Pedestrian Lighting

Description

Appropriate pedestrian lighting facilitates safe movement and provides a sense of safety and security for pedestrians. Adequate street lighting lends character to a street and, by highlighting salient features, can reveal a unique identity. Pedestrian lighting is particularly important in business districts along mixed-use street types where it can enhance the environment and highlight businesses.

Pedestrian scale lighting is installed by the City of Dallas and by private developers. The City contracts with Oncor Electric Delivery to perform installation, operations, and maintenance of street lights within the City. Oncor installs a limited number of pedestrian lighting fixture styles. Within developments, the developer pays for installation, operations, and maintenance, and lighting costs for 20 years. Currently, pedestrian-scale lighting specifications are determined on a case-by-case basis, the process by which the City reviews and approves new street lighting installations.

Application

- Lighting is critical to ensure the safety of intersections and midblock pedestrian crossings. Lamps are needed at both sides of crosswalks.
- Pedestrian-scale lighting (lampposts lower than 20' tall) should be used alone or in combination with roadway-scale lighting in high activity areas.
- New pedestrian lighting shall be dark-sky compliant with cutoff fixtures to ensure that 2.5% or less of the lamp lumens are emitted above a horizontal plane through the luminaire's lowest part, and 10% or less of the lamp lumens are emitted at a vertical angle 80 degrees above the luminaire's lowest point, per the Texas Health and Safety Code Chapter 425, Regulation of Certain Outdoor Lighting.
- Light poles should typically be located in the furnishing zone and should not impede the pedestrian zone. The location of light poles must coordinate with landscape, civil, utility, and traffic control plans to ensure that appropriate clearances are maintained and that lighting is not obscured by tree canopies.
- Light poles should be placed a minimum of 3' from the curb face and 5' from fixed objects such as fire hydrants.
- Lighting should coordinate with structures.
- Coordinate the position of light poles with current and future planned street trees.
- Overhead pedestrian lighting should be 12-15' above the sidewalk.
- Light spacing should be determined by the type of light fixture and amount of light emitted to maintain continuous illumination along the sidewalk and to avoid dark spots between light poles.
- Banners and plants must be installed parallel to the roadway.
 - 15' banner brackets
 - 9' bottom of banner
 - 13' hanging plant brackets
 - 9' bottom of hanging plant



Proper lighting enhances pedestrian safety at crosswalks.



Light spacing should eliminate dark spots between light poles.



Wayfinding kiosks are an attractive and useful street feature.

Considerations

- Paired alignment of light poles across a street provides a more formal look, while staggered arrangement of light poles provides a less formal look that may allow for fewer lights
- Lighting designs on neighborhood residential streets are often affected by existing utilities. Staggered spacing is preferred to provide more uniform lighting
- As LED technology develops, future consideration should be given to providing network control devices to allow for dimming and/or color control as a way to highlight locations during emergencies or to reduce energy consumption and dark sky impacts during periods of lowest activity (12 a.m. to 5 a.m.)

SIGNAGE

Informational Kiosks

Description

Kiosks in public areas provide valuable information, such as maps, bulletin boards, and community announcements. Kiosks can often be combined with gateway signs and are an attractive and useful street feature.

Application

Kiosks may be located in any of the following areas:

- The sidewalk, furniture, or frontage zones
- Curb extensions
 - Near to transit stops: At a minimum, kiosks should be placed at least 7' from the stop, typically downstream. Their placement should not interfere with loading or unloading. They should be placed in a manner to allow pedestrians to easily access and read the panels.
- Placement of kiosks should:
 - Ensure appropriate sidewalk clearances (minimum 5')
 - Preserve sight visibility for motorists
 - Maintain 18" clearance from back of curb
 - Be no more than 18" from sidewalk zone if buffer/furnishing zone is wider than 7' 6"
 - Not obstruct more than 50% of a retail display window if this is the only display window of the affected business
 - Not block scenic views

Considerations

- Kiosks should include bulletin boards or an enclosed case for display of information.
- As a gateway element, the kiosk should include the neighborhood, commercial district, street, or park name; a map; and other pertinent information.
- Kiosks should have details and features coordinated with other street elements and should have a similar architectural character.

Wayfinding

Description

Vehicle and pedestrian wayfinding signs direct people to destinations within a city and influence the safe travel of all street users. Messages typically include guidance toward important destinations, landmarks, and parking areas.

Application

- Signs intended for vehicles should be placed in the curb zone or the median. A limited number of messages should be included on these signs for ease of reading while driving.
- Pedestrian signs are intended to be read while walking and may be placed in either the edge, curb, or furnishing zones.
- Bikeway wayfinding signs are intended for bike users and may include route options, direction of travel, time/distance to destinations, and bicycle safety information.
- Informational signs are intended to give more detail about the City surroundings. They may include parking information, location maps, area business directories, and other public information.

Considerations

- Overuse of wayfinding should be avoided as to not create a cluttered streetscape.
- Design of wayfinding signs can enhance a distinctive corridor or district identity by use of a standard design format, color scheme, and logo.



Wayfinding sign

UTILITIES

Description

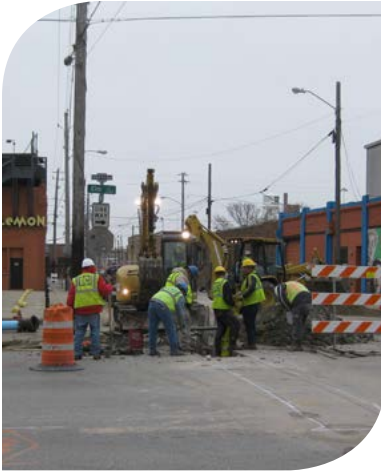
Utilities are a necessary and ubiquitous element of streetscape environments. Though essential, utilities often constrain the ability to locate other streetscape elements and can create a cluttered visual environment. Conversely, other streetscape elements may conflict with the ability to access and maintain utilities. Utilities in the streetscape consist of utility poles and overhead wires, surface-mounted utility boxes, utility mains, laterals, vaults, and valves. They include sewer, water, gas, and telecommunications, as well as traffic signals, street lights, and electrical poles and wires.

Well-organized utility design and placement can lead to:

- Minimization of streetscape clutter to achieve a cohesive streetscape design
- Maximization of space for plantings
- Improved efficiency of utilities and integrated alignment with stormwater facilities, street furnishings, and street lighting
- Reduced cutting and trenching
- Possible reduction of long-term street and sidewalk closures
- Reduced long-term maintenance conflicts and potential costs
- Improved pedestrian safety, quality of life, and right-of-way aesthetics



Utilities



Utility construction should avoid disruption of sidewalks.



Above ground and overhead utilities should be relocated or placed underground whenever possible.

Considerations

Utilities should be placed to minimize disruption to pedestrian through travel and potential planting and site furnishing locations, while maintaining necessary access for maintenance and emergencies. The following guidelines apply to utilities in the public right-of-way:

- Utilities should be located underground wherever possible, as opposed to overhead or surface-mounted.
- Large utility vaults such as network or transformer vaults, and conduits running the length of a City block, should be located in the roadway or parking lane where access requirements allow.
- Small utility vaults, water meters, gas valves, and gas vaults should be located in the curb zone.
- Utilities should be consolidated to the extent feasible for efficiencies and to minimize disruption to the streetscape.
- Utility vaults and boxes should be located outside of the furnishing zone whenever possible to maximize the number and size of tree wells and the ability to connect tree wells into continuous strips.
- Major utilities (sewers, fire hydrants, gas and water meters and mains, manholes and utility vaults, and utility poles) should be installed at least five feet from the edge of existing or proposed tree basins.
- Minor utilities (laterals, vaults, valves, etc) should be installed at least three feet from the edge of new or existing tree basins.
- Utility laterals should run adjacent to, not directly under, potential site furnishing and tree planting locations wherever possible (such as through driveways or between tree basins).
- Subsurface utility conduits and irrigation lines should avoid running under the length of the planting area to minimize root interference.

- If several shallow utility laterals are unavoidable, planting areas may still be created and should utilize ground cover or low shrub plantings without the incorporation of deep-rooted trees.
- Utility vaults and valves should be minimized in curb extensions where plantings or site furnishings are desired, or where they may obstruct sight lines to pedestrians entering a street crossing.
- If existing vaults conflict with curb ramp areas, vaults should be moved or modified to meet accessibility requirements as feasible as part of utility upgrades.
- Other design, operations, and maintenance considerations include the following:
 - Utility vault covers should be made of slip resistant materials.
 - Any utility-related roadway or sidewalk work should replace paving material in-kind (e.g., brick for brick) where removed during emergency or construction.
 - Utility construction should use “trenchless” technologies, such as sealants, pulling cables through tunnels, etc., wherever possible, to avoid excavation and disruption of streetscape elements.



Sometimes existing overhead power lines can remain to serve adjacent property owners and be successfully incorporated into the complete streets design.



Burying or relocating overhead utilities creates extra room for pedestrian amenities.



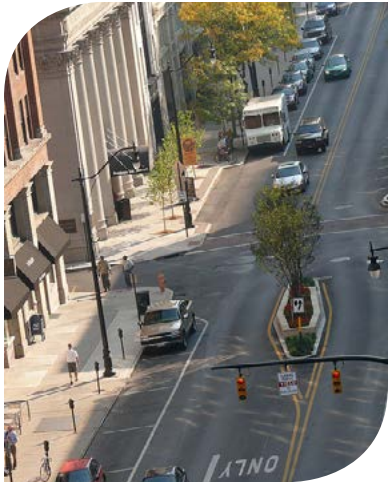
Portions of Chapter 5 were derived from the Boston Complete Streets Guidelines, prepared by the City of Boston Transportation Department, with permission.

5. STREET ZONE DESIGN ELEMENTS



Complete Streets provide the opportunity to avoid traffic congestion and increase the overall capacity of the transportation network.

STREET ZONE DESIGN ELEMENTS



Street Zone

The organization and distribution of right-of-way has a profound effect on safety, roadway capacity, and how comfortable and convenient transportation modes are relative to each other. In the past, the Thoroughfare Plan was the primary driver of roadway design in Dallas. The focus was on moving motor vehicles safely and efficiently. A Complete Streets approach takes a more comprehensive view of the street and all users. In a Complete Streets zone, the space typically between curbs supports adjacent land uses and balances the efficiency of motor vehicle travel with considerations for pedestrians, bicyclists, and transit users.

The example cross sections in Chapter 2 identify primary and secondary priorities within the cross section for each street type. Since there is significant variation in how each street cross section can be configured, these priorities are intended to help direct decisions with respect to roadway design, particularly in constrained rights-of-way where ideal widths cannot be met. This chapter provides further design guidance on specific elements within the traveled way.



Street Zone



Street Zone



A speed table will encourage drivers to slow down and be more alert to pedestrians and bicyclists.



Mini-roundabouts provide traffic calming benefits in residential areas.

TRAFFIC CALMING ELEMENTS

Safe Speeds

The streets in Dallas will be designed to limit the excessive speeds of vehicles. Managing vehicular speed is particularly important on streets where pedestrian and bicycle use is desired. In crashes involving these more vulnerable users, vehicular speed at the point of impact is directly related to pedestrian or bicyclist survival. For example, a pedestrian who is hit by a motor vehicle traveling at 20 mph has a 95% chance of survival, whereas a pedestrian hit by a motor vehicle traveling at 40 mph has a 15% chance of survival. Studies have also shown that motor vehicle crashes decline where roadway speed is reduced. In addition, drivers are far more likely to yield to pedestrians at crosswalks when speeds are lower.

Mixed use and residential streets in Dallas should be designed for a target design speed of 25 mph. The context of an individual street should factor into whether or not adjustments to this base design speed are appropriate. Target design speed will be lower at intersections and crossings. Transportation Planning and Street Operations should take the lead on determining target design speeds during the corridor planning stage of the Complete Streets design process in the context of the community vision.

For major roadway construction and reconstruction projects, the geometric design of the roadway should be such that excessive speeds feel uncomfortable. This can be accomplished through a creative approach to roadway design. Curves (chicanes) should be incorporated, long vistas should be broken with vertical elements such as street trees, and traffic calming features should be introduced.

The following speed-reduction strategies will be considered for traveled way design on Dallas roadways and are discussed in more detail later in this chapter:

- Lane widths
- Road diets
- Center medians/islands
- Midblock curb extensions (neckdowns)
- Bikeways
- Transit lanes
- On-street parking
- Paving treatments
- Shared streets
- Chicanes
- Speed tables
- Street lighting

Road Diets

Description

There are many streets in Dallas that are wider than necessary given the volume of traffic they carry during peak hours. Road diets are therefore a solution that can be useful on a wide variety of roads throughout Dallas. A road diet reduces the number of travel lanes on a roadway, typically removing one lane of traffic in each direction. The reduction of travel lanes provides additional space for expanded sidewalks, bike lanes, or plantings.

Road diets not only provide additional space necessary to build a Complete Street, but they also provide measurable safety benefits to all users. Research has shown that road diets reduce the total crashes from 81% to 53%. Road diets are officially recognized by the Federal Highway Administration (FHWA) as a proven safety countermeasure. In a January 2012 memorandum, FHWA division offices were advised to advance the use of road diets with their State DOT counterparts.

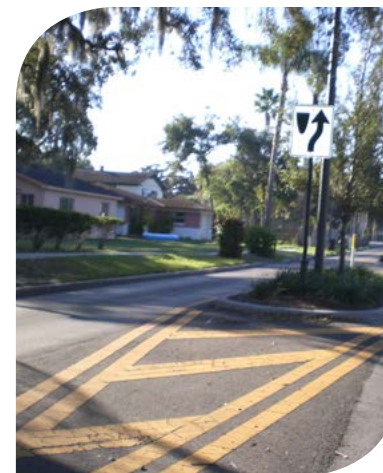
Application

Road diets are an important measure in the implementation of Complete Streets principles in Dallas. The following issues should be considered when reducing travel lanes on streets:

- Four-lane roads with average daily traffic volumes up to 20,000, and six-lane roads with up to 30,000 vehicles per day are candidates for road diet treatments. A capacity analysis may be necessary to ensure the reduction of travel lanes does not create significant delays for motor vehicles.
- On four-lane undivided roadways, road diets typically remove two travel lanes and convert the road to a two-lane road with a center-turn lane and bike lanes. In Dallas, however, many of the roads that are eligible for road diets already have left turn lanes, thus the additional space can be used for buffered bike lanes, transit lanes, and expanded streetscape improvements.
- Some road diets will be implemented as a part of the roadway repaving/reconstruction process, as this offers an opportunity to reconfigure the roadway with new pavement markings.

Considerations

- Particular to the individual project, a thoroughfare plan amendment might be necessary.
- Road diets require special attention to public involvement of surrounding communities. Gaining public support is a key aspect in the success of a road diet.
- A low-cost road diet reconfigures existing roadway space and does not involve curb reconstruction. While sidewalk width remains the same, these types of road diets still benefit pedestrians due to the increased buffer between the sidewalk and the nearest motor vehicle travel lane.
- Where road diets are implemented through the repaving/reconstruction process, consideration should be given to the long-term maintenance needs of the resulting bike lanes. They will need periodic maintenance to remove debris and ensure they are usable facilities.
- Road diet projects require careful attention to motor vehicle capacity issues at intersections.



Road diets and medians are used to reduce excess travel lane capacity and improve conditions for other travel modes.



Clearly marked crosswalks and bulbouts increase pedestrian safety.



Road diets encourage drivers to slow down



Road diet with median

One-way to Two-way Street Conversions

Description

Converting a one-way street to a two-way street is an effective strategy for managing traffic patterns, reducing motor vehicle speeds, improving access to businesses, and changing the character of a neighborhood from being a pass-through to a destination for motorists. Conversely, conversion of a two-way street to a couplet may provide space for other street zone elements within the same right-of-way as the two-way option, such as a pedestrian plaza, bicycle facilities, or stormwater management features.

Application

One-way streets are often designed as part of a couplets system—a pair of one-way streets, typically separated by one city block—which often results in a higher vehicle capacity than an equivalent two-way street. In some cases, developing a couplet system could be considered as an alternative to widening a two-way thoroughfare. This may be a beneficial option when trying to preserve pedestrian space, trees, and other aesthetic features.

In terms of pedestrian safety, there are benefits of both one-way and two-way streets, so the decision to convert a one-way street to

two-way (or vice versa) is context sensitive.

Studies have shown that converting two-way to one-way streets generally results in fewer crashes involving pedestrians because there are fewer turning movements. However, one-way streets tend to encourage higher motor vehicle speeds, and may increase vehicular traffic if motorists are required to circle around to access destinations in a dense, urban environment. Two-way streets may reduce vehicle speeds due to increased turning movements and increased perceived friction along the roadway. In addition, many one-way streets have multiple lanes, which may create a multiple threat crash condition for pedestrians crossing the road. Converting a multi-lane, one-way street to a two-lane, two-way street can eliminate this safety issue if crossing islands are installed.

If a street is converted to one-way, it should be evaluated to see if additional changes should be made. Potential changes include lane diets, road diets, curb extensions, turning radius reductions, and signal timing that discourages higher vehicle speeds. Also, traffic circulation in the surrounding area must be carefully considered before converting streets to one-way travel.

Considerations

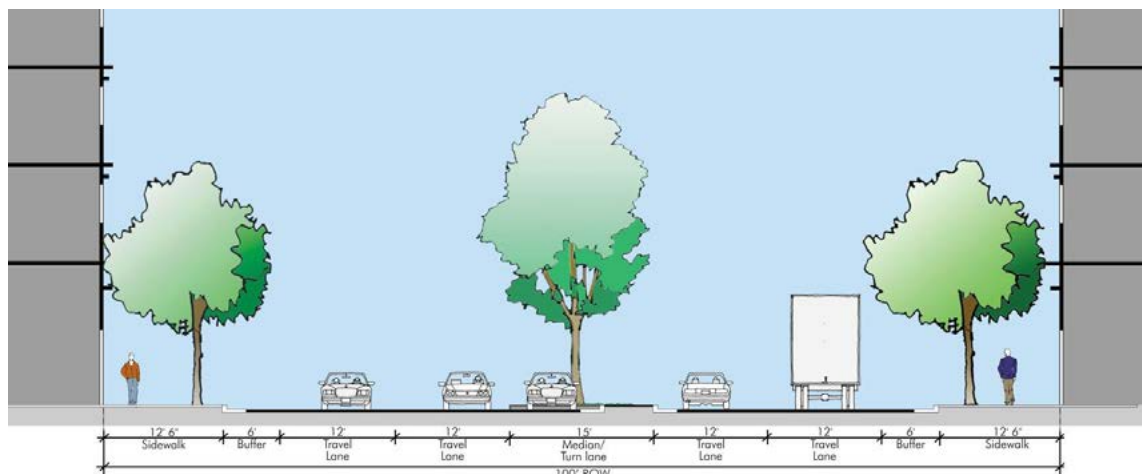
- Protected left-turn signal phasing and center turn lanes are not required on one-way couplets. Conversion of a two-way street to a couplet may provide space for other street zone elements within the same right-of-way as the two-way option.
- Narrowing the travelway of a one-way couplet street provides opportunities for shorter and safer pedestrian crossings.
- Streets with lower traffic volumes may not demand the use of one-way couplets.
- Many communities have found that local businesses benefit from one-way to two-way conversions because access is improved and motorists are more likely to stop and patronize businesses.

Slip Streets

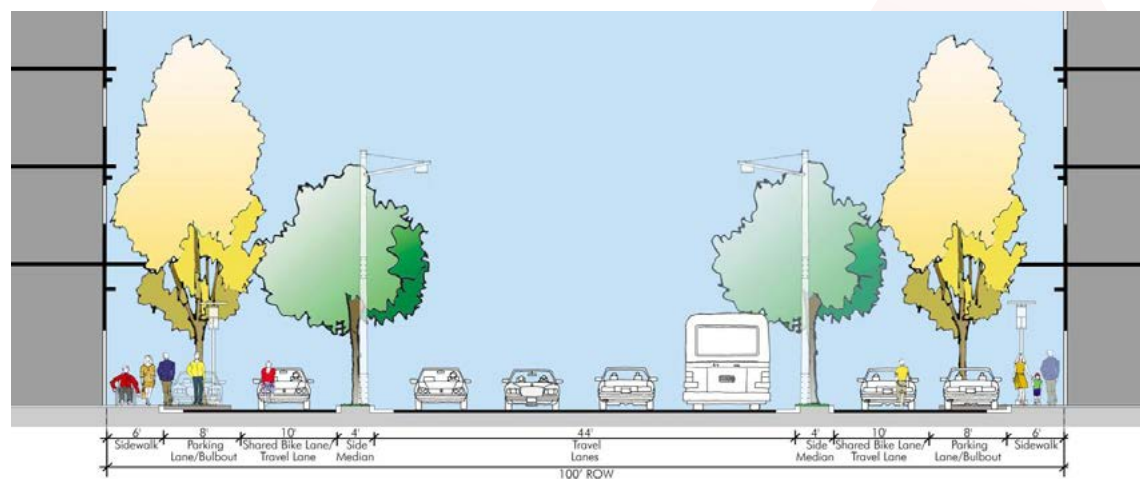
Description

Slip streets, also known as frontage roads or local roads, run parallel to higher speed limited access roads. Slip streets are located between an arterial and developed land and are often used where a major road passes through an urban area. They may provide access to private driveways, shops, or houses. Slip streets provide a more pedestrian-friendly street edge with slower moving local traffic, parked cars, and landscaping essentially acting as a buffer between land uses and the higher volume, higher-speed arterial street. A good example is Northwest Highway east of Preston Road.

PEARL STREET- TYPICAL SECTION - EXISTING CONDITIONS



PEARL STREET- TYPICAL SECTION- FUTURE





Slip streets, such as this one along Blackburn, slow traffic adjacent to the pedestrian zone.



Bike lane with parallel parking

Slip streets reduce conflict points between through traffic and turning traffic associated with direct property access to the arterial. These streets also reduce conflict points on the arterial, increasing roadway safety, and operations, and provide a more pedestrian friendly street edge with slower moving traffic on the outside lanes. This roadway configuration also improves compatibility between high capacity arterials and lower intensity contexts.

Application

Slip streets separate local traffic from through traffic, and are most effective on higher volume, higher speed arterials. Opportunities to construct slip streets are generally restricted to locations with substantially longer block lengths, little if any existing development, and a development plan. Retrofits may be possible where developed properties have large setbacks or redevelopment of existing land uses is occurring.

Considerations

- Space between the slip street and main roadway should be of sufficient width to accommodate plantings and a comfortable waiting area (refuge) for pedestrians waiting to cross the main roadway. This space may also provide opportunities for natural drainage elements
- Slip streets provide improved access to individual properties, which may in turn increase value and potential of adjacent properties
- Separation between arterials and slip streets should be carefully planned to reduce conflict areas of vehicles entering and exiting the roadways. Slip streets require a larger area of space dedicated to roadways, and increase the distance pedestrians have to cross roadways. See Chapter 6 for guidance on slip street intersections

Center Medians/Islands

Description

Medians are raised barriers in the center portion of the roadway. Median width can vary greatly, from a minimum of 6' to 20' or more along parkways and light rail transit lines. Medians with street trees or other landscaping can be used to add prominence to a segment of road, extend a park-like environment along a corridor, and to reduce the heat island effect. Medians can also provide a location for transit and a refuge for pedestrians crossing multi-lane roadways. Studies show that intermittent (midblock) islands can result in up to a 7% reduction in motor vehicle speeds.

Dallas has many streets with concrete medians, however, these were mainly constructed to channelize turning movements and to control access to adjacent land uses. Through a Complete Streets approach, medians on Dallas roadways should be pedestrian-friendly, reduce travel speeds, and should provide landscaping whenever possible.

Application

- Medians are particularly helpful as pedestrian refuges at controlled and uncontrolled crossings. When designed properly, medians offer protection to pedestrians crossing the road.
- The minimum width for a center median is six feet. This width is necessary to ensure the median serves as an adequate pedestrian refuge. A wider median is necessary if it will serve a dual purpose as a left turn lane, to accommodate both the width of a turn lane as well as adequate space for the pedestrian refuge

- Signalized intersections with medians should be designed to allow pedestrians to cross the entire roadway during a single signal cycle.
- Pedestrian cut through medians should be of at least equal width to the approaching sidewalks. At midblock locations, consider angling the pedestrian cut to direct pedestrian sight lines to on-coming traffic.
- Care should be taken to ensure median plantings do not limit the sight lines for pedestrians and motorists at intersections.

Considerations

- Center medians should be carefully designed to ensure proper drainage and maximize potential for on-site stormwater retention and filtration. Drought-resistant and low-maintenance plant species should be used.
- Trees and landscaping should be maintained for sight lines and vehicle operation per the Department of Street Services *MOWmentum Program Landscaping Guidelines*.
- Sidewalks should not be reduced in width, and bike lanes should not be eliminated, to provide space or additional width for medians.

Midblock Curb Extensions (Neckdowns)

Description

At midblock locations with on-street parking, curb extensions, also called neckdowns, can be installed on both sides of the road to create a visual pinch-point, helping to calm motor vehicle traffic. They are particularly useful on streets with longer block lengths where motorists tend to gain speed at midblock locations. They can be combined with midblock pedestrian crossings to further enhance pedestrian safety by lowering motor vehicle speeds, reducing crossing distances, and increasing visibility.

Application

- Midblock curb extensions should only be used on streets with on-street parking.
- They can be used on two-way streets with one lane in each direction, and one-way roads. Where used on streets with multiple lanes in one direction, other crossing enhancements such as crossing islands, which allow pedestrians to cross the street in two stages, and rapid flashing beacons should be considered.



Midblock curb extension



Midblock curb extension



Cycle track



Shared-use path

- Midblock curb extensions are sometimes combined with intermittent medians to reduce speeds along the length of a roadway and provide a crossing refuge in the center of the street, allowing pedestrians to cross the street in two stages.
- Where curb extensions provide pedestrian crossings, ADA compliant curb ramps, tactile warning strips, and cross slopes must be provided.
- Street trees are encouraged within midblock curb extensions. However, sight distances are a primary issue at midblock pedestrian crossings. Therefore, shrubs and other types of vegetation that would block drivers' view of approaching pedestrians should be avoided.

Considerations

- Midblock curb extensions can be combined with speed tables to provide raised crossings for pedestrians. For more information, see Chapter 6: Intersections Design Guidelines, Raised Crossings, and Intersections.
- Bicycle lanes should not be eliminated at midblock curb extensions. In constrained spaces, care should be taken to avoid suddenly squeezing bicyclists into the traffic flow on streets with higher volumes of traffic, particularly in locations with steep uphill grades where bicyclists may be travelling considerably slower than motor vehicle traffic.
- On low-volume residential streets, midblock curb extensions can reduce the street to one lane, requiring on-coming drivers to alternate passage through the midblock curb extensions, while keeping enough space for fire trucks and other large vehicles.

BIKEWAYS

Bicyclists should be considered and anticipated on all streets in Dallas where they are legally allowed to operate. The bicycle is an ideal vehicle for trips that are too far to comfortably walk, but are still fairly short. Bicycling is an excellent option for trips that are less than three miles in length, which are half of all trips made on a daily basis. The *2011 Dallas Bicycle Plan* sets a vision for bicycle facilities in Dallas in the future, and identifies specific locations where it may be feasible to retrofit roadways to accommodate bicycles.

Like pedestrians, bicycles are vulnerable road users who can be seriously injured in a simple collision. For many people, bicycling in close proximity to faster moving traffic can be an uncomfortable experience. Lack of bicycle accommodations on the street can increase the number of bicyclists riding on the sidewalk, which conflicts with pedestrian traffic. Well-designed bikeways reduce these conflicts and create a more predictable traffic environment for everyone.

Bikeways can be divided into two general categories: exclusive facilities, where roadway space is designated for bicycle use, and shared facilities, where bicycles and other vehicles share roadway space.

In general, shared facilities are more appropriate in low speed (25 mph or less) environments where motorists are going slow enough to be able to see and react to the presence of bicyclists. As vehicular speeds increase, so does the need for greater separation between the bicyclists and motor vehicles.

General Design Considerations for Bicyclists

- In order to provide adequate space for bicycle facilities, road diets and lane diets should be considered. More guidance on optimizing street capacity is provided earlier in this chapter, including minimum lane widths for Dallas streets.
- Bicyclists provide their own energy and as such are sensitive to distance and frequent stops. They typically seek the most direct, continuous route that does not require a lot of stops and starts. Bikeway design should always keep this in mind.
- Bicyclists are more sensitive to broken or uneven pavement which can cause them to lose balance or swerve suddenly. This includes potholes, uneven or sunken drainage structures, and utility access covers. Where possible, the installation of bicycle facilities should be coupled with an evaluation of pavement conditions and improvements as necessary to ensure a smooth riding surface.
- Drainage inlets should be safe for bicycle wheels
- Angled parking, if provided adjacent to an on-street bikeway, should be back-in to increase visibility between bicyclists and drivers exiting spaces.
- Refer to the AASHTO Guide for the Development of Bicycle Facilities for additional guidance.

More detailed information on several common bikeway types is provided on the pages that follow. Guidance on bicycle facility design at intersections is provided in Chapter 6.



Buffered bike lane



Bike lane with parallel parking



Bike lane with right-turn lane



Left side bike lane

Bike Lanes

Description

Bike lanes provide an exclusive space for bicyclists through the use of lines and symbols on the roadway surface. Bike lanes are for one-way travel and are normally provided on both sides of two-way streets, or on one side of one-way streets. Bicyclists are not required to remain in a bike lane when traveling on a street, and may leave the bike lane as necessary to make turns, pass other bicyclists, or to properly position themselves for other necessary movements. Bike lanes may only be used temporarily by vehicles accessing parking spaces and entering and exiting driveways and alleys.

Application

- Bike lanes are normally placed on the right-hand side of the road to reflect the general traffic principle of slower traffic keeping to the right.
- The minimum width of a bike lane next to a parked car or a vertical curb is five feet. Bike lanes on open shoulders (without curbs) may be a minimum of four feet wide (refer to the lane width chart for desired widths).
- Bike lanes are typically installed by reallocating existing street space—narrowing other travel lanes, removing travel lanes, and/or reconfiguring parking lanes.
- Bike lanes require on-going maintenance to ensure debris does not collect in the lane
- Refer to the MUTCD and the AASHTO *Guide for the Development of Bicycle Facilities* for more information on bike lane design

Considerations

- On one-way streets and streets with wide medians, a left-side bike lane can be advantageous, particularly in locations with heavy bus traffic or frequent right-turns.
- Where additional space is available, consider providing a buffered bike lane (three-foot minimum buffer recommended). The buffer can either be placed between the bike lane and the travel lane (in locations with higher speeds and volumes), or between the bike lane and the parking lane (in locations with a high rate of parking turnover).
- Where there is insufficient space to provide a buffered bike lane on a street with designated on-street parking, offsetting the bicycle symbol to encourage bicyclists to ride in the left side of the bike lane, away from the door zone of parked vehicles, should be taken into consideration.
- Contra-flow bike lanes may be used on one-way streets to provide more convenient connections for bicyclists where other alternative routes are less desirable or inconvenient.
- Wider bike lanes enable bicyclists to pass one another on heavily traveled corridors and increase separation from faster traffic.

Cycle Tracks

Description

Cycle tracks are a portion of the right-of-way contiguous with the traveled way for the exclusive use of bicyclists. Cycle tracks provide added separation that enhances the experience of bicycling adjacent to streets. Separation is achieved through a variety of methods. Some cycle tracks are placed at a higher elevation than the adjacent street (i.e. curb height, or at an intermediate height between the curb and the street level). Other cycle tracks are placed at street level, but are physically separated from the adjacent travel lane by a raised median, a row of parked cars, flexible bollards, or some combination of these.

Application

- Refer to the Lane Width Chart on page 83 for minimum cycle track widths.
- Cycle tracks may be placed between the parking zone and the pedestrian zone. Other configurations are acceptable as well, such as a cycle track that is separated from the motor vehicle lane by a concrete curb or other buffer.
- When adjacent to on-street parking, a minimum 3' buffer should be provided between parking and the cycle track. The buffer serves as a pedestrian loading and unloading zone.
- Cycle tracks can either be one-directional (one-way on each side of a street), or two-directional (two-way on one side of a street).
- Intersection design for cycle tracks is very complex and requires careful attention to conflicts with turning vehicles. For example, turning movements across cycle tracks should be carefully assessed to reduce or eliminate conflicts. If intersection conflicts cannot be adequately addressed, it is likely that a cycle track will not be a feasible solution due to safety concerns.
- Cycle tracks can be useful on streets that provide connections to off-street trails, since bicyclists on these streets may be more accustomed to riding in an area separated from traffic.
- Consult the NACTO *Urban Bikeway Design Guide* and the *Dallas Bike Plan* for more information on cycle track design.

Considerations

- Cycle tracks require increased parking restrictions as compared to bike lanes to provide for visibility at intersection transitions.
- Frequency of driveway crossings is a factor in determining if a cycle track is feasible. Frequent driveway crossings are incompatible with cycle track design.
- Colored pavement can be beneficial to highlight the presence of a cycle track, particularly at intersections and other locations where motor vehicle traffic crosses the cycle track.
- When a cycle track is provided on the same side of the road as transit operations, transit stops and waiting areas should be provided between the cycle track and the roadway to reduce conflicts with pedestrians loading and unloading.
- The presence of drainage and utility structures along the curb may reduce the effective width of the cycle track.



Cycle track



Cycle track



Shared lane marking



Shared lane marking

Shared Lane Markings

Description

Shared lane markings, or sharrows, are pavement markings that are placed within the vehicular travel lane of the roadway. Unlike bike lanes, they do not designate a particular part of the roadway for the exclusive use of bicyclists. The symbols alert motorists to locations where bicyclists should be expected to ride, and encourage safer passing behaviors.

Application

- Shared lane markings are typically used on streets where space constraints make it impractical to provide bike lanes. They should not be used on streets with speed limits higher than 30 mph.
- On streets with narrow lanes, the shared lane marking is typically placed in the center of the lane to indicate that motorists must change lanes to pass bicyclists.
- On narrow travel lanes adjacent to on-street parking, shared lane markings should be placed in a location that is outside of the door zone of parked vehicles
- Refer to the MUTCD and the AASHTO *Guide for the Development of Bicycle Facilities* for more information on the application of shared lane markings.

Considerations

- Marked, shared lanes should be provided after considering narrowing or removing travel lanes, parking lanes, and medians as necessary to provide a bike lane or cycle track.
- Shared lane markings are less effective on streets with an on-street parking lane that is frequently unoccupied, because bicyclists often feel more comfortable riding in the parking lane.
- Shared lane markings can be used in lieu of a bike lane where bicyclists may be operating at higher than normal speeds due to downhill grades, particularly if bicyclists are operating at or near the speed of adjacent motor vehicle traffic.
- Shared lane markings can be used in constrained corridors as a temporary solution to complete connections between bike lanes and other facilities.

BICYCLE BOULEVARDS

Description

Bicycle boulevards, also called neighborhood greenways, are streets with low motor vehicle speeds that are designed to allow bicyclists to travel comfortably in a low-stress environment. Bicycle boulevards often give priority to bicycle use, and discourage through-traffic by motor vehicles. Ideally, they are designed to minimize the number of stops that a bicyclist must make along the route. Separated bicycle facilities (i.e., bike lanes) are not necessary on bicycle boulevards because motor vehicle speeds and traffic volumes are low. Bicycle boulevards are typically designated by special wayfinding signs and pavement symbols.

Application

- Bicycle boulevards are usually more feasible in neighborhoods with a gridded street network (one street is chosen as the bicycle boulevard), but can also be accomplished by combining a series of road and trail segments to form one continuous route.
- At major street crossings, bicycle boulevards may need additional crossing measures for bicyclists, such as quick-response traffic signals with bicycle-sensitive loop detectors, crossing beacons, median refuge islands, and/or curb extensions.
- Traffic calming measures can be used to maintain low speeds (20 mph or less) on bicycle boulevards.

Considerations

- Ideally, bicycle boulevards should not carry more than 1,000 motor vehicles per day to be compatible with bicycling. Diverters and other traffic management devices are typically used to discourage motor vehicle through-traffic, while still enabling local traffic access to the street.
- Bicycle boulevards should be long enough to provide connectivity between neighborhoods and common destinations.



Bicycle boulevard



Bicycle boulevard

PAVED SHOULDERS

Description

Paved shoulders provide space on the outside of travel lanes for bicycle and pedestrian use. Paved shoulders should be a minimum of 4' without the curb and 5' minimum with a curb. Travel lanes can be narrowed to achieve adequate space to provide a paved shoulder within the lane width. On some roadways without curbs, paved shoulders can provide important bicycle connections. Paved shoulders also improve safety for motor vehicles and prevent pavement damage at the edge of the travel lanes.

Application

Continuous paved shoulders are typically provided in rural areas where bike lane markings are not necessary. They can be supplemented with bike route signage (see section below) where necessary to provide wayfinding for bicyclists.



Back-in angled parking



Parallel parking

Considerations

- A bicycle level of service analysis (per the *Highway Capacity Manual*) is useful to determine the amount of width needed to achieve the desired level of comfort for a bicyclist.
- Rumble strips located on paved shoulders create hazardous conditions for bicyclists and should be avoided. If they are needed due to a history of run-off-the-road crashes, they should be designed according to the AASHTO Guide for the Development of Bicycle Facilities
- Paved shoulders should be continuous at turn lanes and shoulder bypass lanes.

BICYCLE ROUTE SIGNAGE

Description

Bicycle route signs are wayfinding signs that guide bicyclists along preferred, designated routes to destinations within the City of Dallas and throughout the region. The intent is to create a single, integrated signing system that is instantly recognizable by bicyclists.

Application

It is expected that as the Dallas bike network is built out over time that many bicycle facilities will have bicycle route signage. Some routes within the planned bike network may only have signs and no other treatments.

ON-STREET PARKING

Description

On-street parking is clearly a key to the success of small business districts, and can add energy and excitement to the street. This encourages the concept of *park once*. On-street parking has a very positive impact on the pedestrian realm—research shows that pedestrians feel far more comfortable and safe on streets with occupied on-street parking. Parked cars provide a traffic calming effect by visually narrowing the roadway and increasing friction along the edge of the roadway.

It is important to get the ingredients right to achieve the maximum benefit from on-street parking. When on-street parking is underutilized, the result is a wider street with faster speeds.

Application

- On-street parking is most appropriate for mixed-use and residential streets. In these types of streets it can provide a traffic-calming effect and convenience to local shops and residences
- On-street parking is ideally created by these parking types: parallel, angle, reverse angle, and unmarked parallel spaces.
- Parking lanes should be a minimum of 7' wide, with 8' being the desired width.

- The potential hazard of opening car doors should be considered when developing an appropriate design. Crashes can occur in locations with high parking turnover; such as main streets and commercial streets with restaurants and businesses. Adjacent to a narrow parking lane (7 feet) with high turnover, a 6-foot bicycle lane is recommended.

Considerations

- In mixed-use, a parking lane can be designated for different purposes throughout the day, such as commercial loading during the morning, public parking during the day, and valet at night.
- On-street parking should be prohibited approaching intersections or driveways since it can obscure sight lines for all users of the road. See Chapter 6 for more detail.
- Angled parking maximizes the parking supply and is appropriate when sufficient curb-to-curb widths are available. Where angled parking is used, the preferred orientation is back-in angled parking. This configuration has been shown to provide numerous safety benefits for pedestrians, bicyclists, and motorists. It provides more visibility when pulling back into traffic, and more visibility between bicyclists and motorists. Back-in angled parking requires the use of wheel stops to ensure parked vehicles do not encroach upon the sidewalk. Consideration should be given to outdoor cafés and seating areas adjacent to back-in parking.
- Parallel parking is appropriate on streets with narrower curb-to-curb widths, and when trying to accommodate other elements such as bicycle lanes and wider sidewalks. Higher volume arterial streets should primarily use the parallel configuration.

TRANSIT LANES

Description

A transit-way is an exclusive space separated from motor vehicle travel lanes. Transit-ways can be located in a median or on the outside lane of a multi-lane road. In Dallas, transit-ways may accommodate buses, street cars, or light rail.

Providing dedicated space for transit within the public right-of-way can improve transit service, reduce traffic volumes, and reduce conflicts between modes of travel. Transit lanes should be considered for streets shown on the Transit Overlay Map on page 68 of Chapter 2. There are two types of transit lanes:

- **Priority transit lanes** are not separated from travel lanes, however they may include treatments such as signal prioritization, queue jumps, bulbouts, signage, turning restrictions for other vehicles, and off-vehicle fare collection. Priority transit lanes can increase the frequency and reliability of bus and streetcar service along a corridor and reduce congestion in other travel lanes. In Dallas, priority transit lanes can accommodate bus and streetcar service.
- **Shared transit lanes** are travel lanes in which transit is given priority using some or all of the treatments mentioned above, however, transit vehicles may share the travel lane with other vehicles such as bicycles and right-turning motor vehicles.



Exclusive transit-way



Priority transit lanes



Shared street



Shared street

For transit route locations and recommendations, refer to the DART System Plan as amended.

Application

- Refer to the Lane Width Chart on page 83 for the minimum widths of transit lanes for different street types in Dallas.
- Median transit-ways are in the center of multi-lane streets with station stops located on traffic islands. Pedestrian and bicyclist safety, connectivity, and comfort are critical to the success of median transit-ways. Intersections should be carefully designed and well-lit to encourage pedestrian and bicycle access to the stop. Distances and out-of-direction travel for pedestrians should be kept to a minimum.
- With regard to bus lanes, curb side bus lanes are less expensive and easier to install than median bus transit-ways, and are easier for pedestrians to access. However, curb side bus lanes can be compromised by turning vehicles, double parked vehicles, and vehicles accessing parking lanes. Design and enforcement are critical to deter vehicles from blocking the lane.

Considerations

- Shared bus/bike lanes (SBBLs) can be considered where there are street right-of-way constraints, and in situations where there is a need to accommodate both bicyclists and buses on a particular street. Sharing a lane between buses and bicyclists is generally not conducive if bus headways are heavy and there are frequent bus stops.
- A SBBL may vary in width, but generally should not be narrower than 12'. When SBBLs are developed, it is desirable for the lanes to be wide enough (15' min.) for buses and bicyclists to pass each other comfortably in the lane.
- Pavement markings within a SBBL may include a bicycle symbol or "BUS/BIKE ONLY" symbol. A shared lane marking may be used, but only on roadways with a posted speed limit of 35 mph or less. More guidance on shared bus/bike lanes can be found in the *AASHTO Guide for the Development of Bicycle Facilities*.
- Shared use with bicycles should not be considered in exclusive transit ways where buses travel at high speeds and curbs limit access to the travel way
- Colored or different pavement materials can be used to differentiate transit lanes from other parts of the roadway

SHARED STREETS

Description

Streets where the curb and gutter are eliminated create roadways with no designation between the traveled way and the side of the road. These are often called shared streets since all roadway users share the same space.

Shared streets work well when the total right-of-way is relatively narrow, and motor vehicle speeds and volumes are low. They create zones of extreme traffic calming, ensuring that the difference in speed between different modes of travel is minimal. Shared streets maintain vehicular access for loading and emergency vehicles, but otherwise function as extensions of the sidewalk to accommodate free-flowing pedestrian movements, bicyclists, street vendors and cafes, and occasionally on-street parking.

Shared streets can be paved with special materials to help indicate the special type of low-traffic zone. Chicanes, described later in this chapter, can be used to ensure speeds are low on shared streets.

Application

Shared streets are appropriate for some mixed-use streets in Dallas. Shared streets, or secondary networks—such as rail beds in the Design District and commercial alleys in high density areas—can be permanent installations, or can be shared for events or on certain days of the week. Examples include streets in State Thomas and the MEWS in Addison Circle.

Planters, bollards, or other vertical markers can be used to designate zones within a shared street. Paint and roadway materials can also delineate zones of the street. Since the goal of a shared street is to mix roadway uses and users as much as possible, treatments to delineate space should be limited. In addition, care should be taken when using bollards to delineate space, since they can become tripping hazards for pedestrians during crowded events.

Shared streets are also appropriate for some residential streets, as well as in subdivisions, campuses, and parks where there is a desire to limit motor vehicle traffic while placing a high priority on non-motorized traffic. A system of linked shared streets or alternating shared streets with standard streets can create a pedestrian-oriented district that maintains access for local traffic.

Considerations

- Parking is sometimes allowed on shared streets. Paint or special paving can be used to demarcate a parking zone or individual spaces.
- Because there are no curbs, shared streets require special drainage treatments and grading to prevent ponding of water.

CHICANES

Description

Chicanes are curb extensions that alternate from one side of the street to the other, creating an “S” curve that drivers must weave through. Chicanes provide opportunities to increase sidewalk space and introduce green street elements in the right-of-way. Chicanes can be created with curb extensions, tree pits or planters, or by alternating parking from one side of the roadway to the other.



Chicane



Chicane



Speed table



Bike lane

In addition to slowing vehicular traffic, chicanes can provide opportunities to increase sidewalk space and introduce landscaping in the right-of-way. They can be used in combination with other traffic calming devices such as speed tables, discussed below, and with midblock neckdowns or center islands (discussed earlier in this chapter).

Application

- Chicanes are appropriate for mixed use and residential streets.
- On residential streets, chicanes can serve as an alternative to speed tables, and provide additional areas for landscaping or neighborhood amenities.
- Chicanes and neckdowns can be used on two-way streets with one lane in each direction, and one-way roads with no more than two lanes.
- The amount of horizontal deflection in a chicane should be based on the target design speed of the roadway.

Considerations

- Vegetation used in chicanes should generally be low-growing (less than two-feet tall) and low-maintenance. In locations with midblock pedestrian crossings, sight lines should be maintained.
- Bikeways should be continuous through chicanes so that bicycles are not squeezed into the traffic flow, particularly in locations with steep uphill grades where bicyclists may be travelling considerably slower than motor vehicle traffic. Shared bikeways are appropriate on streets with chicanes that result in low-speed environments.
- Chicanes can serve in conjunction with iSWM Principles as bioswales.

SPEED TABLES

Description

Speed tables are raised pavement areas that are placed at midblock locations to reduce vehicle speeds. They are gentler than speed bumps (which are not recommended for public streets) but have been shown to effectively reduce 85th percentile speeds by 13 to 15 mph. Well-designed speed tables enable vehicles to proceed comfortably over the device at the intended speed, but cause discomfort when traversed at inappropriately high speeds.

Speed tables are a good tool for retrofitting streets with traffic calming devices. If full reconstruction is planned, consider achieving traffic calming with horizontal devices such as roadway width and chicanes, which are more subtle and require less signage. Speed tables should be used in combination with other traffic calming devices such as curb extensions, chicanes, and crossing islands.

Application

- Residential streets and mixed-use are appropriate locations for speed tables.
- Speed tables are usually 3" higher than the roadway surface. They are typically 10' to 14' in length and extend the full width of the roadway, although sometimes they are tapered at the edges to accommodate drainage patterns.
- Speed tables should be designed with a smooth leading edge and a parabolic profile, which provides a

smoother transition for bicyclists.

- Speed tables should be clearly marked with reflective pavement markings (per the MUTCD) and signage so that motorists and bicyclists are aware of their presence and can adjust their speed accordingly.
- Speed tables are generally not appropriate for streets with bus routes. They can, however, be installed on streets with school bus service.

Considerations

- Longer speed tables (up to 22' in length) have a design speed of 25 to 30 mph and are easier for large vehicles to negotiate.
- Avoid placing speed tables at the bottom of steep inclines where bicyclists travel at higher speeds and may be surprised by their presence.
- When used alone without complimentary traffic calming devices, speed tables may result in speed spiking where motorists may travel at higher speeds between tables.
- Speed tables should be located in consultation with the Dallas emergency service departments
- Raised crosswalks are discussed in Chapter 6.

STREET LIGHTING

Description

Street lighting is an important consideration in the design of the traveled way. A well-lit street contributes to the safety and comfort of vulnerable users, but is also a factor in economic development. Basic standards for street lighting are established in the *Street and Pedestrian Lighting Criteria* for the City of Dallas.

It is important to provide increased illumination where modes merge or cross paths, such as at intersections, bus stops, and midblock crossings.

The City of Dallas primarily maintains high-pressure sodium and metal halide lamps. The light produced by metal halide lamps is closer in quality to daylight, which improves the visibility of pedestrians to motorists, and is often perceived as providing greater personal security. Dallas is currently testing LED lighting, which has lower energy demands, longer lamp life, and light color similar to metal halide lamps.



Street lighting



Street lighting



Street lighting



Street lighting

Application

The street type, hours of activity, and adjacent uses are all important factors in setting street lighting levels.

- Mixed-use streets require the highest level of illumination. These streets are designed to encourage all modes of travel, especially those along the edges of the traveled way. Street activity is encouraged to extend into the evening
- Parkways may require lower overall levels of illumination. However, trail crossings and intersections should meet the recommended safety standards for light levels. It may also be appropriate to operate street lights on parkways for longer periods than on other street types, since side-paths have increased recreational activity at dawn and dusk.
- Residential streets should have lower levels of illumination except in the vicinity of transit stops, schools, other public buildings, and parks. Meeting illumination minimums is essential in order to encourage pedestrian travel, particularly for trips to and from school and transit, which may occur around dawn and dusk. Dimming the lights during the middle of the night, when there is very low activity on residential streets, can cut down on light pollution and energy costs. Street lighting should illuminate the public right-of-way, but be shielded from private property.

There are three basic poles for street lighting in Dallas: utility poles, fiber glass poles, and steel poles.

- Utility Poles are permissible on parkways, industrial, and residential streets. However, these will be phased out as more utility lines are buried.
- Fiberglass poles are acceptable on residential streets, in addition to steel and utility poles. Light fixtures in residential districts are mounted lower than on other street types since the travel way is generally narrower
- Steel poles are the preferred pole and are required on commercial and mixed use.
- Transit ways may have special fixtures that are combined with overhead-power structures

The spacing of light fixtures is mainly a function of the output of the type of lamp and the mounting height. Fixtures should be spaced to provide sufficient light to meet illumination standards. Regardless of the overall spacing, it is important to illuminate.

Considerations

- Over-illumination should be avoided to diminish light pollution and conserve energy.
- Requests for lighting above the guidelines in the *Street and Pedestrian Lighting Criteria* require cost participation for the portion in excess of the City's standard expenditure.
- Street lighting and pedestrian lighting fixtures may be combined in some locations. Refer to Chapter 3 for pedestrian lighting guidelines.
- Special fixtures are allowed in historic districts and plazas. Where possible, they should meet the same energy standards as other types of fixtures.
- Tree growth can reduce the amount of light that reaches the roadway or side of the road. Regular tree maintenance is recommended so that crossings and critical points along the traveled way, such as neckdowns or chicanes, are sufficiently illuminated. Pedestrian-scaled lighting along the side of the road closer to pedestrians and bicycles can also mitigate heavy foliage along the traveled way.

TREES AND GREENSCAPE SPACE

Trees and other greenscape plantings have a variety of functions – they can provide shade, buffer traffic in opposing travel lanes in medians, and provide aesthetic enhancements. Trees and other plantings must conform to Article X, of the Dallas Development Code, The Landscape and Tree Preservation Ordinance. When placing trees, consideration should be given to the placement and interaction of street and pedestrian lighting, utilities, and signage. Tree and plant selection is very important to ensure selection of climate-appropriate trees and plants (see Article X and the NCTCOG's iSWM guidelines.) Another consideration is the tree's anticipated mature canopy height, to ensure that there is adequate clearance for vehicles, buses, pedestrians and utilities so that all of these elements can function together efficiently.



Street lighting and tree space



An abundantly landscaped traffic diverter creates a new greenscape opportunity

6. INTERSECTION DESIGN ELEMENTS





A Complete Streets approach creates intersections that balance the needs of all users.

6. INTERSECTION DESIGN ELEMENTS



Intersection

Intersections are where streets converge, modes come together, and most conflicts occur on the roadway. Traditionally, Dallas' intersection design has been focused on maximizing the efficient movement of vehicles through the City. The Complete Streets approach expands this focus so that safety is the primary driver of intersection design. All intersections must safely accommodate people, whether they are walking, bicycling, driving, or riding transit.

Intersections should be designated and planned in context with the surrounding land uses as well as cultural and environmental considerations. Intersections should highlight the unique spaces where streets converge, making seamless connections from one street type to another. These Complete Streets guidelines emphasize the need to create multimodal intersections that are vibrant public spaces, balance the needs of all users, and enhance the quality of street life.



Intersection



Roundabout intersection



Underutilized areas of pavement should be reclaimed for pedestrian use.



Safe and accessible designs for all modes of transportation must guide intersection design.

MULTIMODAL INTERSECTIONS

Multimodal safety, with an emphasis on safety for vulnerable users, is the driving factor for intersection design in Dallas. It is important to recognize that non-motorized users are more vulnerable, and suffer far greater injuries in the event of a crash. Regardless of whether a trip is made on foot, by bicycle, via transit, or in an automobile people should feel safe, comfortable, and experience a minimal amount of delay during all trips.

Extensive guidance exists to design streets for motor vehicles. Specific engineering factors such as horizontal and vertical alignments, sight distance calculations, capacity, and coordinated signal timing are covered by a range of design manuals.

Traditionally in the City of Dallas, the manuals listed below have been used by engineers to design intersections and roadways:

- U.S. Access Board's *Public Right-of-Way Accessibility Guidelines* (PROWAG)
- AASHTO's *Policy on Geometric Design of Highways and Streets*
- Texas Department of Transportation (TxDOT) *Roadway Design Manual*
- *Highway Capacity Manual* (HCM)
- *Texas Manual on Uniform Traffic Control Devices* (TMUTCD)
- Institute of Traffic Engineers (ITE) *Traffic Signal Timing Manual*
- *Dallas Paving Design Manual*

The Dallas Complete Streets Design Manual is geared to supplement these manuals and guide the City's design process to require incorporation of multimodal design. Multimodal intersections should be functional and easy to navigate through clear regulatory and wayfinding signage, pavement markings, and signals. Designs should reflect users' desired travel paths as seamlessly as possible.

There are trade-offs with all intersection designs, and different design elements that can improve conditions for one mode may negatively impact conditions for other modes. The goal of Complete Streets is to consider the needs of all users, ensuring safe and efficient movements for all. The following guidelines discuss types of intersection controls, and key geometric design.

INTERSECTIONS AT SLIP STREETS

Description

Slip streets—also called frontage roads—are local roads, designed for lower volume local traffic, that run parallel to limited access highways or major arterials. Although slip streets reduce conflict points along the arterial by separating through traffic from vehicles accessing local businesses, parking, and residences, slip streets can create complicated intersection geometries and need to be carefully laid out in order to minimize conflicts.

Application

- Slip streets should control access points to and from the main arterial.
- An important objective for intersection design with slip streets is to ensure that slip streets do not become another route for through traffic.
- Through traffic on local roads may be discouraged by implementing low speed limits, narrow lane widths, on-street parking, bicycle facilities, and other traffic calming measures such as diverters.

Considerations

- Slip streets should prioritize safety and facilitate pedestrian and bicycle access.
- Space between the slip street and main roadway should be sufficient to accommodate plantings and a comfortable waiting area for pedestrians waiting to cross the main roadway. This space may also provide opportunities for natural drainage elements.
- Intersections with slip streets and major arterials may pose challenges to pedestrians due to the higher number of turning movements and associated conflict points.
- One strategy to reduce conflicts is to terminate a slip lane prior to a major intersection, forcing local vehicles into the main arterial or an adjacent street. Such a strategy may be implemented where there is a high demand for pedestrian crossings, or where there is the potential for cut-through traffic.
- Turning restrictions, including right-turn-on-red restrictions and left turn restrictions, should also be considered to minimize conflicts where slip streets intersect with other streets.
- Bicycle and pedestrian connectivity should be maintained on corridors with slip streets, and may require special treatments at major intersections such as exclusive phasing, signage, and pavement markings. Where a slip lane is terminated (e.g., vehicle traffic is diverted into the main arterial), bicycles and pedestrians should be allowed to continue along the path of the slip street and not diverted to the main roadway.



People should feel safe and comfortable, and should experience minimal delay during trips.



The goal of Complete Streets intersection design is to consider the needs of all users.



Mid-block crossing design should emphasize clear sight lines for all users.



Stop-controlled intersection in the West End

INTERSECTION CONTROLS

Uncontrolled and midblock crossings can be the most challenging places to provide safe pedestrian crossings.

Uncontrolled Intersections

Uncontrolled intersections are those where no traffic control devices facilitate the movement of traffic, and users yield the right-of-way to those who have already been established in the intersection, or those approaching from the right.

Midblock Crossings

A midblock crossing is a pedestrian crossing that is not located at a roadway intersection. If a midblock crossing is not designated by a marked crosswalk, then pedestrians must yield the right-of-way to motorists.

A discussion of when to mark crosswalks and provide additional safety treatments at uncontrolled intersections and midblock crossings is provided in this chapter. Specific warrants provided in the TMUTCD must be met in order to create signalized midblock crossings.

Uncontrolled intersections and midblock crossings should aim to maximize safety for all users by providing the following:

- Clear sight lines
- Appropriate lighting levels
- Regulatory and warning signage
- Marked crosswalks as determined by an engineering study (see Crosswalk Markings at Uncontrolled Locations)
- Traffic calming strategies

Stop-Controlled Intersections

Stop-controlled intersections are easiest for pedestrians to cross because motorists and cyclists must stop, encouraging them to yield to pedestrians and reducing pedestrian wait time. However, the use of STOP signs must balance safety with efficient traffic flow for all modes, including bicycles and transit vehicles. STOP sign installation on a major street requires that specific certifications be met, as determined by the TMUTCD.

In general, STOP signs may be appropriate if one or more of the following conditions exist:

- Where the application of the normal right-of-way rule (yield to those already in the intersection or to those approaching from the right) would not provide reasonable compliance with the law
- A street entering a highway or through street
- An unsignalized intersection in a signalized area
- High speeds, restricted view, or crash records indicate a need for control by a STOP sign

STOP signs should be installed in a manner that minimizes the number of vehicles having to stop. At intersections where a full stop is not necessary at all times, consideration should be given to using less restrictive measures, such as YIELD signs. Where feasible, the use of STOP signs should also be limited on streets with bikeways, especially on bicycle boulevards, as it requires significant energy to stop and start for bicyclists, resulting in lower levels of compliance.

Signalized Intersections

The Dallas Traffic Management Center remotely controls over 1,275 traffic signals in Dallas. The system can scan all traffic signals within 12 seconds for the status of equipment failure, as well as monitor, coordinate, and adjust the signals to improve traffic flow and pedestrian safety. Any recommended changes to signalized intersections should be based on an engineering study.

All signalized intersections should contain signals for motor vehicles and pedestrians. Additionally, bicycle signals and transit signals should be considered where appropriate. Signal phasing and timing should be designed to meet the unique needs of all users at the intersection. By optimizing signal phasing and timings, multiple modes are able to move safely and comfortably through the intersection with limited conflicts and delay.

Signalized intersections should conform to the latest version of the TMUTCD, HCM, and the Institute of Transportation Engineer's *Traffic Signal Timing Manual*. The TMUTCD contains specific warrants for the installation of a traffic signal at an intersection. The Dallas Public Works Department reviews and approves all proposed signal designs.

Signal Timing

Description

The overall goal of signal timing is to minimize cycle lengths to reduce delay for all users. Long cycle lengths make walking less convenient and may encourage unsafe behavior such as pedestrians jaywalking and bicyclists running red lights. Signals should be optimized to balance the needs of all users and to minimize delay for pedestrians, bicyclists, motor vehicles, and transit vehicles.

Signal timing is a tool used to optimize safety and efficiency for all modes of travel through an intersection. Over time, traffic volumes and patterns change; retiming signals requires evaluating changes in traffic patterns to minimize signal cycle lengths, reduce delay, improve safety, and reduce fuel consumption and emissions.

Application

- Signal retiming should be conducted to optimize intersection operations, and to globally coordinate the function of signals in relation to one another. This will allow groups or platoons of vehicles to efficiently travel through a series of intersections along a corridor. Vehicles can progress along a corridor at a set speed in order to obtain green lights at signalized intersections. Signal progression at slower speeds can help calm traffic, but should be used in conjunction with other methods to deter speed spiking in between signals.



Signalized intersection



Signalized intersection



Residential street roundabout

- Proper optimization of a traffic signal system is performed by a traffic engineer. The process includes taking an inventory of the system, collecting traffic and pedestrian volume data, reviewing intersection safety, and updating signal timing software.
- Traffic changes, which can occur due to new development along a street, may require the adjustment of traffic signal timing.
- Signal retiming should be evaluated regularly to better optimize the performance of signalized intersections due to changing development and traffic flow patterns.

Considerations

- Technology improvements in signal timing hardware and software should be considered during system upgrades.
- Changes in the number of travel lanes, switching direction of traffic, and other travelway enhancements can be considered with the signal retiming process.
- Factors of effective signal timing include a lack of travelway capacity, a high use of midblock access points, irregular signal spacing, transit/rail influence, and pedestrian signal demands. These should be assessed during the regular reviews of the system performance.

Modern Roundabouts and Traffic Circles

Description

Modern roundabouts are circular intersections designed for yield-controlled entry and typically channelized approaches. Modern roundabouts are different from traditional traffic circles, also called rotaries, are designed with larger diameters of about 300' or more and operate at higher speeds (30 mph or greater). Some rotaries use signals, stop signs, or yield signs at one or more entries. Rotaries tend to be difficult for pedestrians and bicyclists to navigate because of higher speeds.



Residential street roundabout

- Modern roundabouts have different design specifications than rotaries. The important difference between roundabouts and rotaries is the reduction in speeds and diameters, as well as yield-controlled entry in roundabouts. Pedestrian access is allowed, and median islands are installed where necessary to make crossing safer. Modern roundabouts should be designed to encourage slow entry speeds. In accordance with the Draft PROWAG, multi-lane roundabouts require accessible pedestrian signals at all crosswalks, which are expensive but necessary for safety.
- Another type of circular intersection is a neighborhood traffic circle, which is a smaller type of roundabout and generally used for low-speed residential street types.
- Roundabouts and traffic circles provide an opportunity to incorporate iSWM techniques through bioretention or other techniques described in Chapter 7.

Application

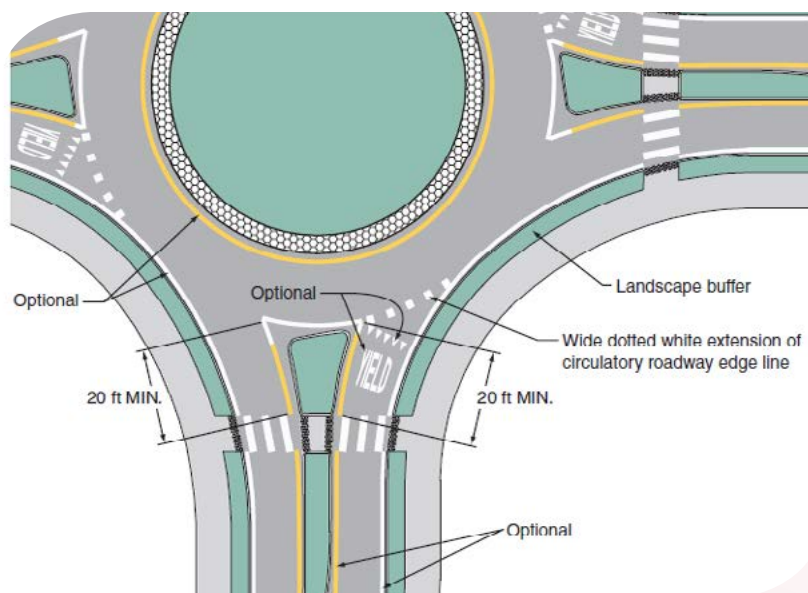
When determining whether to install modern roundabouts, general considerations would include the design vehicle, pedestrian volumes, amount of pedestrians with visual impairments, and effects on pedestrian route directness. Roundabouts are not recommended if they would create greater vehicle delay or increased difficulty for pedestrians navigating the intersection. Intersections with more than four legs can be good candidates for conversion to modern roundabouts. However, an engineering study must be conducted in order to determine whether a modern roundabout would be appropriate.

Modern roundabout designs should reduce relative speeds and improve traffic flow. ADA compliant pedestrian crosswalks with detectable warning strips and ramps at least 20' from the entry of the roundabout should be provided. Sight distance for drivers entering the roundabout must be maintained to the left so that drivers are aware of vehicles and bicycles in the circle (visibility across the center of the circle is not critical). Proper signing and pavement markings must conform to the latest version of the TMUTCD.

Considerations

- Yield lines should be provided at the entry of the roundabout.
- High pedestrian volumes may require larger crosswalk widths.
- Multi-lane roundabouts may not be recommended in areas where high levels of pedestrian and bicycle activity are anticipated.
- If multi-lane roundabouts are installed, in addition to pedestrian signals, splitter island medians should be provided on the approaches in order to reduce crossing distances, and allow pedestrian to cross one direction of travel at a time. At-grade pedestrians cut-throughs should be provided at splitter island medians with ADA compliant detectable warning strips
- Intersections near active railroad at-grade crossings are typically poor candidates for roundabouts since traffic would be blocked in all directions when trains are present
- Where there are high pedestrian volumes, signal controls should be considered

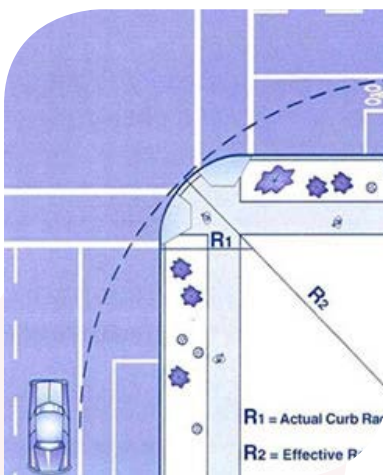
- Permitting bicyclists to use the sidewalk at roundabouts should be considered for comfort and safety of all types of bicyclists, such as young children. Ramps from the street to the sidewalk, as well as appropriate signage to inform pedestrians of a mixing zone, should be installed if sidewalk riding is permitted.
- Modern roundabouts also provide excellent opportunities to implement stormwater management techniques. Visibility and sight distances must not be obstructed due to plant growth.



Example of markings for approach and circulatory roadways at a roundabout



DART buses are up to 40 feet in length, and must be able to navigate intersections.



Adding parking and/or bicycle lanes increases the effective radius of a corner.

KEY GEOMETRIC DESIGN GUIDANCE

Well-designed intersection geometry is crucial for creating safe, efficient, and multimodal intersections. Changes in geometry can help to reduce vehicle turning speeds, increase pedestrian comfort and safety, and create space for dedicated bicycle facilities. Dallas' intersections must combine well-designed geometry with efficient traffic control measures to maximize safety for all users.

Curb Radii

Description

Corner design has a significant impact on how well an intersection serves the diversity of roadway users. Larger curb radii typically result in higher-speed turning movements by motorists, while smaller curb radii require sharper turns that reduce speeds, shorten crossing distances for pedestrians, and improve sight distances.

Two of the most important corner design elements are the *effective radius* and the *actual curb radius*. Actual curb radius refers to the curvature along the curb line. Effective radius refers to the curvature that vehicles follow when turning, which may be affected by on-street parking, bicycle lanes, medians, and other roadway features.

Application

The smallest practical actual curb radii shall be chosen to accommodate the design vehicle while balancing the needs of pedestrians. When designing the actual curb radii to accommodate the chosen design vehicle, assessments should be based on how the effective radius interacts with the design vehicle's turning radius. See Chapter 3 for more information on design vehicles.

An actual curb radius of 5'-10' should be used wherever possible, including where

- there are higher pedestrian volumes,
- there are low volumes of large vehicles,
- bicycle and parking lanes create a larger effective radius.

The desired maximum effective curb radius is 35' for large vehicles. There are several factors that may affect the curb radii and must be taken into consideration. These include

- the street types,
- the angle of the intersection,
- curb extensions, and
- the receiving lane width.

Where there are high volumes of large vehicles making turns, inadequate curb radii could cause large vehicles to regularly travel across the curb and into the pedestrian waiting area.

Considerations

A variety of strategies can be used to accommodate large vehicles while preserving benefits for pedestrians:

- Adding parking and/or bicycle lanes increases the effective radius of the corner.
- Striping advance stop lines on the destination street of multi-lane roadways (at least two lanes in each direction) enables large vehicles to make the turn by encroaching into the opposing lane.
- Installing a textured, at-grade paving treatment discourages high-speed turns while permitting turns by larger vehicles.
- Varying the actual curb radius over the length of the turn, also known as a compound curve, creates a radius that is smaller as vehicles approach a crosswalk and larger as they make the turn.
- Restricting access and operational changes prohibit certain turning movements.

Curb Ramps

Description

A curb ramp is a ramp that provides a smooth transition from the sidewalk to the street. Appropriately designed curb ramps are critical for providing access across intersections for people with mobility and visibility disabilities. One of the key considerations of intersection geometry is the location of curb ramps and crossings relative to desired lines and vehicle paths.

Application

Title II of the ADA requires that all pedestrian crossings be accessible to people with disabilities by providing curb ramps. Curb ramps must comply with standards established by the Dallas Public Works Department.

Curb ramps, not including flares, must be a minimum of 4' wide and contained within the marked crosswalk. Curb ramps shall have a slope of no more than 8.33 percent, a minimum 2' detectable warning strip, and level landing pads at the top and bottom of the ramp. Detectable warning strips include a series of truncated domes and are colored to contrast with the surrounding pavement.

Intersection geometry should be influenced by the following curb ramp design principles:

- Wherever feasible, curb ramps should be located to reflect pedestrians' desired path of travel through an intersection, while also considering sight lines of approaching motor vehicles.
- If possible, two separate curb ramps should be provided at corners instead of a single ramp that opens diagonally at the intersection.
- Curb ramps should be designed to avoid accumulation of water or debris to the maximum extent feasible. Drainage inlets should be considered with the design of curb ramps.



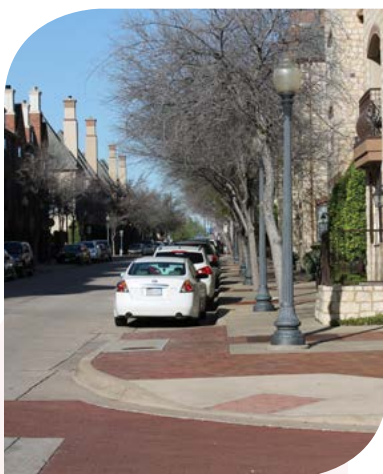
Curb ramps in the State-Thomas neighborhood



Major thoroughfare curb ramps



Dallas Main Street curb extensions



State Street curb extensions

Considerations

There are a variety of standard curb ramp designs, including perpendicular ramps and parallel ramps. The appropriate design for a particular location is determined on a site-by-site basis. Key factors to consider include pedestrian desire lines, sidewalk widths, buffer widths, curb heights, street slopes, and drainage patterns.

Raised crossings extend the sidewalk environment across a roadway and do not require people to navigate curb ramps. Consider installing raised crossings at locations with high pedestrian volumes, and where low speeds are desired. Detectable warning strips are also required at crossings where there is no grade separation between the sidewalk and the roadway, such as at raised crossings and intersections. For more information, see Special Paving Treatments on page 179 of this chapter.

Curb Extensions

Description

Curb extensions, also known as neckdowns or bulbouts, reduce the effective width of the street by extending the curb line across a parking lane to the beginning of the adjacent travel lane.

Curb extensions have a variety of potential benefits:

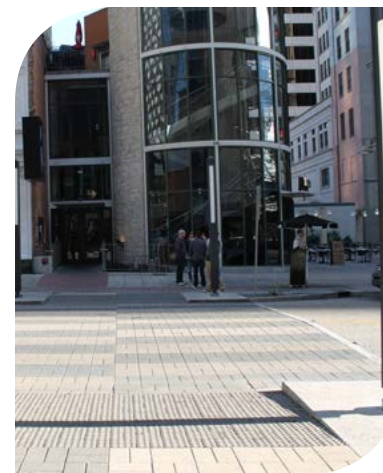
- Additional space for pedestrians to queue before crossing
- Improved safety by slowing motor vehicle traffic and emphasizing pedestrian crossing locations
- Less exposure for pedestrians by reducing crossing distances
- Space for ADA compliant curb ramps where sidewalks are narrow
- Enhanced visibility between pedestrians and other roadway users
- Restricting cars from parking too close to the crosswalk area
- Space for utilities, signs, and amenities such as bus shelters or waiting areas, bicycle parking, public seating, street vendors, newspaper stands, trash and recycling receptacles, and stormwater management elements or street parks

Application

- Curb extensions should be considered only where on-street parking is present, including at corners and midblock.
- A typical curb extension extends 6' from the curb (the approximate width of a parked car).
- The minimum length of a curb extension shall be the width of the crosswalk, allowing the curvature of the curb extension to start after the crosswalk. Note that the angle of curvature should deter parking, supplemented by NO STOPPING signs. The length of a curb extension can vary depending on the intended use (i.e., stormwater management, bus bulb, restrict parking).
- Curb extensions should not reduce a travel lane or a bicycle lane to an unsafe width.
- Curb extensions at intersections may extend into either one or two legs of the intersection, depending on the configuration of parking.
- Street furniture, trees, plantings, and other amenities must not interfere with pedestrian flow, emergency access, or visibility between pedestrians and other roadway users.

Considerations

- Curb extensions are particularly valuable in locations with high volumes of pedestrian traffic, near schools, or where there are demonstrated pedestrian safety issues.
- The turning needs of larger vehicles should be considered in curb extension design. When curb extensions conflict with turning movements, they should be reduced in size rather than eliminated.
- Emergency access is often improved through the use of curb extensions if intersections are kept clear of parked cars.
- Curb extension installation may require the relocation of existing storm drainage inlets.
- Curb extensions may also impact underground utilities, curbside parking, delivery access, garbage collection, and street sweepers. These impacts should be evaluated when considering whether to install a curb extension.
- Curb extensions are not desirable on arterials that have peak hour parking restrictions to move traffic more efficiently.



Downtown Dallas Main Street curb ramps



Residential street curb ramps



New crossing median island



Crossing island on commercial thoroughfare

Crossing Islands

Description

Crossing islands are raised, protected areas within a crosswalk that divide a roadway into segments so pedestrians only have to cross one direction of traffic at a time. Crossing islands reduce pedestrian exposure, and are particularly valuable when used along multi-lane roadways. Crossing islands can be used at signalized intersections, but signal timing should always be designed to allow pedestrians to cross the entire roadway in one stage.

Application

Crossing islands design should:

- include at-grade pedestrian cut-throughs as wide as the connecting crosswalks and detectable warning strips, and be gently sloped to prevent ponding and ensure proper drainage;
- direct pedestrians at an angle to face on-coming traffic;
- be at least 6' wide, but preferably 8' wide;
- accommodate turning vehicles if applicable;
- extend beyond the crosswalk at intersections;
- incorporate diverging longitudinal lines on approaches to crossing islands, per TMUTCD standards.

Considerations

- Crossing islands should be considered where crossing distances are greater than 50'.
- Where possible, stormwater management techniques should be utilized on crossing islands with adequate space, but not in the pedestrian clear path to and from crosswalks. Plantings should not obstruct sight lines.

Diverter

Description

Diverter are curb extensions or traffic islands at intersections used specifically to restrict motor vehicle access and deter heavy volumes of through vehicle traffic on residential street types. All diverters should maintain pedestrian and bicycle access. There are many types of diverters:

- full-closures—restricts travel in both directions
- half-closures—restricts travel in one direction on an otherwise two-way street
- diagonal diverters—placed diagonally across an intersection, preventing through traffic by forcing turns in one direction
- forced turns—forces travel in a specific direction

Application

- Diverters should be installed on streets where eliminating cut-through traffic is desired.
- Diverters should only be considered as part of an overall traffic calming strategy. Include street direction changes for an area when less restrictive measures, such as signs, are not effective.
- Diverters should be designed to impact motor vehicle movement, but should facilitate bicycle and pedestrian access.
- The design of diverters must consider impacts to emergency vehicle response times. Designs that allow emergency vehicle access are preferred and should be coordinated with a local emergency response program.
- Diverter designs should be carefully thought out to ensure proper drainage and maximize the potential for on-site stormwater retention and infiltration.
- Vegetation used in diverters should be low growing to maintain sight lines and also be drought-resistant.

Considerations

- Diverters directly affect people living in the neighborhood and so require strong local support. A highly interactive public input process is essential.
- Different elements can be used as a diverter, including concrete medians, stormwater planters, public art sculptures, etc. Diverters provide excellent opportunities to introduce green elements at intersections, and can be used to absorb stormwater and reduce the heat island effect.
- Temporary diverters can be installed to test how permanent diverters might affect traffic flow.
- Diverters are an important component of bicycle boulevards, which allow through bicycle traffic but discourage through motor vehicle traffic.

A diverter's impact on speeding is generally limited to the intersection. Additional countermeasures are usually necessary to address speeding at midblock locations.



Diverter detail showing drainage design



Bike lane diverter



Marked pedestrian crosswalk



Pedestrian crosswalk with stained pavement treatment

KEY PEDESTRIAN TREATMENTS

Pedestrians are the most vulnerable users of the transportation system. As a pedestrian, motor vehicle speeds greatly affect the severity of crashes and impact fatality rates. Streets with high pedestrian activity should maintain slow motor vehicle speeds, which can be achieved through roadway design and traffic calming strategies. In addition, areas close to parks, schools, and similar pedestrian destinations require special pedestrian consideration. Pedestrian-oriented designs should also aim to minimize conflicts with other modes and exposure to motor vehicle traffic.

Intersections must be designed for pedestrians of all ages and abilities. ADA compliant curb ramps, crosswalks, and accessible pedestrian signals should be provided to the maximum extent feasible, following the minimum guidelines set by the U.S. Access Board PROWAG.

Crosswalk Design

Description

Well-designed crosswalks are crucial to creating pedestrian-friendly walking environments. Crosswalks may be marked or unmarked. While most intersections have marked crosswalks at each approach, other locations can be marked specifically to emphasize unique pedestrian desire lines and to ensure safe access to local institutions, parks, and housing for the elderly.

Safety for all pedestrians, especially for those with disabilities, is the single most important criteria informing crosswalk design. Crosswalks serve a dual function of guiding pedestrians to locations where they should cross the street, and alerting drivers of pedestrian movements.

Application

- All crosswalk designs must conform to the latest edition of the TMUTCD.
- The Dallas Public Works Department shall approve the location of all proposed crosswalks.
- Different types of crosswalk markings can be used in the City of Dallas. Typically, two parallel transverse lines (or continental style) crosswalk markings are installed.
- Enhanced crosswalks should be considered in transit areas.
- Nonstandard materials and designs must be approved by the Director of Public Works and Transportation, and typically require a special maintenance agreement.
- Crosswalks should be at least 10' wide or the width of the approaching sidewalk if it is greater. In areas of heavy pedestrian volumes, crosswalks can be up to 25' wide.
- ADA-compliant curb ramps should direct pedestrians into the crosswalk and the bottom of the ramp should lie within the area of the crosswalk. Flares do not need to fall within the crosswalk.
- The TMUTCD provides guidance on crosswalk markings for an intersection with an exclusive pedestrian phase that permits diagonal crossings.

Considerations

The location of crosswalk markings should be designed at right angles where practical, and must be balanced with pedestrian desire lines, accessibility requirements, and the constraints of the site. Particularly at complex intersections, crosswalks should be placed at locations that reflect pedestrian desire lines while also considering the safest location to cross—that is, where there is the least amount of exposure to conflicts with other modes. Crosswalk placement should also maximize the visibility of pedestrians to turning vehicle movements.

Crosswalk markings should consist of non-skid, thermoplastic, retro-reflective material. Durability and ease of maintenance must be a consideration in material selection.

Crosswalk Markings At Uncontrolled Locations

Description

This section presents guidance as to when and where it is appropriate to provide marked crosswalks at uncontrolled locations, as well as when additional safety enhancements are required to increase visibility, awareness, and yielding to pedestrians.

The NCHRP Report 562, *Improving Pedestrian Safety at Unsignalized Intersections*, found that “the safest and most effective pedestrian crossings use several traffic control devices or design elements to meet the information and control needs of both motorists and pedestrians.”

Additional safety improvements which are discussed on the following pages include the following:

- raised crossings and intersections
- advance yield markings and signs
- in-street YIELD TO PEDESTRIAN signs
- rectangular rapid-flash pedestrian beacons
- pedestrian signal leads
- accessible pedestrian signals
- signal phases for pedestrians

Application

An engineering study should be performed to determine the feasibility of a marked crosswalk at uncontrolled locations. Components of such a study include the following:

- traffic speeds and volumes
- crossing distances
- need or demand for crossing
- distance from adjacent signalized intersections and other crosswalks, and the possibility to consolidate multiple crossing points



Pedestrian crosswalk with special pavers



Pedestrian crosswalk with special pavers



Textured crosswalk pavement

- sight distance and geometry of the location
- availability of street lighting
- locations of drainage structures

Locations where crosswalk markings alone are insufficient to address pedestrian safety include any street where any of the following conditions exist:

- The roadway has four or more lanes of travel without a raised median or pedestrian crossing island and an ADT of 12,000 vehicles per day or greater
- The roadway has four or more lanes of travel with a raised median or pedestrian refuge island and an ADT of 15,000 vehicles per day or greater
- The speed limit exceeds 35 mph

Considerations

At uncontrolled intersections on major arterials, marked crosswalks may not be appropriate on each leg of the intersection. It is more appropriate to mark only a single side of the intersection, particularly in cases where pedestrians can easily be directed to one location. In selecting the most appropriate side of an uncontrolled intersection for the marked crosswalk, the following should be considered:

- pedestrian demand (such as location of bus stops or metro stations)
- vehicle turning movements; multi-leg intersections (three or more roadways) require a careful consideration of vehicular turning movements balanced against the pedestrian crossing
- sight distance
- proximity to other marked crosswalks or crossing locations

There are a number of measures that can be used at uncontrolled locations, in addition to marked crosswalks, to improve the safety of pedestrians crossing the street:

- Reduce the effective crossing distance for pedestrians by
 - providing curb extensions,
 - providing raised pedestrian crossing islands, and/or
 - performing road diets or lane diets.
- Install traffic calming measures to slow vehicle speeds.
- Provide adequate nighttime lighting for pedestrians.
- Using various pedestrian warning signs, advance stop lines, rapid-flashing beacons, and other traffic control devices to supplement marked crosswalks (see the following sections for more details).
- Install traffic signals with pedestrian signals where warranted.



Katy Trail crosswalk at Knox Street

SPECIAL PAVING TREATMENTS

Description

Special paving treatments can be used on roadway surfaces to reduce speeds, increase durability, manage stormwater, or to demarcate a special zone like a bike lane, bus stop, or speed table. A change of color or material can produce a traffic calming effect. Examples of special roadway materials include colored asphalt or concrete, textured asphalt or concrete, pervious pavement, stamped patterns, and pavers. The location and extent of special paving materials depends on the design of the roadway and the expected vehicle types and volumes. See Chapter 7 for additional information on the applicability of pervious surfaces for iSWM implementation.

The choice of a contrasting paving material affects the safety and maintenance of the road. Different materials have different qualities with respect to road noise, porosity, heat absorption, surface friction, bicyclist comfort, and maintenance.

Application

- Light colored asphalt and concrete should be utilized wherever possible to reduce heat.
- Colored pavement can be used to delineate special lanes for transit, bicycles, or parking on mixed use streets. Limits to durability make this treatment less appropriate for lanes on parkways, industrial, and commercial streets. On these street types, colored pavement may be more appropriate for conflict zones, such as merge areas and intersections, or for special districts, shared paths, or streets meant for slower speeds.
- Special paving treatments may be used on crosswalks, in special districts to delineate the distinct streets designed for slower speeds, and streets intended to be shared with pedestrians.
- The use of concrete bus pads should be considered on high-frequency bus routes where heat and the heavy weight of vehicles can create channels in asphalt.
- Porous pavement, in theory, allows water to move through the pavement and become absorbed into the soil below, rather than running off the pavement into drains and ditches. Because many parts of Dallas are situated on clay soils which do not readily absorb rainwater, porous pavements may be less effective at absorbing rainwater. Even in areas of the country with more suitable soil, porous pavements have been shown to collect particulates over time which reduces their porosity.

Considerations

- Consideration should be given to long-term maintenance of porous pavement materials.
- Care must be taken to ensure textured pavements are structurally sound and able to support the type and volume of vehicles that are likely to use the street.
- Particular care should be taken with placing different materials adjacent to each other (for example, concrete pavers adjacent to an asphalt roadway). Over time, the edges between the two pavement materials can become uneven.
- Noise can be a concern with textured pavements.



Pedestrian crosswalk with special pavers



Pedestrian crosswalk with special pavers



Raised intersection



Katy Trail crosswalk at Knox Street

Advance Yield Markings and Signs

Description

Advance yield markings are yield markings that are striped further back from the crosswalk and used in conjunction with YIELD HERE TO PEDESTRIAN signs. Advance yield markings make it easier for pedestrians and motorists to see one another. On multi-lane roadways, they help reduce multiple-threat collisions. Multiple-threat collisions occur when there are multiple lanes of travel in the same direction and the vehicle in the near lane yields to the pedestrian, blocking the view of the motorist in the far lane.

Application

- Advance yield markings and signs can be used on two-lane, three-lane, and four-lane roadways. They are less effective on four-lane roadways unless vehicle operating speeds are 25 mph or less. On four-lane roads with higher speeds, the rapid flashing beacon may be a better solution. See the Rectangular Rapid-Flash Pedestrian Beacon section later in the chapter.
- Yield markings at unsignalized crossings should be accompanied by YIELD HERE TO PEDESTRIAN signs.
- Advance yield markings and signs should be placed 20'-50' in advance of crosswalks on unsignalized multi-lane approaches. Parking should be prohibited in the area between the yield line and the crosswalk. Pavement markings can be used to reinforce NO PARKING signage.
- Yield lines should not be used at locations where drivers are required to stop in compliance with a STOP sign, a traffic control signal, or other traffic control device.

Considerations

- When determining where to place advance yield markings and signs within the 20' - 50' range, consideration should be given to the number of lanes pedestrians must cross, motor vehicle speeds, sight lines, on street parking, and turning movements.
- Advance yield markings may be staggered so that yield markings in one lane are closer to the crosswalk than the yield markings in an adjacent lane. Staggered yield lines can improve drivers' view of pedestrians, provide better sight distance for turning vehicles, and increase the turning radius for left-turning vehicles.

In-street YIELD TO PEDESTRIAN Signs

Description

A variety of signs may be used to indicate locations where drivers must yield to pedestrians. In-street signs are placed in the roadway to alert drivers to be aware of the crossing and to effectively yield to pedestrians. In-street signs can be permanently installed in the roadway or mounted on a portable base. In-street YIELD TO PEDESTRIAN signs are a cost effective treatment to increase motorists' compliance to pedestrian laws.

Application

- In-street YIELD TO PEDESTRIAN signs must only be used at unsignalized intersections. They are prohibited from use at signalized or stop-controlled intersections.
- In-street YIELD TO PEDESTRIAN signs should be placed in the roadway prior to the crosswalk location on the center line, on a lane line, or on a median island. They should not obstruct the crosswalk, and should be designed to bend over and bounce back when struck by a vehicle.
- In-street YIELD TO PEDESTRIAN signs work best on low speed, two lane streets. They are not recommended on roads with high motor vehicle speeds or volumes, where drivers are less likely to see them.

Considerations

- In-roadway YIELD TO PEDESTRIAN signs require regular monitoring and should be replaced when damaged. Damaged signs send the message to pedestrians that a crossing is not safe.



In-street YIELD TO PEDESTRIAN sign



Rectangular rapid-flash beacon



Rectangular rapid-flash beacon

SPECIAL PEDESTRIAN SIGNALS

Rectangular Rapid-Flash Pedestrian Beacons

Description

At some unsignalized crossings, particularly those with four or more lanes, it can be very challenging to get drivers to yield to pedestrians. Vehicle speeds and poor pedestrian visibility combine to create conditions in which very few drivers stop.

One type of device proven to be successful in improving yielding compliance at these locations is the rectangular rapid-flash beacon. The rectangular rapid-flash beacon's effectiveness has been confirmed by multiple studies, including an FHWA study the *Effects of Yellow Rectangular Rapid-Flashing Beacons on Yielding at Multilane Uncontrolled Crosswalks*.

Rectangular rapid-flash beacons are placed curb side below the pedestrian crossing sign and above the arrow indication pointing at the crossing. They should not be used without the presence of a pedestrian crossing sign. The LED flash is an irregular flash pattern. The beacons are activated by a pedestrian call button.

Another LED panel should be placed facing the pedestrian to indicate that the beacon has been activated. The push-button and other components of the crosswalk must meet all other TMUTCD accessibility requirements.

Application

- Design of rapid-flash beacons should be in accordance with FHWA's *Interim Approval for Optional Use of Rectangular Rapid-Flash Beacons* issued July 16, 2008.
- Rectangular rapid-flash beacons can be used when a signal is not warranted at an unsignalized crossing. They are not appropriate at intersections with signals or STOP signs.
- Rectangular rapid-flash beacons are installed on both sides of the roadway at the edge of the crosswalk. If there is a pedestrian refuge or other type of median, a beacon should be installed in the median rather than the far-side of the roadway.

Considerations

- Rectangular rapid flash beacons are considerably less expensive to install than mast-arm mounted signals, but they are more expensive than signs. They can also be installed with solar-power panels to eliminate the need for a power source.
- Rectangular rapid-flash beacons should be limited to locations with critical safety concerns, and should not be installed in locations with sight distance constraints that limit the driver's ability to view pedestrians on the approach to the crosswalk.
- Rapid-flash beacons should be used in conjunction with advance yield pavement markings and signs, as discussed on the previous page.

Pedestrian Signal Heads

Description

Well-designed signalized intersections help reduce delay for all modes, minimize conflicts between modes, and help reduce risk-taking behavior. Pedestrian signal heads display each part of the pedestrian phase as listed below:

- The WALK indication, represented by a walking person symbol, signifies the WALK interval.
- The Flashing DON'T WALK indication, represented by a flashing upraised hand, signifies the pedestrian change interval. Typically, the flashing DON'T WALK indication is accompanied by a countdown display depicting how much time is left to cross the street. Countdown displays are required on new installations to encourage pedestrians to finish crossing before the DON'T WALK indication, and better serves pedestrians with faster walking speeds.
- The DON'T WALK indication, represented by a steady upraised hand, signifies that pedestrians are not permitted to cross. The DON'T WALK indication should be displayed for a three-second buffer interval prior to the release of any conflicting motor vehicle movements.
- Accessible pedestrian signals are discussed later in this chapter and on the next page.



Pedestrian signal head

Application

Pedestrian signal heads should be provided at all signalized intersections for all marked crosswalks. Additionally, it is highly recommended to install crosswalks on all legs of a signalized intersection unless determined otherwise by an engineering study. The design of pedestrian signal heads must conform to the 2011 edition of the TMUTCD.

The timing for each phase must account for the walking speeds of people of all ages and abilities, especially children, the elderly, and disabled. The timing of each interval must conform to calculations according to the 2011 edition of the TMUTCD.

Considerations

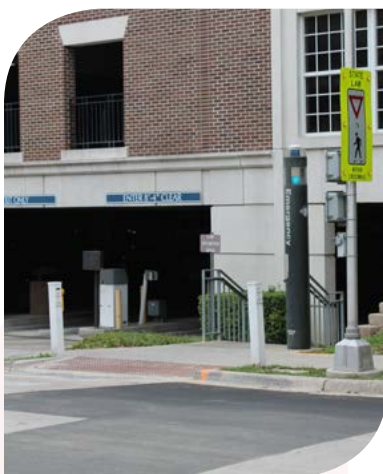
One of the primary challenges for designers is to balance the goal of minimizing conflicts between turning vehicles with the goal of minimizing pedestrian and motorist delay. Requiring pedestrians to wait for extended periods can encourage crossing against the signal. The 2010 *Highway Capacity Manual* states that pedestrians have an increased likelihood of risk-taking behavior (i.e., jaywalking) after waiting longer than 30 seconds at signalized intersections. Strategies to achieve this balance include minimizing signal cycle lengths, restricting right-turn-on-red, introducing leading pedestrian intervals, and reducing turning speeds to increase yielding times.

Opportunities to provide a WALK indication should be maximized whenever possible. Vehicular movements should be analyzed at every intersection in order to utilize nonconflicting movements to implement WALK intervals. For example, at a four-leg intersection with the major road intersecting a one-way street, when the major road has the green indication pedestrians can always cross the approach where vehicles cannot turn.

Intersection geometry and traffic controls should facilitate turning vehicles yielding to pedestrians unless providing an exclusive turning interval or protected/exclusive pedestrian phase. At unsignalized intersections, turning vehicles must yield to pedestrians. This expectation should be continued to signalized intersections to the greatest extent possible.



Accessible pedestrian signal



Accessible pedestrian signal

Accessible Pedestrian Signals (APS)

Description

Accessible pedestrian signals (APS) and accessible detectors are devices that communicate the WALK and DON'T WALK intervals with nonvisual indications at signalized intersections to people with visual and/or hearing disabilities. Accessible pedestrian signals and detectors may include features such as audible tones, speech messages, detectable arrow indications, and/or vibrating surfaces.

The major functions of accessible pedestrian signals are to provide information for:

- location of push buttons, if used
- beginning of WALK indication
- direction of crossing
- location of destination sidewalk
- intersection street name in Braille or raised print
- intersection signalization with speech messages
- intersection geometry through detectable maps or diagrams or through speech messages

Push-button locator tones are used for locating the pedestrian push-button needed to actuate the WALK indication. Vibrotactile devices vibrate to communicate when the WALK indication is in effect. Detectable arrows indicate the direction of travel on the crosswalk.

Application

- All pedestrian signal designs must conform to the latest edition of the TMUTCD.
- Accessible pedestrian signals and detectors must be used in combination with pedestrian signal timing.
- The proposed *Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way* require accessible pedestrian signals and push buttons when pedestrian signals are newly installed, when the signal controller and software are altered, or when the signal head is replaced. The TMUTCD currently states that accessible pedestrian signals shall be provided based on engineering judgment.
- Information provided by an accessible pedestrian signal must clearly indicate which pedestrian crossing is served by each device.
- At corners where two push buttons are present, to the maximum extent feasible they should be separated by at least 10'.

Considerations

- Accessible pedestrian signal detectors may be push buttons or passive detection devices. At locations with pretimed traffic control signals or nonactuated approaches, pedestrian push-buttons may be used to activate the accessible pedestrian signals.
- APS are typically integrated into the pedestrian push-button, and the audible tones and/or messages come from the push-button housing. APS also have a push-button locator tone and detectable arrow, and can include audible beaconing and other special features.
- Detectable arrows should be aligned toward the destination across the street; they should not point toward the beginning of the crosswalk or the curb ramp location. Misalignment of the arrow may direct pedestrians with disabilities into the center of the intersection.
- Audible WALK indications should coincide with the pedestrian WALK. If the pedestrian signal rests in the WALK phase, the audible indication should be provided in the first seven seconds of the WALK phase.
- Detailed information on accessible pedestrian signals is also provided through the United States Access Board.



Pedestrian signal with countdown indication



Accessible pedestrian signal



Pedestrian signage



Pedestrian signage

Signal Phases for Pedestrians

Description

There are three ways to time a pedestrian phase:

- A **concurrent pedestrian phase** occurs when pedestrians have the WALK indication while parallel and conflicting (turning) vehicular traffic is permitted.
- A **protected pedestrian phase** occurs when pedestrians have the WALK indication while conflicting movements are prohibited by a signal or NO TURN ON RED sign.
- An **exclusive pedestrian phase** occurs when pedestrians have the WALK indication while all other movements are prohibited by a signal or NO TURN ON RED sign.

Application

Concurrent pedestrian phases are the most common application at signalized intersections where pedestrian accommodations exist.

Protected pedestrian phases can be used when there are high volumes of vehicle turning movements conflicting with pedestrian traffic. This phasing will provide a pedestrian WALK indication at the same time as the through movement in the same direction, while prohibiting the conflicting turning movements that could cross an active crosswalk.

Exclusive pedestrian phases can be used when there is a very high volume of pedestrians. This phase allows all pedestrian movements at once and may increase motorist delay. It may not be ideal at intersections with high volumes of motor vehicle traffic.

Exclusive pedestrian phases and protected pedestrian phases should generally be considered at intersections where:

- sight distance is restricted
- intersection geometry is complex
- the intersection is near elderly housing, schools, recreational areas, medical facilities, or other facilities within a safety zone
- the intersection is near special event locations with high pedestrian volumes

Considerations

- Exclusive pedestrian phases increase pedestrian safety, but also increase delay for vehicular intersection users.
- Leading pedestrian intervals may be considered for concurrent phasing where appropriate, and are discussed in Signalization Strategies to Reduce Conflicts.
- NO TURN ON RED signs should be considered at intersections with exclusive pedestrian phases.
- TURNING VEHICLES YIELD TO PEDESTRIANS and WATCH FOR TURNING VEHICLES signs may be used to provide additional awareness at intersections with concurrent pedestrian phases where conflicting vehicle/pedestrian movements are present.

Signalization Strategies to Reduce Conflicts

Description

There are several signalization strategies to reduce conflicts between pedestrians and other modes of transportation. These typically involve separating movements, including the following:

- exclusive and protected pedestrian signal phases
- leading pedestrian intervals
- lagging vehicle turn arrow
- restricting turns on red

Exclusive and protected signal phasing separates pedestrian traffic and reduces conflicts between pedestrians and motorists; however, there are significant impacts to signal cycle lengths that need to be considered.

Another strategy is called the Leading Pedestrian Interval (LPI), which initiates the pedestrian WALK indication three to seven seconds before motor vehicles traveling in the same direction are given the green indication. This technique allows pedestrians to establish themselves in the intersection in front of turning vehicles, increasing visibility between all modes.

Left-turn arrow indications can be provided before the opposite direction through movements (leading left-turn) or after the opposite direction through movements (lagging left-turn).

NO TURN ON RED signs can also be used to restrict vehicles from turning right—or from turning left on intersecting one-way streets during the red indication. Restricting this movement eliminates conflicts with pedestrians crossing in front of vehicles making turns.

Application

The LPI should be used at intersections with high volumes of pedestrians and conflicting turning vehicles, and at locations with a large population of elderly or school children who tend to walk slower. The LPI should be at least three seconds to allow pedestrians to cross at least one lane of traffic to establish their position ahead of turning traffic. The FHWA has determined that the LPI currently provides a crash reduction factor of 5%. Newly-installed LPIs should provide accessible pedestrian signals to notify visually-impaired pedestrians of the LPI.



Protected pedestrian signals



Pedestrian signals



NO TURN ON RED sign



NO TURN ON RED sign

Additionally, without an accessible pedestrian signal, visually-impaired pedestrians may begin to cross with the vehicular movement when motorists are not expecting them. Accessible pedestrian signals are discussed further on pages 184.

NO TURN ON RED signs should be considered when one or more of the following conditions apply:

- an exclusive pedestrian phase is provided
- LPI is provided
- poor sight distances reduce visibility
- geometry of the intersection may result in unexpected conflicts
- more than three accidents are reported in a 12-month period between pedestrians and vehicles where turns-on-red are permitted that could be prevented with this action

Considerations

- NO TURN ON RED signs can be provided at all times or by a dynamic sign that changes when pedestrians are present, by time of day, by a call made by an emergency vehicle, and/or at rail or light transit crossings.
- If concurrent phasing is provided in conjunction with NO TURN ON RED signs, there may be an increase of conflicts with pedestrians by forcing motorists to turn only when the green indication and pedestrian WALK indication overlap. At locations with high volumes of pedestrians crossing during a concurrent pedestrian phase, permitting turns on red or implementing exclusive pedestrian phasing should be considered.
- In general, concurrent pedestrian phasing should appropriately match the motor vehicle signal phasing. At intersections with high pedestrian volumes where drivers have difficulty finding gaps to turn, the green time can be intentionally extended past the DON'T WALK indication in order to allow the turning movement.
- Intersections with LPIs should be accompanied by appropriate signage, such as TURNING VEHICLES YIELD TO PEDESTRIANS.
- In addition to LPIs and NO TURN ON RED signs, bicyclists traveling in the same direction as pedestrians may be provided a leading bicycle interval using a bicycle signal head.

KEY BICYCLE TREATMENTS

The majority of motor vehicle crashes involving bicycles occur at intersections. In Texas, on-street bicycles are operating vehicles and are required to follow the same rules of the road as motorists. Yet intersection designs traditionally do not take into account the needs of bicyclists. Well-designed intersections that make bicycling more convenient and attractive, minimize delay, reduce conflicts with motor vehicles and pedestrians, and contribute to reduced crashes and injuries are of critical importance in order to increase bicycling in the City of Dallas.

The following principles are applied to intersection design in order to accommodate bicyclists:

- Provide a direct, continuous facility to the intersection
- Provide a clear route for bicyclists through the intersection.
- Reduce and manage conflicts with turning vehicles
- Provide signal design and timing to accommodate bicyclists, based on an engineering study.
- Provide access to off-street destinations.

Guidance on different types of bicycle facilities such as bicycle lanes and cycle tracks is covered in Chapter 5.

Intersection improvements for bicycles should be considered during all roadway improvement projects, street redesign, and safety improvements or upgrades. All bicycle-related improvements should be coordinated with the *2011 Dallas Bike Plan*.

Bicycle Lanes at Intersections

Description

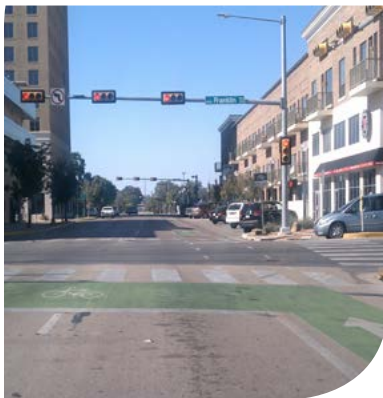
Bicycle lanes provide a dedicated space for bicyclists to predictably ride along roadways and at intersections. When designing intersections for bicyclists, the approaches should be analyzed and designs should maintain continuity of bicycle facilities to the maximum extent possible. Streets with dedicated bicycle lanes may continue striping through unsignalized and complicated intersections to provide additional guidance and safety measures for bicyclists. This design principle is especially important at intersections where there are conflicting vehicular movements, unsignalized crossings, and/or crossings of more than four moving traffic lanes. Signalized intersections may not require striping through each intersection, and should be evaluated on a case-by-case basis.



Bike lane at signalized intersection



Well-designed intersections make bicycling more convenient and attractive.



Bike lane at intersection



Bike lane at intersection

Application

- Standard details for bicycle lane markings at intersections are provided in the *TMUTCD* and *AASHTO Guide for the Development of Bicycle Facilities*.
- Dedicated bicycle lanes should be provided on all major intersection approaches on street types that support on-street bicycle lanes and are recommended in the *Dallas Bike Plan*. For higher speed roadways, dedicated bicycle lanes may not be well-suited for the context and land-use of the street type, and grade separated cycle tracks or off-street facilities may be more appropriate. Also, shared lane markings may be appropriate on residential, lower volume roadways.
- At intersections with a dedicated right-turn lane, bicycle lanes should be provided to the left of the right-turn-only lane, unless bicycle signals and dedicated phasing is provided.

Considerations

- Bicycle lane markings—including green colored pavement, shared lane markings, dashed bicycle lane lines, and signage—may be provided through intersections, per engineering judgment.
- Selective removal of parking spaces may be needed to provide adequate visibility and to establish sufficient bicycle lane width at approaches to intersections.
- Shared lane markings may be used where space is not available for bicycle lanes at intersections.
- Although the minimum recommended width of a bicycle lane is 5', four-foot bicycle lanes may be considered at constrained intersections in order to provide a dedicated space for bicyclists, per engineering judgment.
- Bicycle lanes at the entrance and exit of a roundabout should allow direct access to a shared use bicycle/pedestrian path around the perimeter of the roundabout through properly designed ramps. They should also enable bicyclists to mix with traffic and proceed through the roundabout as a vehicle.

Bicycles at Signalized Intersections

Description

Bicycles have different operating characteristics than motor vehicles, and special considerations are necessary to design traffic signals that serve both motorists and bicyclists. In general, bicyclists have slower acceleration and velocity than motorists. To offset this disadvantage, traffic signal design should include considerations of minimum green intervals, clearance time, and extension time to ensure that bicyclists can safely traverse Dallas' intersections. Signal progression should balance the needs of all users with appropriate design speeds and traffic signal coordination settings. Appropriate signal timing also can minimize cyclist delay, discourage red-light running, and reduce potential crashes.

Application

Where actuated signals (loop or video detectors) are present, the signal system should detect bicycles as well as motor vehicles. In order for bicyclists to prompt the green indication at these intersections, loop or video detectors should be adjusted to detect bicycles, or separate bicycle-detectors should be installed.

- Detection devices should be located within bicycle lanes or bicycle boxes, marked with a bicycle detector symbol, and supplemented by appropriate signage according to the TMUTCD.
- When it is not feasible for the detection device to be located within the bicycle lane or bicycle box, detection devices should be located prior to the stop bar and span an appropriate distance to provide for left-, through-, and right-turning bicyclists.
- Bicycle signals can be used to separate conflicting movements, provide leading bicycle intervals, provide controls at shared-use paths, or to accommodate an exclusive left-turn phase.

Considerations

Please reference the latest edition of the *AASHTO Guide for the Development of Bicycle Facilities* for more details on the signal timing needs of bicyclists at intersections.

Special attention should be given to signal timing at locations with higher vehicular speeds and longer crossing distances. At these locations bicyclists are more likely to have different signal timing needs than motorists.

Bicycle signal heads can be used to provide dedicated signal indications to bicyclists and should be positioned to maximize visibility to bicycle traffic. They should be coordinated with pedestrian and non-conflicting vehicular movements to increase safety and minimize overall delay. Bicycle signal heads should be installed on a case-by-case basis determined by an engineering study.

Bicycle Boxes

Description

A bicycle box is dedicated space located between the crosswalk and the motor vehicle stop line used to provide bicyclists a dedicated space to wait during a red light at signalized intersections. Placing bicyclists ahead of stopped vehicular traffic at a red light improves visibility and reduces conflicts among all users. Bicycle boxes also provide bicyclists a head start to get through an intersection, which aids in making difficult turning movements and improves safety and comfort due to the difference in acceleration rates between bicycles and motor vehicles. In all cases, the bicycle box places bicyclists in front of motor vehicles, allowing them to “claim the lane” if desired. Bicycle boxes also provide more space for multiple bicyclists to wait at a red light, as opposed to being constrained to a 5' wide bicycle lane.



Bike lane and buffer transition at intersections



Bike lane with right-turn lane



Bicycle box at an intersection



Bicycle box at an intersection

Application

In locations with high volumes of turning movements by bicyclists, a bicycle box should be used to allow bicyclists to shift towards the desired side of the travel way. Depending on the context of the bicycle lane—left or right side of the road—bicyclists can shift sides of the street to align themselves with vehicles making the same movement through the intersection.

In locations where motor vehicles can continue straight or turn right and cross a right side bicycle lane, the bicycle box allows bicyclists to move to the front of the traffic queue and make their movement first. This minimizes conflicts between the right turning motorist and the bicyclist. In order to successfully minimize this conflict, right-turn-on-red movements should be prohibited.

Considerations

- Bicycle boxes are currently an experimental treatment that requires TxDOT and FHWA approval.
- Bicycle box design should be supplemented with appropriate signage according to the latest version of the TMUTCD.
- Where right-turn-only lanes for motor vehicles exist, bicycle lanes should be designed to the left of the turn lane. If right-turn-on-red is desired, consider ending the bicycle box at the edge of the bicycle lane to allow motor vehicles to make this turning movement.

Cycle Tracks at Intersections

Description

Cycle tracks provide an exclusive travel way for bicyclists alongside roadways separate from motor vehicle travel lanes, parking lanes, and sidewalks. This separation may increase comfort for bicyclists, but at intersections this can create a false sense of security and decrease visibility between all modes. Cycle track designs at intersections must manage conflicts with turning vehicles, and increase all users' visibility.

Application

Increasing visibility and awareness are two key design goals for cycle tracks at intersections. Parking restrictions between 20' and 40' minimum should be provided at the near- and far-side of intersections. Additional space may be needed based on sight distance calculations.

If possible, cycle tracks should be routed behind transit stops (i.e., the transit stop should be between the cycle track and motor vehicle travel lanes). If this is not feasible, the cycle track should be designed to include pavement markings, rumble strips, and signage to alert the bicyclist to stop for buses and pedestrians accessing transit stops. Cycle track design often involves relocating transit stops to the far-side of the intersection to reduce conflicts.

Cycle tracks should be given priority at low-volume intersections, which can be provided by markings and signage.

Considerations

- Cycle track designs at intersections must give consideration to signal operation and phasing in order to manage conflicts with turning vehicular movements and bicyclists. Bicycle signal heads should be considered in order to separate conflicts, especially for two-way cycle tracks.
- Shared lane markings and/or colored pavement can supplement short dashed lines through intersections, where engineering judgment deems appropriate.

At non-signalized intersections, design options to increase visibility and safety include the following:

- warning signs
- raised intersections
- special pavement markings (including green surface treatment)
- removing parking prior to the intersection

Consider narrowing or designing a chicane for cycle tracks at intersections to slow bicycle traffic. Another option is to remove the separation prior to the intersection and provide standard bicycle lanes with bicycle boxes to raise awareness and increase visibility.

KEY TRANSIT TREATMENTS

The following transit treatments should be considered for streets on the Transit Overlay Map, shown in Chapter 2. When designing intersections to accommodate transit vehicles, key goals are to improve the reliability and efficiency of transit service. Waiting at traffic signals accounts for at least 10% of overall bus trip time and up to 50% or more of bus delay.

Dallas Area Rapid Transit (DART) operated 135 bus routes and over 655 buses which provided about 38 million passenger trips in fiscal year 2010. A majority of DART's transit stops are located near intersections on Dallas' streets. This section covers design strategies to improve transit operations and reduce delay for transit vehicles at intersections. Design guidance on the individual bus stops and connections to the sidewalk are discussed in Chapter 4.

While individual strategies can be implemented independently, a combination of strategies including the appropriate location of the bus stop and traffic signal prioritization will be the most effective. Implementation of these strategies should also be complemented by operational improvements being carried out by DART, including smart fare payment systems and real-time tracking.



Bike lane at intersection



Raised intersection on the Katy Trail



Downtown transfer station



Transit service can increase bicycle usage.

Bus Stop Location

Description

All bus stop locations must be ADA compliant, as well as being safe, convenient, well-lit, and clearly visible. Proper spacing and siting of bus stops involves many considerations, such as the bus route, population density, popular destinations, transfer locations, intersection operations and geometry, parking restrictions, and sight lines.

Application

Where buses are required to pull out of traffic, bus stops should be located at the near- or far-side of intersections wherever possible, and not at midblock locations. Mid-block bus stops require the most amount of curb side space. Intersections are also convenient for passengers because they can easily intercept other transit connections, crosswalks, pedestrian routes, and building entrances.

Where bus bulbs are provided, the length of the bus stop can be less than the prescribed minimums listed below because buses will not be required to pull out of traffic. The minimum bus stop length at bus bulbs should provide a clear and level landing pad at each door of the bus. For more information on bus bulbs, please see page 197 of this chapter.

The frequency of stops should be a balance between passenger convenience and minimizing bus travel times. Spacing is typically determined by population density, with the minimum spacing between bus stops generally about 750'.

Considerations

Selecting a location for a bus stop at an intersection depends on a variety of factors:

- available curb side space
- conditions of sidewalks
- width of sidewalks
- traffic and pedestrian volumes
- number and width of travel lanes
- turning movements
- sight distances
- presence of parking, bicycle facilities, and crosswalks

At signalized intersections, far-side placement is generally recommended. Location selection should be done on a site-by-site basis in consultation with DART and the Dallas Public Works Department.

Additional advantages of locating stops on the far-side of an intersection include the following:

- Pedestrians are encouraged to cross behind the bus, reducing conflict and bus delay.
- Buses are allowed to take advantage of gaps in traffic flow, especially with signal prioritization, rather than needing to be at the front of the queue at an intersection for a near-side stop.
- Conflicts between buses and right turning vehicles are minimized and additional right-turn capacity is provided on the near-side of the intersection.

Transit Prioritization at Intersections

Description

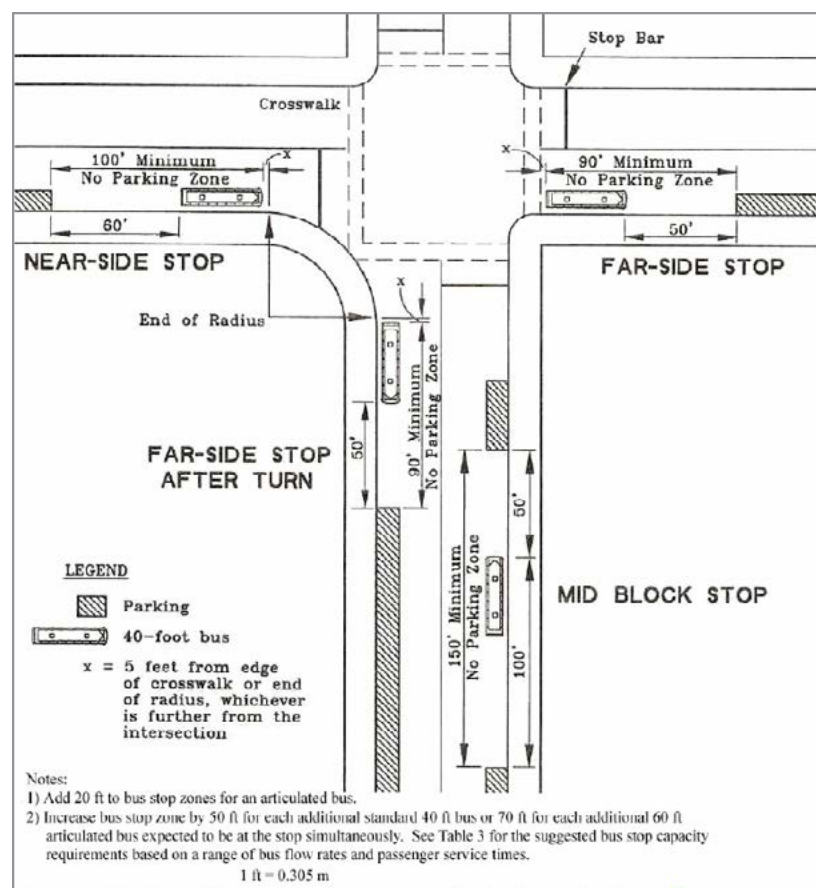
By prioritizing transit at intersections, service can become more reliable, efficient, and environmentally friendly due to less queuing and stopping and starting. This makes transit a more attractive mode of transportation. Transit prioritization strategies include signal coordination, signal priority, transit only lanes, and queue jump or bypass lanes.

The first strategy for improved traffic flow is coordinated signal timing. In addition to signal coordination, transit signal priority enables transit vehicles to shorten or extend a traffic signal phase without disrupting the phase sequence or overall signal timing.

Transit-only lanes at intersections provide transit vehicles a dedicated space to bypass traffic, and can typically be shared with bicyclists. Queue jump or bypass lanes are specially designated transit lanes at intersections that share a similar idea to the leading pedestrian interval discussed on page 183. Queue jump lanes provide an early green signal, or hold a green signal, for transit vehicles while other vehicles traveling in the same direction are given a red light.

Application

Signal coordination can reduce delay for transit as well as motor vehicles. In addition to coordination, signal priority for transit vehicles allows transit to stay on schedule during peak hours when there is congestion. Signal priority allows delay to be reduced by extending the green time for an approaching bus or shortening time for the opposing movements for a waiting bus. The difference in the time can be made up in the next cycle of the signal, but all other signal operations can remain intact. All transit



Typical types of, and dimensions for, on-street bus stops

signal prioritization must be coordinated with DART and the Dallas Traffic Management Center.

Signal coordination and signal priority can be used with or without the presence of dedicated transit only lanes along a corridor or queue jump. Queue jump lanes can be used at intersections without a bus stop as well as with one at either the near- or far-side, so long as there is enough space on the roadway.



Near-side bus stop on Jefferson Street



Near-side bus stop on Hillcrest at bulbout

Placement	Definition	Advantages	Disadvantages
Far-side Bus Stop	The bus stops immediately after passing through an intersection	This type of stop minimizes conflicts between buses and vehicles turning right. It also encourages pedestrians to cross behind the bus.	An increase in the number of rear-end crashes may occur, since drivers do not expect buses to stop again after stopping at a red signal indication. Also, the traffic stopped behind the bus could queue into the intersection.
Near-side Bus Stop	The bus stops immediately prior to an intersection	Patrons can board and alight while the bus is stopped at a red signal intersection, and the bus driver has the width of the intersection available for pulling away from the curb.	Stopping at the near-side of an intersection can increase conflicts with right-turning vehicles and could limit sight distance to curb side traffic control devices and crossing pedestrians.
Midblock Bus Stop	The bus stops within the block	It can minimize intersection sight distance restrictions for vehicles and pedestrians.	It encourages patrons to cross the street at midblock, and it could increase walking distance.

Considerations

- Providing a queue jump lane with a leading signal phase must take into consideration the overall signal cycle lengths and impacts to delay for other users.
- If space is not available for a queue jump lane or bypass lane, consider using a right-hand turn lane to double as a bus advantage lane by allowing buses to move up in the queue at a signal where right- turn-on-red is permitted. If right-turn lanes are used, appropriate signage such as RIGHT LANE MUST TURN RIGHT must be accompanied by EXCEPT BUSES placards.
- Transit signal priority should be considered on all priority transit routes, as shown on the Transit Overlay map.
- Transit signal priority studies should be conducted to understand the impact to traffic on cross streets of the transit route.
- Signal coordination should not increase delay for other modes, and should take into consideration the acceleration rates and speeds of bicyclists.
- Transit agencies must train employees on how to handle bus and bicycle interactions in transit- and bus-only lanes.
- Transit priority may be considered for late buses only in order to keep on schedule.

Bus Bulbs

Description

Bus bulbs are curb extensions along the length of a bus stop that eliminate the need for buses to pull in and out of traffic. Similar to normal curb extensions found at intersections, bus bulbs have the same advantages of reducing crossing distances for pedestrians and providing additional space for street furniture such as bus shelters, landscaping, and pedestrian queuing.

Application

Bus bulbs are only appropriate on streets where on-street parking is present. Bus bulbs are most appropriate at stops with higher passenger volumes or where it is desired to eliminate buses pulling out of traffic.

Bus bulbs are effective in enforcing parking restrictions within bus stops and do not require as much space as curb side stops because the bus does not need space to pull in and out of the stop. They may, however, cause occasional traffic delay behind them. Bus bulbs will be installed on a case-by-case basis determined by an engineering study.

Considerations

- Since the bus remains in the travel lane while stopped, bus bulbs can result in traffic delays or unsafe maneuvers by drivers and bicyclists to steer around buses. Designs must consider the street type, number of travel lanes, and headways of buses.
- Bus bulbs can interfere with right-turning vehicle movements at near-side intersections.
- Bus bulbs are most effective at reducing travel time if they are utilized throughout a corridor by eliminating the need for buses to pull in and out of traffic all together.

Landscape areas within bus bulbs also offer opportunities for rain gardens.



Transit only lanes on Harry Hines Blvd



Midblock bus stop





7. GREEN STREETS



Complete Streets can reduce demand on existing infrastructure by incorporating stormwater management into street designs

7. GREEN STREETS



Integration of green street features

Green Streets are defined as urban transportation rights-of-way that provide source control of stormwater, limit its transport and pollutant conveyance to the collection system, and provide environmentally enhanced roads. Green streets improve water quality through the integration of stormwater treatment techniques, which use natural processes and landscaping. All of this works to reduce the heat island effect.

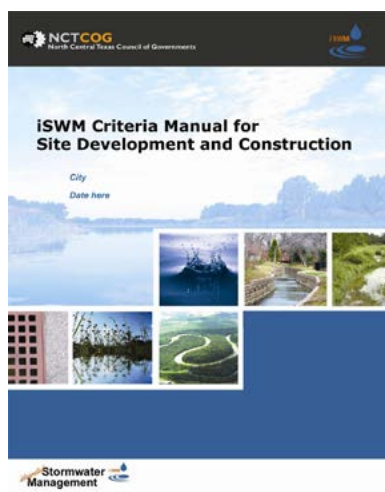
Currently, Dallas and other North Texas communities manage stormwater through a large system of drainage infrastructure that directs runoff back into the water system. This system requires a large capital outlay to build and maintain over time, with needs increasing exponentially as development increases impervious surfaces.



Integration of green street features



Integration of green street features



iSWM Manual



Bioswale

Cities across the country are looking for more sustainable solutions to handle stormwater. The most efficient and cost effective way to manage stormwater is to collect it where the water falls. Many cities are shifting their thinking on how to manage stormwater and are replacing conventional stormwater infrastructure with green infrastructure within the street right-of-way, as well as on development sites. These types of stormwater filtering and holding systems allow water to infiltrate into the soil instead of rushing into storm sewers and streams, carrying a toxic mixture of pollutants and chemicals. This type of treatment potentially reduces infrastructure costs, as more water is treated and filtered at the source. By using bioretention areas, permeable surfaces, bioswales, and other green techniques, roadways can be built to help reduce runoff into the stormwater system.

This chapter summarizes some of the techniques that can be used when developing buffers, sidewalks, paths, parking areas, medians, and other street facilities as described in Chapters 4, 5, and 6.

The North Central Texas Council of Governments' iSWM program was used as a source for some of the materials and photos in this chapter.

GENERAL POLICY GUIDANCE

Integrated Stormwater Management (iSWM)

This chapter:

- introduces the application of Integrated Stormwater Management (iSWM) design practices within the roadway right-of-way to achieve Complete Streets objectives;
- creates a link between the Complete Streets Manual and the City of Dallas' *iSWM Manual*; and
- provides an introduction and overview to iSWM design practices that apply to roadways.

The North Central Texas Council of Governments' iSWM Program for Construction and Development is a cooperative initiative that assists municipalities and counties to achieve their goals of water quality protection, stream bank protection, and flood mitigation while also helping communities meet their construction and post-construction obligations under state stormwater permits.

Development and redevelopment increase the amount of imperviousness in our surrounding environment. This increased imperviousness translates into loss of natural areas, more sources for pollution in runoff, rapid water flows, and heightened flooding risks. To help mitigate these impacts, more than 60 North Texas governments are cooperating to proactively create sound stormwater management guidance for the region through the iSWM Program. It will help to implement low impact development concepts throughout the region.

The iSWM Program provided on the NCTCOG website has four types of documentation and tools that support the development process:

- *iSWM Criteria Manual* – This document provides a description of the development process, the iSWM focus areas, and locally adopted design criteria, allowing municipalities a flexible approach to apply at a local level.
- *iSWM Technical Manual* – This set of documents provides technical guidance necessary for design, including equations, descriptions of methods, fact sheets, and best management practices.
- iSWM Tools – These tools include web-served training guides, examples, design tools, etc., that could be useful during design.
- iSWM Program Guidance – This includes reference documents that guide programmatic planning rather than technical design.

BENEFITS OF GREEN STREETS ELEMENTS

Green street elements reduce the need for stormwater infrastructure. Greenscape practices provide trees, shrubs, grasses, and other landscape plantings that play an important role in making streets inviting, comfortable, and sustainable. Used appropriately, they can help define the character of a street or plaza, provide shade and cooling in strategic locations, reduce energy consumption in buildings, and absorb and clean stormwater. They also absorb greenhouse gases and help filter airborne pollutants.

In addition to providing environmental benefits, a healthy greenscape provides psychological and social benefits. Plants help reduce stress and restore a sense of calm and focus.

Studies have shown that people are attracted to places that have well-maintained plantings. Healthy greenscapes are good for City life and business.



Tree boxes



Tree boxes



Integrating these practices into the design of a neighborhood can greatly increase the appeal of the street, while improving drainage.



Green streets

INTEGRATED SITE DESIGN PRACTICES

Review of iSWM projects is incorporated into the street development process discussed in Chapter 1. The process follows the planning, conceptual design, and engineering phases outlined for roadway projects and includes the following:

- Planning Phase:
 - review requirements and processes
 - collect data and perform site analysis
 - summarize data collected in iSWM plans
- Conceptual Design Phase
 - prepare concept iSWM plan
 - prepare preliminary iSWM plan
 - engineering phase
 - prepare final iSWM plan and iSWM construction plan
 - use data collected to protect water quality during construction
 - prepare operation and maintenance plans

Implementing stormwater management practices begins with the site planning and design process. Development projects can be designed to reduce their impact on watersheds when careful efforts are made to conserve natural areas, reduce impervious cover, and better integrate stormwater treatment. By implementing a combination of these non-structural approaches, it is possible to reduce the amount of runoff and pollutants that are generated from a site and provide for some nonstructural on-site treatment. The integration of site design includes the following:

- Managing stormwater (quantity and quality) as close to the point of origin as possible and minimizing collection and conveyance
- Preventing stormwater impacts rather than mitigating them
- Utilizing simple, non-structural methods for stormwater management that are lower cost and lower maintenance than structural controls
- Creating a multifunctional landscape
- Using hydrology as a framework for site design
- Reducing the peak runoff rates and volumes, and thereby, reducing the size and cost of drainage infrastructure

Integrated site design for stormwater management includes a number of site design techniques such as preserving natural features and resources, effectively laying out the site elements to reduce impact, reducing the amount of impervious surfaces, and utilizing natural features on the site. The aim is to reduce the environmental impact

by filtering water through vegetation and soil while retaining and enhancing the owner or developer's purpose and vision for the site. Many of the integrated site design practices can reduce the cost of infrastructure while maintaining or even increasing the value of the property.

Operationally, economically, and aesthetically use of integrated site design practices offers significant benefits over treating and controlling runoff downstream. Therefore, all opportunities for using these methods should be explored before considering traditional stormwater controls.

Integrated site design can reduce the volumes of runoff and pollutants that need to be conveyed and controlled on a site. In some cases, the use of integrated site design practices may eliminate the need for structural controls entirely.

The level of impervious cover—i.e., rooftops, parking lots, roadways, and sidewalks—is an essential factor to consider in integrated site design for stormwater management. Increased impervious cover means increased stormwater generation and increased pollutant loadings.

Thus, by reducing the area of total impervious surface on a site, a site designer can directly reduce the volume of stormwater runoff and associated pollutants that are generated. It can also reduce the size and cost of necessary infrastructure for stormwater drainage, conveyance, and control and treatment. In some cases the use of integrated site design practices may eliminate the need for stormwater controls entirely.

Stormwater integrated site design also has a number of other ancillary benefits:

- reduced construction costs
- increased property values
- more open space for recreation
- more pedestrian friendly neighborhoods
- protection of sensitive forests, wetlands, and habitats
- more aesthetically pleasing and naturally attractive landscape
- easier compliance with wetland and other resource protection regulations

The integrated site design practices and techniques covered in this manual are grouped into four categories:

Integrated Site Design Practices and Techniques

- preserve natural features and resources
- preserve undisturbed natural areas
- preserve riparian buffers
- avoid floodplains
- avoid steep slopes



Bioretention area



Bioswale



Reduced Parking Footprint

Lower Impact Site Design Techniques

- fit design to the terrain
- locate development in less sensitive areas
- reduce limits of clearing and grading
- utilize open space development
- consider creative designs

Reduction of Impervious Cover

- reduce roadway lengths and widths
- reduce building footprints
- reduce the parking footprint
- reduce impervious setbacks and frontages
- use fewer culs-de-sac
- create parking lot stormwater islands



Bioswale

Utilization of Natural Features for Stormwater Management

- use buffers and undisturbed areas
- use natural drainageways instead of storm sewers
- use vegetated swales instead of curb and gutter
- drain rooftop runoff to pervious areas

More detail on each site design practice is provided in the North Central Texas Council of Governments' *iSWM Technical Manual: Planning*.

The integrated site design practices may be subject to other ordinances within a municipality and could require approval before implementation. All relevant materials should be reviewed before developing a site plan.

PAVEMENT

Porous/Permeable Pavement

Description

Permeable paving materials allow stormwater runoff to infiltrate through the material, unlike traditional paving materials that divert runoff to the storm sewer system. Water permeates through the material into the ground and recharge the water table or local waterway. Permeable materials filter pollutants, reduce flow rate, improve water quality, and reduce the volume of infrastructure necessary to direct and convey stormwater offsite. Parts of Dallas have high-plasticity soil and, therefore, the use of permeable pavements require special consideration.

Permeable pavements are typically underlaid with an infiltration bed and subgrade soil. Permeable materials come in five basic varieties:

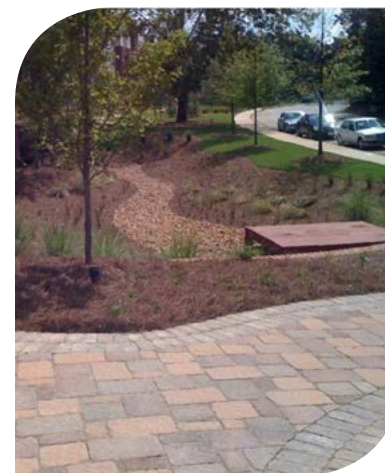
- soft paving such as grass, bark, mulch, crushed shells, and loose aggregate (gravel)
- permeable concrete paving, created by mixing concrete with fewer fine particles, creating void spaces that allow air and water to navigate throughout the material or porous asphalt
- open joined and open cell unit pavers filled with porous aggregate or turf
- plastic grid systems covered with pavers, soil and grass, or gravel
- bound resin with aggregates or bound recycled material such as glass, rubber, and plastic

Application

Permeable paving can be utilized in a broad variety of settings. All designs must consider the drainage characteristics of the underlying soils, the depth of the water table, and the slope of adjacent land.

Permeable pavements can be used in sidewalks, plazas, cafes, overflow parking areas, emergency access roads, and other low-traffic areas.

Soft paving materials and loose aggregate are only appropriate for the greenscape/furnishing zone or frontage zone typically around trees, planters, and enclosed greenscape elements.



Use of natural drainageways



Reduction of impervious cover in a parking lot



Street trees



Tree wells

Permeable concrete pavement can be used in the pedestrian zone, as long as the resulting surface is smooth, stable, slip resistant, and meets all other accessibility guidelines.

Porous unit pavers that utilize gaps are only appropriate in the greenscape/furnishing zone or the frontage zone (except where there is active pedestrian use).

In specific locations where infiltration is not desired, such as adjacent to building foundations, a geo-textile liner can prohibit infiltration and redirect discharge to an appropriate location while still providing the other benefits of permeable paving.

Considerations

Permeable pavements provide increased traction when wet because water does not pool, and the need for salt and sand is reduced during winter due to low/no black ice development. Nevertheless, permeable paving requires regular maintenance including the following:

- annual inspection of paver blocks for deterioration
- periodic replacement of sand, gravel, and vegetation
- annual vacuuming of pavements to unclog sand and debris (Note: The use of sand in ice prevention should be avoided because it will clog pavement pores.)

PERMEABLE ASPHALT/CONCRETE

Description

Permeable concrete is a concrete mixture using minimal cementitious materials to coat the aggregate, using little or no sand, leaving substantial void content through which water can drain. Porous asphalt is mixed at conventional asphalt plants, but fine aggregate is omitted from the mixture. The remaining large aggregate particles leave open voids that lend the material its porosity.

Application

Permeable asphalt and concrete should be used on a level street above the high water table with low pedestrian traffic and no vehicular encroachment. There must be adequate subsurface conditions to detain stormwater.

Considerations

This is not appropriate for use where there is water-sensitive subsurface infrastructure, or where there is the potential for soil contamination since porosity can convey harmful materials to the soil. Pervious concrete is not intended for use at greater than 5 percent slope. Routine vacuuming of the surface may be necessary to maintain porosity.

Special features, such as the underlying stone bed, are more expensive than conventional pavements, but these costs are often offset by the elimination of many elements of a conventional storm drain system.

Permeable Brick Pavers

Description

Permeable brick pavers enable stormwater to filter into the soil instead of draining into storms and rivers. They differ from conventional pavers in that they create more spacing between the pavers – a higher void area – which allows water to infiltrate through the pavement surface. The support system should consist of coarser aggregates than found in conventional construction.

Application

Commercial and residential applications are available and both can meet ADA requirements.

Considerations

A system that uses permeable pavers can help developers obtain LEED credits.



Permeable brick pavers

LANDSCAPING

Bioretention

Description

Bioretention areas are shallow stormwater basins or landscaped areas that utilize engineered soils and vegetation to capture and treat runoff. Bioretention areas function like stormwater planters, but generally have fewer structural elements. They may appear more like conventional landscaped areas, but are depressed rather than elevated from the surrounding area. They can be used in areas where a more natural, garden aesthetic is desired. Bioretention areas feature high pollutant removal and good absorption of wind, noise, and sunlight.

Application

Bioretention areas are commonly used in residential areas and urban settings with planting room, such as bulbouts, medians, and landscape areas. They are often larger and more diverse in plant community than planters. A maximum contributing drainage area of less than two hours is recommended.



Bioswale



Infiltration Trench



Infiltration Trench

Considerations

- Bioretention areas have very small drainage areas.
- They provide flexible siting and are good for highly impervious areas.
- Bioretention areas are good options for retrofits.
- They require relatively low levels of maintenance.
- They do, however, require extensive landscaping if in public areas.
- A maximum contributing drainage area of less than two hours is recommended.

Infiltration Trenches

Description

An infiltration trench is an area of soil that is covered with mulch, ground cover, grass, trees, or other plantings. Trenches are generally located in the furnishing zone, though they can also be located in the frontage zone. For stormwater benefits, the sidewalk should be pitched toward the open trench. Nonlinear open areas can also be used for planting trees in clusters. Trees planted in open trenches and areas with a sufficient amount of soil that is not compacted have the greatest chance of surviving and thriving in an urban environment.

Application

Curbside open trenches are commonly used on neighborhood residential street types. Wide trenches provide sufficient rooting volume while maintaining appropriate sidewalk clearances. The trench should be filled to sidewalk level to avoid creating a tripping hazard.

Considerations

Areas with heavily-used, high-turnover curbside parking are not ideal for open trenches, as the soils become compacted over time and will need to be replaced. Consideration should be given to planting bare-root trees where permissible.

Planter Boxes

Description

Planter boxes are precast concrete boxes, filled with bioretention type soil media, installed below grade at the curb line. A standard street tree or shrub is planted in the box, which resembles a curbside planter. Planter boxes are located upstream of a standard curb inlet. For low to moderate flows, stormwater enters through the planter box's inlet, filters through the soil, and exits through an underdrain into the storm drain. For high flows, stormwater will bypass the planter box filter if it is full and flow directly to the downstream curb inlet.

There are several variations of this basic design. The contained planter box receives only rainfall, which filters through the soil and is then either taken up by its vegetation or allowed to seep out the bottom of the planter to the pavement or sidewalk. The infiltration planter box can receive both rainfall and runoff, which eventually filters through the bottomless planter and enters the underlying soil. The flow-through planter box collects flow in a perforated pipe along the bottom of the box and discharges out the side of the planter into a storm sewer.

Application

Planter boxes are used on impervious surfaces in highly urbanized areas to collect and detain/infiltrate rainfall and runoff. The boxes may be prefabricated or constructed in place and contain growing medium, plants, and a reservoir. Planter boxes should not be used for stormwater containing high sediment loads, to minimize clogging potential. These are intended for space-limited applications, or for areas requiring additional pollutant removal capability.

Considerations

- The contained planter is not tied into underlying soil or pipes and can therefore be placed almost anywhere and moved when needed. However, it does not have a reservoir to provide additional storage for flow control. Care should also be used in placing it next to building foundations and heavy pedestrian traffic areas.
- The infiltration planter should not be used next to foundations and underlying soils must drain rapidly enough to avoid ponding.
- The flow-through planter can be used next to building foundations since it directs flow off to the side and away from the building. It must be located next to a suitable discharge point into the stormwater conveyance system.
- Vegetation will require frequent maintenance.
- Filter may require more frequent maintenance than most of the other stormwater controls.



Planters contained with bulb-outs provide a road diet



Tree depression



Tree box filter

Enhanced Swales

Description

Enhanced vegetated swales are linear bioretention areas that convey runoff that can be used to augment traditional pipe and gutter systems. They do this by slowing runoff velocity, filtering stormwater pollutants, reducing runoff temperatures, and—in low volume conditions—recharging groundwater.

Application

Grasses are the most common plants in vegetated swales. Check dams, placed periodically along the length of the swale, slow runoff and promote infiltration. The bottom width of the swale should be 2 to 8 feet with side slopes 4:1 recommended.

Considerations

Plant selection should reflect maintenance capacity, stormwater sources, and context. Low flow conditions may require a 100-year overflow path and engineered section. Combine stormwater treatment with runoff conveyance system. Swales are less expensive than curb and gutters, however, maintenance costs may be higher.



Landscaped median

Landscaping in Medians

Description

Landscaped medians are an effective way to improve the safety and accessibility of arterial streets. For pedestrians, a raised and landscaped median decreases the total crossing width of the street. Additionally, it gives the street a more natural, shaded appearance. Bioretention areas can be located in landscaped medians.

Application

Landscaped medians are most useful on high volume, high speed roads.

Considerations

Landscaping in medians should not obstruct the visibility between pedestrians and approaching motorists.

Landscaped medians should be at least 6 feet wide to allow enough room for a pedestrian and a wheelchair to meet within a pedestrian refuge while crossing the street.

Desired turning movements need to be carefully provided so that motorists are not forced to travel on inappropriate routes such as residential streets, or an unsafe U-turn condition is not created.

Underground Detention

Description

In relatively dense urban areas where a large percentage of the landscape may already be developed, underground facilities may be the most practical way to achieve substantial flow volume and rate reductions. Although costs for constructing underground storage practices may be high, it may be the most economical way to detain stormwater in urban settings where land values are high. There are a number of types of underground storage available. In the simplest system, oversized pipes replace standard pipes in a storm drain, providing temporary storage of water. More storage can be achieved by using a series of interconnected pipes or a single large storage vault.

Application

The use of underground stormwater storage would be driven by project economics. Land cost, cost to remedy an inadequate receiving stormwater system, or some other unique condition or opportunity would warrant the typically substantial additional cost to construct such a system.

Considerations

Underground storage is effective for reducing stormwater runoff however little reduction of sediments or pollutants occurs without supplemental means to filter stormwater. The size of the system will largely be defined by the amount of stormwater to detain, the size of the site, and the elevation of tie-in points. Large continuous areas are more suited to large vault-type systems, while more linear, angular sites are better suited for pipe-based system. Construction materials are influenced by the usable depth and size of the site. Sites requiring more shallow construction should use pipes, because corrugated steel and plastic must be surrounded by more fill.

Pavement Design Considerations

Many Green Street applications and iSWM Best Management Practices (BMPs) will introduce water to the subgrade adjacent to and below the roadway and sidewalk pavements. Our North Texas soils are very sensitive to changing moisture conditions, and those soils can create forces that will destroy the strongest pavements far short of their expected design life. Use of iSWM BMPs and other penetrations into a traditionally designed watertight 'cap' over a moisture conditioned subgrade will require that innovative pavement design be performed where these methods are applied. The use of liners, geomembranes, underdrains, and other methods may be required to mitigate the introduction of additional sources of water into the pavement subgrade.



Detention storage located in underground pipe and tank systems.



Stormwater can be retained and filtered in the medians of boulevards

APPENDIX

1. Complete Streets Design Review Checklist
2. Implementation Plan
3. Knox Street Demonstration Evaluation
4. Proposed Major Thoroughfare Plan Change Priorities
5. Potential Revisions to Manuals

Photo Credits

The Following Agencies and Organizations are credited for the photos used in this Manual:

Access Press/Jane McClure

DART

Kimley-Horn and Associates, Inc. (KHA)

MIG

NCTCOG

TOOLE DESIGN GROUP (TDG)

University of Texas at Arlington Library

COMPLETE STREETS DESIGN REVIEW CHECKLIST

The Complete Streets Design Review Checklist is intended for project sponsors to provide information about how bicyclists and pedestrians will be accommodated in the planning and design of transportation projects. Download the Dallas Complete Streets Design Review Checklist and fill it out as thoroughly as possible as the first step in initiating a Complete Streets project in the City of Dallas. This checklist will be used in initiating both public and private Complete Streets projects.

Step 1: Identify the street typology on the Dallas Complete Streets Vision Map.

- Mixed Use
- Commercial
- Residential
- Industrial
- Parkway

Step 2: Fill out the following questions to the extent possible.

Project Information

- a. Project Name:
- b. Project Budget/CIP Funding (if applicable):
- c. Design Completion (%):
- d. Lead Agency/Entity:
- e. Contact(s):
- f. Partner Agencies/Entities:
- g. Project Location
 - County (Dallas, Collin, Denton):
 - City Council District:
 - Special District(s) (Planned Development, PID, TIF, etc.) list all that apply:
 - TxDOT Highway Designation (if any)

- h. Project Area (precise street limits):
- i. Project Goals:
- j. Project Scope:
- k. Project History & Impetus:
- l. Project Budget:
- m. Funding Sources:
- n. Dates started/Anticipated to Start:
 - Conceptual Planning:
 - Preliminary Design:
 - Final Design:
 - Construction:
- o. Context Zone:

Describe the type of context zone that best describes corridor. Is it: Natural, Rural, Suburban, General Urban, Urban Center, Urban Core or a Special District? Definitions can be found on page 49 of Designing Walkable Urban Thoroughfares: A Context Sensitive Approach, An ITE Recommended Practice.

- p. History & Character:

Describe any special history or background of the area along the corridor that will assist in understanding the context of the project.

q. Land Use:

Describe the predominant land uses and densities within the project area, including any historic districts or special zoning districts, and the compatibility of the proposed design with these.

r. Major Sites:

Describe any major sites, destinations, and trip generators within or proximate to the project area, including prominent landmarks, commercial, cultural and civic institutions, educational facilities and public spaces, and how the proposed design can support these sites.

2. *Operations*

a. Walking:

Describe existing walking conditions within the project area, desired future conditions, and how the proposed design addresses walking conditions, including pedestrian safety, volumes, comfort and convenience of movement, important walking connections, and quality of the walking environment.

b. Bicycling:

Describe existing bicycling conditions within the project area, desired future conditions, and how the proposed design addresses bicycling conditions, including bicyclist safety, volumes, comfort and convenience of movement, existing or proposed bike routes and other important bicycling connections, and bicycle parking.

c. Motor Vehicles:

Describe existing motor vehicle conditions within the project area, desired future conditions, and how the proposed design addresses motor vehicle conditions, including motor vehicle safety, volumes, access, important motor vehicle connections, appropriateness of motor vehicle traffic to the particular street (e.g., local versus through traffic) and reducing any negative impacts of motor vehicle traffic.

d. Transit:

Describe existing transit conditions within the project area, desired anticipated future conditions, and how the proposed design addresses transit conditions, including bus routes and operations, light-rail, commuter rail or other transit station access, and supportiveness of transit usage and users.

e. Trucks/Freight:

Describe existing truck conditions within the project area, desired future conditions, and how the proposed design addresses truck conditions, including truck routes, safety, volumes, access, and mobility and reducing the negative impacts of truck traffic.

f. Access:

Describe how the proposed design addresses the needs of those with increased access or mobility requirements such as the disabled, elderly, and children, including ADA compliance and any school or senior safety zones within the project area, if applicable.

g. Curbside Conditions:

Describe existing curbside demand and usage patterns within the project area, desired future conditions, and how the proposed design addresses curbside conditions, including allocation of space for parking, loading, and drop-off, and pedestrian space.

h. Public Space:

Describe existing public space conditions within the project area and how the proposed design affects public space, including any proposed new public space and any new pedestrian seating or other enhancements to the public realm.

i. Drainage:

Describe potential disturbance to existing stormwater flow patterns or existing catch basins, and /or the need for new sewer connections.

j. Street Cuts:

Describe observed frequency of utility “cuts” into the roadway within the project area and how the proposed design addresses street cut conditions, including improvement or consolidation of utility infrastructure.

3. *Greening/ISWM*

a. Street Trees:

Describe existing street tree coverage within the project area and how street trees are included in the proposed design.

b. Greenstreets & Plantings:

Describe any existing Greenstreets and Greenstreet opportunities within the project area and any Greenstreets or other planted areas that are included in the proposed design.

c. Stormwater Control:

Describe stormwater runoff conditions including the infiltration ability of underlying soil within the project area and what, if any, stormwater source controls area included in the proposed design.

d. Flooding:

Describe any flooding conditions within the project area and how the proposed design addresses flooding.

e. Maintenance Partner(s):

Describe any potential and/or committed public and/or private maintenance partners and level of commitment (e.g., watering, weeding, pruning, litter removal, replacements).

f. Permits:

Describe whether any wetlands or protected areas are within 100 feet of the project area and whether permits from the State of Texas or Army Corps of Engineers approvals are necessary.

4. *Paving Design Manual*

a. Materials, Lighting & Furniture:

Describe existing and proposed street materials, lighting and furniture, including paving materials; lighting poles, fixtures and levels; and street furniture.

b. Application:

Describe how the proposed design follows the guidelines of the City of Dallas Paving Design Manual in regards to overall policies and principles, street geometry, materials, lighting, and street furniture.

c. Major Deviations from Guidelines:

Where the design deviates from the guidelines or policies and principles of the manual, provide explanation.

d. Pilot Treatments:

Describe any pilot treatments being proposed, whether geometric or material treatments.

5. *Additional Information*

Provide any additional information or considerations regarding this Complete Streets project that will help the design and review teams make informed decisions.

IMPLEMENTATION PLAN

DALLAS COMPLETE STREETS INITIATIVE Implementation Strategies

Implementation Strategies Summary	
Action 1	✓ Adopt the Complete Streets Design Manual through Council Resolution
Action 2	✓ Task a Team with Effective Leadership, Resources and Responsibility for Complete Street Policy Implementation Across Departments
Action 3	✓ Enhance Inter-departmental Coordination on Street Improvement Projects
Action 4	✓ Implement Phased Thoroughfare Plan amendments
Action 5	✓ Amend Other Related Policies and Regulations for Consistency and Linkage to Complete Streets Manual
Action 6	✓ Explore Alternative Funding Mechanisms for Complete Streets Capital and Operation / Maintenance Costs
Action 7	✓ Expand Dallas' Current Offering of Neighborhood-Initiated Street Improvement Programs to Incorporate Complete Streets Design Options and Considerations
Action 8	✓ Initiate a Monitoring & Evaluation Program

Action 1	Adopt the Complete Streets Design Manual through Council Resolution
TBD	<ul style="list-style-type: none"> ✓ Acknowledge changing trends towards a more sustainable transportation system through proactive implementation of a complete streets program ✓ Establish the Dallas Complete Street Manual as the comprehensive street design policy guide and the basis for future Thoroughfare Plan and code amendments

Action 2	Task a Team with Effective Leadership, Resources and Responsibility for Complete Street Policy Implementation Across Departments
TBD	<ul style="list-style-type: none"> ✓ Assign leadership and ombudsman role to one group/department ✓ Include city departments involved in planning, design, construction, operation and maintenance of street-related improvements: <ul style="list-style-type: none"> ➤ Public Works & Transportation ➤ City Design Studio ➤ Sustainable Development and Construction ➤ Economic Development ➤ Streets ✓ Establish team responsibility to include coordination of all aspects of complete streets policy implementation: <ul style="list-style-type: none"> ➤ Street improvement projects ➤ Regulatory changes ➤ Private development project review ➤ Ongoing staff training to institutionalize complete streets design practices
Action 3	Enhance Inter-departmental Coordination on Street Improvement Projects
TBD	<ul style="list-style-type: none"> ✓ Maintain an ongoing priority list of capital improvement and resurfacing/restriping projects that are budgeted to include complete street design elements ✓ Ensure early and continual inter-departmental coordination to facilitate proper execution of complete streets design principles from corridor planning through conceptual design, engineering and construction ✓ Focus on reaching early consensus on conceptual street cross-sections and project scopes through community involvement during the corridor planning stage ✓ Conduct temporary complete street demonstrations as needed to test new street design solutions involving significant change from current conditions ✓ Ensure coordination with utility repair/replacement projects where relevant

Action 4	Implement Phased Thoroughfare Plan amendments
Initiated; Ongoing	✓ Implement a strategic work program of targeted, case-by-case thoroughfare plan amendments to incorporate complete street design changes for funded street improvement projects
TBD	✓ Amend the Thoroughfare Plan to clarify the administrative relationship with the Complete Streets Manual and to incorporate complete street typology and policy guidance
TBD	✓ Undertake a comprehensive, citywide update of the Thoroughfare Plan functional and dimensional classifications

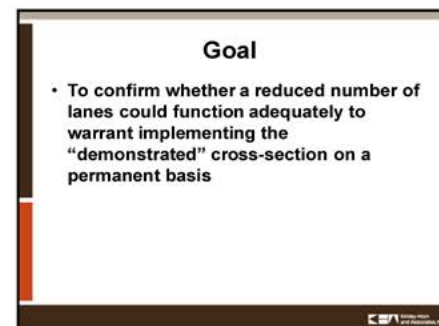
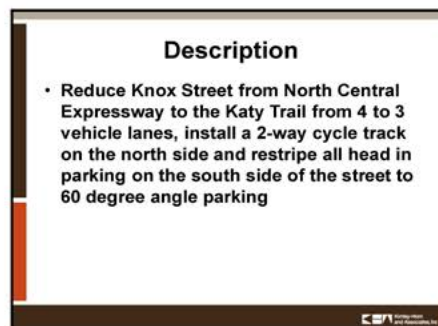
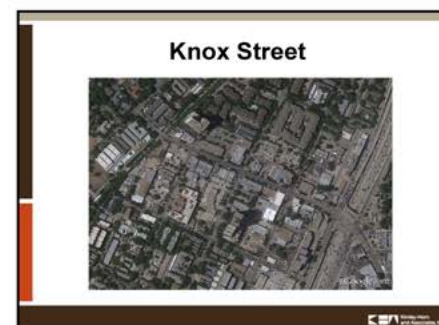
Action 5	Amend Other Related Policies and Regulations for Consistency and Linkage to Complete Streets Manual
TBD	✓ Update forwardDallas! Comprehensive Plan Transportation Element
TBD	✓ Incorporate complete street design practices into engineering manuals in coordination with iSWM (Public Works, Streets, Dallas Water Utilities, Trinity Watershed Management)
TBD	✓ Evaluate ROW use regulations and licensing requirements relative to best practices for encouraging private investment in public ROW: <ul style="list-style-type: none"> ➤ Landscaping, street furniture, street lighting, awnings and other non-revenue producing public amenities ➤ Sidewalk cafes and other private revenue producing uses ➤ On-street parking
TBD	✓ Amend Chapter 28 and 43 of the Dallas Code <ul style="list-style-type: none"> ➤ Consistency in traffic operation and speed standards ➤ Encouraging on-street parking where appropriate
TBD	✓ Amend the Dallas Development Code (Chapter 51-A) <ul style="list-style-type: none"> ➤ Sidewalk and planting zone width requirements and design standards ➤ Complete street design guidance for minor streets and subdivisions ➤ Sidewalk policy waivers ➤ Standards for access management, drive cuts and drive closures ➤ Ownership, responsibility and maintenance of rights-of-way

Action 6	Explore Alternative Funding Mechanisms for Complete Streets Capital and Operation / Maintenance Costs
TBD	<ul style="list-style-type: none"> ✓ Review TIF and PID requirements to proactively encourage Complete Streets implementation and maintenance through public/private partnerships ✓ Explore new opportunities for funding capital and operation/maintenance costs through public-private partnerships and grant opportunities ✓ Bring recommendations forward for Council consideration to address enhanced public funding options for complete street project implementation

Action 7	Expand Dallas' Current Offering of Neighborhood-Initiated Street Improvement Programs to Incorporate Complete Streets Design Options and Considerations
TBD	<ul style="list-style-type: none"> ✓ Expand on current traffic calming, pavement and sidewalk petition and safe routes to school programs to incorporate a broader list of design options based on the Complete Streets Design Manual
TBD	<ul style="list-style-type: none"> ✓ Initiate a competitive neighborhood matching grant program focused on modest complete street improvements similar to the Loving My Community program

Action 8	Initiate a Monitoring & Evaluation Program
TBD	<ul style="list-style-type: none"> ✓ Incorporate a Monitoring & Evaluation Plan into the Complete Street corridor planning and development process ✓ Identify measures of effectiveness consistent with the Complete Street project context using FHWA and AASHTO as a guide ✓ Measure return on Complete Streets investment in quantitative and qualitative terms ✓ Establish time horizons and frequency of data collection based on realistic expectations ✓ Identify and conduct public surveys that respond to stakeholder goals, objectives and expectations

KNOX STREET DEMONSTRATION EVALUATION



Objectives

- Construct a temporary cross-section with traffic signs, barricades and pavement marking tape and test it for a total of four days (2 weekdays and 2 weekend days);
- Create a Traffic Control Plan (TCP) approved by the City of Dallas that utilizes temporary construction barricades and devices and meets budget constraints;

CSF1 Consulting and Research, Inc.

Objectives

- Develop and execute a TCP that encourages an appropriate vehicle speed; minimizes delays and congestion; accommodates high turnover on-street parking; and is robust enough to provide a safe separation between vehicular and bicycle traffic.
- Create a more walkable and bikeable street than currently exists.

CSF1 Consulting and Research, Inc.

Concept Plan



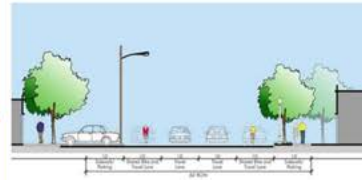
CSF1 Consulting and Research, Inc.

Existing Conditions



CSF1 Consulting and Research, Inc.

Option A



CSF1 Consulting and Research, Inc.

Option A



CSF1 Consulting and Research, Inc.

Option B



CSF1 Consulting and Research, Inc.

Option B



CSF1 Consulting and Research, Inc.

Option C



CSF1 Consulting and Research, Inc.

Option C

Knox - Plan - Future (Option C)



CSA Consulting Group and Associates, Inc.

Proposed Demonstration Option



CSA Consulting Group and Associates, Inc.

Proposed Demonstration Option



CSA Consulting Group and Associates, Inc.

Proposed Demonstration Option



CSA Consulting Group and Associates, Inc.

Traffic Control Plan



CSA Consulting Group and Associates, Inc.

Demonstration



CSA Consulting Group and Associates, Inc.

Demonstration



CSA Consulting Group and Associates, Inc.

Demonstration

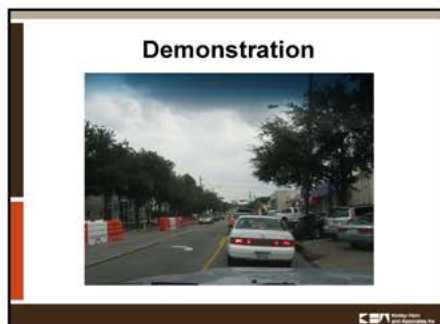


CSA Consulting Group and Associates, Inc.

Demonstration



CSA Consulting Group and Associates, Inc.



Demonstration



Knox 24-Hour Traffic Volumes

Day	Before	During
Thursday	-	19,755
Friday	18,254	16,970
Saturday	16,794	15,005*
Sunday	12,560	12,609
*Rain		

Source: City of Dallas

Knox Intersection Counts

	Travis Before	Travis During	McKinney Before	McKinney During	N. Central Before	N. Central During
Weekday						
AM	932	991	1462	1507	3480	3355
Midday	1044	1123	1755	1918	3457	3825
PM	1232	1082	2280	2091	3715	3510
Total	5915	5917	9811	9882	19250	19482
Saturday						
Midday	1314	1177*	1989	1721*	3662	3587*
* Rain						

PM Peak Queuing



PM Peak Queuing



Knox Bicycle & Pedestrian Counts

	Travis Before	Travis During	McKinney Before	McKinney During	N. Central Before	N. Central During
Weekday						
Combined Peak Periods	30/312	42/415	35/496	47/681	33/44	35/73
Saturday						
Midday Peak Period	43/385	6/216*	15/567	2/356*	21/46	2/18*
* Rain						
XX/YY =	Bicycles/	Pedestrians				

Knox Speed Observations

	During (Thursday 9/27)	After (Thursday 10/4)
Number of Observations	36	46
High (MPH)	26	37
Low (MPH)	11	19
Average (MPH)	21.0	26.1
85 th % (MPH)	24	30

Note: All observations WB mid-afternoon.

Feedback Property Owners & Tenants

- The bike lanes are not a good idea on Knox. I think the Demonstration was a great idea but simply pointed out the problems, especially with the traffic problems it creates. Vehicular traffic through the area is challenging enough. We do not want to deter traffic flow in any way. This would be a disservice to the merchants in the area that rely on customers getting there as easily as possible.

Feedback Property Owners & Tenants

- In my opinion the bike lane along Knox Street just doesn't work. I watched very carefully to see what benefits it could have versus the issues that it causes. Change is never easy, but I believe this really is not it.
- I like the concept, but unfortunately I heard a lot of negative comments from customers about traffic, parking, etc. I hate that it rained, but numbers are consistent with last year.

Feedback Property Owners & Tenants

- When I asked my customers how they liked the experiment, several replied that once they realized the new setup, they avoided the street and came a different route. I thought that was a telling example. I also feel we need to install areas to park and lock a bike, preferably around restaurants, so when they do ride to a destination, they have somewhere to park.

Feedback Property Owners & Tenants

- Everyone complained about traffic and having to wait longer (though the middle lane was distracting). On the other hand, they liked the angled parking spaces on Knox because this did make it easier to get in and out of those stores.
- I found it difficult to get out of the parking lot at Starbucks which is a main entrance used for our shopping strip. I have concerns with losing business due to the difficulties of getting in the entrance around the cyclists as well. This being said, I think it brings a different generation to our area.

Feedback Property Owners & Tenants

- While I tried to have an open mind, I thought that this was a disaster...the bike lanes made it difficult for people to turn into local businesses as well as being able to park on Knox. There was more street congestion due to the fact that it was one lane in certain areas. To do this correctly you would have to totally redesign the sidewalks.

Feedback Property Owners & Tenants

- The bicycle lanes did have a pretty big impact on traffic causing gridlock and back up in the intersections from the time of the install. When the lanes were removed this morning, the flow eased up again.
- I know cross at the cross walks, but customers do not do that. I just do not see us gaining business from the bike lane because they are just using it to get to Katy Trail. It would be safer for them to use a side street to get to the trail and we keep a lane of traffic going.

Feedback Pedestrians and Bicyclists

- A Local Bicyclist: This is a busy narrow street. There are 6-lanes on Fitzhugh and a new connection at McCommas. Too much traffic in and out...angry drivers.
- Jason Roberts: "If we're wrong, at least you're using the scientific method as opposed to assuming and going to public meetings nonstop and debating whether it will work or not," he said.
- "We can go back and see: Did people bicycle more? Did they walk more? Was there a better pedestrian experience? ...At least let us try it. Maybe they're right. Maybe they'll come back Saturday and it'll be a nightmare. But it was just four days. Let us just try it at the very least."

Lessons Learned

Design concept

- ✓ Need extra room for angle parking and maneuvering.
- ✓ Signs and pavement markings conform to MUTCD.
- ✓ Need more advance warning for a lane drop.
- ✓ Created bulb-out to direct drivers.
- ✓ Stop bars set back to accommodate turning vehicles.
- ✓ Lose a few parking spaces converting from 90-degree to angle.
- ✓ Yellow delineator at ends of cycle track worked out.
- ✓ Utility poles and concrete bases are a barrier.
- ✓ Use lower traffic barriers (water filled).

Lessons Learned

Installation

- ✓ Black out tape or paint is a necessity.
- ✓ Tape stands up to rain & normal traffic, but not turning and parking maneuvers.
- ✓ Be vigilant & flexible - created bulb-out to direct drivers.
- ✓ Restriping of parking requires additional cleaning & care.
- ✓ Installation during off-peak vs. peak traffic periods.
- ✓ The weather determines what materials you use.
- ✓ 4-foot bike lane (8-foot cycle track) next to a gutter is tight.
- ✓ Confusing signs & markings for bicyclists at east terminus.
- ✓ Start the design earlier working with contractor re: availability and cost of materials.

Lessons Learned

- ✓ Unique uses like valet parking stands need to be identified & accommodated.
- ✓ Take TCP to meeting(s) of all business and property owners before finalizing.
- ✓ Provide more advance advertising.
- ✓ Develop a Demonstration Primer & Checklist
- ✓ Other lessons learned...

Conclusions

- Demonstrations can model permanent Complete Streets installations for a reasonable cost
- Demonstrations can ensure input from all stakeholders
- Knox can "technically" be converted to a 3-lane section and accommodate the existing vehicle demand
- The allocation of space in the existing ROW would still need to be perfected:
 - Recommend removal of utility poles and concrete bases
 - If you have additional 4'-8" you could accommodate other stakeholder needs

PROPOSED MAJOR THOROUGHFARE PLAN CHANGE PRIORITIES



POTENTIAL REVISIONS TO MANUALS

POTENTIALLY AFFECTED SECTIONS IN:

THE PAVING DESIGN MANUAL
251D – STANDARD CONSTRUCTION DETAILS
DRAINAGE DESIGN MANUAL
DALLAS WATER UTILITIES DESIGN MANUAL

Following is a summary of the City of Dallas Design Manuals and a list and general description of section changes that should be explored.

THE PAVING DESIGN MANUAL

Section	Comment	Recommendation
Overall comment	<p>Much of the information in the manual is an overview of AASHTO design criteria and TDLR guidelines. This information has been supplemented with city-specific requirements.</p> <p>As AASHTO and TDLR guidelines are updated, the Paving Design Manual has not been updated, resulting in out-dated standards in some instances.</p>	<ul style="list-style-type: none"> Consider revising the paving manual to reference AASHTO and TDLR criteria rather than repeat the information (remove redundancies and out-dated references) Update the Paving Design Manual to incorporate the Complete Streets guidelines, as noted below
Section I – Introduction	Describes overview, purpose and scope of Manual and references other standards, ordinances, and studies	<ul style="list-style-type: none"> Add new Dallas Complete Streets Manual and Vision Map to list of references
Section II – Functional and Dimensional Classification 2. Functional Classification 2.01 General 2.02 Principal Arterial Freeways 2.03 Arterial Thoroughfares	Describes City Thoroughfare plan; Defines Functional Class (Arterial, Collector, Local); Defines Dimension Class (Standard, Minimum, Existing, Special Roadway Sections)	<ul style="list-style-type: none"> Reference new Vision Map and street typologies. Address how they are tied to the Thoroughfare Plan Update Dimensional Class section OR add more guidance to “Special Roadway Sections” OR simply reference the new Dallas CS Manual

THE PAVING DESIGN MANUAL

Section	Comment	Recommendation
2.04 Collector Thoroughfares 2.05 Local Streets 2.06 Alleys 3. Dimensional Classification 3.01 General 3.02 Arterial Thoroughfares 3.03 Collector Thoroughfares 3.04 Local Streets 3.05 Alleys		
Section II, Figures and Tables	Figure II-1 Functional Classification: Relationship of Access to Mobility Table II-2A Typical Characteristics of Functional Classifications Table II-2B Description of Categories Used to Define Functional Classes Table II-3 Typical Daily Volumes of Functionally Designated Thoroughfares Table II-4 Street & Thoroughfare Geometric Standards	<ul style="list-style-type: none"> Review for consistency and updating
Section III – Access Control 2. STREETS 2.01 Intersections 2.02 Traffic Barriers 2.03 Median Openings 4. DRIVEWAY APPROACHES AND CURB OPENINGS 4.01 General 4.02 Spacing 4.03 Intersections 4.04 Freeways and Expressways	Documents City's access requirements (intersection spacing, median openings, driveway spacing, alleys)	<ul style="list-style-type: none"> Review to target influence of complete streets initiative
Section IV – Geometric Design	Describes geometric design for city roadways and sidewalks. Consistent with AASHTO Criteria.	<ul style="list-style-type: none"> No change to 95% of chapter Incorporate recommendations from the

THE PAVING DESIGN MANUAL

Section	Comment	Recommendation
<p>2. DESIGN CRITERIA</p> <p>2.01 Design Vehicles</p> <p>2.02 Design Speed</p> <p>2.03 Design Traffic Volumes</p> <p>3. DESIGN ELEMENTS</p> <p>3.01 Typical Cross Sections</p> <p>3.07 Arterial Thoroughfares</p> <p>3.08 Sidewalks</p> <p>3.09 Parkways</p> <p>3.10 Medians</p> <p>3.11 Median Openings</p> <p>3.12 Driveways and Curb Openings</p> <p>3.13 Street Lighting and Traffic Control Devices</p> <p>3.15 Utilities</p> <p>4. ADA REQUIREMENTS</p> <p>4.01 General</p> <p>4.02 Public Rights-of-Ways</p>	<p>Addresses design vehicle, speed, traffic volumes; Addresses design elements (cross section, horizontal curves, vertical profiles, storm drain criteria, crosswalks, sidewalks/ADA, parkways, street lighting, utility assignments, on-street parking, etc)</p>	<p>Dallas CS Manual with technical information (standard details, minimum criteria, etc)</p> <ul style="list-style-type: none"> Address utilities in ROW to possibly allow more flexibility
Section IV, Figures and Tables	<p>Table IV-4 Design Vehicle Criteria</p> <p>Table IV-6 Typical Volumes and Capacities for Streets of Given Design</p> <p>Table IV-7 Design Traffic Volumes for Streets</p> <p>Figure IV-19 Driveway Standards</p> <p>Figure IV-20 Utility Zones in Typical Streets</p> <p>Figure IV-21 Utility Zones in Alleys</p> <p>Figure IV-22 Accessible Route</p> <p>Figure IV-23 Protruding Objects</p> <p>Figure IV-25 Public Sidewalk Curb Ramps Various Concepts</p> <p>Figure IV-26 Public Sidewalk Curb Ramps at Marked Crossings</p> <p>Figure IV-28 Examples of Accessible Parallel On-</p>	<ul style="list-style-type: none"> Review for consistency and updating

THE PAVING DESIGN MANUAL

Section	Comment	Recommendation
	<p>Street Parking</p> <p>Figure IV-29 Dimensions of Parking Spaces</p> <p>Figure IV-30 Access Aisle at Passenger Loading Zones</p>	
<p>Section V – Pavement Structure</p> <p>3. ALTERNATE PAVING DESIGN</p> <p>3.01 Traffic</p> <p>3.02 Subgrade Soils</p> <p>3.03 Pavement Widening</p>	<p>Defines minimum requirements for pavement structure for roadways, alleys, and sidewalks. Based on roadway classification, traffic volumes, truck percentages, and soil type for 30-year design life. Allows for alternate pavement designs subject to City approval.</p>	<ul style="list-style-type: none"> ▪ No significant changes ▪ However, the engineering side of hardscape (stamped, pavers, etc), aesthetic treatment, green paving improvements should be addressed/incorporated into this chapter
<p>Section VI – Construction Plan Preparation</p>	<p>Defines the submittal requirements for conceptual, preliminary, and final design phases. Includes checklists, etc. Does not detail process.</p>	<ul style="list-style-type: none"> ▪ Reference Dallas CS Manual for PROCESS prior to and/or concurrent with conceptual and preliminary phases. ▪ No changes to final design phase.
<p>APPENDICES</p> <p>D. STREET CENTERLINE AND CORNER CURB RERUN</p>	<p>Radii Determinations-Examples</p>	

251D – STANDARD CONSTRUCTION DETAILS

<i>Section</i>	<i>Recommendation</i>
Overall comment	<ul style="list-style-type: none"> Of the 36 Standard Details, most can remain as they are. Following are sections that should be reviewed for potential revisions. A few details, as noted below, will need to be revised and/or supplemented with additional information
Paving 1001 Paving Sections and Street Layouts with Medial Details Monolithic Median Noise	<ul style="list-style-type: none"> Evaluate and revise typical sections for potential context-specific adjustment/alteration, , lane width, etc to be consistent with new street typologies
Paving 1004 and 1004A Pavement Joints and Bridge Approach Slab Driveway Turnouts Special Driveway Turnout Details	<ul style="list-style-type: none"> May need to supplement with other driveway scenarios
Paving 1007	<ul style="list-style-type: none"> Supplement sidewalk/ramp details
Paving	<ul style="list-style-type: none"> Consider additional Complete Street – Paving Details (hardscape, stamped/colored concrete, pavers, etc)
Drainage Lined channels	<ul style="list-style-type: none"> iSWM influence could add alternative channel treatments
Structures	<ul style="list-style-type: none"> No changes to existing details. Consider making these obsolete and reference TxDOT standards.
Alley Intersections	<ul style="list-style-type: none"> Evaluate at roadway intersections
Traffic Control 5003 and 5004 Traffic Signal Foundation Details Pavement Markings	<ul style="list-style-type: none"> Supplement pavement marking details to incorporate bicycle facilities, etc. Should alternative signal poles be used?
Miscellaneous 9004, 9005, 9007, 9008, 9009 Aluminum Bridge Railing Details Miscellaneous Construction Items Bicycle Paths Reinforced Sidewalk and Barrier Free Ramps Barrier Free Ramps Paving Details Steps and Handrail	<ul style="list-style-type: none"> Review in more detail for areas to refine or supplement Update/revise/supplement sidewalk/ramp/step/handrail details for consistency Supplement median details with other treatments Update/revise/supplement street lighting details for consistency Multiple options could be added to this set of base details

DRAINAGE DESIGN MANUAL

Section	Recommendation
<p>Section II-Drainage Design Criteria</p> <p>3. HYDRAULIC DESIGN CRITERIA FOR DRAINAGE RELATED STRUCTURES</p> <p>3.1 Design of Enclosed Storm Drain Systems</p> <ul style="list-style-type: none"> *3.1.2 Gutter Flow/Inlet Location *3.1.3 Street Capacity *3.1.5 Flow in Alleys *3.1.8 Manhole Placement and Design *3.1.9 Outfall Design 	<ul style="list-style-type: none"> ▪ Review for potential adjustments
<p>SECTION III-CONSTRUCTION PLAN PREPARATION</p> <ul style="list-style-type: none"> *PLATTING/DEDICATION OF WATER COURSES AND BASINS – P5 	<ul style="list-style-type: none"> ▪ Potential iSWM Influence
<p>SECTION IV-APPENDIX</p> <ul style="list-style-type: none"> *Storm Drain Inlet Chart - p *Gutter Flow/Inlet Computation Table – p77. *Ratio of Intercepted to Total Flow Inlets on Grade- p8. *Capacity of Triangular Gutters – p9. *Capacity of Parabolic Gutters -p10.- 11. *Alley Conveyance p. 11A-11B *Detail of Alley Paving at a Turn - p24. 	<ul style="list-style-type: none"> ▪ Review for potential adjustments

DALLAS WATER UTILITIES DESIGN MANUAL (OCTOBER 2011)

Section	Recommendation
<p>PART II-WATER MAIN CONSTRUCTION</p> <p>*3/4" Water Service Installations (Sidewalk Adjacent to Curb) 201</p> <p>*1" Water Service Installations (Sidewalk Adjacent to Curb) 202</p> <p>*1 1/2" or 2" Water Service Installations (Sidewalk Adjacent to Curb) 203</p> <p>*3/4" Water Service Installations (Sidewalk 5' from Curb) 204</p> <p>*1" Water Service Installations (Sidewalk 5' from Curb) 205</p> <p>*1 1/2" or 2" Water Service Installations (Sidewalk 5' from Curb) 206</p> <p>*Bull Head Water Services 206A</p> <p>*Flush Point Installation--Type 1 207</p> <p>*Automatic Flush Point 207A</p> <p>*Air Release Valve--Type 1 208</p> <p>*Air Release Valve--Type 2 (Elevation) 209</p> <p>*Air Release Valve--Type 2 (Details) 210</p>	<ul style="list-style-type: none"> Review for potential adjustments
<p>*Methods for Setting Fire Hydrants 224</p> <p>*Pipe-to-Soil Potential Test Station (Post Mounted) 226</p>	<ul style="list-style-type: none"> Review for potential adjustments

DALLAS WATER UTILITIES DESIGN MANUAL (OCTOBER 2011)

Section	Recommendation
<ul style="list-style-type: none"> *Pipe-to-Soil Potential Test Station (Buried Configuration) 227 *Guard Post Protection for Fire Hydrants 237 *Guard Post Protection for Water Meters 238 *Single PRV Assembly 239 *Dual PRV Assembly 240, 241-243 	
PART III-WASTEWATER MAIN CONSTRUCTION <ul style="list-style-type: none"> *Wastewater Lateral Width 319 	<ul style="list-style-type: none"> Review for potential adjustments
PART IV-WATER AND WASTEWATER ADJUSTMENTS <ul style="list-style-type: none"> *Meter Box Placement 409 	<ul style="list-style-type: none"> Review for potential adjustments
PART V-LARGE WATER SERVICE INSTALLATIONS <ul style="list-style-type: none"> *Large Service Installation Details and Plan Views 502 *Minimum Easement Sizes for Meter Installation 502A *Large Service Installation Detail--Elevation View 503 *Suspended Vault Installation Details--Plan View 523 *Suspended Vault Installation Details--Elevation View 524 	<ul style="list-style-type: none"> Review for potential adjustments

PHOTO CREDITS

Photo credits are listed in order of left to right, top to bottom.

Introduction

KHA	2
KHA, KHA, MIG, DART	3
KHA	4
University of Texas at Arlington Library	5
KHA, KHA	6
forwardDallas!, MIG	8
MIG	10
KHA	11

Chapter 1

KHA	14
KHA, KHA, KHA, DART	15
KHA, MIG	16
KHA, MIG	18
MIG, MIG	22
KHA	26
KHA	28
MIG, MIG	30

Chapter 2

KHA	42
KHA, KHA	43
forwardDallas!, forwardDallas!	44
KHA	45
KHA	46
KHA, KHA	47
KHA, KHA	48
KHA, KHA	49
TDG	50
KHA, KHA	51
KHA, KHA	52
KHA, KHA	53
MIG	54
KHA, KHA	55
KHA, KHA	56
KHA, KHA	57
DART	58
KHA, KHA	59

KHA, KHA	60
KHA, KHA	61
KHA	62
KHA, KHA	63
KHA, KHA	64
KHA, KHA	65
KHA	67
KHA	68
KHA	69

Chapter 3

MIG	72
TDG, DART, KHA, KHA	73
MIG	74
KHA, KHA	75
MIG	76
TDG	79
KHA	84
KHA	86
MIG	88
MIG, MIG	89
MIG, MIG	90
MIG, MIG	91
MIG, MIG	92
MIG, MIG	93
MIG, MIG	94
MIG, MIG	95
MIG, MIG	96
MIG, MIG	97
MIG, MIG	98
KHA	100
KHA	102
KHA	103
KHA	104
TDG	105
MIG	106
KHA	107
City of Dallas	108
KHA	109
KHA	110
KHA	111

Chapter 4

TDG	114
MIG, TDG, TDG	115
KHA, TDG	116
MIG, KHA	117
KHA, KHA	118
MIG, TDG	119
TDG, KHA	120
KHA, KHA	121
KHA, KHA	122
MIG, KHA	123
DART, KHA	124
DART, KHA	125
KHA, DART	126
KHA, KHA	127
MIG, KHA	128
KHA, KHA	129
KHA, KHA	130
KHA, KHA	131
KHA	132
KHA, KHA	133
KHA, KHA	133
KHA, KHA	134
KHA, KHA	135

Chapter 5

DART	138
MIG, KHA, KHA	139
MIG, MIG	140
KHA, TDG	141
MIG, KHA	142
MIG, MIG	143
KHA, KHA	144
KHA, KHA	145
MIG, MIG	146
KHA, KHA	147
KHA, KHA	148
TDG, KHA	149
KHA, KHA	150
TDG, KHA	151
KHA, KHA	152

KHA, KHA	153
KHA, KHA	154
KHA, KHA	155
TDG, KHA	156
KHA, KHA	157
KHA, KHA	158
KHA, TDG	159

Chapter 6

MIG	162
KHA, MIG, TDG	163
KHA, KHA	164
KHA, KHA	165
KHA, KHA	166
KHA, KHA	167
KHA, KHA	168
MUTCD/TDG	169
KHA, TDG	170
KHA, MIG	171
KHA, KHA	172
KHA, KHA	173
KHA, KHA	174
KHA, KHA	175
TDG, KHA	176
KHA, MIG	177
KHA, KHA	178
KHA, KHA	179
KHA, KHA	180
TDG	181
TDG, TDG	182
TDG	183
Access Press: Jane McClure, KHA	184
TDG, TDG	185
TDG, KHA	186
KHA, TDG	187
TDG, TDG	188
KHA, TDG	189
KHA, KHA	190
KHA, KHA	191
TDG, TDG	192
TDG, KHA	193

DART, DART	194
TDG	195
DART, KHA	196
DART, KHA	197

Chapter 7

MIG	200
MIG, TDG, KHA	201
NCTCOG, MIG	202
MIG, KHA	203
KHA, KHA	204
MIG, TDG	205
NCTCOG, MIG	206
NCTCOG, NCTCOG	207
KHA, KHA	208
MIG, NCTCOG	209
KHA, KHA	210
MIG, MIG	211
MIG, KHA	212
NCTCOG, KHA	213





 Dallas