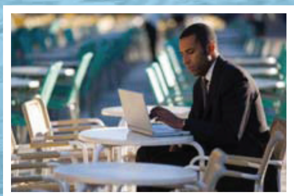
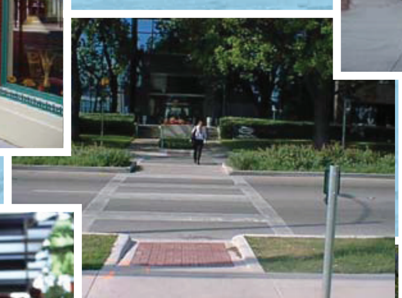
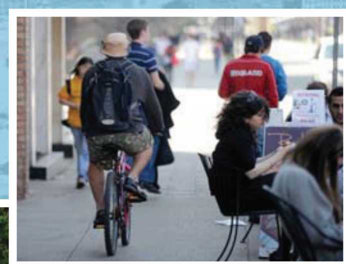




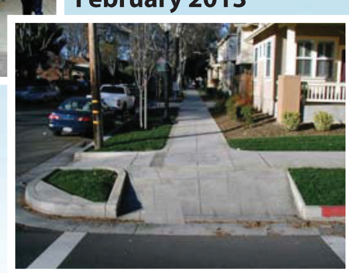


City of Tulsa

Complete Streets Procedural Manual

FINAL REPORT

February 2013



Prepared by:

Kimley-Horn and Associates, Inc.

CITY OF Tulsa

A New Kind of Energy™

INTRODUCTION

COMPLETING TULSA'S STREETS

Through PLANiTULSA, the Vision for Tulsa places an emphasis on coordinating transportation facilities' design with the land uses or context they serve. Like many American cities, Tulsa's transportation system has been historically oriented to support automobile-based land development forms. While cars will continue to play a large role in how Tulsans get around town in the future, the public input process found significant support for expanding the range of transportation options and a desire to have land development forms that are walkable, bikeable, and easily served by transit. Fortunately, Tulsa has a well connected, gridded street network that possesses the elements needed to transform into a high performance, multi-modal transportation system.

The basis for creating a more multi modal Tulsa is Complete Streets. The idea of Complete Streets is the final product of the vision, but how a roadway is adapted to a Complete Streets model in a realistic and appropriate manner is critical. This is the Context Sensitive Solutions (CSS) process which is used to bridge the gap from a traditional roadway design to one that takes into consideration pedestrian, bicyclist, and transit design components. The CSS process is a crucial tool Tulsa will use to create appropriate innovative changes to the existing roadways when redesign is needed. Some road segments may not require redesign, as they are currently context sensitive.

GUIDING PRINCIPLES

1. Create a vision for how and why Tulsa wants to "complete the streets"
2. The CSS process is used to define the approach to determine if and to what degree Complete Streets is appropriate for a corridor.
3. 'All users' includes pedestrians, bicyclists and transit passengers of all ages and abilities, as well as trucks, buses, automobiles and right-of-way occupants (utilities, right-of-way permit holders, etc.)
4. Applies to both new and retrofit projects impacting the entire right-of-way.
5. Any exceptions must be specific, and high-level approval for exceptions is necessary.
6. Encourage street connectivity and a comprehensive, integrated network for all modes.
7. Use the latest and/or best design criteria and guidelines while recognizing the need for flexibility in balancing user needs — no streets are going to be exactly the same.
8. Complete Streets solutions will complement the context of the community.
9. Performance standards with measurable outcomes are necessary.
10. Create specific next steps for implementation of Complete Streets.

CONTENTS

1 EXECUTIVE SUMMARY

1.1 PURPOSE

This procedural manual provides an overview on Complete Streets, guidance on the process for corridor planning, conceptual design, engineering design, and best practice guidelines for city departments, design professionals, private developers, and community groups for street improvement throughout the City of Tulsa. It serves as a resource for promoting higher quality street designs and more direct connection to the vision for streets within the City (as detailed in the recent update to the Comprehensive Plan). This Procedural Manual should supplement — rather than replace — existing engineering and environmental standards and requirements, including but not limited to the *Manual on Uniform Traffic Control Devices* (MUTCD), *AASHTO Policy on Geometric Design of Highways and Street*s ("Green Book"), and *Designing Walkable Urban Thoroughfares: A Context Sensitive Approach* (ITE recommended practice). 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 and right-of-way.

Example Complete Street in Tulsa

1.2 BACKGROUND

The vision for Tulsa was mapped out during the 2010 update to the City of Tulsa's Comprehensive Plan. It discusses how the City of Tulsa will look, function, and feel over the next quarter century. The policies noted in the Comprehensive Plan are the starting point for creating the kinds of places, economy, housing and transportation choices, parks, and open spaces that thousands of Tulsa's citizens worked for over multiple years. To get started on making the changes that will eventually achieve the vision, the Strategic Plan included in the Comprehensive Plan lays out the first steps to take, one of which involves implementing Complete Street policies and procedures within the City. This Procedural Manual is the product of an inter–agency initiative to streamline design concepts between City Departments arriving at a best design solution.

The Complete Streets movement began with an idea that streets should not cater only to motor vehicles. The initial roots of the Complete Streets movement began in Oregon in 1971 with the Oregon Bike Bill. This bill required a reasonable amount of the state highway funds to be spent on pedestrian and bicycle accommodations. This bill applied to both new and reconstructed roads. The concept has expanded over the last 40 years to include transit accommodations as well as other concepts like green streets and CSS.

The Federal Highway Administration (FHWA) is committed to the advancement of CSS nationwide as one of the objectives of its Vital Few Goal on Environmental Stewardship and Streamlining. The objective is to improve the environmental quality of transportation decision making by incorporating Context Sensitive Solutions principles in all aspects of planning and the project development process.

1.3 ORGANIZATION OF THIS DOCUMENT

This procedural manual is structured with four chapters and two appendices.

- Chapter 1 Executive Summary
- Chapter 2 Complete Streets Overview
- Chapter 3 Tulsa's Complete Streets Process
- Chapter 4 Multimodal Level of Service
- Appendix A – Complete Street Design Elements
- Appendix B – Sample Corridor - Lewis Avenue
- Appendix C – Bike Lanes on 4th Place

2 COMPLETE STREETS OVERVIEW

2.1 DEFINITION OF COMPLETE STREETS

Complete Streets is a relatively new term for an idea from decades past. Long before extensive regulations and requirements that favor 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.

Context Sensitive Solutions (CSS) is taking the concept of Complete Streets and applying it to roadway cross sections during construction, reconstruction, or rehabilitation in an appropriate manner. CSS uses 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 functional and compatible design for the area. **However, there is a difference between Complete Streets and CSS. The CSS process is used to define the approach to determine to what degree Complete Streets is appropriate for a corridor. The CSS approach helps to guide thinking for the long term goals of a corridor.**

2.2 BENEFITS OF COMPLETE STREETS

Complete Streets has many benefits through both the infrastructure and the culture changes that the process can bring. The added landscape and greenery can decrease pollution from emissions as well as the heat island effect due to decreased exposed pavement. The Complete Streets design also leads to increased transit ridership and an increased modal split toward transit, biking, and walking. The Comprehensive Plan encouraged a threefold increase in transit and walking/biking ridership. The increased transit ridership and pedestrian traffic will help to mitigate congestion and vehicle emissions. Along those lines, modes of transportation such as transit and rail can move more people per foot of right-of-way than motor vehicles.

2.3 TULSA'S CURRENT PROJECT DEVELOPMENT PROCESS

Tulsa's current project development process formally begins with a project being identified. Once funded, the design process is fairly straight forward where design phases follow a 30%, 60%, 90%, and 100% completion. At a minimum, public involvement occurs in the initial design phase (30%-60%) and prior to construction. There may be other public meetings during design and/or construction phases as needed. The Major Street and Highway Plan, which is governed by the Tulsa Metropolitan Area Planning Commission (TMAPC), establishes the street hierarchy and recommended cross sections. This manual can provide the City with new procedures to plan and design Complete Streets throughout Tulsa for a variety of project types.

2.4 TULSA'S COMPLETE STREET POLICY

The following is a Resolution adopted by the City of Tulsa in regards to CSS and Complete Streets development:

"A Resolution in support of a policy to create a comprehensive, integrated, and interconnected multimodal network of Complete Streets for the City of Tulsa that supports sustainable development and balances the needs of all users in order to achieve maximum functionality and efficiency. The purpose of this policy is to set forth guiding principles to be considered in all transportation projects, where practicable, economically feasible, and in accordance with applicable laws and ordinances, so as to provide accommodation for walking, bicycling, other non-motorized forms of transit, in addition to motorized transit, including personal, freight, and public transit vehicles.

- Tulsa's Comprehensive Plan recommends the adoption of a Complete Streets Policy; and
- Complete Streets are defined as those that provide safe, accessible and convenient transportation facilities for multiple modes of travel and accommodate all users including pedestrians, bicyclists, public transit riders,

freight providers, emergency responders and motorists that are safe and accessible for users of all mobility levels; and

- The Complete Streets philosophy supports the Goals of the Transportation Chapter of Tulsa's Comprehensive Plan; and

- Complete Streets may enhance economic vitality by providing convenient pedestrian, bicycle, and public transit facilities that help create a sense of place in and around retail districts and provide connection between places of residence to centers of recreation, retail, education, and places of work; and

- The Context Sensitive Solutions process, as detailed in the Comprehensive Plan, is the preferred method for achieving Complete Streets; and

- Context Sensitive Solutions is a flexible problem solving process that results in a wide variety of solutions, and can be tailored to support surrounding land use while providing adequate multimodal capacity; and,

- Complete Streets objectives may be achieved through single construction projects or incrementally through a series of planned improvements or maintenance activities over time, and through a wide variety of funding sources; and

- The City Council, after due study and deliberation, deems it advisable and in keeping with the recommendations and purpose of the comprehensive Plan, to adopt a Complete Streets Policy.

NOW THEREFORE, BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF TULSA, OKLAHOMA:

Section 1. That in the interest of fully implementing the transportation elements of the Comprehensive Plan, it is the consensus of this Council and the advice of this council, that future street projects in the City of Tulsa should be planned, designed, and operated, when possible, in accordance with accepted recommended best practices for Context Sensitive Solutions, as outlined by the *Institute of Transportation Engineers in Designing Walkable Urban Thoroughfares: A Context Sensitive Approach*, as amended and/or updated, to provide for a balanced, responsible, and equitable way to accommodate all users including pedestrians, bicyclists, public transit riders, freight providers, emergency responders, and motorists.

Section 2. That in the interest of sustaining our commitment to the Complete Streets concept, the Mayor will direct city staff responsible for the implementation of the Comprehensive Plan, and in particular those responsible for the planning, finance, design, and development of city streets to be accountable for the following, including but not limited to:

A. Developing a Complete Streets Policy Guide that would provide guidance for future transportation capital improvement projects and programs, including the public engagement methods needed to establish the preferred street context.

B. Context Sensitive Solutions shall be utilized in the planning, design and development of projects wherever possible.

C. Attendance of training on transportation issues and professional development related to Complete Streets through conferences, classes, seminars, webinars, and workshops when available, appropriate, and monetarily feasible to ensure that use of the latest and best practices, policies and guidelines.

Section 3. That upon adoption by the City Council, this Resolution shall be transmitted to the Mayor of Tulsa for his consideration, action and requested approval.

Adopted by the Council on February 2, 2012 and signed by the Mayor."

3 TULSA'S COMPLETE STREETS PROCESS

This chapter introduces a Context Sensitive Solutions (CSS) planning process for the City of Tulsa that begins with project initiation through final design and implementation. The City of Tulsa Complete Street Process is graphically presented on the following page. The project initiation stage begins with a proposed project — led by either the public or private sector — culminating in a coordination or kick off meeting with a multidiscipline project team. The next stage kicks off the conceptual design process. A summary of the Tulsa Complete Streets Process from project initiation through implementation is presented in Figure 3.1 on page 10.

3.1 PROJECT INITIATION

Complete Street projects can be categorized into two types: (1) those that are initiated because of needed street work, and (2) those that are initiated by private development projects. Both types may be constructed or reconstructed as Complete Streets, depending on factors such as the extent of the street project, the area's context, the available right-of-way, and funding.

While there are similarities in how street projects and development projects are conducted, the initiation and planning processes are different. The following sections detail the types of street projects that typically fall under a Complete Streets process.

3.1.1 IDENTIFY PROJECT TYPE

Projects are primarily focused on the street and public right-of-way, and are identified as one of the following types:

- Utility related projects
- Private development projects
- Capital projects
- Minor maintenance projects

A. UTILITY RELATED PROJECTS

Utility replacement projects are large-scale infrastructure projects that are initiated to replace water, sewer, and public or private utility lines. In these cases entire segments of roadways are removed 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. The ability to introduce Complete Streets elements on these projects depends on the size of the project. For example, a 30-foot-long mid-block replacement of a water valve would not be a viable candidate, but a 3-block-long sanitary sewer line replacement would likely create a positive opportunity to add Complete Streets elements.

B. PRIVATE DEVELOPMENT PROJECTS

In some instances, projects may be the result of a public/private partnership in which private funds are matched by state, federal, or local funds. Some projects may be financed 100% by the private sector. Whoever initiates and sponsors a Complete Street project determines the initial review and approval process by the City of Tulsa.

DEVELOPMENT PROJECTS WITH THOROUGHFARE FRONTAGES

Private development adjacent to a thoroughfare may involve roadway construction or reconstruction by a developer where the thoroughfare is not currently built to standard or where additional enhancements are desired to support the new development. These projects usually involve a change in the public right-of-way, resulting in the implementation of Complete Streets design policies and a possible thoroughfare plan amendment. In addition, zoning requirements may require the implementation of Complete Streets policies. These projects may include large, multi-block projects or incremental development occurring along a Complete Streets corridor. In both cases, it is important that conceptual planning occurs prior to roadway improvements to ensure a coordinated Complete Streets program is implemented.

For properties on thoroughfares not built to standard, property owners will need to work through the City's platting process to ensure adequate capacity exists. In addition to thoroughfare plan, right-of-way, and platting requirements, zoning may have special sidewalk and streetscape standards that should be followed.

DEVELOPMENTS WITH MINOR/LOCAL STREET FRONTAGES

The private sector also develops residential and nonresidential local streets. Local street design is governed by suburban regulations and platting requirements. Complete Streets principles and concepts work alongside these regulations to provide guidance to the development of these streets, as appropriate.

C. CAPITAL PROJECTS

Roadway construction and reconstruction projects are typically placed on the City's capital improvement plan (CIP). The scope of these projects are usually large enough to allow for consideration of planning and potential implementation of Complete Streets elements.

D. MINOR MAINTENANCE PROJECTS

The Streets and Stormwater and/or Engineering Services Departments initiate programs such as resurfacing or restriping to maintain existing streets within their current lane configurations. Since these improvement programs may be discontinuous segments based on current roadway conditions, they may not always be appropriate for consideration of Complete Street elements. In some situations these projects may provide an opportunity to make changes in lane configuration based on Complete Street considerations, such as implementing a bike plan or introducing new multimodal features.

3.1.2 ASSEMBLE AVAILABLE DATA

The complete street design process requires both traditional thoroughfare data as well as information about the contextual environment to inform those involved in designing the roadway. Designers of complete streets must balance roadway characteristics, the context and land use of an area, priority design elements, and the construction, operation and maintenance costs associated with the improvements.

Data should be collected to include, but not be limited to the following:

- Existing right-of-way
- Historic traffic/bike/pedestrian volumes and characteristics
- Speed limit
- Previously completed traffic analyses
- Accident data
- Record drawings
- Planned infrastructure projects
- Users
- Topography
- Right-of-way occupants

The following sources will also provide information regarding land use context and thoroughfare functional classification and will be used in 3.1.3 and 3.1.4:

- Comprehensive Plan
- Major Streets and Highway Plan (MSHP)
- Local area plans
- Existing land uses
- Existing zoning
- Development proposals

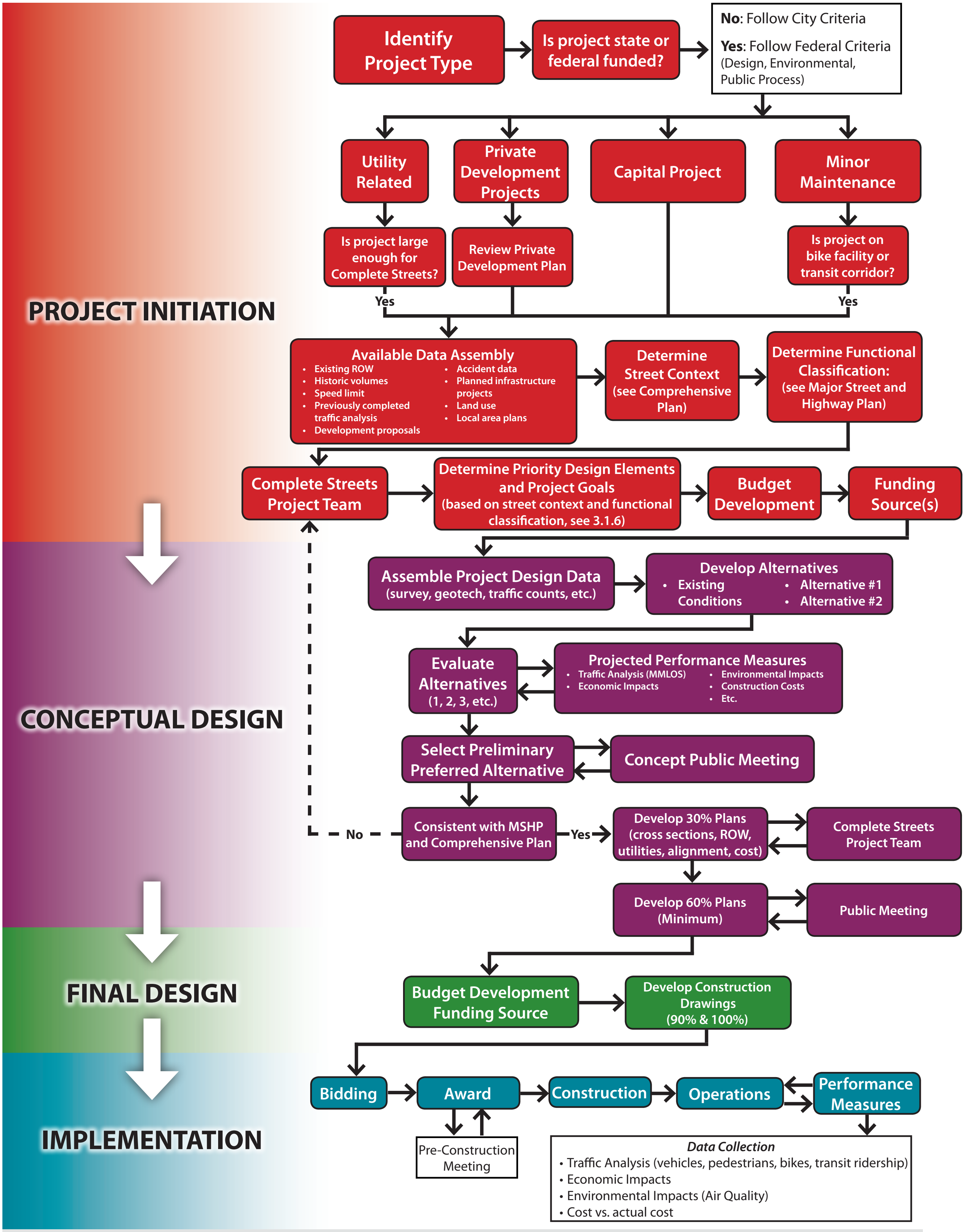


Figure 3.1: City of Tulsa Complete Streets Process

3.1.3 IDENTIFY STREET CONTEXT

Identifying the street context involves assuring that the proposed projects are in compliance with the Comprehensive Plan or any other applicable adopted local area plans. The Vision Map and legend depicted in Figure 3.1.3.1 should be used as a reference point to establish the corridor context. This context — combined with the thoroughfare type defined in 3.1.4 — will be used to identify the priority elements for a given corridor.

Identify Vision & Select the Appropriate Street Context

- Downtown
- New Center
- Employment Center
- New Neighborhood Center
- Intermodal Hub
- Main Street
- Multimodal Corridor
- Commuter Corridor

3.1.4 IDENTIFY MAJOR STREET AND HIGHWAY PLAN CLASSIFICATION

Tulsa is fortunate to have a well-connected street network with an array of roadway sizes and characteristics. These right-of-ways assure that the transportation system can evolve as the City grows and travel modes mature. In the past, the network absorbed increased traffic due to higher vehicular ownership levels and long-distance commutes. With changing community desires for transportation choices and sustainability, Tulsa's network can be adapted for transit, bicycle, pedestrian, and placemaking initiatives. This can be accomplished in concert with improving freight, cargo, and through traffic movement because of redundancies in the roadway and highway network.

The City of Tulsa has worked with INCOG to integrate the street design concepts from the Comprehensive Plan into the Major Streets and Highway Plan (MSHP) and has designated a series of context street types into their adopted plan: **Main Streets**, **Multimodal Streets**, and **Commuter Streets**.

Each street designation implies an overarching vision and character that should be considered when planning specific projects. In addition, the MSHP provides the proposed amount of right-of-way and proposed number of lanes from the corresponding recommended typical section. If changes to the corridor designation are needed, the sponsor agency/department will need to initiate community input (as would any MSHP amendment).

Identify Major Street and Highway Plan Classification

- Freeway
- Parkway
- Special Trafficway
- Primary Arterial
- Primary Arterial-Multimodal Street
- Secondary Arterial
- Secondary Arterial-Main Street
- Secondary Arterial-Multimodal Street
- Secondary Arterial-Commuter Street
- Urban Arterial
- Urban Arterial-Main Street
- Urban Arterial-Multimodal Street
- Commercial/CBD/Industrial Collector
- Residential Collector
- Residential Collector-Main Street

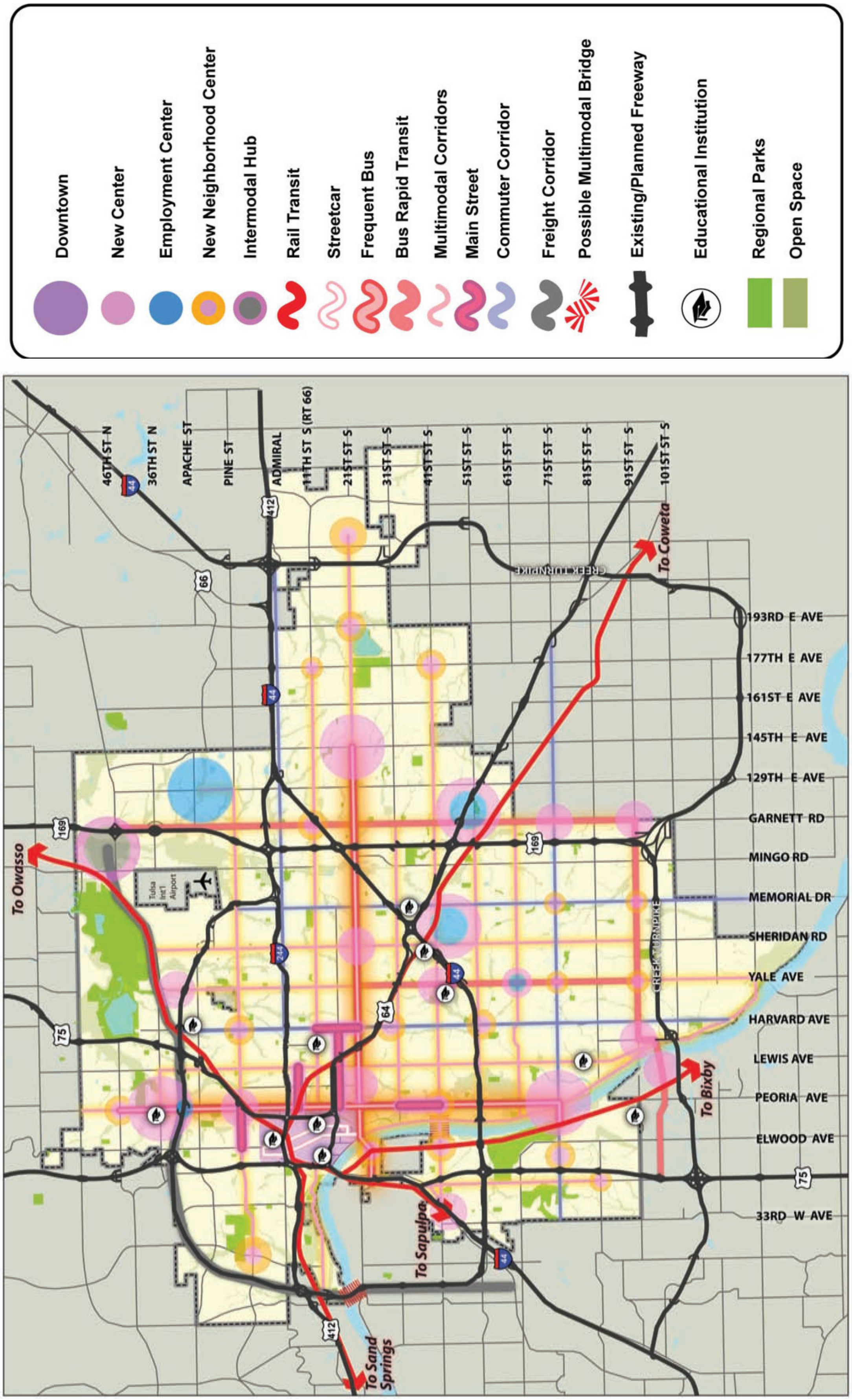


Figure 3.1.3.1 Tulsa Vision Map

3.1.5 ESTABLISH COMPLETE STREETS PROJECT TEAM

A coordination/kick-off meeting is necessary to establish the scope of each Complete Street project and to form a project team involving all appropriate departments/ entities early in the project development process. During this meeting, the project team is presented with the street context, functional classification and other assembled data.

The project team should consist of representatives from:

- Engineering Services Department
- Streets and Stormwater Department
- Traffic Operations Division
- Planning and Economic Development Department
- Water and Sewer Department
- Parks and Recreation Department

During the initial project team meeting the project goals should be set, as well as discussing the priority design elements (3.1.6) and constraints.

3.1.6 SELECT PRIORITY DESIGN ELEMENTS

CSS elements should be used to develop a transportation facility that will improve the multimodal functionality of an area while maintaining a focus on safety and mobility. These approaches should be used on streets where the total context will allow for such improvements. Based on information from 3.1.3 and 3.1.4, the design team should begin to tie the land use vision or context with the street classification to arrive at the best potential cross section. The following elements are grouped into three distinct zones: **Street Side, Pedestrian**, and **Intersection**.

The matrix in Figure 3.1.6.1 categorizes each element within each context as Essential (E), Desired (D), and Optional (O). The design team should use this matrix as the starting point to select the needed elements. As right-of-way issues arise, the design team will need to weigh these concerns within the overall vision and community values. The following table was derived from the *ITE Manual on Walkable Urban Thoroughfares*.

	Downtown	New Center	Employment Center	New Neighborhood Center	Intermodal Hub	Main Street	Multimodal Corridor	Commuter Corridor
Street Side Zone Treatments								
Road Diets	O	D	O	O	O	D	O	O
Medians	D	D	D	D	O	O	E	E
Bike Lanes	D	O	O	E	E	D	E	O
Cycle Tracks	O	O	O	O	O	O	D	O
Shared Lane Marking	O	O	O	O	O	O	O	O
Bicycle Boulevards	O	O	O	O	O	O	D	O
On-Street Parking	D	E	O	D	O	E	O	O
Paving Treatments	E	D	D	D	D	D	E	D
Additional Auto Capacity	E	D	E	D	E	D	E	E
Pedestrian Zone Treatments								
Sidewalks	E	E	E	E	E	E	E	E
Seating	O	O	O	O	O	O	O	O
Bicycle Racks	O	D	O	O	O	E	E	O
Bicycle Shelters	O	D	O	O	O	D	D	O
Bollards	O	O	O	O	O	O	O	O
Recycling Bins and Garbage Cans	O	O	O	O	O	O	O	O
Transit Stops	E	D	D	D	E	D	E	D
Transit Shelters	E	D	D	D	E	D	E	D
Provisions for Sidewalk Cafes	E	E	O	D	O	E	O	O
Plazas, Pocket Parks	D	D	O	D	O	D	O	O
Intersection Zone Treatments								
Curb Extensions	D	E	O	O	O	E	O	O
Crossing Islands	D	D	D	D	O	O	E	E
Crosswalk Design	E	E	E	E	E	E	E	E
In Street Yield to Pedestrian Signs	O	O	O	O	O	O	O	O
Rapid Flash Pedestrian Beacons	D	D	D	D	D	D	D	D
Pedestrian Signal Heads	E	E	E	E	E	E	E	E
Accessible Pedestrian Signals	E	E	E	E	E	E	E	E
Bicycle Lanes and Intersections	D	D	O	E	E	O	E	O
Bicycle Boxes	D	D	O	E	E	O	E	O
Cycle Tracks at Intersections	O	D	O	E	E	O	E	O
Transit Prioritization at Intersections	O	O	O	O	O	O	O	O
Bus Bulbs	O	O	O	O	O	O	O	O
Roundabouts	O	O	O	O	O	O	O	O

Figure 3.1.6.1 Priority Design Elements Matrix

3.2 CONCEPTUAL DESIGN

Once the priority elements have been chosen, the process leads to conceptually detailing the thoroughfare design. The conceptual design involves integrating the design of the street components, context, streetside, travelway, and intersections with a proposed project. As with any design process, this stage is iterative, can involve several options, and can result in potential updates to the thoroughfare plan and cross sections. See Appendix A for Complete Street design elements.

3.2.1 ASSEMBLE PROJECT DESIGN DATA

Prior to conceptual design additional project design data not already available should be collected to be used during he design process. This includes:

- Current traffic/bike/pedestrian volumes
- 85% percentile travel speed
- Survey including right-of-way occupants
- Geotech Analysis

3.2.2 DEVELOP AND EVALUATE ALTERNATIVES

The evaluation and selection of a preferred alternative leads into preliminary and final engineering. Specific tasks in this stage include:

1. Identify available right-of-way and other constraints.

In new developments, this step establishes the necessary right-of-way to accommodate the thoroughfare type and its desirable elements. In existing built areas, this step identifies the available right-of-way and other constraints as an input to the thoroughfare design process. It is important to identify any other constraints that will affect the design (i.e. utilities, right-of-way occupants, physical terrain, adjacent grades, access). In existing areas, an initial cross section of the desirable street side and intersection elements is prepared and compared with the available right-of-way. If the total width of the desirable design elements exceeds the right-of-way, determine the feasibility of acquiring the necessary right-of-way or eliminating or reducing non-vital elements.

2. Design the Street Side Zone elements.

First identify and select the design controls appropriate for the thoroughfare type and context zone. These controls include target speed (affects sight distance and alignment), control/design vehicle (affects lane width and intersection design), and modal requirements, such as level of pedestrian activity, parking, bike routes, primary freight routes, and/or transit corridor. A trade-offs evaluation may be necessary if right-of-way is constrained. The design controls and context, along with the available right-of-way, assist in the selection of the appropriate dimensions for each design element.

3. Design the Pedestrian Zone elements.

The design of pedestrian elements requires understanding the characteristics and activity of the adjacent existing or future context. For example, does (or will) the context include ground floor retail or restaurants, requiring a wider frontage zone to accommodate street cafes? Does (or will) the thoroughfare include a transit corridor, requiring a wider furnishings zone to accommodate waiting areas and shelters? This manual provides general guidance on the optimal and constrained streetside width used initially, but the actual design may require more analysis of existing and future activity levels.

4. Assemble the thoroughfare components.

This process entails identifying trade-offs to accommodate the streetside and traveled way elements within the right-of-way. This is an iterative process, particularly in constrained rights-of-way. It is important to refer back to the Community Vision stage to understand and evaluate the trade-offs. The next section of this chapter provides an approach to design thoroughfares in constrained conditions.

TRADE-OFFS IN LIMITED RIGHT-OF WAY

The art of thoroughfare design is balancing the desired design elements of the thoroughfare with right-of-way constraints. The thoroughfare designs at the planning stage illustrate the desired elements within the cross-section, but actual conditions frequently limit the width of the street. Designing thoroughfares in constrained right-of-way requires prioritizing the design elements and emphasizing the higher-priority elements in constrained conditions. Higher-priority design elements are those that help the thoroughfare meet the vision and context sensitive objectives of the community (the objectives established through the planning process). Lower-priority elements have less influence on achieving the objectives and can be relinquished in cases of constraints. Further analysis may be needed to help weigh the priority of design elements. The next chapter suggests a Multimodal Level of Service (MMLOS) analysis for the City of Tulsa.

When the width of the right-of-way varies, or is constrained, it is useful to prioritize design elements and develop a series of cross-section options accommodating all or many of the higher-priority elements that are appropriate for the corresponding street context. A top priority cross-section would contain all essential and desired design elements. However, in Tulsa, an ideal cross-section may be difficult to achieve because there is limited right-of-way on nearly all city streets. Accommodating adjacent grades/terrain, utilities, water, sewer, stormwater, and other improvements within the right-of-way has historically presented challenges in some parts of Tulsa. In these cases, preferred cross-section options would contain as many essential and desired elements as possible.

3.2.3 PERFORMANCE MEASURES

Performance measures will help the design team evaluate the alternatives and project the effectiveness of the design elements in achieving the preferred results. The performance measures should be linked to the goals of the project that were established during the Project Initiation. Traditionally vehicular level of service, a measure of traffic congestion, has been used for transportation planning for widening projects. However, Complete Streets project evaluation requires addressing how an alternative will serve all users. Measures that can be used to evaluate alternatives and project performance include multimodal level of service analysis (See Chapter 4), economic impacts, and environmental impacts.

3.2.4 SELECT PREFERRED ALTERNATIVE

Based on an evaluation of the projected performance measures and preliminary cost projections a selected preferred alternative can proceed to the Final Design stage if it is consistent with the INCOG or the Comprehensive Plan vision and does not have any additional requirements from federal funding inputs. The selected alternative may be presented to the project team for final review. If a desired alternative does not match the Comprehensive Plan and MSHP or has federal funding, a conceptual design should proceed to a concept public meeting for further review.

3.3 FINAL DESIGN

The final design process should take into account specific construction needs and phasing for the corridor, minimizing the disruption of adjacent businesses and residents while maintaining a safe construction zone for the traveling public. Certain times of the year may prove better for construction than others for a portion of the corridor. Identify those construction seasons early in the design process to set expectations and define alternatives. The project team should refer to the design checklists provided by City Staff.

3.4 IMPLEMENTATION

Well–functioning, high–quality streets are not just a product of their planning and design. The way a street is operated and maintained once built is just as important as its design. The implementation of the project should include the project team.

3.4.1 BIDDING, CONSTRUCTION AND INSPECTION

Once the contractor is selected, a pre-construction meeting is an important element. During the pre-construction meeting the design elements of the project should be clarified to the contractor. Having trained inspectors available on site is critical for a Complete Street project to answer questions of the public and contractor.

3.4.2 PERFORMANCE MEASURES

Collecting "after" data is often overlooked, but can be an important element in validating the Complete Streets program and confirming that the anticipated benefits were obtained (see Section 3.2.3). Some of the performance measures can be determined immediately such as the projected costs versus actual costs or actual experience level of service. However, other performance measure can take years to determine. The economic impacts of a complete street projects need to be measured over a much longer period of time.

3.4.3 OPERATIONS AND MAINTENANCE

Once the project is constructed it is only the beginning of the facilities life. Curbside regulations and traffic controls (i.e., signs, signals, and markings) are a central factor in determining how streets operate and the quality of the street design. For example, access to a street can be limited to pedestrian traffic on certain days or for certain hours, and vehicular traffic can be limited to transit and/or commercial vehicles at certain special events (i.e. license agreements, permits).

Maintenance of street materials, furnishings, and plantings is critical to the long–term success of street designs. The following elements should be considered as part of street maintenance and construction:

- Speed limit
- Traffic controls
- One–way or two–way operation
- Part–time or full–time access
- Access controls
- Regulation of curbside activity (parking, truck loading, curbside trash collection)
- Maintenance/cleaning
- Public space programming
- Short–term operational improvements
- Enforcement

4 MULTIMODAL LEVEL OF SERVICE ANALYSIS (MMLOS)

MMLOS is a method for assessing how well an urban street serves the needs of all users — auto drivers, transit passengers, bicycle riders, and pedestrians. The MMLOS analysis methodology most commonly used is based on research sponsored by the Transportation Research Board, through NCHRP Project 3-70: *Multimodal Level of Service Analysis for Urban Streets*.

4.1 MMLOS ANALYSIS METHODOLOGIES

The NCHRP Project 3-70 method evaluates the MMLOS provided by different urban street designs, controls, and operations. The MMLOS method is designed for evaluating complete streets, context-sensitive design alternatives, and smart growth from the perspective of all users of the street. MMLOS uses quality of service as an indicator of the traveling public's perceived degree of satisfaction with the traveling experience provided by the urban street under prevailing demand and operating conditions.

The result is a perceived MMLOS for each of the four users (auto, transit, bicycle, and pedestrian). The MMLOS analyses are generally considered to be the combination of the perceived service of three travel movements:

- Travel along the street segment between two signalized intersections
- Travel through the downstream intersection of that segment
- Travel crossing the street

4.2 MMLOS MEASURES OF EFFECTIVENESS

MMLOS is described in terms of the following measure of effectiveness for each of the four modes.

AUTO

Auto MMLOS is a function of average vehicle speeds on the roadway. The more stops per mile and higher volumes on the roadway, the poorer the LOS. A higher percentage of intersections having exclusive left-turn lanes will result in a better perceived MMLOS for autos.

TRANSIT

Transit MMLOS is a function of pedestrian accessibility, bus stop amenities, the waiting time for the bus, and the average bus speed. Better pedestrian access, enhanced shelters, more frequent and reliable bus service, and high-speed bus service all improve the perceived MMLOS for bus transit.

BICYCLE

Bicycle MMLOS is a function of the perceived separation between auto traffic and the bicyclist, parked vehicle interference, and the quality of the pavement. Higher vehicle volumes, higher percentage of heavy vehicles, and higher vehicle speeds decrease the perceived separation. A striped bike lane increases the perceived separation. Roadway hazards (such as mid-block driveways and pedestrian conflict points) reduce the perceived MMLOS for bicycles.

PEDESTRIAN

Pedestrian MMLOS is determined by the perceived separation between pedestrians and vehicular traffic. Higher traffic speeds and higher traffic volumes reduce the perceived separation. Physical barriers and parked cars between the traffic and pedestrians increase the perceived separation. Wider sidewalks also increase the perceived separation and alleviate pedestrian density issues increasing MMLOS for pedestrians.

4.3 MMLOS PRIORITIZATION OF MODES BY STREET TYPE

Figure 4.3.1 below can serve as a guide to assist the designer in making mode decisions relative to facility type. As the MMLOS analysis results are discussed, the importance of modes upon each facility can vary thereby influencing decisions relative to available ROW and funding. The table shows modes in four model priorities: Dominant-highest priority, Accommodate-Second priority, Incidental-not a priority, and Prohibit.

● Dominant
◐ Accommodate
○ Incidental
X Prohibit

Street Types	Transit	Bicycles	Pedestrians	Trucks	Automobiles
Freeway	◐	X	X	●	●
Parkway	◐	◐	◐	●	●
Special Trafficway	◐	X	◐	●	●
Primary Arterial	◐	◐	◐	◐	●
Primary Arterial-Multi-Modal Street	●	●	●	◐	◐
Secondary Arterial	◐	◐	◐	◐	◐
Secondary Arterial-Main Street	○	◐	●	◐	◐
Secondary Arterial-Multi-Modal Street	●	●	●	◐	◐
Secondary Arterial-Commuter Street	◐	◐	◐	◐	●
Urban Arterial	●	●	◐	◐	●
Urban Arterial-Main Street	○	◐	●	◐	◐
Urban Arterial-Multi-Modal Street	●	●	●	◐	◐
Commercial/CBD/Industrial Collector	◐	◐	◐	●	●
Residential Collector	○	◐	◐	◐	◐
Residential Collector-Main Street	○	◐	◐	◐	◐

Figure 4.3.1 MMLOS Prioritization of Modes

4.4 MMLOS DEFINITIONS AND CHARACTERISTICS BY TRAVEL MODE

The facility design, operation, and travel demand characteristics of a street are used to compute MMLOS service scores for each travel mode. These service scores can be translated into mode specific MMLOS A through F, with MMLOS A being the best and MMLOS F the worst. Refer to the Figure 4.4.1 below.

For specific measures of effectiveness and analysis techniques refer to NCHRP Project 3-70: *Multimodal Level of Service Analysis for Urban Streets.*

Figure 4.4.1 Understanding MMLOS (Levels of Service)

LOS	AUTO	TRANSIT	BICYCLE	PEDESTRIAN
A	Traffic flows at or above the posted speed limit and all motorists have complete mobility between lanes	Good walk access to bus stops, frequent service, good bus stop amenities	Few driveway and cross street conflicts, good pavement condition, ample width of outside lane, including parking and bike lanes	Low traffic volumes, wide buffer separating sidewalk from traffic, numerous street trees, and high parking occupancy
B				
C				
D				
E				
F	Flow is forced; every vehicle moves in lockstep with the vehicle in front of it, with frequent drops in speed to nearly zero mph. A road for which the travel time cannot be predicted.	Poor walk access to bus stops, infrequent service, poor schedule adherence, no bus stop amenities	Poor pavement condition, narrow width of outside lane, frequent driveways, and cross streets.	High traffic volumes, limited buffer separating sidewalk from traffic, few street trees, low parking occupancy

2010 Highway Capacity Manual

4.5 MMLOS MODAL PRIORITY

Further guidance on evaluating the functionality of a mix of transportation modes is included in Figure 4.5.1. Acceptable and desirable levels of service are presented for each type of roadway classification in the MSHP. These performance measures should be used to determine reasonable accommodation for each travel mode. Modal performance of existing and planned roadway sections should be evaluated and compared against these pre-defined performance measures to determine effectiveness of improvements. These pre-defined levels of service are preliminary in nature and will require additional research to be as accurate as possible for each transportation mode and road class.

The pedestrian, bicycle and transit LOS ratings are similar to automobile ratings, in that C and D describe generally acceptable roadway performance. Ratings of A and B would be near perfect conditions, and ratings at or near F are deficient facilities. Higher ratings are included as "desirable" levels of service, but not all roadways in Tulsa should expect to rate at a LOS of A or B. Ratings of C, D, and sometimes E, are considered acceptable in most urban settings. Higher LOS ratings would be desirable in locations with high multimodal activity, such as streets in downtown or other mixed-use activity centers.

Complete Streets Modal Priority

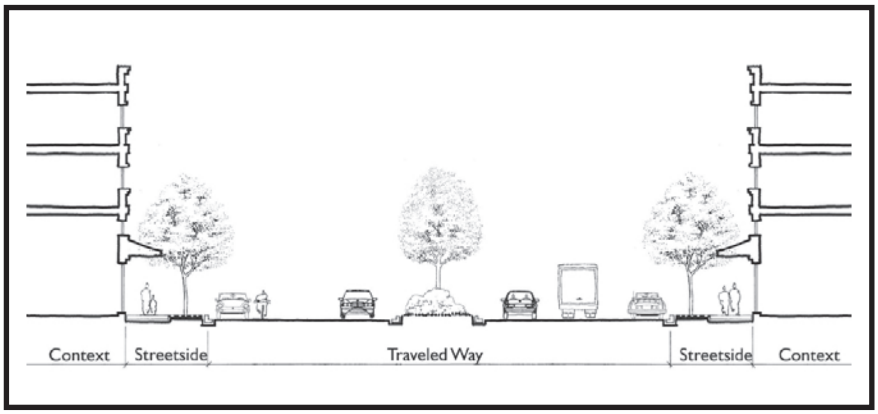
TMA MSHP ROADWAY CLASSIFICATION	ACCEPTABLE LEVEL OF SERVICE (*)				DESIRABLE LEVEL OF SERVICE (*)			
	Automobile	Pedestrian	Bicycle	Transit	Automobile	Pedestrian	Bicycle	Transit
Freeway	D	N/A	N/A	D	B	N/A	N/A	B
Parkway	D	C	C	D	B	B	B	B
Special Trafficway	D	C	C	D	B	B	B	B
Primary Arterial	D	D	D	D	B	C	C	B
Secondary Arterial	D	C	E	D	B	B	D	B
Urban Arterial	D	C	E	D	B	B	D	B
Residential Collector	D	C	D	N/A	C	B	C	N/A
Commercial Industrial Street	D	C	D	D	C	B	C	C
Commercial/CBD/Industrial Collector	D	C	D	D	C	B	C	C
Non-Classified Streets	D	D	D	N/A	C	C	C	N/A
Secondary Arterial - Main Street	D	C	D	D	B	B	C	B
Urban Arterial – Main Street	D	C	D	D	C	B	C	B
Primary Arterial – Multi-Modal Street	D	C	D	D	B	B	C	B
Secondary Arterial – Multi-Modal Street	D	C	D	D	C	B	C	C
Urban Arterial – Multi-Modal Street	D	C	D	D	C	B	C	B
Secondary Arterial - Commuter Street	D	C	D	D	C	B	C	C

(*) Design service flow condition LOS Scores computed in accordance with appropriate 2010 Highway Capacity Manual Methodologies

Figure 4.5.1 MMLOS Modal Priority

APPENDIX A
COMPLETE STREET DESIGN ELEMENTS

The design guidance of this manual provides options for street designs in the form of "best practices" of geometric and furnishing treatments, but in most cases it does not prescribe which specific treatments must be used and in which combination. It also does not dictate which treatment should receive priority when there is a conflict between design alternatives. Rather, it gives users the flexibility to determine which overall design is most appropriate and practical in light of the goals and priorities established through the planning process and the overall guidance of the manual. Best Practices information may also be found in the *Federal Best Practices Manual*, Chapter 4 - Designing Sidewalks and Trails for Access Part II, Section 1 Sidewalk Corridors[1].

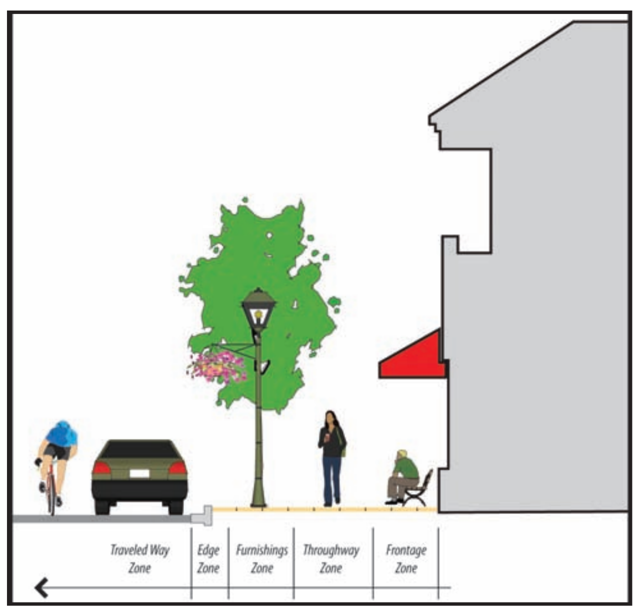


A.1 PEDESTRIAN ZONES

One element of a roadway cross section that is sometimes underdeveloped is the streetside design. The streetside is defined as the area between the termination of the curb and the property line of the bordering parcel. When looking at the cross section of a walkable community the streetside design is a critical part of design that fosters a pedestrian friendly environment. The role of a streetside is to promote pedestrian amenities that encourage growth in a walkable environment that is consistent with the context type. Not all roadways require a detailed design of the streetside. This is where the CSS approach is used to determine the needs of a corridor in regards to the streetside. The context type relates to the type of development of the bordering parcel and also the all-encompassing community influence on the area. Streetside design is interdependent with the context type of the surrounding area and other characteristics like the landscaping, streetside furnishings, and building location. When looking at both the context and the streetside design, public rights-of-way contain great opportunities for advancement in walkability, economic viability and community in key areas. This section will address the different approaches to maximize the context potential of the streetside area for pedestrians by looking at the key aspects of a streetside.

A.1.1 EDGE ZONE

The edge zone represents the area that is between the curb and the furnishing zone. If there is on-street parking, this zone either serves as an area to open vehicle doors if vehicles are parallel parked or as vehicle overhang if parking is not parallel to the curb. This area also serves as a place for parking meters and a place to access public transit. This zone is not primarily used unless for accessing a personal vehicle or public transit. The edge zone serves a purpose as a setback for the furnishing zone and also for pedestrians to transition to transit or to their motor vehicle. Transit shelters and other transit amenities should not be located within this zone.



A.1.2 FURNISHING ZONE

This area can be used for public and private features. Public features that may be used in the furnishing zone are benches, planters, drinking fountains, and trash cans. The furnishing zone is the area between the throughway and the edge zone. This zone is used for public services, landscaping, utilities, and as a buffer. Some of the many uses are listed below:

- Public Services
- Street furniture like benches
- Transit Shelters
- Vendors
- Bicycle rack
- Landscaping
- Trees
- Shrubs and planters
- Decorative artwork
- Utilities
- Fire hydrants
- Utility poles
- Sign poles
- Traffic signal cabinets
- Utility cabinets

Furnishing zone: landscaping and street furniture
Frontage zone: restaurant seating area

This zone serves a great purpose for the appeal of a thoroughfare to motorists, bicyclists, and pedestrians. It also serves as buffer for pedestrians to increase both the tangible safety and the perceived safety to pedestrians. The tangible safety may also be improved between the pedestrian and the roadway by placing objects (such as planters) to separate the two modes of travel. The perceived safety is increased because of the increased space between pedestrians and the roadway, and visual disconnect between the road and throughway by the furnishing zone. Stationary objects, such as planters and landscaping, aid the perceived safety.

With proper license agreements this area can also be used for street vendors or, in some cases, seating for a local restaurant. When done correctly and in the right context, a furnishing zone can greatly increase the lure, walkability, and safety to pedestrians along a corridor.

A.1.3 THROUGHWAY

The throughway is located between the furnishing zone and the frontage zone. This zone serves as the travel way for pedestrians. It is allocated strictly for pedestrian use and should be clear of obstructions that could impair accessibility for pedestrians. When planning for a throughway, a wider throughway encourages pedestrian traffic along a corridor. It is important to decide the needs of a throughway to properly design the width to accommodate the type of alternative mode of transportation desired.

A.1.4 FRONTAGE ZONE

The frontage zone serves as a buffer between the building front (if there is not a setback) and the walkable area (throughway) of the streetside. With proper license agreements, the frontage zone can serve as an area for storefronts to advertise on the street or an area for restaurants or other shops to utilize for seating. When properly executed, there is adequate room for shops to use the space without introducing crowding or interfering with the walkability of a thoroughfare; however, this varies dependent on location. Stationary objects also use this zone. Examples include bay windows for store fronts and overhead awnings (which do not necessary use pedestrian space but add visual appeal). If items are not placed in the frontage zone, the area can serve as an extension for the throughway and an area for window shopping for pedestrians passing by.

A.2 TRAVELED WAY ZONES

A.2.1 LANE WIDTHS

Lane width is an important aspect of design and it creates the balance between pedestrian, bicycle, and motorist friendly thoroughfares. In general, wider lanes are intended to benefit motorists due to higher vehicle speeds and wider interchanges. Wider lanes are less friendly to pedestrians for this same reason. Conversely, narrower lanes promote a lower vehicle speed and narrower crosswalks that lead to a more pedestrian friendly environment when looking at mobility and comfort on the streetside.

Lane width design is contingent on many considerations. There are fire codes that dictate the minimum width of cross sections so emergency vehicles can access the roadway in a time of need. Also, if different lane widths are to be used for multilane roads, the wider lanes should be the outer most lanes to encourage road sharing with bicycles. Lastly, it is important to use wider lanes when entering and maintaining horizontal curves, as larger vehicles (such as delivery trucks) require the extra space for off tracking.

When creating a new alignment, there are five main principles to address. These principles are:

Design Speed: The design speed helps dictate the pedestrian friendliness of a thoroughfare as well as the ease of pedestrians to cross at the intersections. In general, if the target speed is 30 mph or less, the lane widths should be between 10 and 11 feet to encourage motorists to maintain the posted speed limit by decreasing the drivers comfort with decreased lane widths, as well as decreasing pedestrian crossing widths.

Design Vehicle: For multimodal thoroughfares, transit buses usually will be the most appropriate design vehicle. Fire trucks should be accommodated on all roadways, but should not always be the design vehicle. In most cases, transit buses vehicle requires at least 11-foot lanes, with the bus lane increasing to between 13 and 15 feet near bus stops. This added curb lane width helps buses navigate bus stops as well as creating a larger buffer between the bus and through traffic. It is also a good practice to maintain wider right turn lanes near intersections so that larger vehicles are able to negotiate the turn without using a portion of the neighboring lane, which is most likely occupied by vehicles.

Right-of-Way: Lane width is a balancing act with the available right-of-way because there are many other aspects (such as utilities, pedestrian accommodations, streetscaping, land use, grades, driveways, and medians) that also need to be addressed within the right-of-way constraints.

Bicycle Lanes: The addition of a designated bike lane is the preferred method to accommodate bicycle trips on the street network, where right-of-way is available and with appropriate traffic volumes. Additional width to accommodate cyclists can affect overall lane widths as well as on-street parking. Both aspects increase the nearside lane to account for door swing and bicyclists sharing the traveled way. The minimum shared lane width is 13 feet, with a preferred width of 14 feet to allow motorists to pass cyclists without encroaching into adjacent lanes. When parked vehicles are present, 1.5 to 2 feet is added to the lane

width to accommodate for a vehicles door swing. Refer to the *AASHTO Guide for the Development of Bicycle Facilities*.

Parking Lanes. Parking lanes can affect the outside lane width, in addition to the modes of transit that can be made available on the street. If parallel parking, angled parking, and reverse angled parking are operational, their presence should dictate if cyclists, public transit, and pedestrians will be able to comfortably use neighboring space.

A.2.2 MIDBLOCK CROSSINGS

Medians create a great opportunity for pedestrian facilities. One opportunity is to create midblock pedestrian crossings. The midblock crossing serves as a delineated location for pedestrians to cross the road in areas with long blocks from crosswalk to crosswalk, or if there is a heavy pedestrian feature that needs quick access across the road. Midblock crossings are usually unsignalized, but do create a delineated feature that aids in legally crossing the road away from an intersection. There are a few design features that are important to consider (similar to intersections). Curb extensions can be designed to be used when there is on-street parking and adequate curb radii to accommodate local truck and bus turning movements. This helps to increase the visibility of the pedestrian as well as improves the line of sight for the pedestrian to aid in decision making and gap acceptance. Also, there should be a location at the median for pedestrian refuge. The pedestrian refuge does not have to be perpendicular to the roadway centerline, but skewed if possible. This helps pedestrians better identify oncoming traffic.

A.2.3 BICYCLE LANES

A bicycle lane is a portion of the roadway that has been designated by striping, signing, and/or pavement markings for the preferential use of bicyclists. The minimum width for a bicycle lane next to a parked car is 5 feet, with a recommended width of 6 feet. Six feet is preferred next to a curb, though 5 feet from the seam of the gutter pan is adequate on arterials with lower speeds and volumes. Bicycle lanes include a bicycle pavement marking with an arrow to indicate that bicyclists should ride in the same direction as adjacent motor vehicle traffic. These facilities are typically recommended for arterial roadways. These recommendations are in conformance with AASHTO's 4th Edition of the *Guide for the Development of Bicycle Facilities*.

A.2.4 SHARROW

Shared lane markings are pavement markings that are placed within the vehicular travel lane of the roadway. The bicycle symbols used in shared lane markings include two chevrons over a bicycle pointing in the direction of vehicle travel to indicate that bicyclists should also ride in this direction. Shared lane markings may be placed within the center of the travel lane, typically on roadways posted at 35 mph or below, or are not in conflict with any City ordinances and State Law. Refer to the *AASHTO Guide for the Development of Bicycle Facilities* for guidance on marking placement. Shared lane markings have the following benefits:

- Provide a visible cue to bicyclists and motorists that bicycles are expected and welcomed on the roadway;
- Can be used on roadways where dedicated bicycle lanes are not a feasible option;
- Connect gaps between other bicycle facilities, such as a narrow section of roadway between road segments with bicycle lanes; and
- Can be used on roadway segments in lieu of bicycle lanes where bicyclists may be operating at higher than normal speeds (12-14 mph) due to downhill grades adjacent to parked vehicles.

A.2.5 ON-STREET PARKING

On-street parking has many benefits and challenges that help the overall design of a thoroughfare. It provides an area for loading and unloading of cars and trucks which can stimulate sales at commercial retail locations from foot traffic due to ease of access for motorists. On-street parking increases pedestrian comfort and safety by creating a physical and visual buffer between the streetside and roadway. It also creates safer crosswalks due to side friction of on-street parking on through traffic on the roadway. Side friction is defined as all events along the road which have an impact on speed and capacity including pedestrians, bicycles and other non-motorized, slow moving vehicles, roadside parking, etc. On-street parking also improves access to streetside businesses for pedestrians with disabilities. Lastly, it can reduce the cost of development for small businesses as on-site parking needs are decreased.

On-street parking is an appropriate option for increasing walkability and access, but there are also trade-offs to using on-street parking. It decreases the available right-of-way for other facilities. This means that bicycle lanes, motorist lanes, and pedestrians accommodations may be decreased to make room for on-street parking. On-street parking is also a challenge with bicycle lanes since the bicyclists are not as visible to motorist in perpendicular and angled parking. One solution when bicycle lanes or shared lanes are present is to use parallel parking or back in parking. This decreases the blind spot between motorists and bicyclists. It uses right-of-way that could be used for widening pedestrian facilities or widening roadways. **Also, due to side friction created from on-street parking, facilities can see a decrease in capacity of up to 30%.**

On-street parking is most appropriate for low volume and low speed thoroughfares due to the potential safety risk. **It is recommended that above typical operating speeds of 30 mph, on-street parking should not be used.** At lower speeds, traffic is able to slow down and stop to provide time for cars to pull in and out of parking spots without hindering traffic. Due to the desired land uses, on-street parking should be time-based with a short time period to discourage long-term commuter parking and encourage

turnover. Parking needs should reflect surrounding land use and business types. Usually, short-term parking is desired, but not always. This strategy is designed to increase economic activity by opening up parking for customers and compelling commuters to find other options. This can be achieved using meters or signage. If an area is redeveloped with on-street parking the number of spaces should be constructed for what is planned, not what is existing at the location. Parking is most appropriate near ground floor commercial uses. Specific dimensions and economic benefits of on street parking can be found in the *ITE Context Sensitive Solutions in Designing Major Urban Thoroughfares for Walkable Communities.*

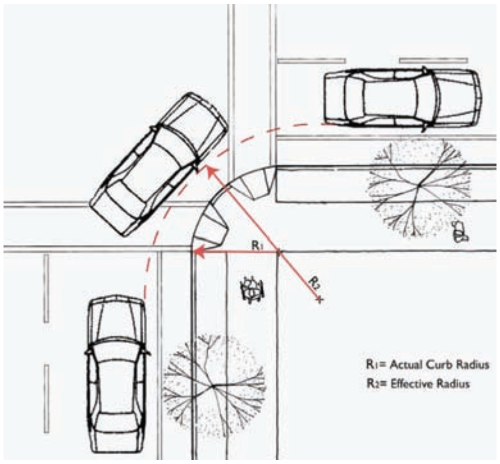
A.2.6 MAINTENANCE

Pavement markings in the traveled way for the designation of bikeways, shared use paths, and on-street parking deteriorate over time, and lanes can accumulate debris. These facilities need periodic maintenance so that they do not become unsafe for regular use. A good roadway maintenance program preserves the investment in striping and pavement markings – and ensures the continued safety of all roadway users. These on-going maintenance costs should be considered and budgeted during the design process.

A.3 INTERSECTIONS

A.3.1 CURB RETURNS

The curb radii are used as a barrier between pedestrians and motorist at intersections. The curb return radius plays a large role in the length of a crosswalk leading to the overall walkability of an intersection. A curb return radius is based on the turning radius of the assumed design vehicle for the facility (R2). The diagram to the right also shows the actual radius (R1). In general, the larger the curb return radii ,the longer the crosswalks are for pedestrians. A larger curb return creates a more motorist friendly environment with higher turning speeds and ease of use that can accommodate larger design vehicles. The curb radius is a trade-off between motorist functionality and walkability at an intersection. Each intersection design needs to be evaluated for appropriate radii.



Curb Return Diagram

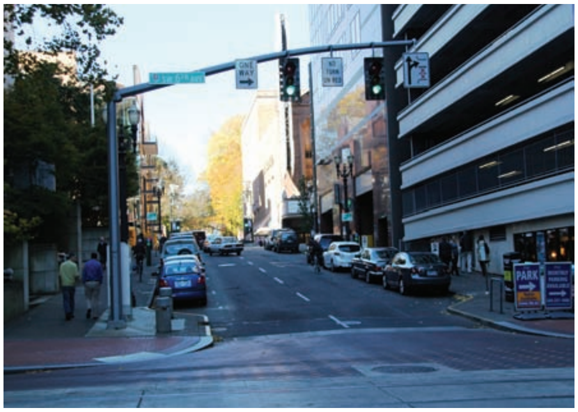
To create a more multimodal thoroughfare in urban areas, it is encouraged to decrease the curb return radii at intersections that currently do not see heavy truck and public transit traffic. Using a smaller radius creates shorter crosswalk lengths, improved visibility between motorists and pedestrians, decreased severity of crashes, and a more accessible route for disabled persons. Specific dimensions can be found in the *ITE Context Sensitive Solutions in Designing Major Urban Thoroughfares for Walkable Communities.*

A.3.2 CURB EXTENSIONS (BULB-OUTS)

Curb extensions serve to decrease the curb-to-curb width at intersections and mid-block locations to increase pedestrian safety. Some advantages of curb extensions are as follows:

- Decreasing motorist speeds due to the narrowing of the road;
- Encouraging pedestrians to use the crosswalks;
- Improving visibility between motorists and pedestrians;
- Keep vehicles from parking too close to the intersection; and
- Separating the merging of parked vehicles from the intersection turning movements; and creating larger landings to accommodate more pedestrians.

The most appropriate location for curb extensions are in high pedestrian urban areas that have design and operational speeds less than 30 mph. Curb extensions should also be used in accordance with on-street parking (especially diagonal) and cannot be used with an exclusive right-turn lane. In areas with bicycle lanes, the curb extensions should not extend past the width of the bicycle lane. These can also be used at midblock pedestrian crossings. Curb extensions are successful at this in both intersection and mid block applications.



Bulb-Out Example

The curb radius at an intersection is recommended to maintain a minimum of 15 feet throughout the curb extension so street cleaners can properly access the facility. The extensions normally extend 6 to 8 feet into the intersection for parallel parking, which effectively discontinues the parking lane near the intersection. In the case of diagonal and perpendicular parking, the extensions should extend into the roadway within a 1 foot tolerance of the stall dimensions. Drainage is also an important issue to ensure that ponding does not occur near the curb extension. This concept is especially important in retrofit applications as the designed flow path of water is usually along the outer curb.

APPENDIX B
SAMPLE CORRIDOR APPLICATION - LEWIS AVENUE COMPLETE STREET

OVERVIEW OF WORKSHOP JULY 21, 2011

Our Vision for Tulsa and the Comprehensive Plan maps out how the City of Tulsa will look, function, and feel over the next quarter century. The policies in this Guiding Vision and Comprehensive Plan are the starting point for creating the kinds of places, economy, housing and transportation choices, parks, and open spaces that thousands of Tulsa's citizens have worked for over multiple years. To get started on making the changes that will eventually achieve the vision, the Tulsa Strategic Plan lays out the first steps to take.

The Context Sensitive Solutions (CSS) process is one of the first steps in the plan's Transportation Strategy, a process of designing streets jointly developed between the Engineering Services Department and the Planning and Economic Development Department, in coordination with INCOG. This collaborative process established an approach that merges the City's project development process with its neighborhood planning process as specified in Tulsa's adopted policies. The ensuing result was not intended to impose wholesale change, rather it is intended to complement and enhance current project development and neighborhood planning processes.

Key staff members in Engineering Services and in Planning and Economic Development are responsible for implementing the policies, plans and vision of the updated Comprehensive Plan. They have joined together to formulate the joint process that is essential in advancing interdepartmental and stakeholder communication, collaboration, and consensus building. Equally important was ensuring that their concerns were addressed in the workshop and that the merged process reflects the responsibilities and priorities of all in attendance. The Context Sensitive Solutions Workshop was led by engineering and planning consultants with expertise in integrating Context Sensitive Solutions into project development and neighborhood planning. The role of the consultant in this project was to describe a framework for merging Tulsa's engineering and planning processes and facilitating a street design demonstration exercise as a tool for developing and assessing the merged process.

Photo of the Lewis Ave. Workshop

STEP 1: IDENTIFY CORRIDOR VISION AND DETERMINE STUDY AREA

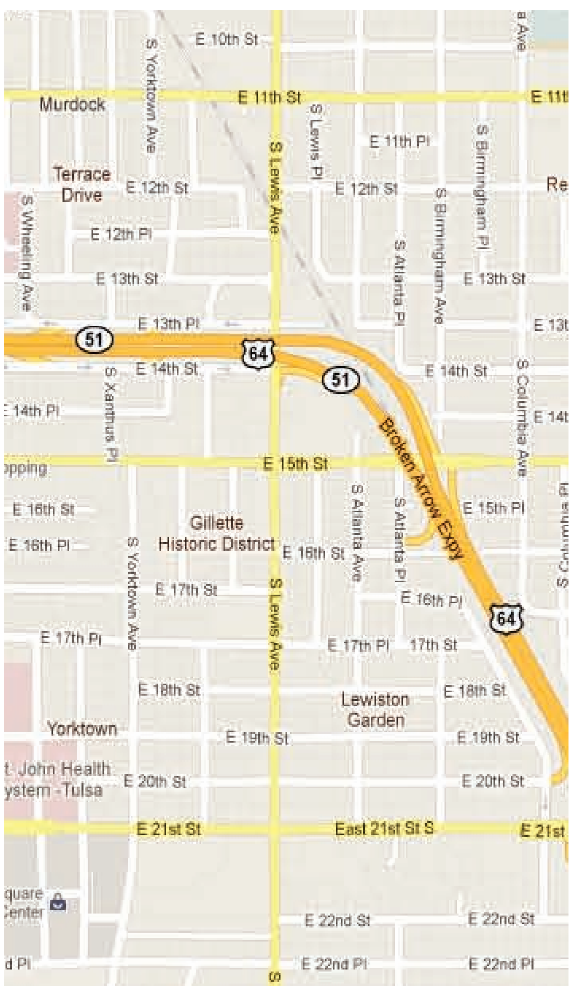
The corridor chosen for the workshop was Lewis Avenue from 11th Street to 21st Street. During the first breakout session participants were asked to brainstorm goals and objectives of this study area to arrive at an overall corridor vision.

STEP 2: DETERMINE AREA CONTEXT AND NEEDS

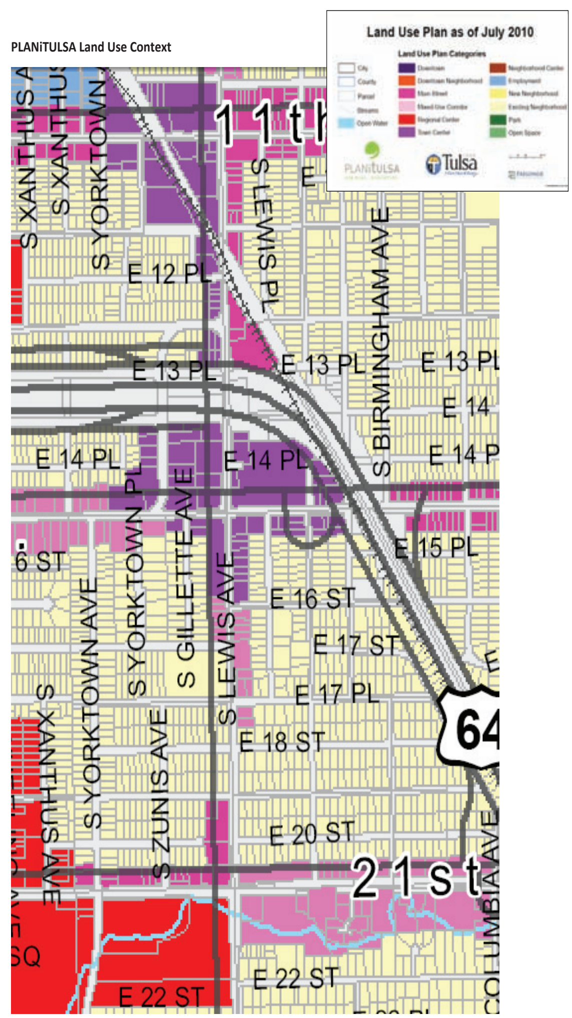
Our Vision for Tulsa from the Comprehensive Plan Update describes this area as both Main Street and Town Center contexts. Main streets serve the highest intensity retail and mixed land uses in Tulsa's areas such as downtown and in regional and neighborhood centers. While Town Centers also serve a mix of uses they are generally more focused on commercial uses with a healthy mix of urban style residential.

Since the construction of the Broken Arrow Expressway, Lewis Avenue functions as a main artery feeding traffic to and from that highway. In the recent past, this corridor has taken-on typical strip commercial development patterns of development that emphasize automobile over pedestrian access, lot parking over on-street, and front doors directed towards parking lots instead of sidewalks.

The vision of creating a Main Street and Town Center corridor improves the overall safety of the corridor while at the same time creating an environment that is pleasing to pedestrians.



Lewis Ave Area Map



Land Use Context

STEP 3: ALTERNATIVES DEVELOPMENT

During the workshop participants created mock-up corridor maps with various ideas and alternatives. Ideas such as widening the street, reducing lanes and lane widths, adding bike lanes and additional parking were discussed. In the end, participants marked up aerial photos with their preferred alternative. Cross sections were also sketched out using pre-prepared cross section grid paper that was to scale.

STEP 4: ALTERNATIVES EVALUATION

The refinement of the alternatives developed during the workshop was brief, but the discussion lead the team to several refinements. First, the traffic volumes were at a range between 10,000 and 18,000 ADT. The areas transitioning to and from US 64 (Broken Arrow Expressway) were generally in the 18,000 VPD range and required the group to realize that maintaining the current lane configuration was important. However, north of the Broken Arrow Expressways and south of 15th Street allowed for the ability to convert the 4-lane undivided areas into 3-lane sections. The primary reason this works for these areas is the addition of a center turn lane and wider outside lanes improve the safety of the road segment. If bus operations becomes an issue, the use of bus pullout lanes should be explored.

STEP 5: SELECTION OF A 'PREFERRED ALTERNATIVE'

The preferred alternative as a result of the mock workshop is illustrated on the following page.

LEWIS AVENUE WORKSHOP OUTCOMES

The following is a summary of the workshop vision, goals, and objectives and priority components:

VISION/GOALS/OBJECTIVES

- Meet multimodal needs
- Improved safety
- Phasing of improvements
- Facilitate redevelopment
- Walkability
- Connectivity
- Aesthetics

PRIORITY COMPONENTS

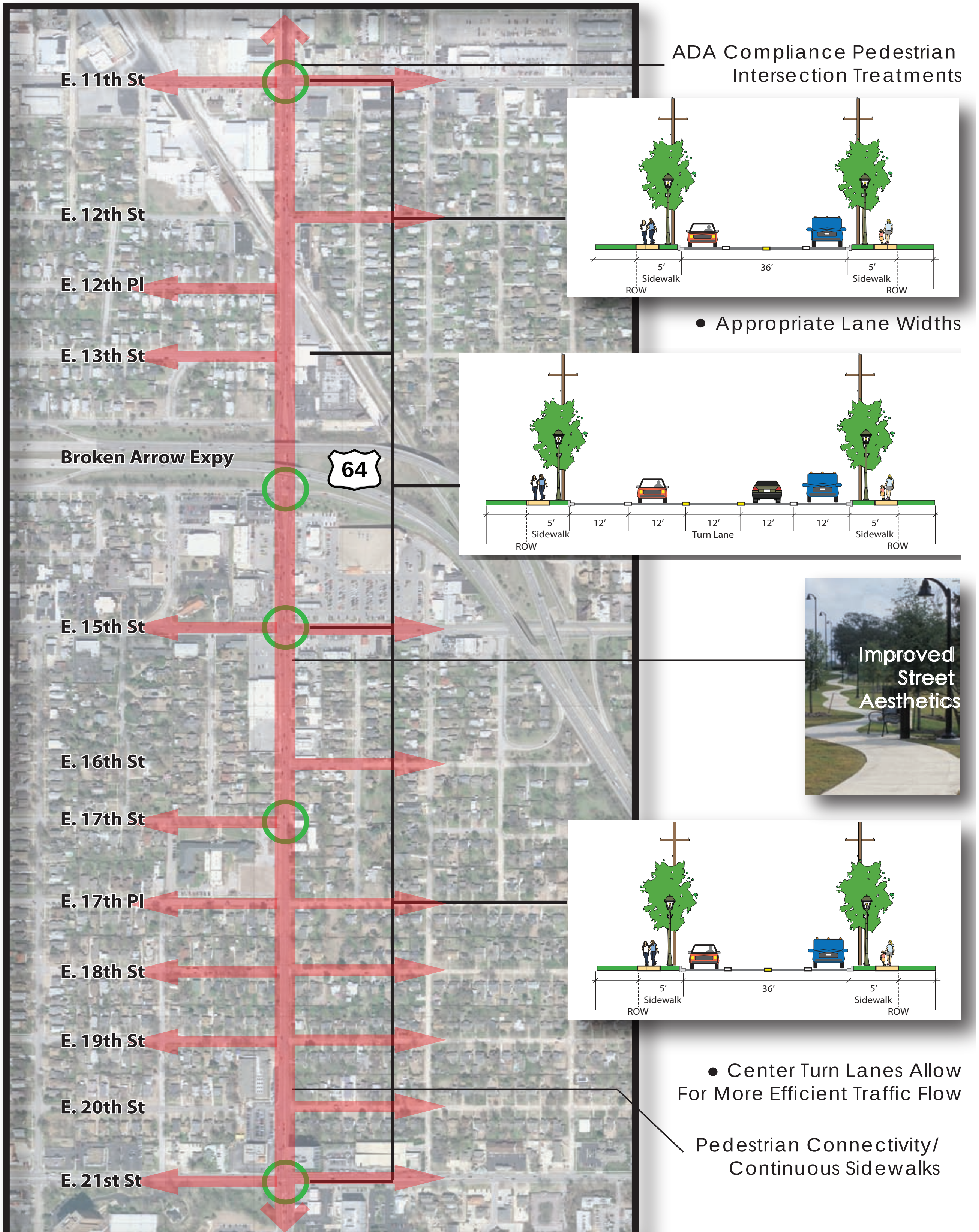
- Appropriate lane widths
- Improved sidewalks
- Turn lanes
- ADA accessible
- Consistent speed
- Preserve capacity

LESSONS LEARNED

The Lewis Avenue workshop was created as an internal exercise only (sample corridor application). A full public and stakeholder process needs to be conducted as part of a detailed CSS design process (See Section 3). It should be noted that the results of the Lewis Avenue workshop are not binding upon the final design of Lewis Avenue. This project is a voter approved street rehabilitation project. Funding was not defined for implementation of an ultimate, Complete Streets solution.

Lessons learned through this process warrant additional public review, AASHTO Analysis, and acknowledgment of the limited right-of-way along the Lewis Avenue corridor. Also, consideration of the limited budget constraints, utility conflicts, driveways, drainage, storm water system conflicts, and overall pavement condition.

It was extremely beneficial to have most of the City departments present during this time. However, a multi day workshop would have allowed for more review time and an additional feedback loop to occur to get full agreement on the preferred alternative. It may also be beneficial to have a Complete Streets Design Manual or defined elements in the City Standards and Specifications to reference minimum design criteria for all the necessary design components.


E. 11th St
E. 12th St
E. 12th Pl
E. 13th St
Broken Arrow Expy
64
E. 15th St
E. 16th St
E. 17th St
E. 17th Pl
E. 18th St
E. 19th St
E. 20th St
E. 21st St
ADA Compliance Pedestrian Intersection Treatments
5' Sidewalk
36'
5' Sidewalk
ROW
ROW
• Appropriate Lane Widths
5' Sidewalk
12'
12'
12' Turn Lane
12'
12'
5' Sidewalk
ROW
ROW
Improved Street Aesthetics
5' Sidewalk
36'
5' Sidewalk
ROW
ROW
• Center Turn Lanes Allow For More Efficient Traffic Flow
Pedestrian Connectivity/ Continuous Sidewalks

APPENDIX C
BIKE LANES ON 4TH PLACE

BIKE LANES ON 4TH PLACE: SUCCESSFUL COMMUNITY ENGAGEMENT

FOURTH PLACE

4th Place between Yale and Sheridan is designated a residential collector. At one point in Tulsa's history, it was contemplated that it might be needed as an arterial street, and was designed accordingly. But over time, conditions changed. Foremost was the introduction of the Crosstown Expressway (I-244) roughly 3/8th of a mile to the north, which quickly began to carry most of this corridor's through traffic.

Tulsa traffic engineers were the first to observe that there really was no need for this street to remain striped as a four lane arterial: traffic volumes were very low. They further noted that this was designated as an on-street bikeway. When an existing plan to recondition this street first crossed their desks, they saw an opportunity to reinvent this street.

The existing plan proposed to rebuild the street with concrete and introduce a sidewalk on the north side of the street. The north side of the street featured shallower lots and dramatic grade changes. It was determined that sidewalks on this side of the street were not feasible in this round of investment.

Traffic engineers reviewed this plan, which was scheduled to be built in just a few months, with an eye towards adaptation. Several features were locked in by the budget: a second sidewalk was infeasible, the curb-to-curb width couldn't be altered, and other features like center islands were simply out of reach. But restriping was certainly possible.

OPTIONS

Designing the street two 20-foot lanes was found to be problematic. While traffic speeds were generally low, traffic engineers postulated that this condition might be partly attributable to the 10-foot lanes, which were narrower than those on most arterial streets. Other contributing factors could include the fact that this street did not connect major traffic generators and had a railroad crossing in the center of the mile, though the tracks were being removed. They worried that going with two lanes could induce higher traffic speeds, perhaps exacerbated by the removal of the tracks. They resolved to attempt to utilize the extra curb width. Dedicated bike lanes would help, but that would still leave two fifteen-foot driving lanes. They then sketched options, one contained a center turn lane, and another had on-street parking on one side of the street.

FIRST THINGS FIRST

As an imminent construction project, any changes to the street configuration would first need to be understood and embraced by Engineering Services, which had the task of ensuring that the project would be built on budget. Changes to the bid specifications would need to flow through them. Traffic partnered with Engineering Services to run this as a demonstration project, with an understanding that changes should be cost-neutral. Engineering Services did, however, express a desire to ensure that joints between concrete slabs match up with the lane configuration, due to visibility during rain events and degradation of striping over time. Therefore, this was not just a simple (and reversible) re-striping project.

Traffic operations also recognized that changes would require a new public engagement campaign with the White City and Glenview neighborhoods that abut 4th Place. Engineering Services had already vetted the four-lane proposal at a public meeting. They then asked a city planner to assist in a context-sensitive design discussion with residents from White City and Glenview. Finally, Traffic contacted the White City Neighborhood Association President and asked if they would be willing to collaborate on some "bike-lane" options. They were very receptive.

PRE-ENGAGEMENT

A small working group was formed that included engineers from Engineering Services , Traffic Engineering, and a city planner from the Planning Department. Though it was understood that each group had an individual role in the implementation, this group discovered real value crossing over, offering up ideas, and working as a team of peers.

Due to time constraints, the group decided they would attempt to engage the public in one sitting. Further, because of budget constraints, the group decided that different on-budget designs should be offered in a menu format. Some "a la carte" mixing and matching of ideas would be allowed, but only to a point. They decided not to reject a single idea from the public, even if it was off-budget. Instead, if the public settled on a new, expensive, but otherwise safe idea, they would simply offer to put that item back on the CIP for future consideration.

To get to a resolution in a single meeting, the city planner offered to take citizens through a consensus building exercise in steps:

- *Active Listening* – Begin by getting the public to share their knowledge of the street: how it functions; what they like and don't like about it. The planner would take thorough notes (never leaving anyone out, no filtering, and no undue commentary) on a large flip chart and pin each sheet of notes on the walls around the room. The planner would close this portion of the meeting by asking people to continually review these notes as they think about the options, explaining that it's not just one's own opinion that matters, but the thoughts and issues of neighbors are important too. There will be some conflicting ideas, but together, we can work through them.
- *Unveil the Options* – The group settled on three options: the original four-lane, a three-lane with bike lanes, and a two-lane with bike lanes and parking on one side of the street. If the public decided to start mixing and matching, one traffic engineer was nominated to do some real-time sketches on the flip charts.
- *Build Consensus* – After review and discussion, citizens would be asked to express their preference for an option. The group or groups of citizens in the minority would be asked to restate their reasons and introduce new arguments. Then there would be another round. This process would continue for as many rounds as necessary, but the city planner assured the working group that it would not take more than two or three rounds to arrive at a consensus.
- *Next Steps* – Explain where this new shared idea was heading. In this case, traffic engineers would need to apply the preferred cross-sections to the street and would need to retain some design flexibility for safety reasons.

The group decided that any attendee could participate, but that it was also important to send an invitation to every property owner that abutted the street. Notices were mailed to abutting property owners and a formal email invitation went to the White City Neighborhood Association president for distribution.

THE BIG EVENT

Over forty citizens attended the meeting, almost all from the immediate vicinity. Most were retirees, but some families attended. The Active Listening portion of the meeting went smoothly; comments were varied, sometimes conflicting, but generally on-topic:

- Very busy on Lakewood near the public elementary (before and after school)
- Bank on Admiral Place generates traffic
- Kids drive TOO FAST!!!
- They speed because it's a straight shot through the neighborhood, no breaks (except the tracks)
- Dangerous for kids to play in front yards
- Stray dogs are constantly running on this street
- Very poorly lit at night
- Not enough streetsweeping…bad for bikes
- Never any policemen keeping speeders in check
- No school crossings, especially at Lakewood
- Needs stop signs to slow traffic (At this point, a traffic engineer did need to intervene to explain that stop signs must be warranted, or else there is a risk that they can cause more harm than good. Some were surprised to hear this, but the engineer was polite and diplomatic and most people took him at his word.)
- Need bike lanes
- Don't need lanes, retain as shared route
- No parking should be allowed, rear-ended on this street two times (a traffic engineer asked if this perhaps might be because the street is striped like an arterial, and it's uncommon to see cars parking in what most would perceive to be a four-lane)
- Need a flashing sign (traffic engineer pointed out that their experience with these features has been largely unsuccessful, resulting in only a temporary reduction in speed)
- Need to lower the 35 mph limit

The options were unveiled and studied. The engineer from Engineering Services explained some of the details of the construction, and was also able to answer some incidental questions about other projects like waterline relocation, removal of the tracks, and a larger effort to introduce sidewalks in the area.

Soon the group began talking about their preferences, starting the consensus building process. Fairly quickly, most in the room stated a preference for dedicated bike lines, but there was a genuine difference of opinion over the three-lane option versus the two-lane with on-street parking on one side. In the first consensus call, 20 people stated a preference for the two-lane/parking option and 13 people liked the three-lane. The minority was offered a chance to restate and introduce new ideas. At the second consensus call the count was 30-3 in favor of the two-lane/parking option. People rose to leave, a strong indication that the citizens felt they had reached an acceptable level of consensus. The working group congratulated them on their work, there was applause, and participants parted on good terms.

DEBRIEF

The event and outcome were an overwhelming success. There was indication that this process could and should be applied to future projects. Undoubtedly, the most difficult role at the meeting was that of the traffic engineers, who had the difficult challenge of sharing a vast knowledge of safety and best practices while trying not to hurt anyone's feelings. Overall, this first official CSS effort can be deemed a success at every level.