CITY OF SAN MARCOS

Transportation Design Criteria Manual

Engineering and Capital Improvements Department

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INTRODUCTION

The purpose of this Manual is to provide minimum guidelines for the design and construction of transportation infrastructure within the City of San Marcos, Texas and its extraterritorial jurisdictions (ETJ) using the complete street and context sensitive solution approach. The goal is to create safer, more livable places that are consistent with their social, environmental, and economic values.

Complete streets are transportation facilities that are planned, designed, operated, and maintained to provide safe mobility for all users, including bicyclists, pedestrians, transit vehicles, truckers, and motorist, appropriate to the function and context of the facility. Context sensitive solutions formulate a complete street design considering contextual applications. Contextual applications can be of geographical nature such as Urban Core, General Urban, Suburban, University Core, and other typical service areas that require unique components to address the overall transportation facilities.

The criteria established in this Manual have been developed from a review of various TxDOT and American Association of State Highway and Transportation Officials (AASHTO) publications, City of San Marcos Transportation Master Plan, other City Transportation Manuals from various cities in the surrounding area, regulatory requirements, and City of San Marcos offices which oversee the design, construction, and maintenance of public transportation infrastructure.

This Manual is not intended to be a complete design criterial for all circumstances and conditions. Other design criteria may be warranted from applicable resources. The Federal Government, the State of Texas, National Association of City Transportation Officials (NACTO), Hays County, Federal Highway Administration (FHWA) and other related organizations and resources shall be consulted for additional criteria as may be deemed necessary.

This Manual is to be used by the City in the design of Capital Improvement Projects, consulting engineers employed by the City and engineers of subdivisions and land development infrastructure projects proposed for construction and acceptance by the City within the City. The criteria established in this Design Manual provides basic guidance. However, full responsibility and liability for proper design remains with the design engineer. Users of this Manual should be knowledgeable and experienced in the theory and application of transportation engineering. The Director of Engineering or their designee or their designated representative must approve any deviation from criteria established in this Manual.

Along with this Design Manual, the City of San Marcos Land Development Code shall be consulted for additional guidance. The criteria established in this Manual do not supersede the requirements contained in City of San Marcos Land Development Code. Any revision to the City of San Marcos Land Development Code supersedes the criteria in this Manual.

This manual will serve as an introductory section to describe some general concepts that are important when developing projects in the City of San Marcos.

0 DESIGN CRITERIA GENERAL GUIDELINES

0.1 REFERENCE STANDARDS

The most current version of the references provided in Bibliography may be used along with engineering judgment to justify waivers from the criteria outlined below in support of the Vision and Goals of the

City's Comprehensive Plan, Transportation Master Plan and the Transportation Criteria Manual. Inconsistencies between references shall be resolved by the Director of Engineering or their designee.

0.2 SPECIFIC DESIGN CRITERIA

Transportation projects shall be developed in accordance with the design criteria in the Transportation Criteria Manual, the references listed in APPENDIX I, City Ordinances, and accepted industry practice. Future maintenance and operational concerns shall also be considered.

The following Manuals are to be included and referenced during project development within the City of San Marcos. The Design Criteria, Specifications, and Construction Details shall govern the design and construction of all projects within the City. Where there is any conflict between any of the criteria in the Manuals listed below and other criteria contained herein, whichever imposes the more stringent shall control;

- Transportation Design Criteria Manual
- Stormwater Design Criteria Manual
- Utilities Design Manuals
- City of San Macros & TxDOT Design Details, Specifications and Standard Product List

The following planning documents shall be used in conjunction with the reference documents to develop projects in the City:

- Land Development Code
- Transportation Master Plan
- Transit Plan
- Other Master Plans Relevant to the Project
- TxDOT's Access Management Plan for State Highways

Refer to the City's website or appropriate City Department for the current version of these plans. Also, refer to the Bibliography of the Transportation Criteria Manual for further information.

0.3 DESIGN EXCEPTIONS AND DESIGN WAIVERS

Once the appropriate functional classification and design criteria have been established for a transportation project, it is important to maintain consistent criteria throughout the project limits. The design of transportation projects shall conform to the approved design criteria for the appropriate roadway classification, whenever possible; however, in some situations, achieving conformance with all design criteria is not practical or reasonable.

When certain design criteria cannot be achieved, a design exception or waiver request is used to evaluate, document, and approve the request.

A design exception request and approval is required whenever the criteria for certain controlling criteria specified for a project are not met. The following controlling criteria will require a design exception:

- Design Speed;
- Lane Width;
- Shoulder Width;
- Horizontal Curve Radius;

- Superelevation rate;
- Stopping Sight Distance (SSD);
- Maximum Grade;
- Cross Slope;
- Vertical Clearance; and,
- Design Loading Structural Capacity.

The stopping sight distance (SSD) applies to horizontal alignments and vertical alignments except for sag vertical curves for roadway facilities with continuous street lighting.

A design waiver request and approval is required when criteria in a non-controlling category is not met.

- Curb Parking Lane Width;
- Speed Change (refuge) Lane Width;
- Length of Speed Change Lanes;
- Curb Offset;
- Median Opening Width;
- Horizontal Clearance (clear zone);
- Railroad Overpass Geometrics; and,
- Guardrail Length (Length of Need).

0.4 DESIGN VARIANCES (ADAAG/TAS)

A design variance is required whenever the design guidelines specified in the Americans with Disabilities Act Accessibility Guidelines (ADAAG) and the Texas Accessibility Standards (TAS) are not met. Design variances should be sent to the Texas Department of Licensing and Regulation (TDLR) for approval prior to incorporating into the project design. The Project Engineer is responsible for obtaining the approval; however, granting of design variances is rare, and every effort should be made to comply with the requirements.

1 STREET DESIGN CRITERIA

1.1 GENERAL

This section provides design criteria for the various functional classifications of streets and roadways within the City. The criteria described in this section are the minimum values. The design engineer shall provide higher values where feasible. Exceptions to these criteria shall be as specifically approved by Director of Engineering or their designee.

The user should be aware of and utilize the City of San Marcos Land Development Code, Chapter 3: Articles 6, 7, and 8 in conjunction with this Manual.

One of the primary design criteria for a new facility is the target speed. The proper target speed selection is influenced by the character of terrain, the density and type of adjacent land use, the classification and function of the roadway, the traffic volumes expected to use the roadway and by economic and environmental considerations. It is important to recognize and treat individual roadways based on their specific characteristics. The target speed should be determined based on the design engineer's judgments on what design criteria are the most feasible for that particular roadway. The target speeds specified in **Table 1-1**, **Table 1-2**, **Table 1-3**, **Table 1-4**, and **Table 1-5** shall be used for each of the street classifications, unless otherwise directed by Director of Engineering or their designee.

When designing a new facility, or modifications to an existing facility, the operating speed of vehicles is assumed to be, in order of desirability, a) the 85th percentile speed, b) the posted speed limit, or c) in the case of a new facility, the target speed.

This manual is intended to provide design criteria for urban streets with a design speed of 45 mph or less. The designer shall refer to the design resources listed in the Bibliography for highways with a design speed of greater than 45 mph.

Refer to the Transportation Master Plan for designation of Highways, Boulevards, Avenues, Commercial Streets, Residential Streets, Roads and Alleys within the City limits and extraterritorial jurisdiction. Other street classifications shall be as designated through the planning process in consultation with the Engineering Department.

The design criteria for the various street classifications are summarized in **Table 1-1**, **Table 1-2**, **Table 1-3**, **Table 1-4**, and **Table 1-5** on the following pages. **Figure 1-1** through **Figure 1-32** depict the typical section for each street classification. **Figure 1-40** through **Figure 1-51** provide graphical information regarding medians, tapers and intersection sight triangles.

1.1.1 Reference Standards

The most current version of the reference documents shall be used for project development of transportation facilities. Engineering judgment shall be used to justify waivers from the design criteria; however, Design Exceptions or Waivers shall only be granted at the sole discretion of the City’s Engineering Department. Inconsistencies between references shall be resolved in consultation with the City’s Engineering Department.

1.2 STREET CLASSIFICATIONS

Street classifications are used to categorize streets according to their functions. The classification of roadways into functional classes and geometric configurations is necessary for communication among administrators, engineers, and the general public.

There are seven street classifications for urban roadways: Highways, Boulevards, Avenues, Commercial Streets, Residential Streets, Roads and Alleys. Freeway design criteria are not included in this Manual, and therefore the designer should reference the appropriate design criteria in the Texas Department of Transportation (TxDOT) Roadway Design Manual.

The functional classification for each street shall be identified in accordance with the adopted thoroughfare plan and shall be reviewed and approved by the City at the first submittal of plans.

- **Highways:** are freeways and parkways with limited access including frontage roads along IH 35, as well as parkways at the periphery of the City. Parkways have a green space buffer between the roadway and adjacent development. Parkways preserve and enhance the natural environment as much as possible. Designations include the following:
  - Four Lane Highway with Off-Street Shared Use Path (HW 158-72, HW 150-72). See **Figure 1-1**and **Figure 1-2**

- **Boulevards:** Boulevards are 2 to 6 lane streets with left turn lanes at intersections. They have raised medians, sidewalks, and protected/separated bike facilities. Boulevards are designed to carry high volumes of through traffic. Access is usually limited to intersections and major driveways. Boulevards serve as a link between major activity centers within the urban area. Designations include the following:
  - Six Lane Boulevard with Access Lane (BV 173-110). See **Figure 1-3**
  - Six Lane Boulevard with Off-Street Shared Use Path (BV 150-72, BV 140-72, BV 125-72). See **Figure 1-4** and **Figure 1-5**
  - Four Lane Boulevard with One Way Cycle Track (BV 125-63, BV 115-71, BV 100-50). See **Figure 1-6**, **Figure 1-7**, and **Figure 1-8**
  - Four Lane Boulevard with Off-Street Shared Use Path (BV 110-50). See **Figure 1-9**
  - Two Lane Boulevard with One Way Cycle Track (BV 100-41, BV 100-41B). See **Figure 1-10** and **Figure 1-11**

- **Avenues:** Avenues are 3 to 4 lanes streets without raised medians. They have sidewalks, protected/separated bike facilities and roadside trees spaced at regular intervals. Avenues are designed to carry medium volumes of traffic. The primary function of Avenue is to intercept traffic within a residential subdivision or serve several subdivisions. Avenues provide limited access to abutting properties. Designations include the following:
  - Four Lane Avenue with One Way Cycle Track (AV 100-47). See **Figure 1-12**
  - Three Lane Avenue with One Way Cycle Track (AV 100-50, AV 82-43A). See **Figure 1-13**, and **Figure 1-14**
  - Three Lane Avenue with Off-Street Shared Use Path (AV 82-43B). See **Figure 1-15**

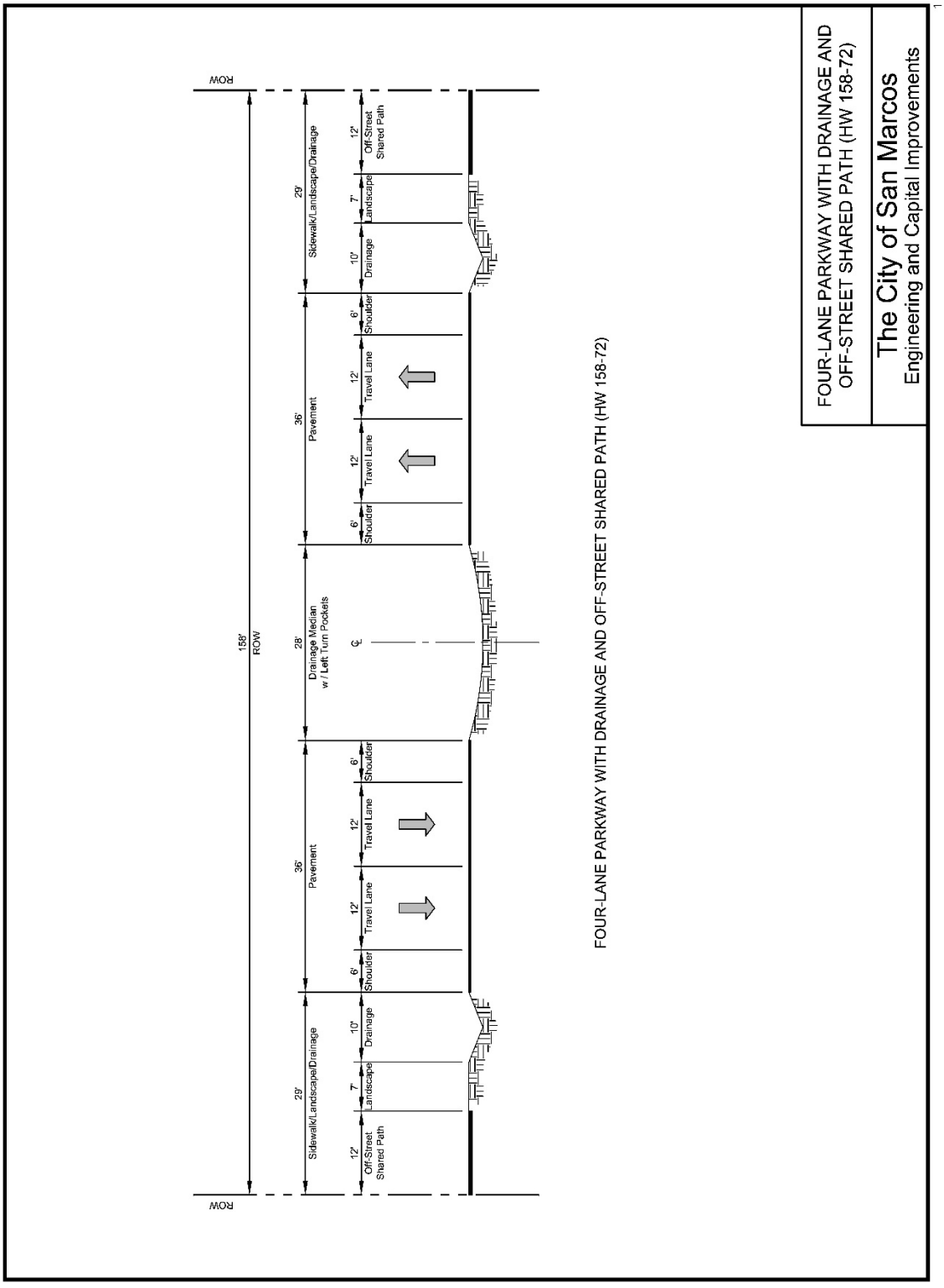


Figure 1-1: Four Lane Parkway (HW 158-72)

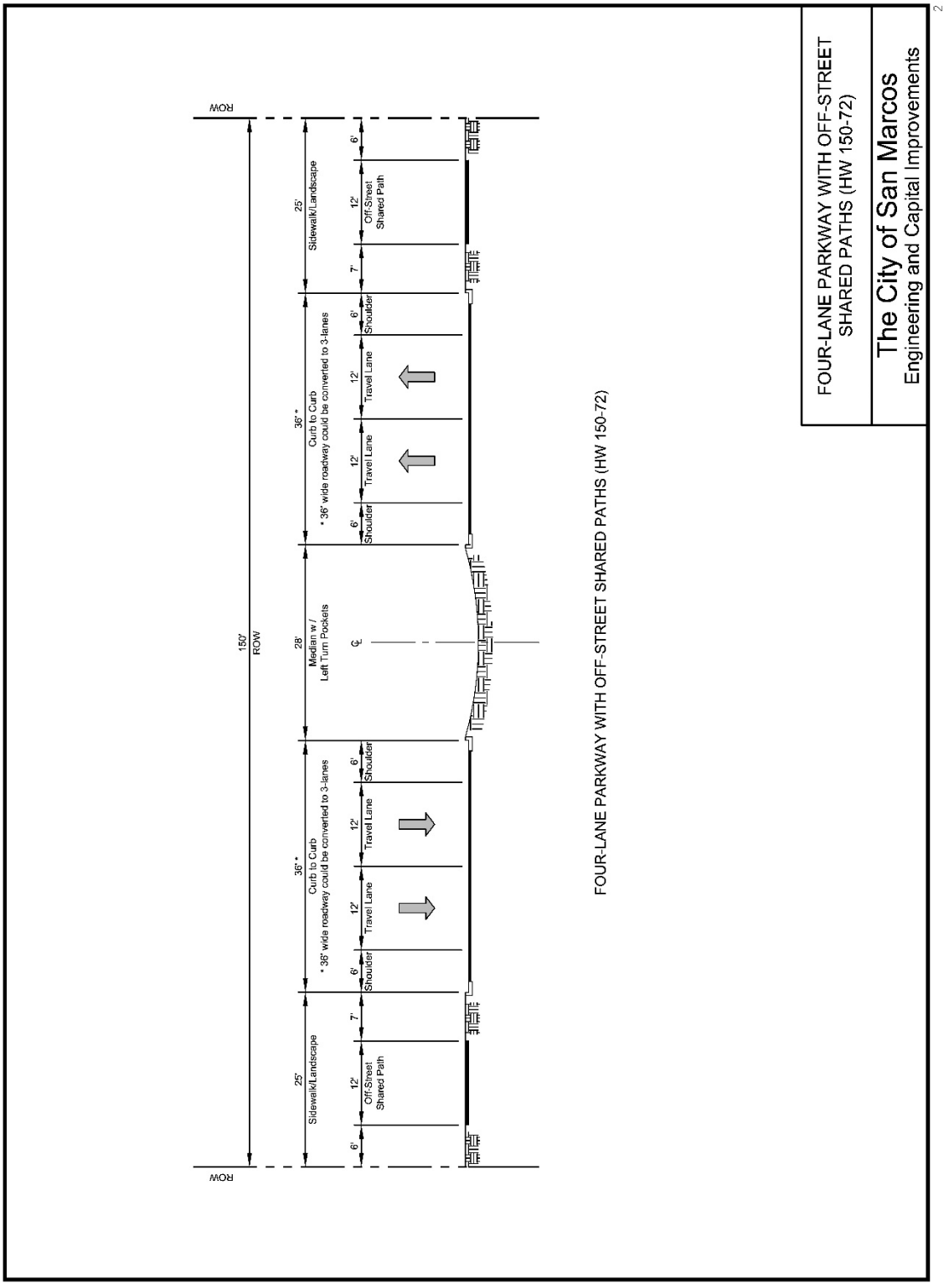


Figure 1-2: Four Lane Parkway (HW 150-72)

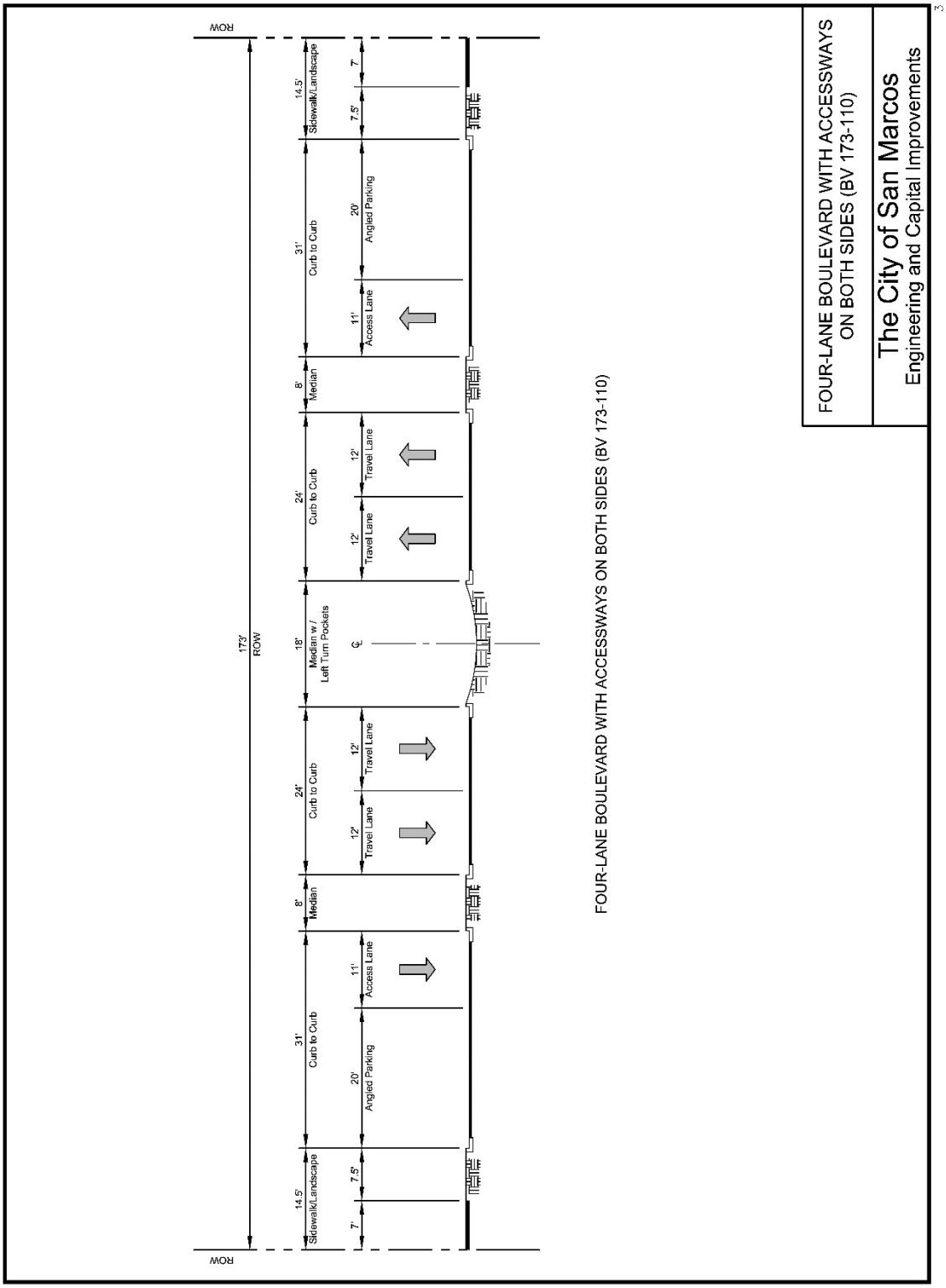


Figure 1-3: Four Lane Boulevard with Access-ways (BV 173-110)

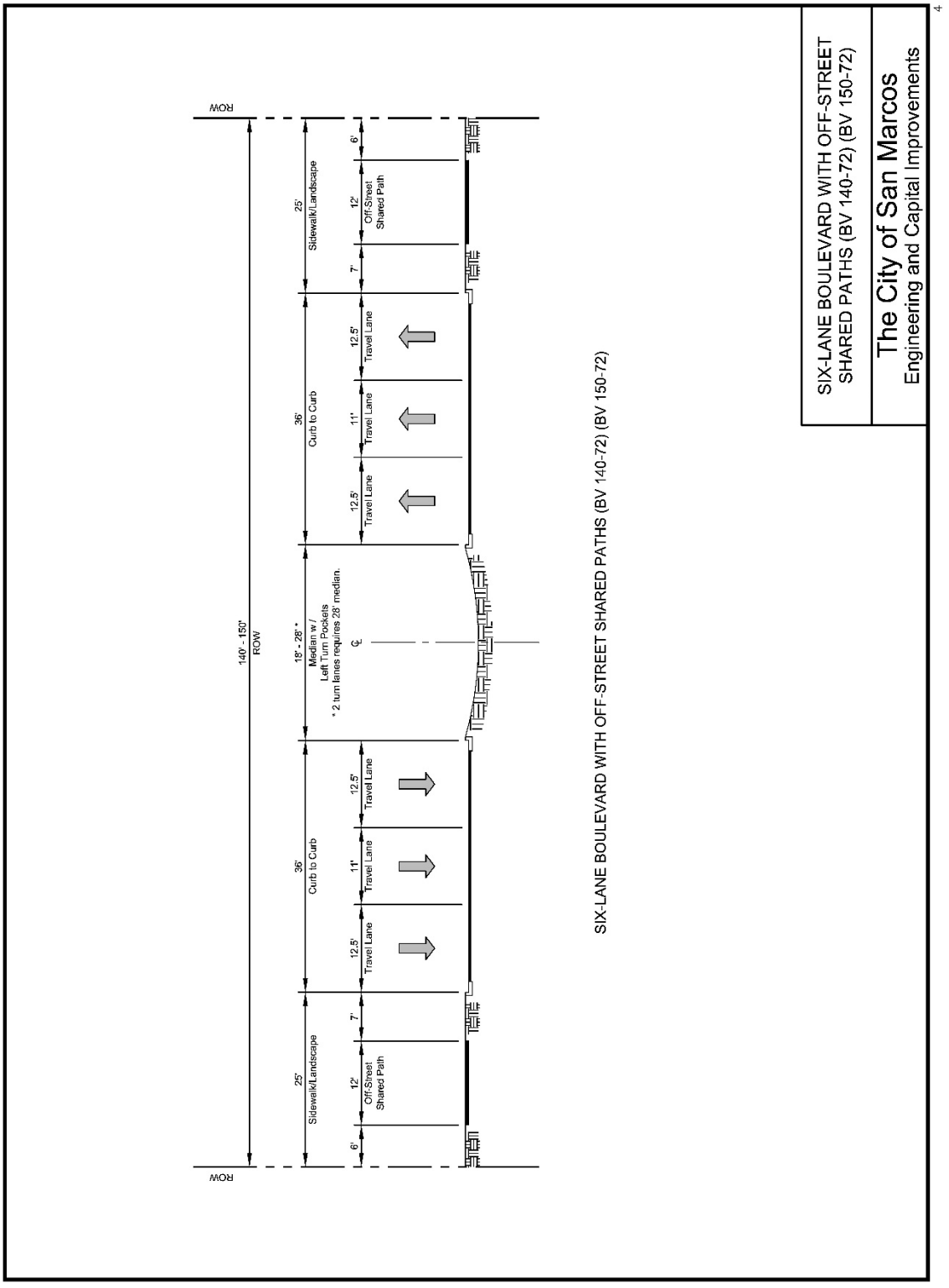


Figure 1-4: Six Lane Boulevard (BV 140-72) (BV 150-72)

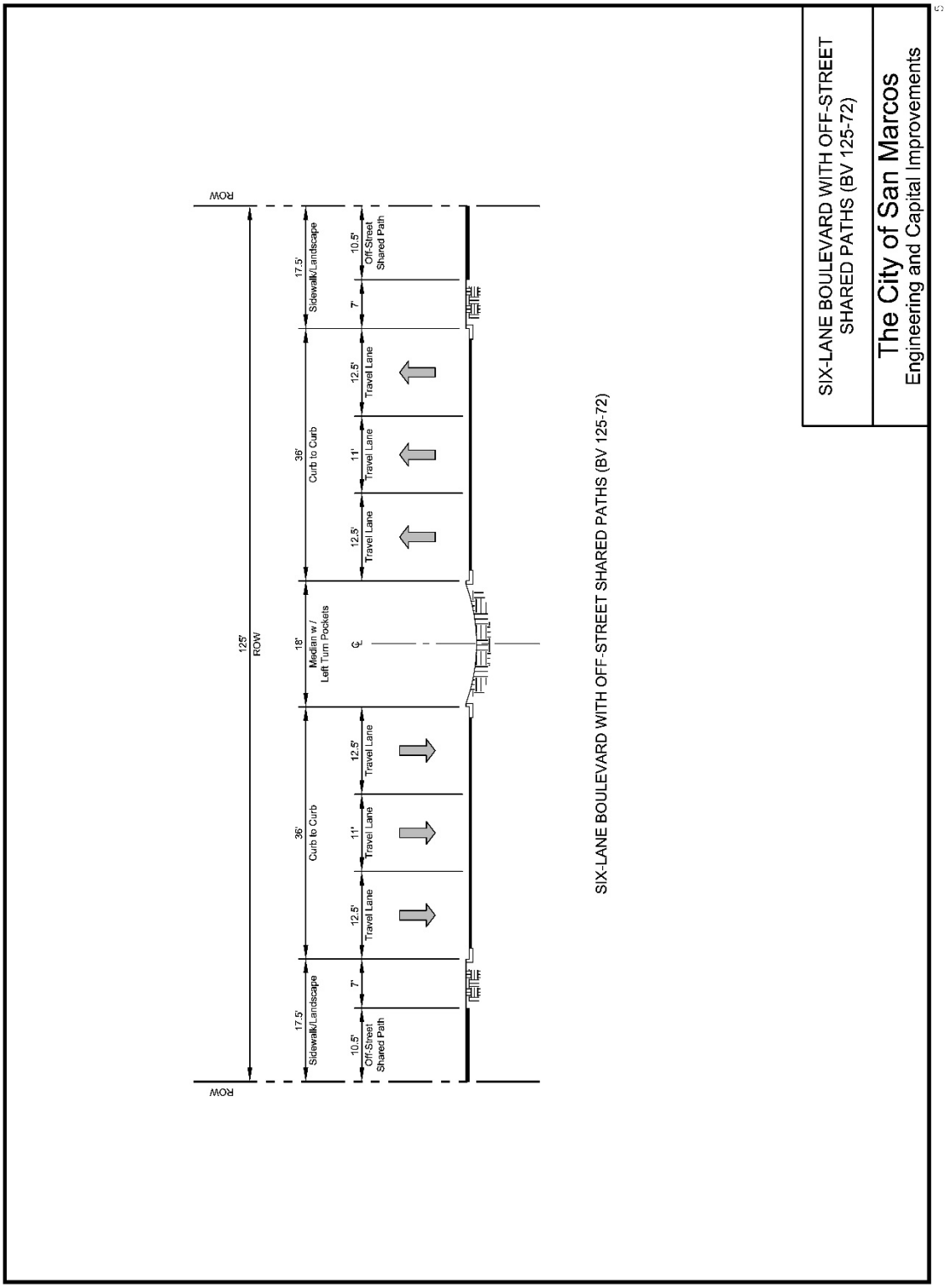


Figure 1-5: Six Lane Boulevard (BV 125-72)

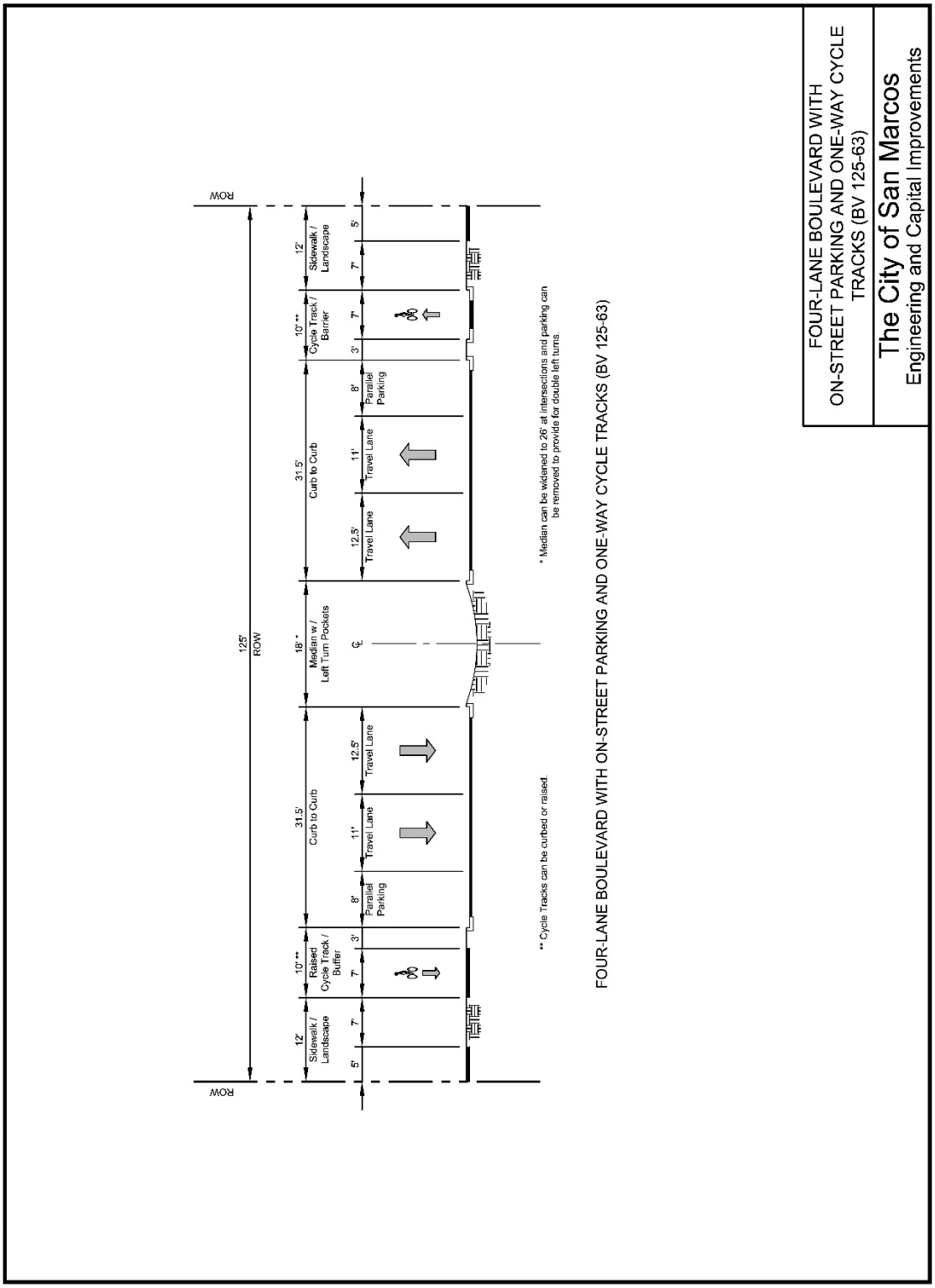


Figure 1-6: Four Lane Boulevard (BV 125-63)

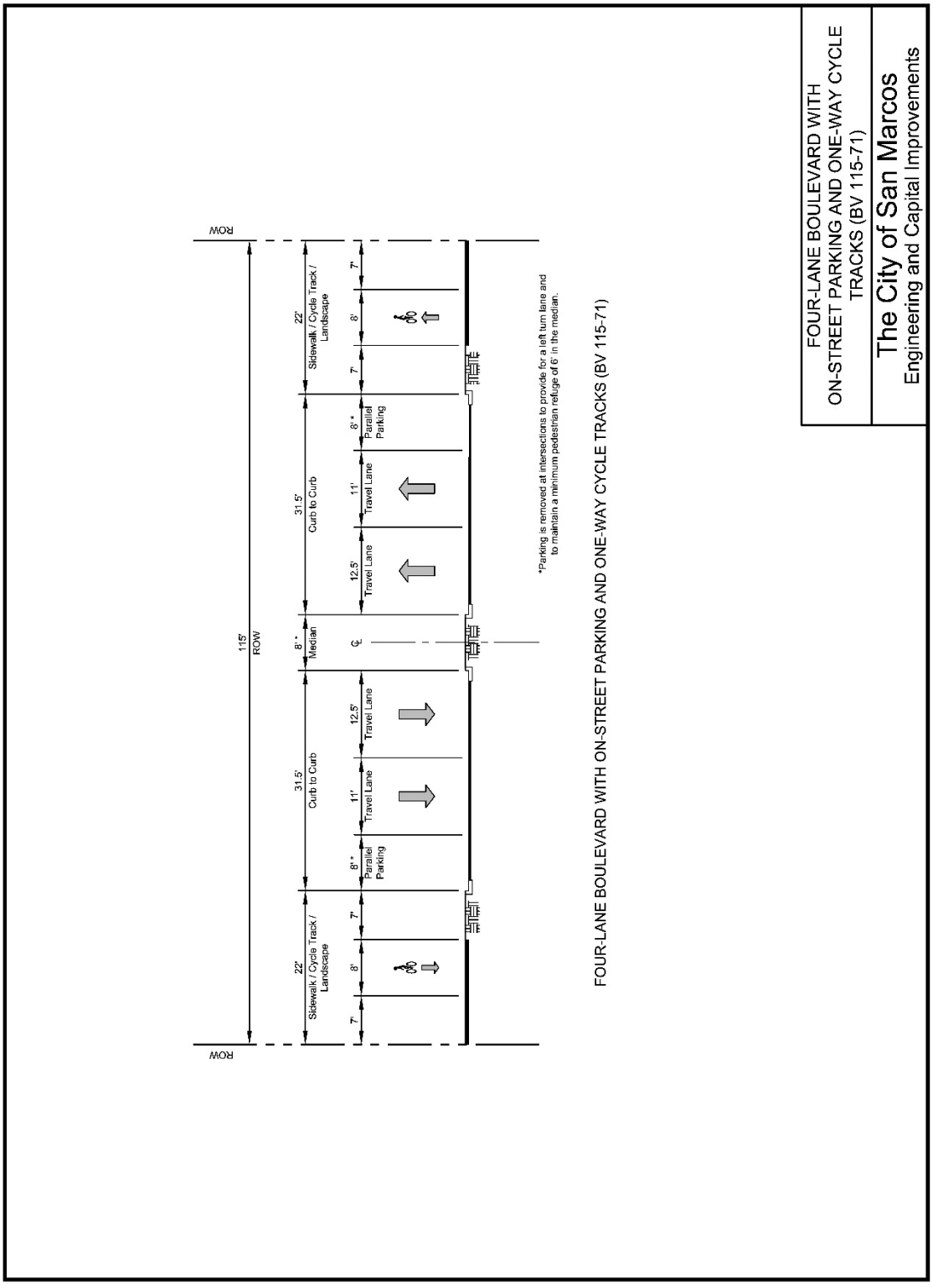


Figure 1-7: Four Lane Boulevard with Cycle Track (BV 115-71)

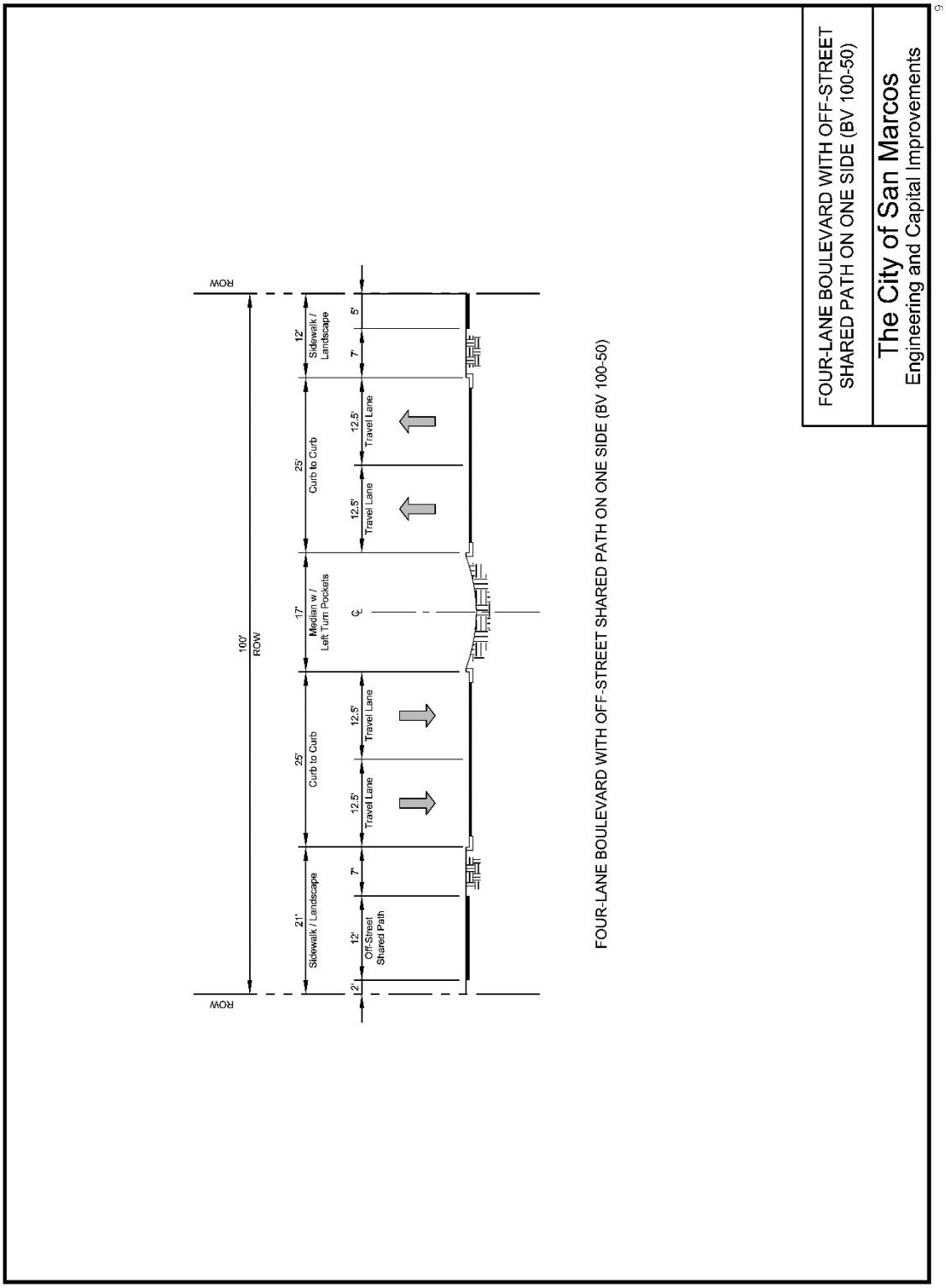


Figure 1-8: Four Lane Boulevard with Shared Use Path (BV 100-50)

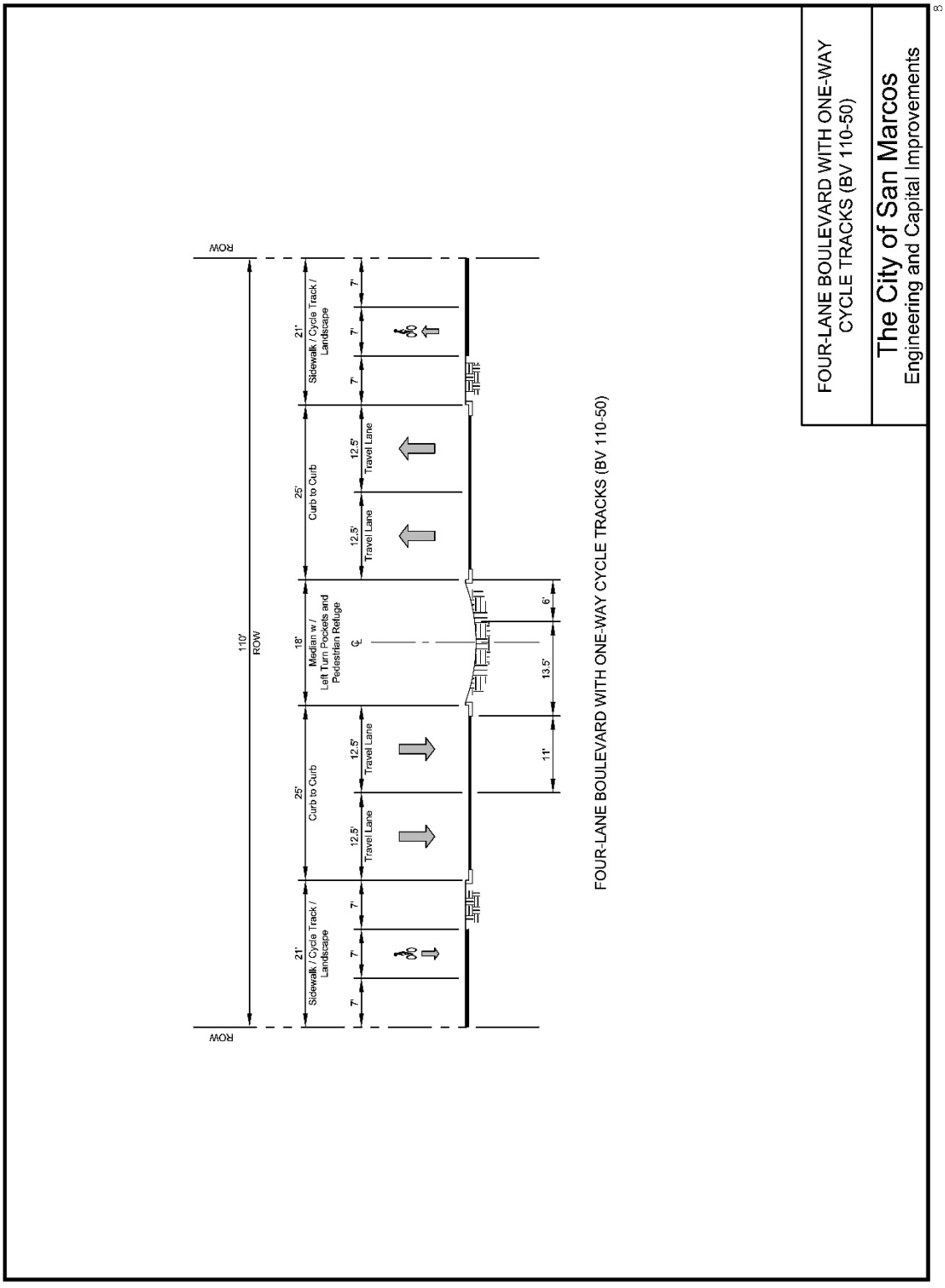


Figure 1-9: Four Lane Boulevard with Shared Use Path (BV 110-50)

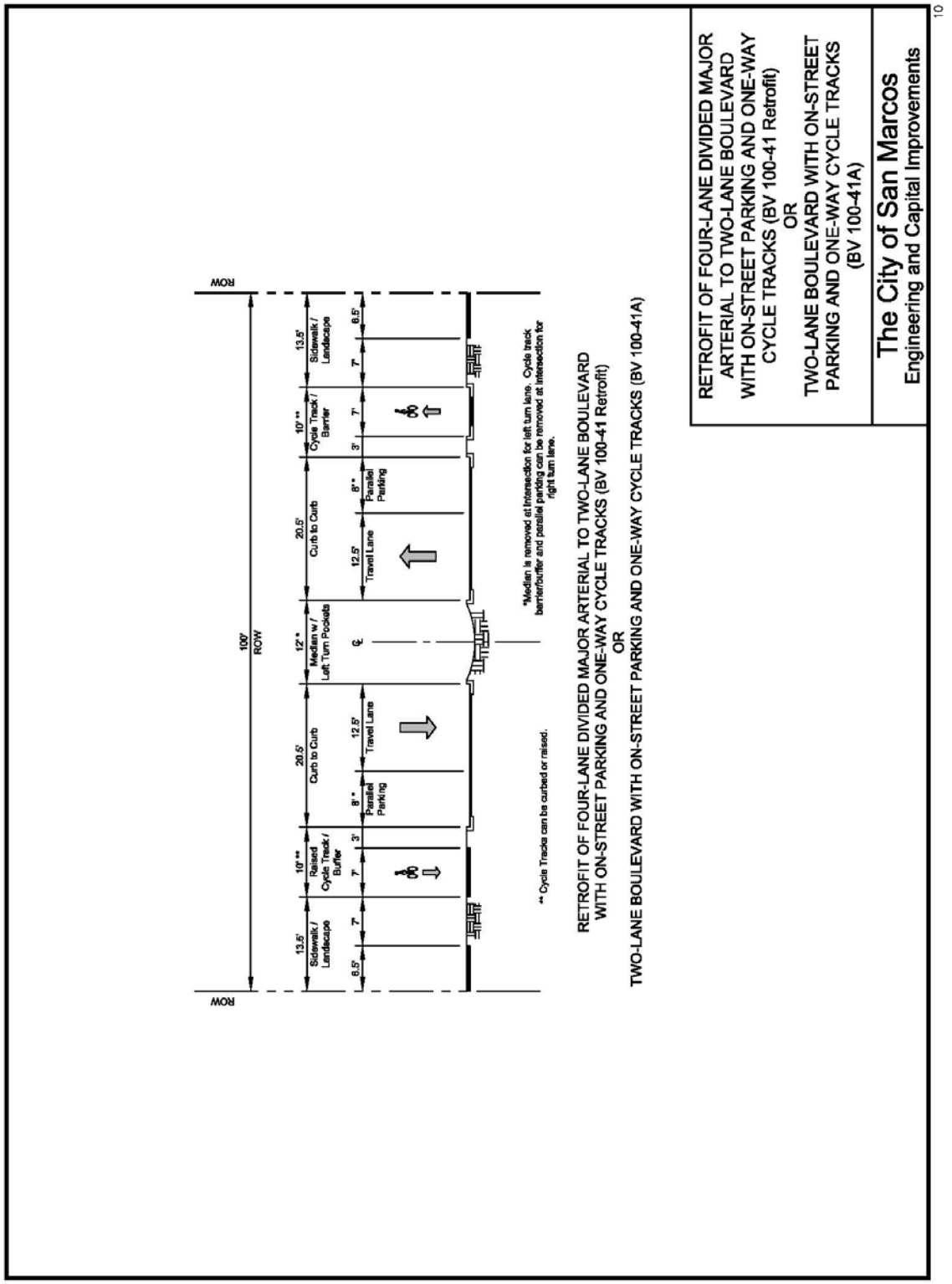


Figure 1-10: Two Lane Boulevard with On-Street Parking (BV 100-41)

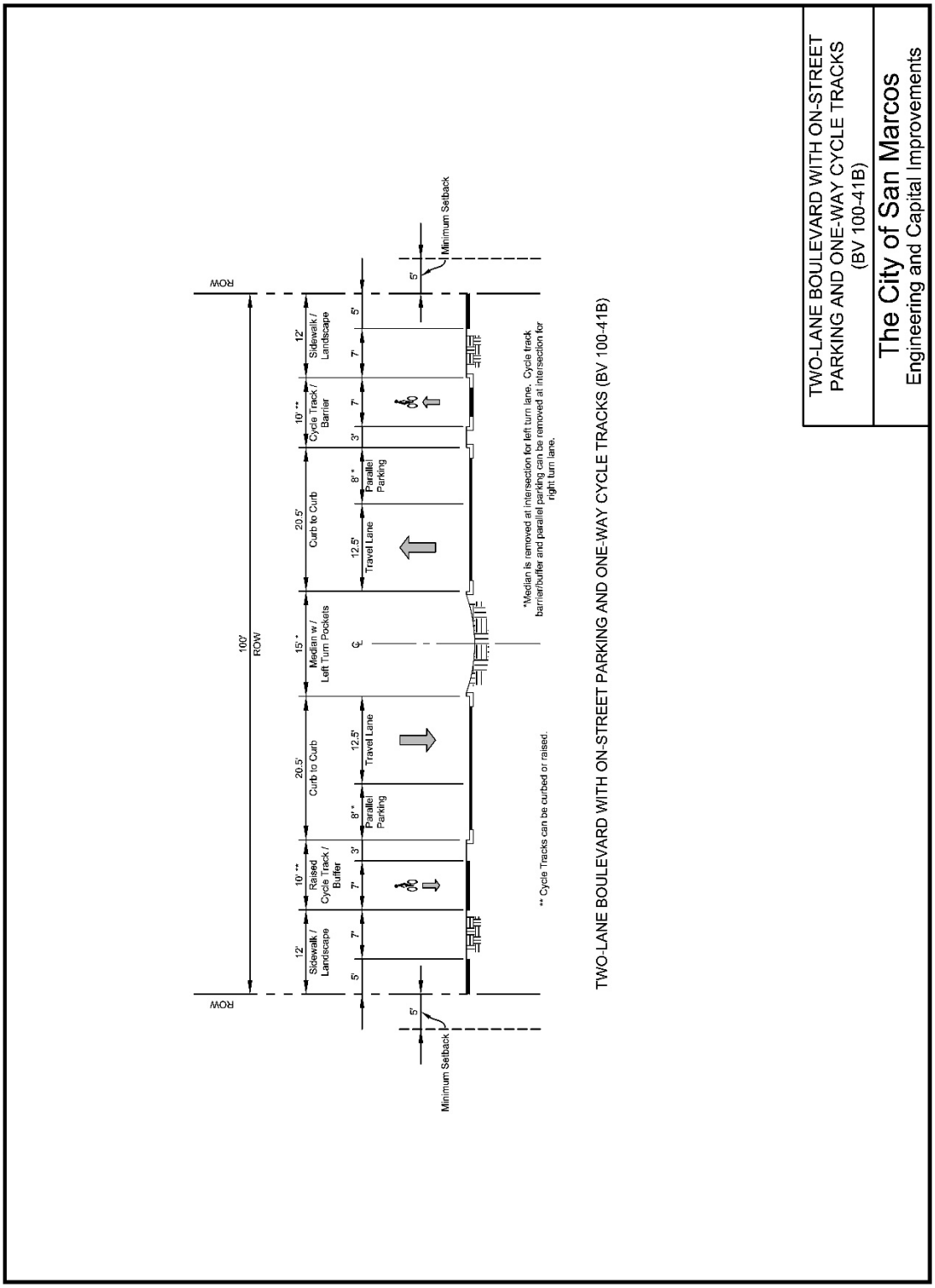


Figure 1-11: Two Lane Boulevard with On-Street Parking (BV 100-41B)

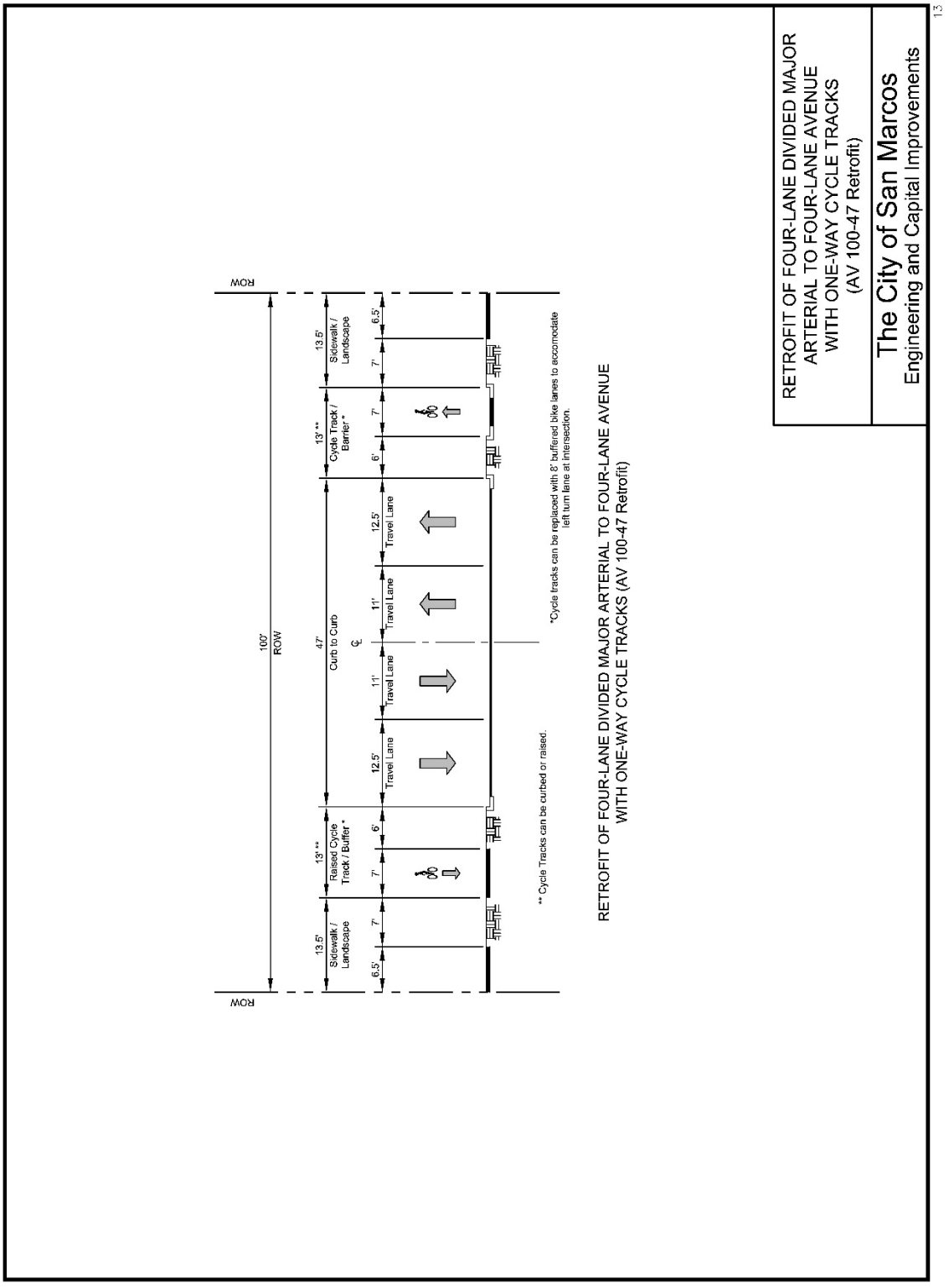


Figure 1-12: Four Lane Avenue with Cycle Track (AV 100-47)

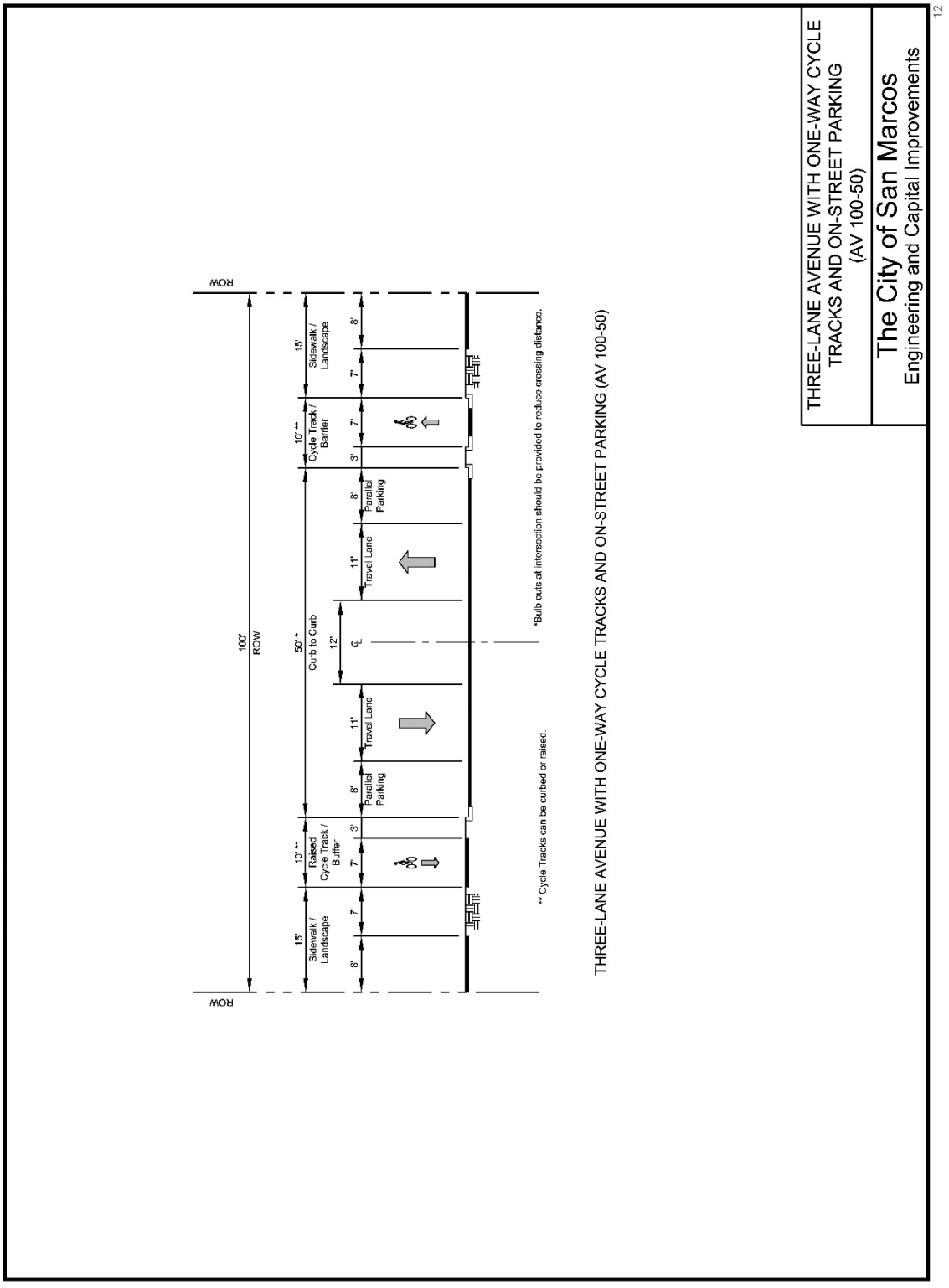


Figure 1-13: Three Lane Avenue with Cycle Track (AV 100-50)

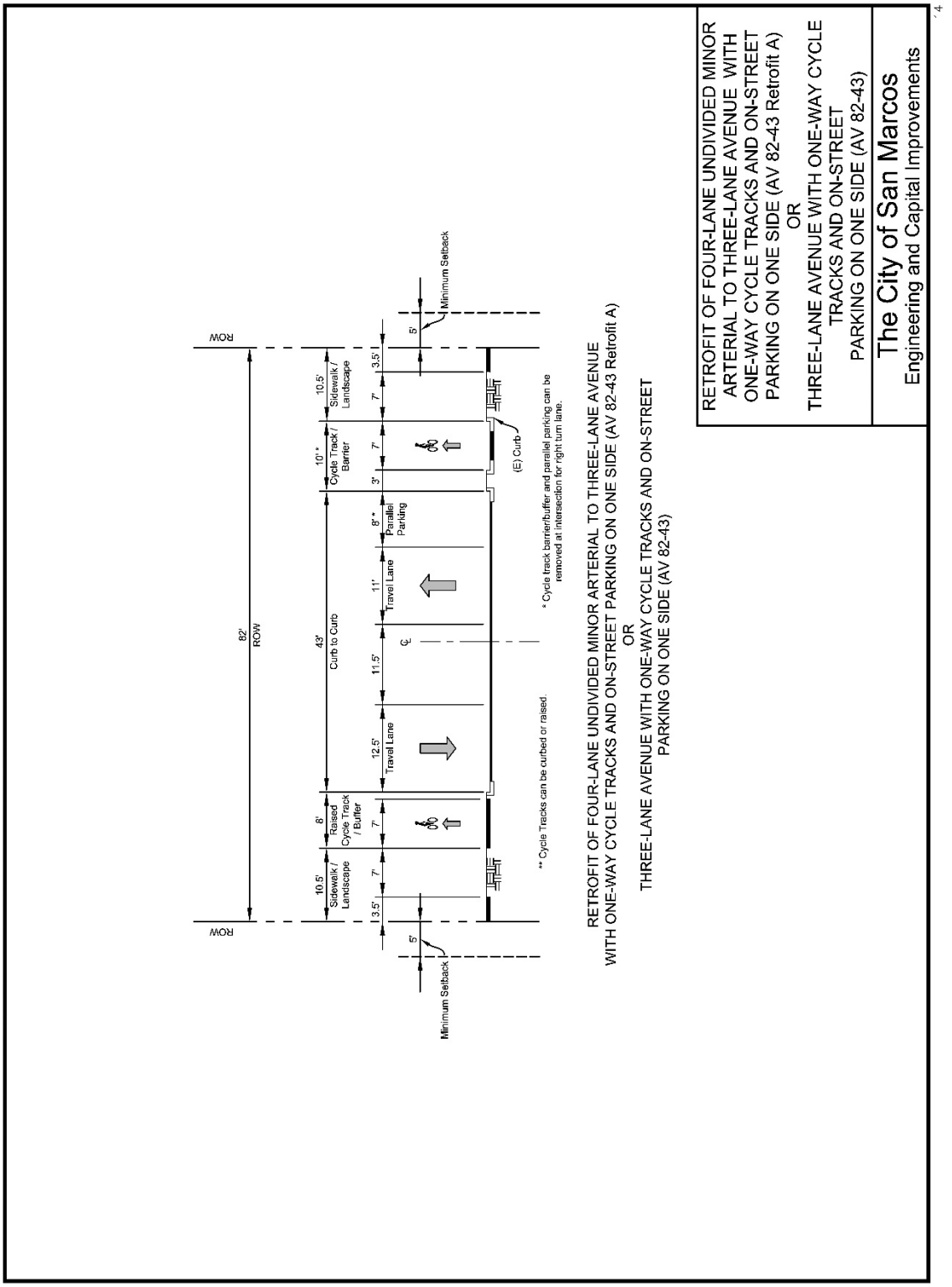


Figure 1-14: Three Lane Avenue with Cycle Track (AV 82-43 Retrofit A)

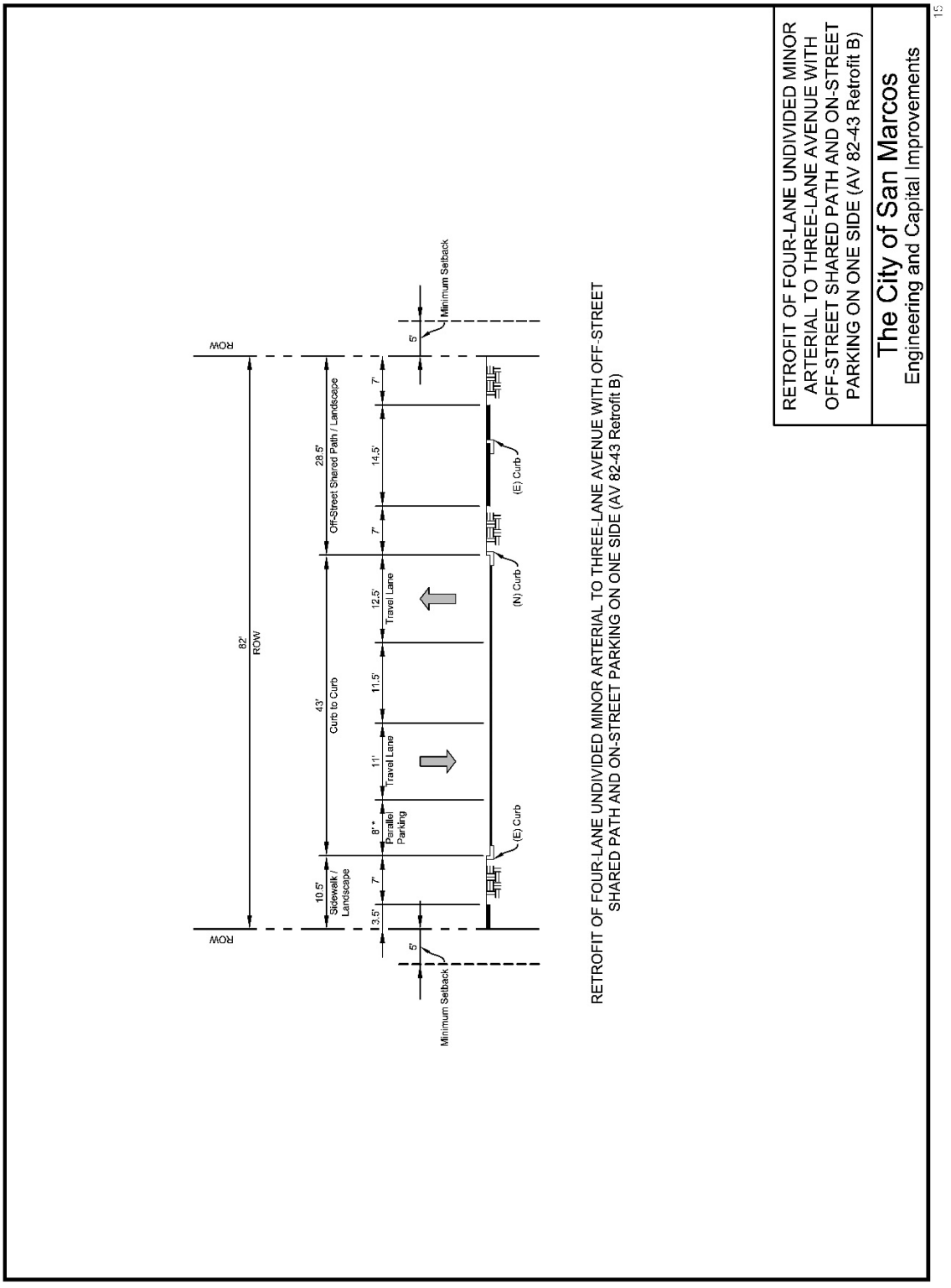


Figure 1-15: Three Lane Avenue with Shared Use Path (AV 82-43 Retrofit B)

- **Commercial Streets:** Commercial Streets are 2 Lane streets fronting commercial uses and are characterized by wider sidewalks and on-street parking. Commercial Streets are designed to carry medium volumes of traffic. The primary function of Commercial Street is provide access to large vehicles and provides access to abutting properties. Designations include the following:
  - Two Lane Commercial Street with One Way Cycle Track (CS 100-50, CS 90-40). See **Figure 1-16**, and **Figure 1-17**
  - Two Lane Commercial Street with Angle Parking (CS 90-61). See **Figure 1-18**
  - Two Lane Commercial Street with On Street Parking (CS 80-51, CS 70-40, CS 67-40, CS 60-36). See **Figure 1-19**, **Figure 1-20**, **Figure 1-21**, and **Figure 1-22**
  - One Lane Commercial Shared Street with On Street Parking (CS 53-30, CS 44-20). See **Figure 1-23**, and **Figure 1-24**

- **Residential Streets:** Residential Streets are 2 Lane streets serving residential neighborhoods outside of a commercial district. The primary function of Residential Street is to serve abutting land uses and traffic within a neighborhood or residential district. A Residential Street is not generally continuous through several districts. Residential Streets are designed to carry low volumes of traffic. Designations include the following:
  - Two Lane Residential Street (RS 70-24). See **Figure 1-25**
  - Two Lane Residential Street with Off Street Shared Use Path (RS 70-30). See **Figure 1-26**
  - Two Lane Residential Street with On Street Parking (RS 54-30B, RS 54-30C). See **Figure 1-27**, and **Figure 1-28**
  - Two Way Residential Queuing Street with On Street Parking (RS 54-30A). See **Figure 1-29**

- **Roads:** Roads are 2 Lane streets serving rural areas with low traffic volumes and lack curb and gutter, sidewalks, bike lanes and other multimodal features. Designations include the following:
  - Unstriped Two-way Road with No Sidewalks (RD 50-18, RD 40-18). See **Figure 1-30**

- **Alleys:** An Alley is a passageway designed primarily to provide access to or from the rear or side of property otherwise abutting on a public street. Designations include the following:
  - Rear Alley in Commercial District (RA 24-24). See **Figure 1-31**
  - One Way Rear Alley in Residential Neighborhood (RA 20 -15). See **Figure 1-32**

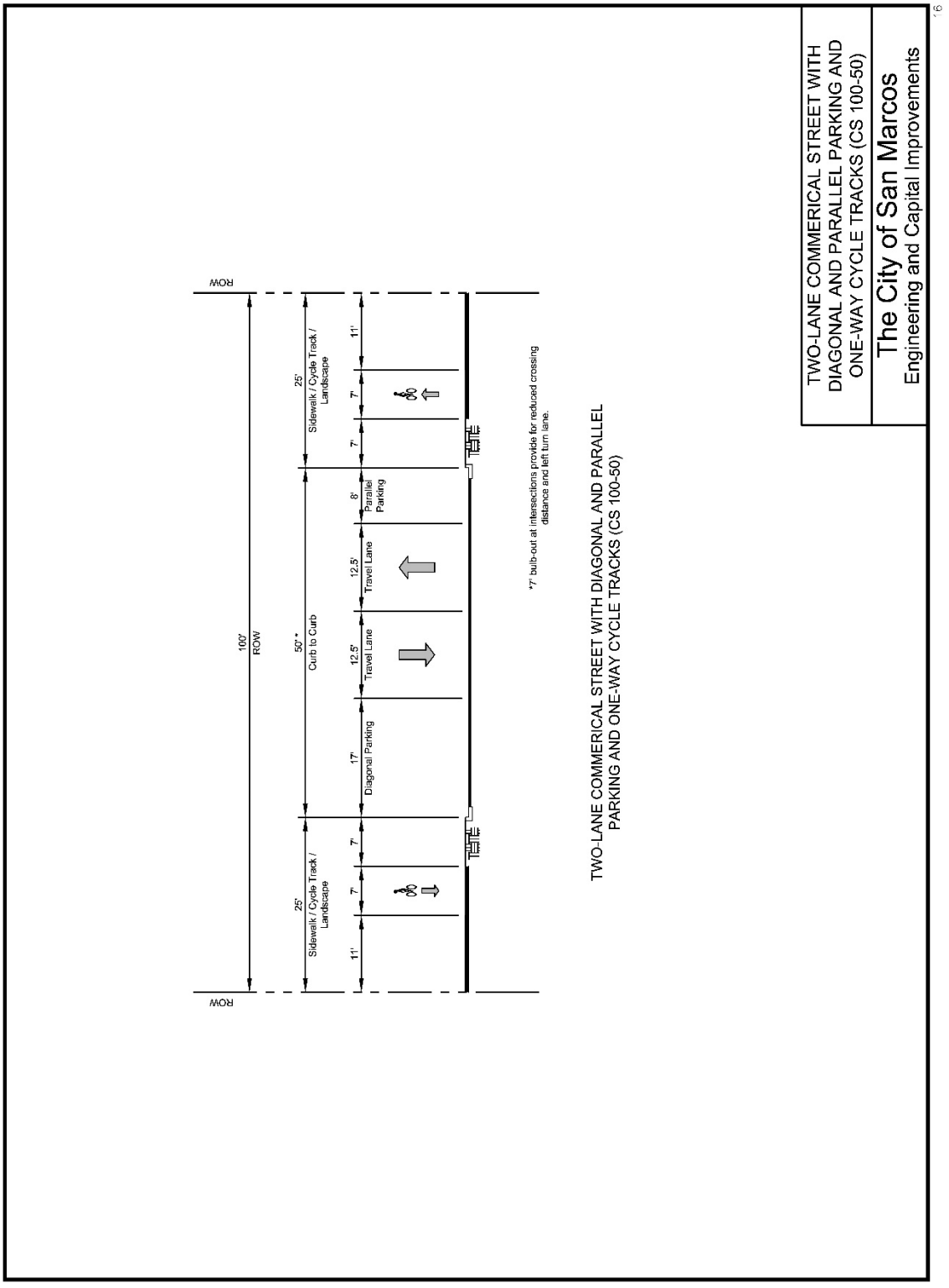
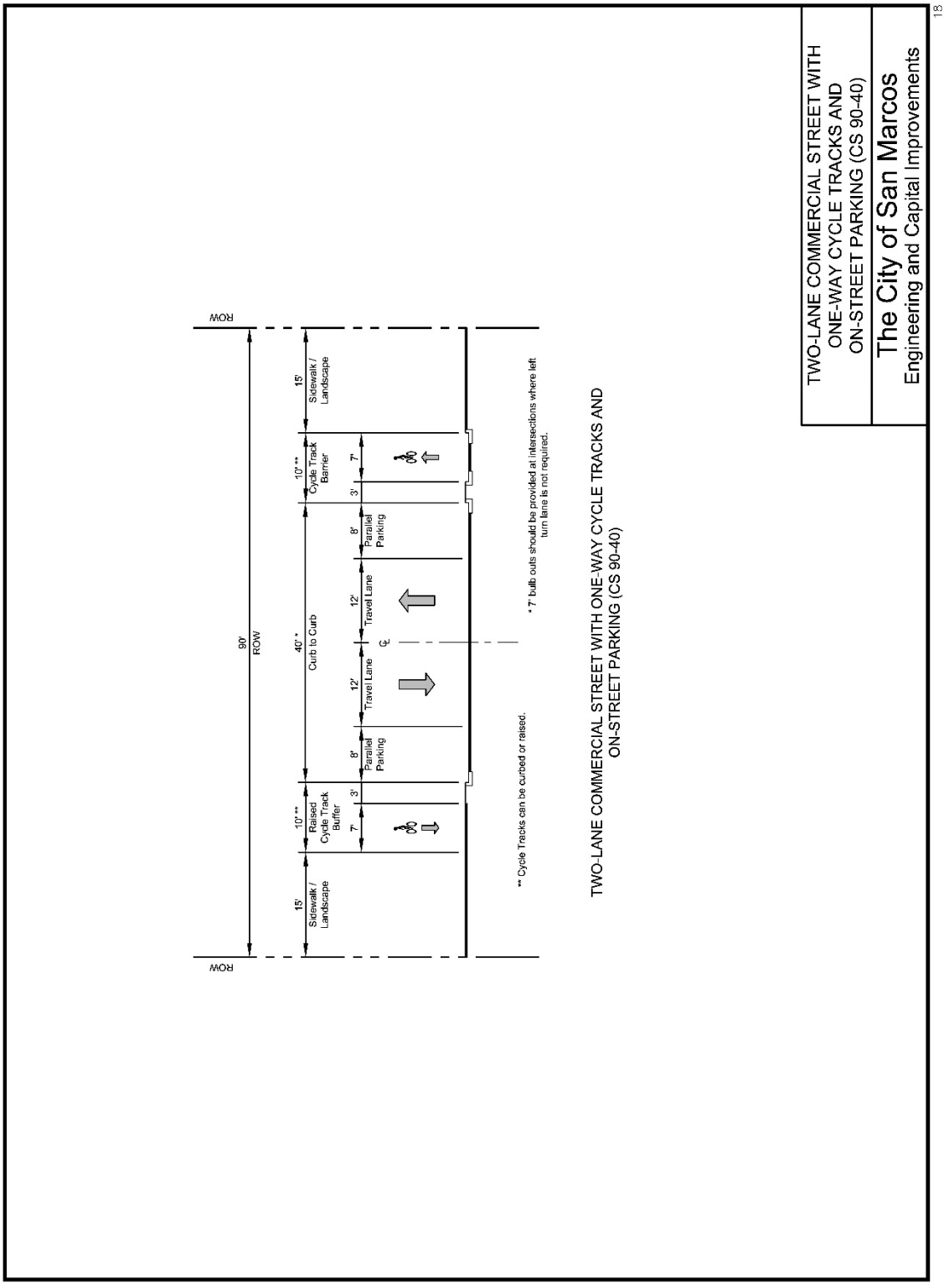


Figure 1-16: Two Lane Commercial Street with Angle Parking (CS 100-50)

Figure 1-17: Two Lane Commercial Street with Cycle Track (CS 90-40)



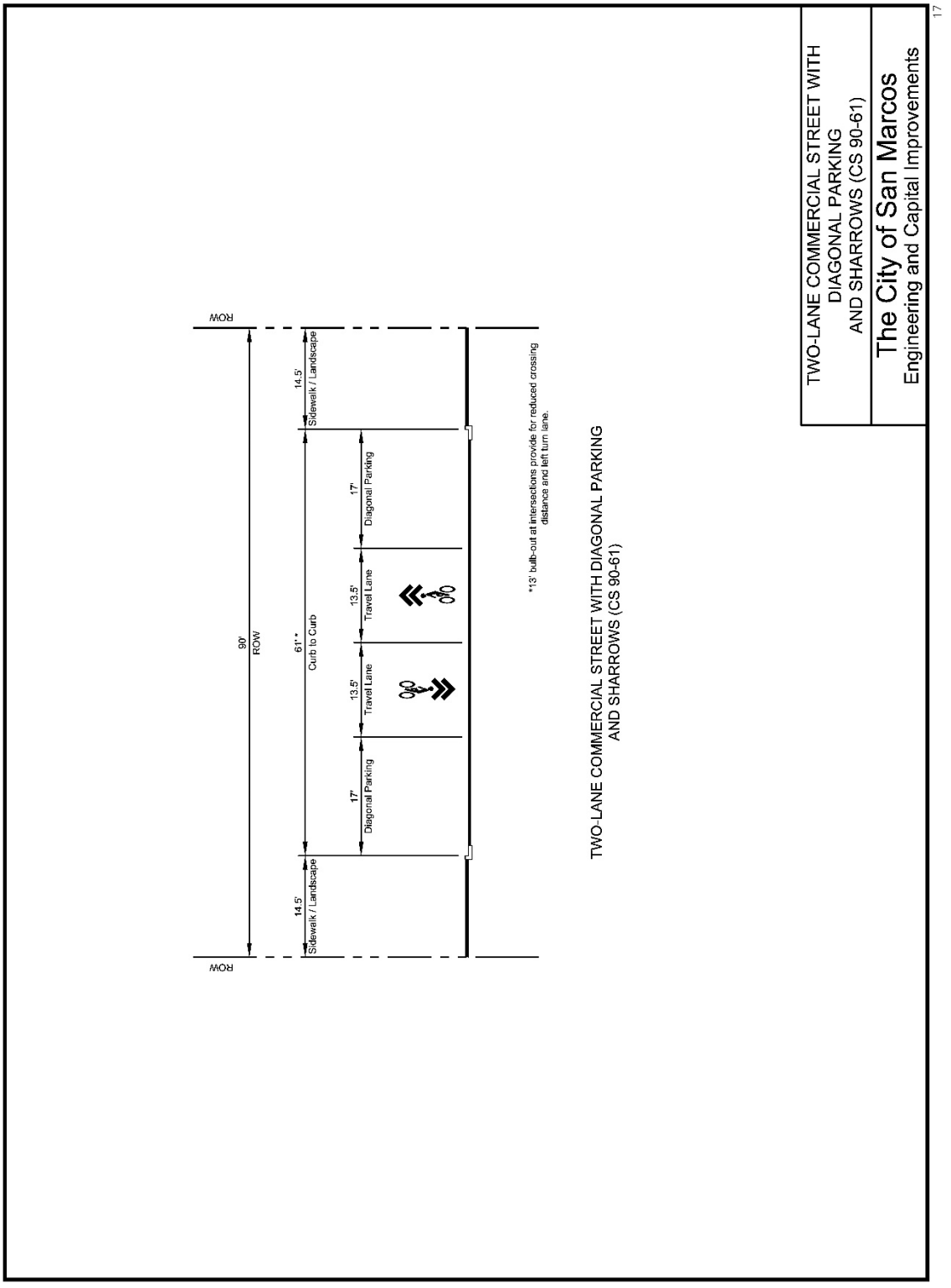


Figure 1-18: Two Lane Commercial Street with Angle Parking (CS 90-61)

Figure 1-19: Two Lane Commercial Street (CS 80-51 Retrofit)

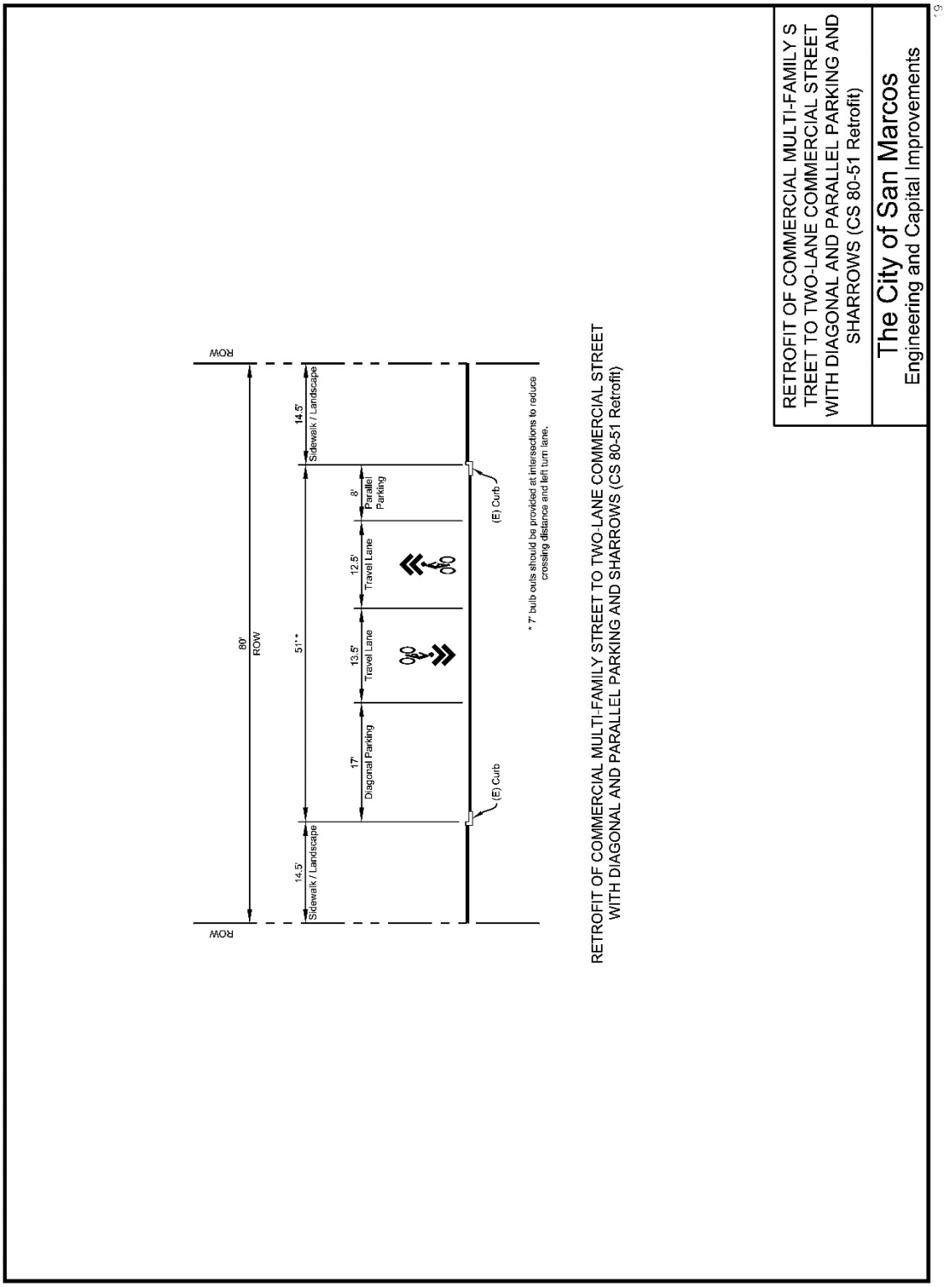
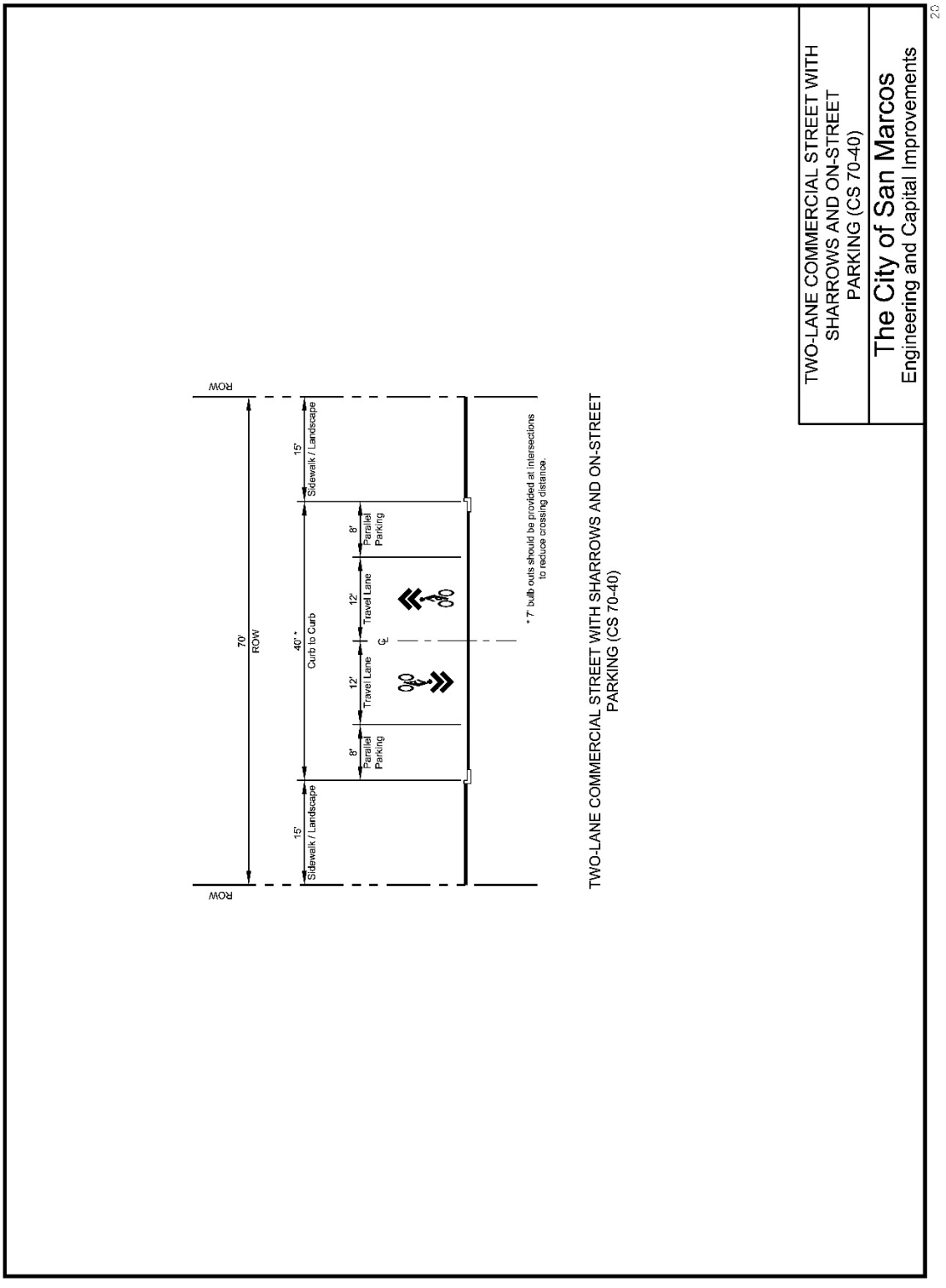


Figure 1-20: Two Way Commercial Street with Parallel Parking (CS 70-40)



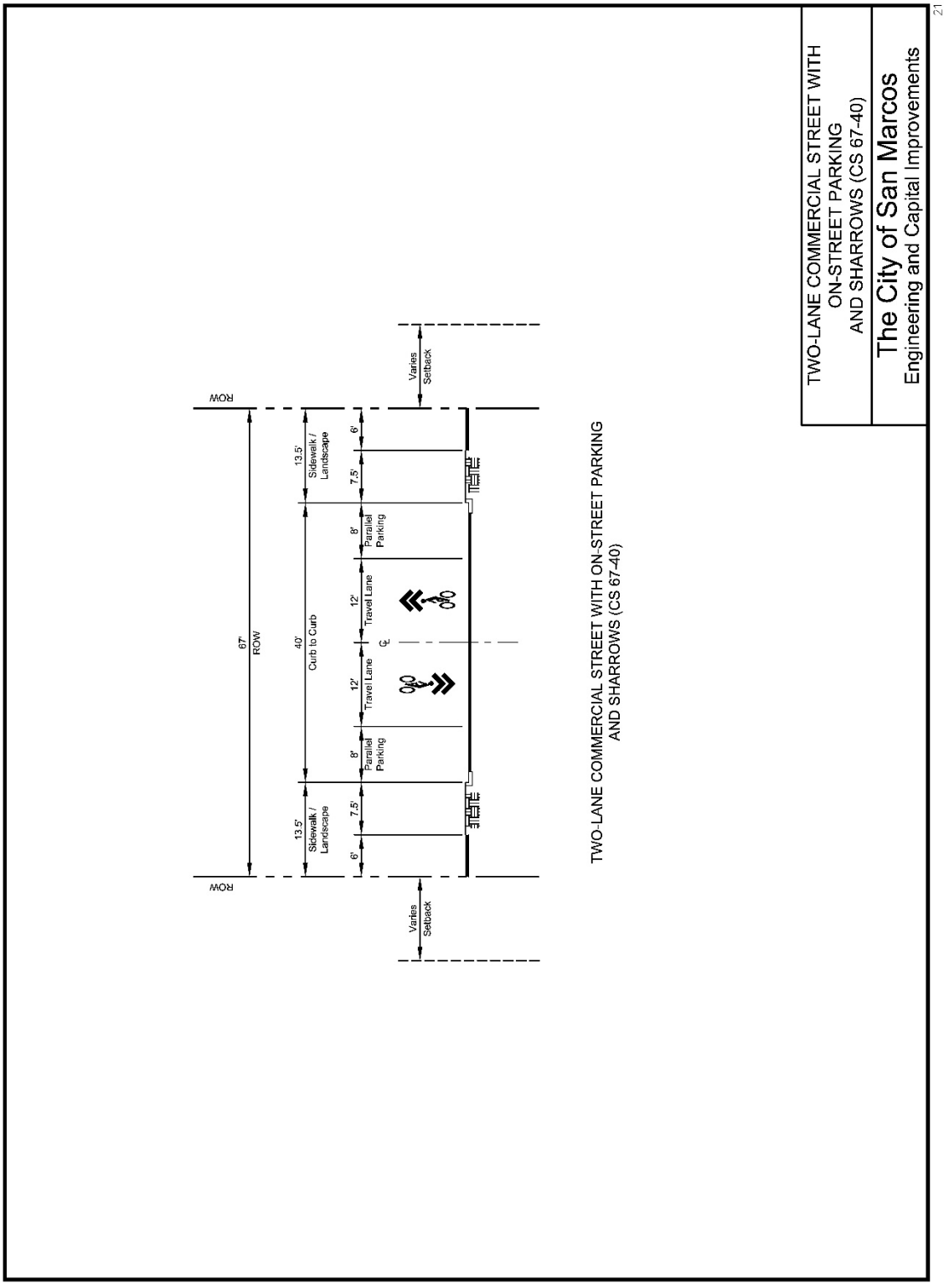
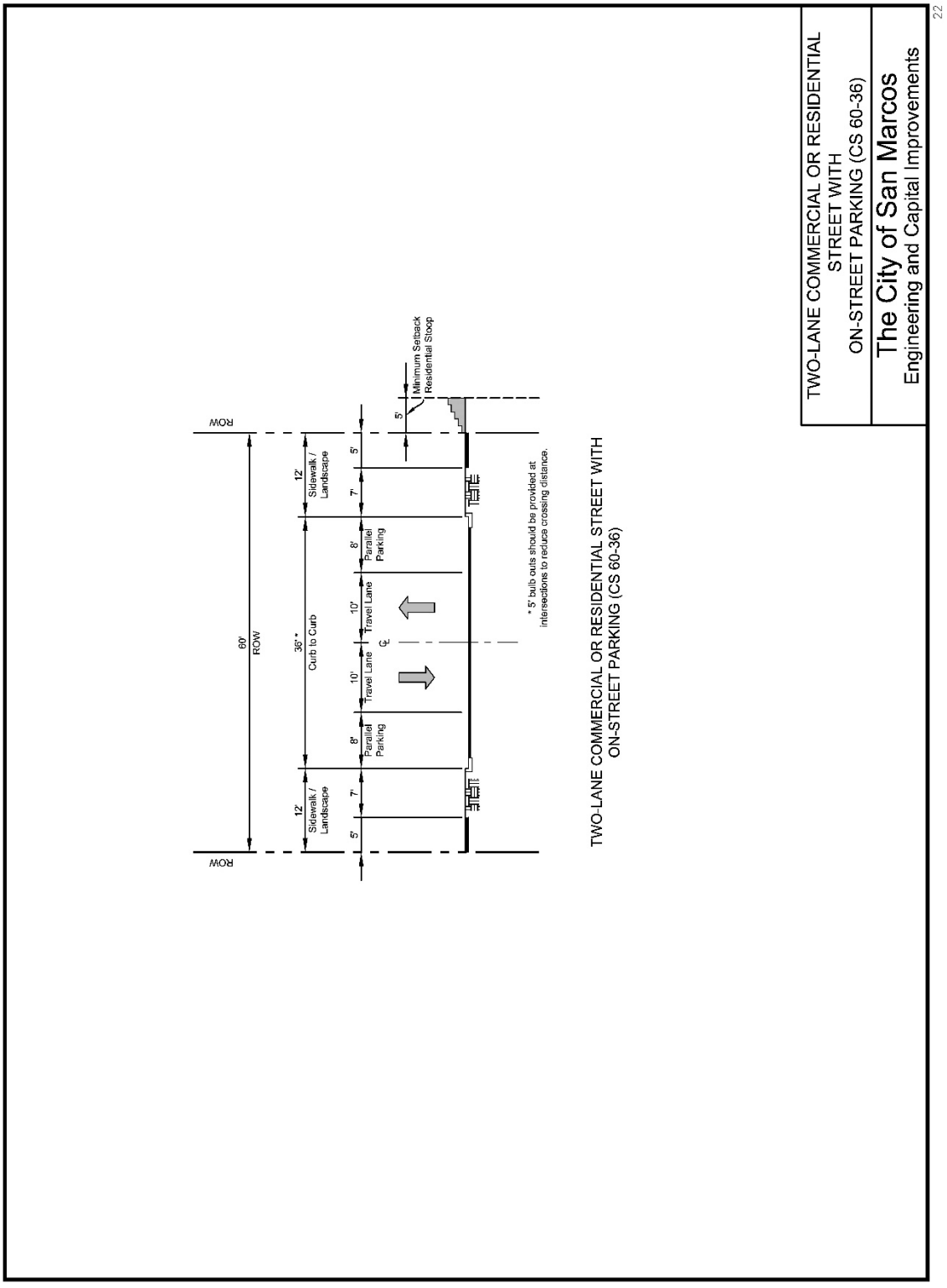


Figure 1-21: Two Lane Commercial Street with Sharrows (CS 67-40)

Figure 1-22: Two Lane Commercial Street (CS 60-36)



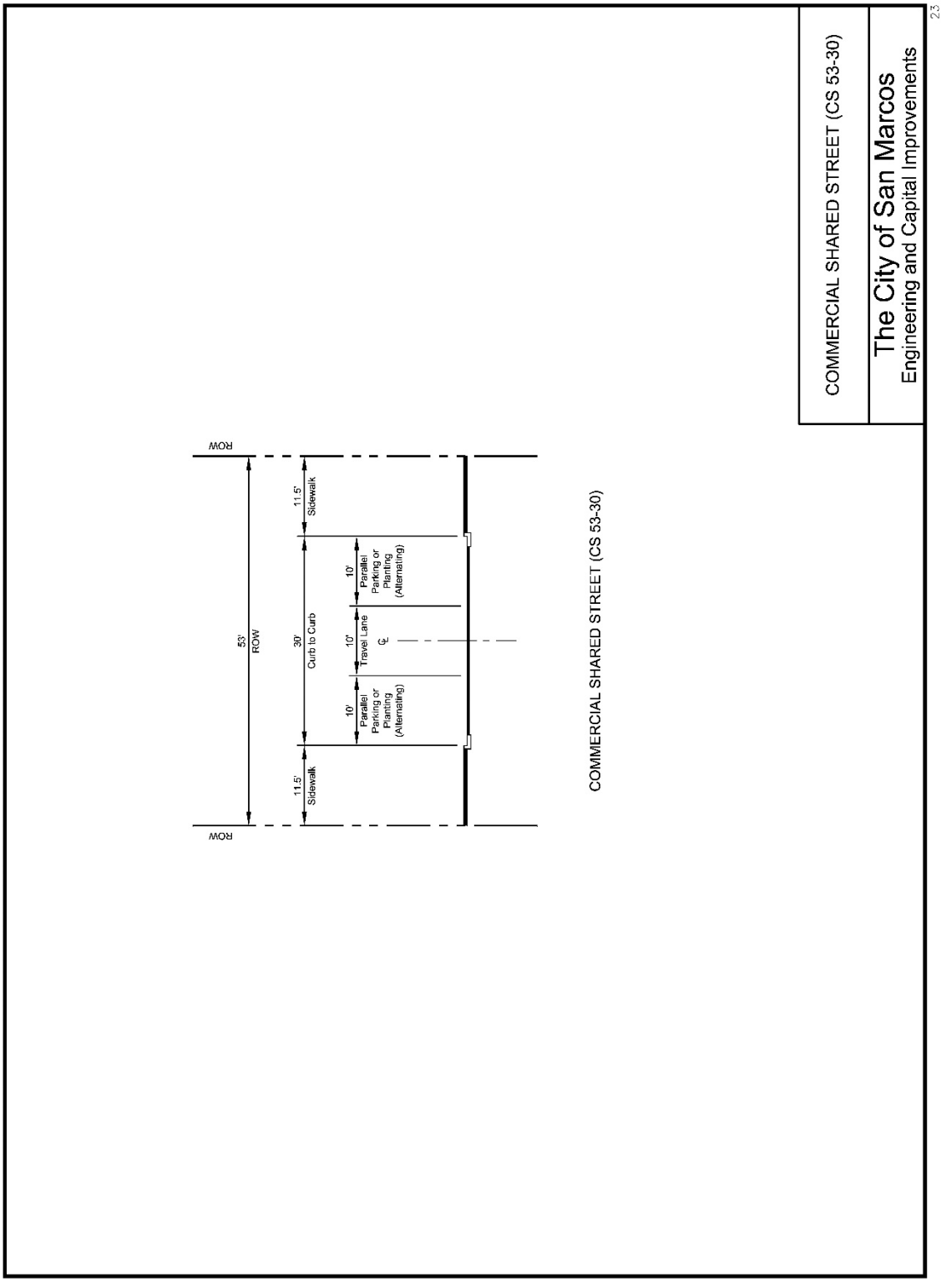


Figure 1-23: Commercial Shared Street (CS 53-30)

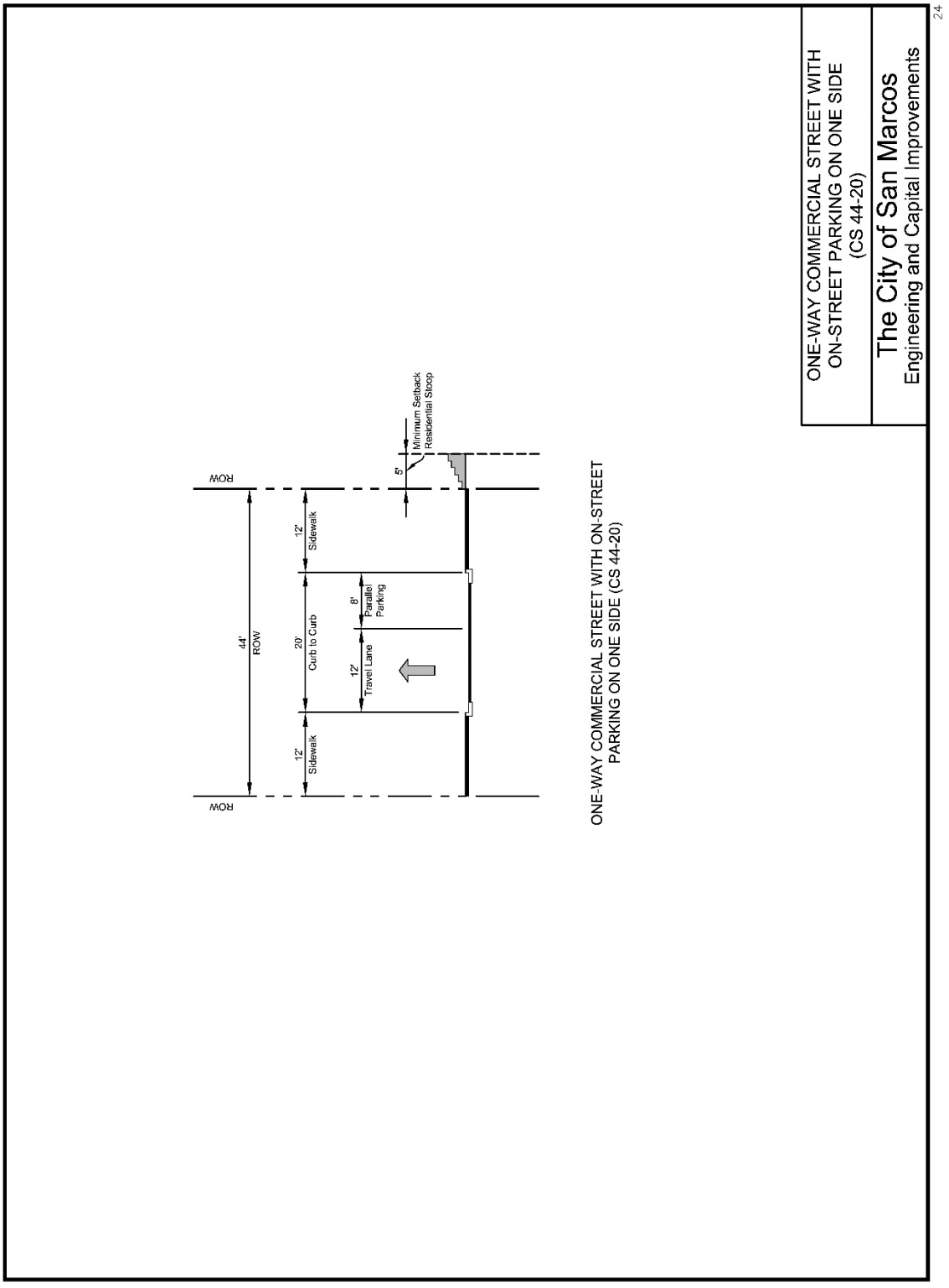


Figure 1-24: One Way Commercial Street (CS 44-20)

Figure 1-25: Two Lane Residential Street (RS 70-24)

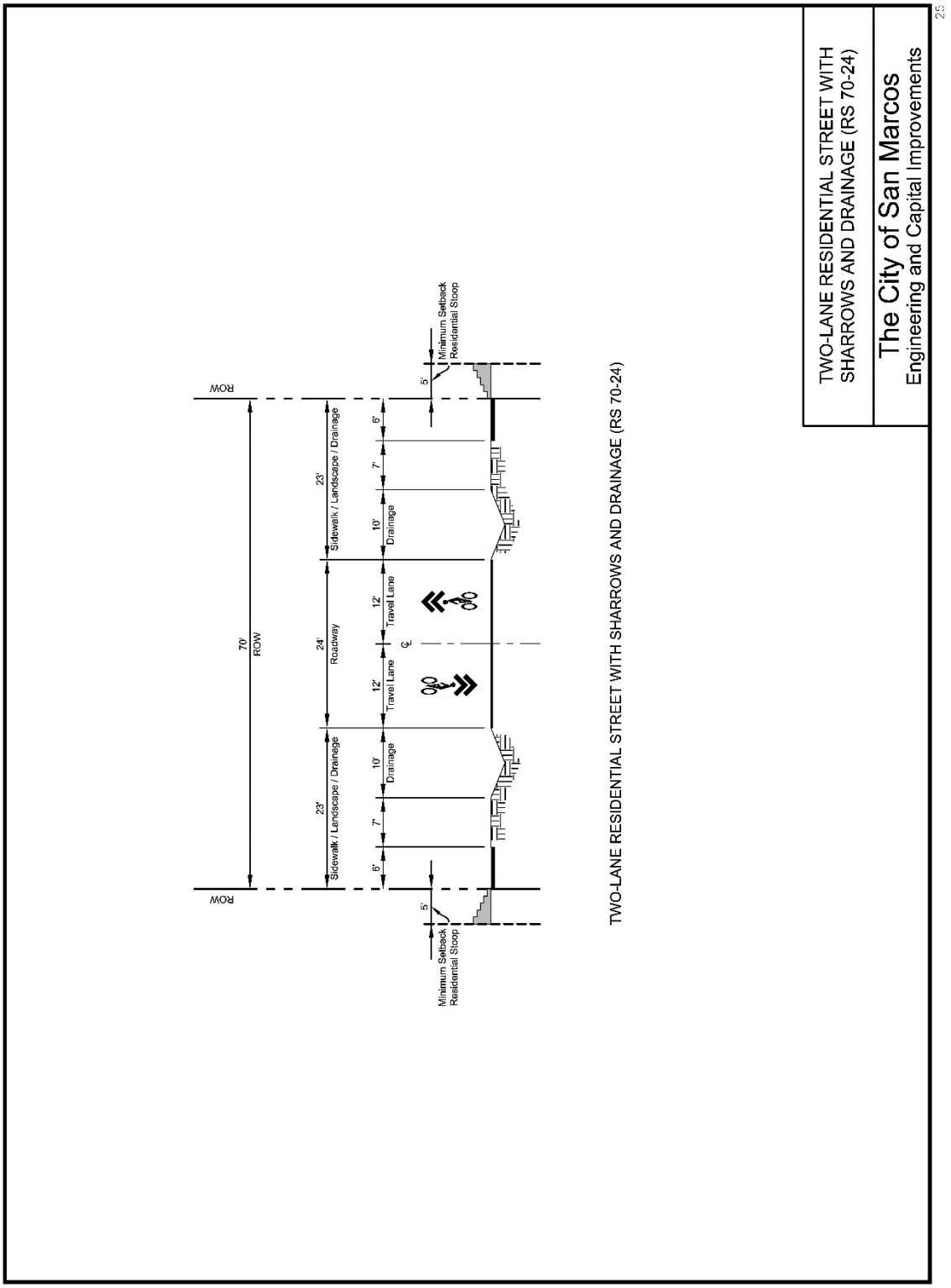
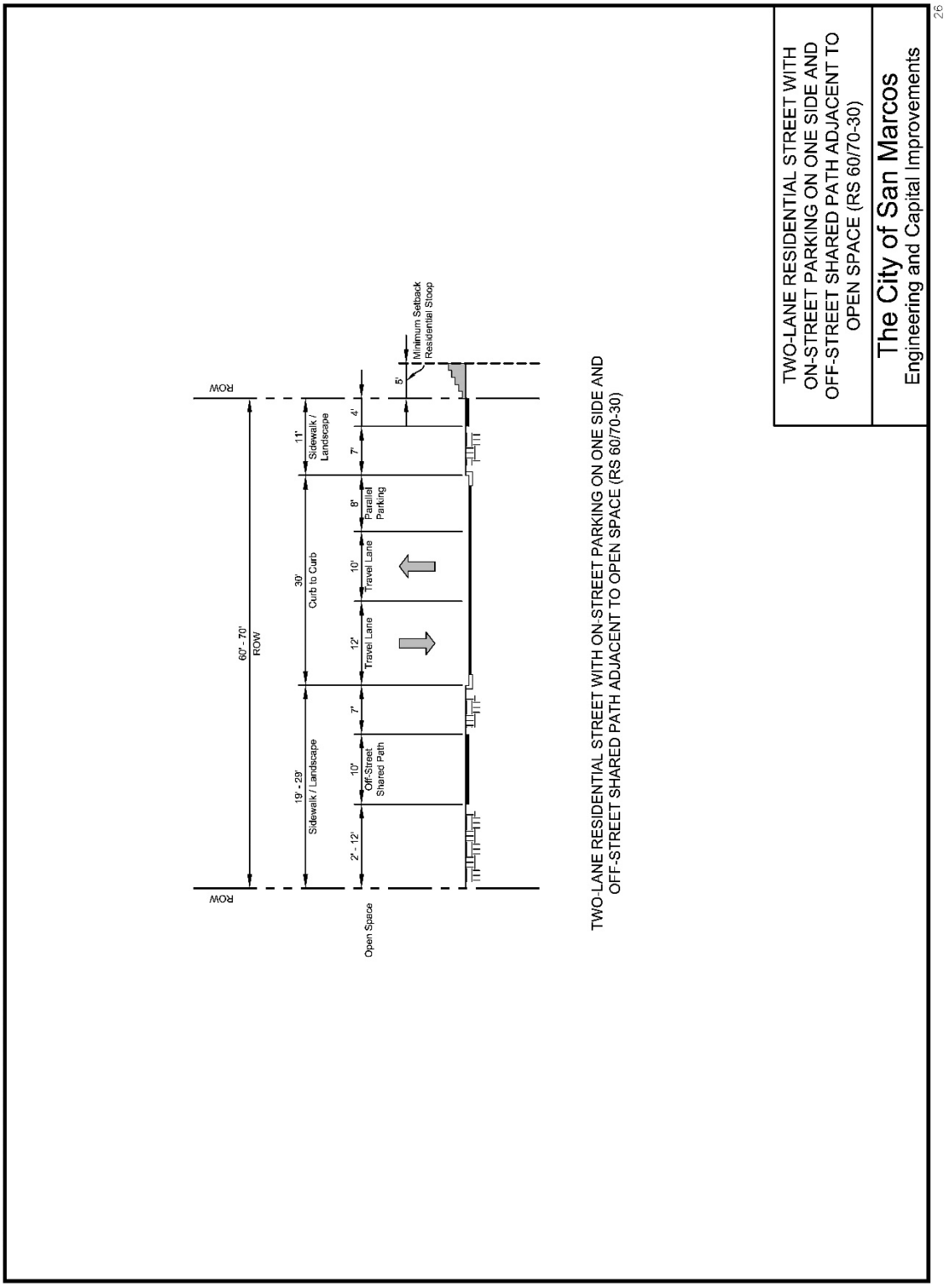


Figure 1-26: Two Lane Residential Street with Shared Use Path (RS 70/60-30)



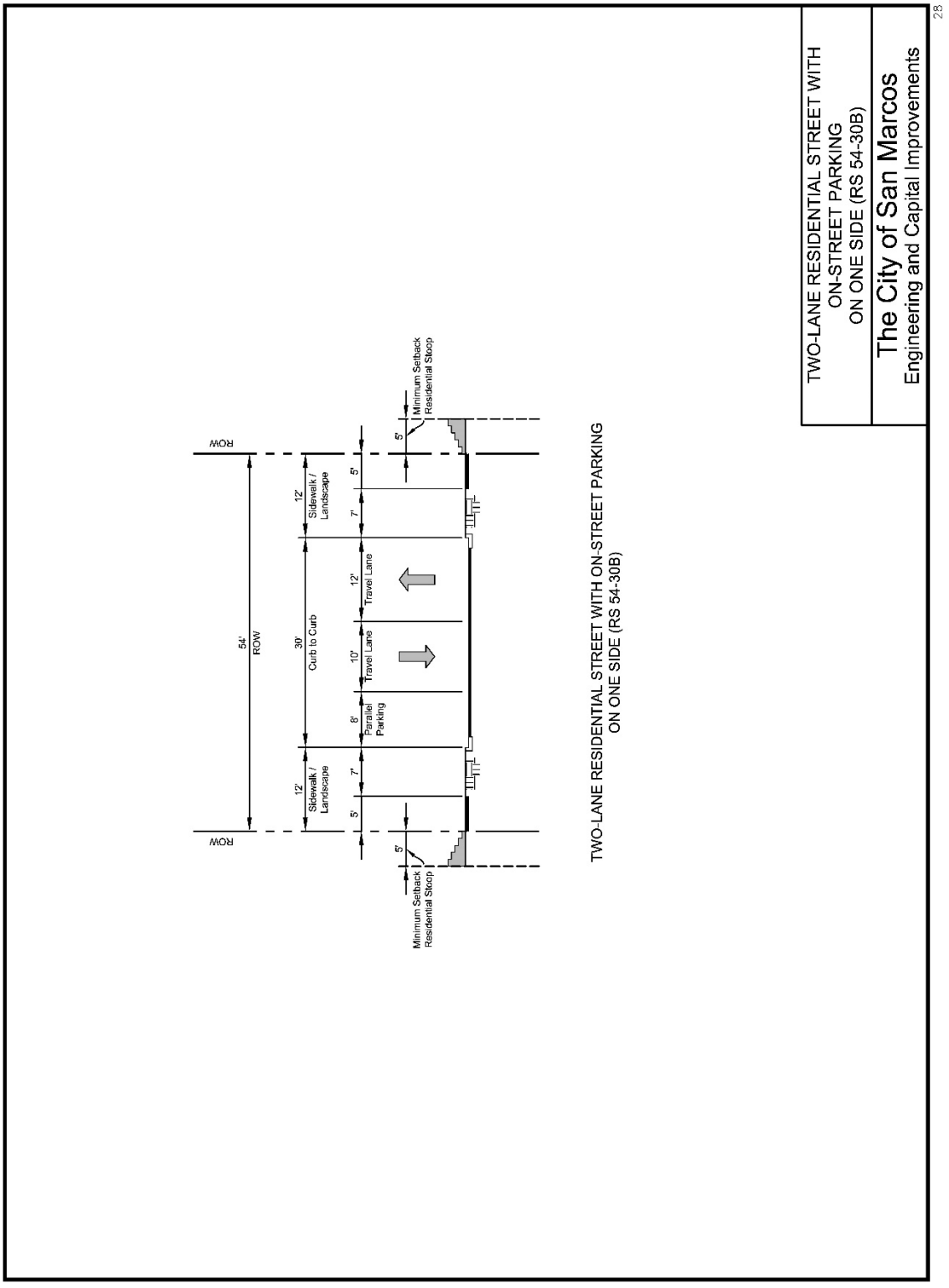


Figure 1-27: Two Lane Residential Street (RS 54-30B)

Figure 1-28: Two Lane Residential Street (RS 54-30C)

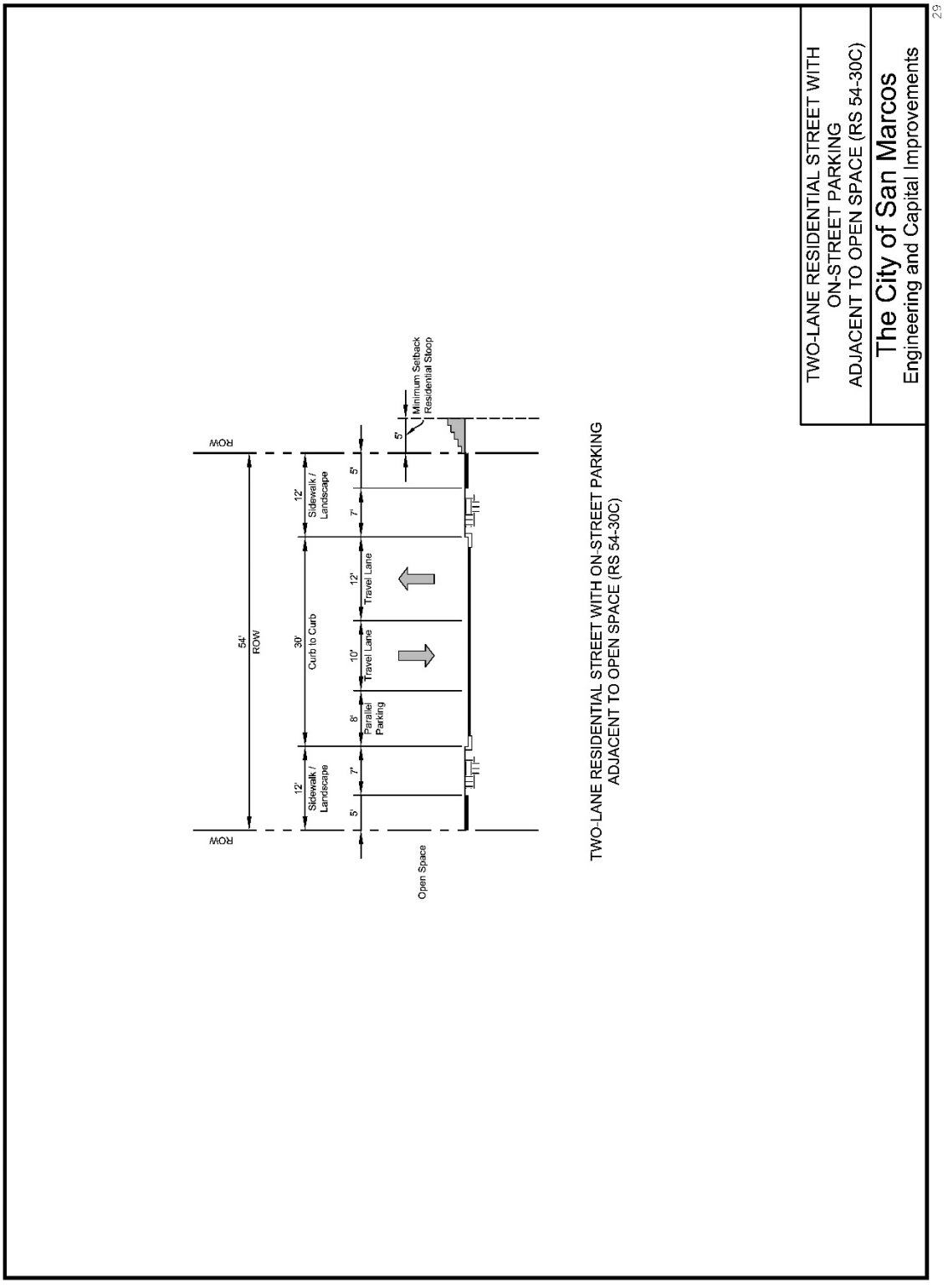
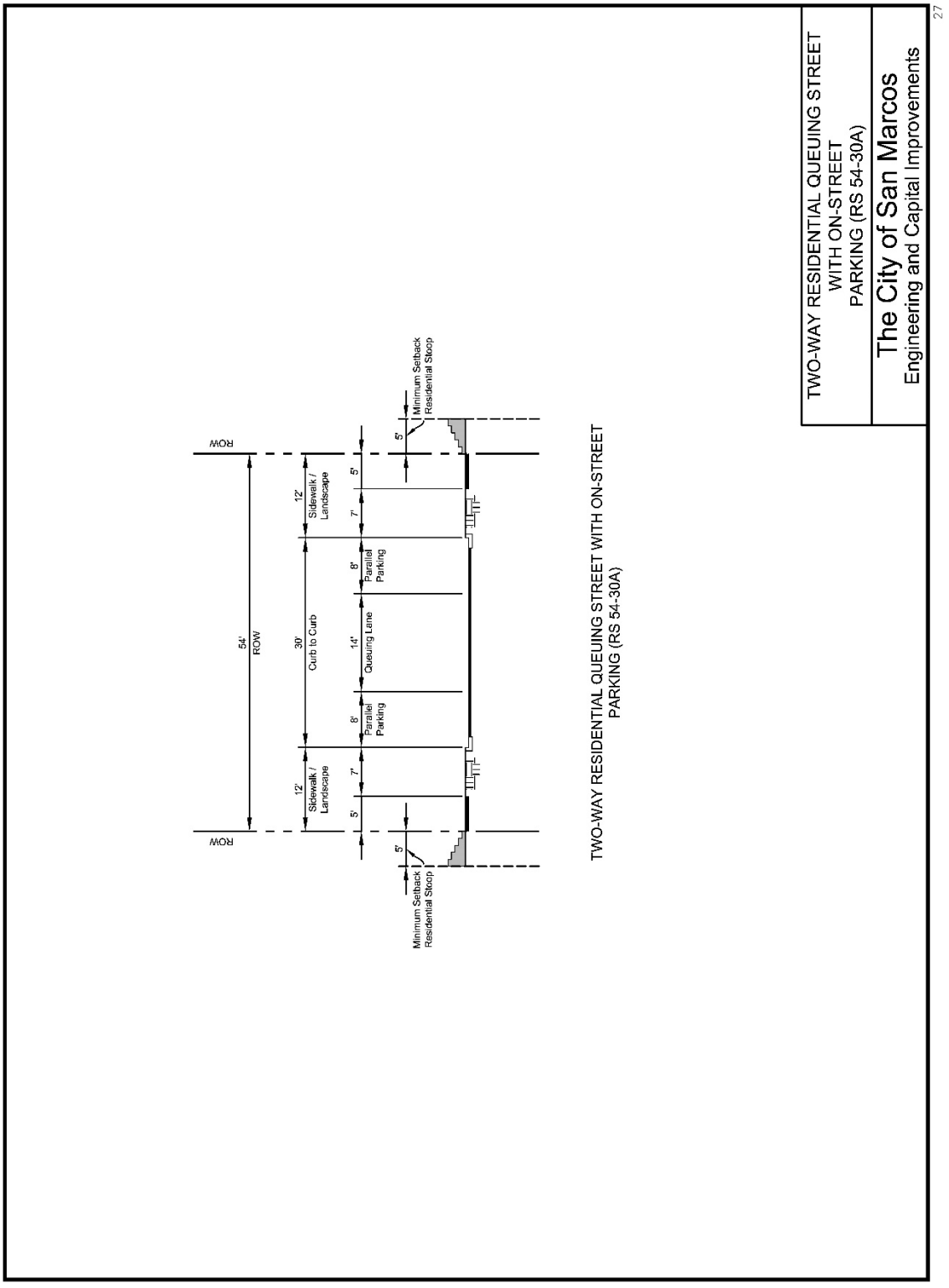


Figure 1-29: Two Lane Residential Queuing Street (RS 54-30A)



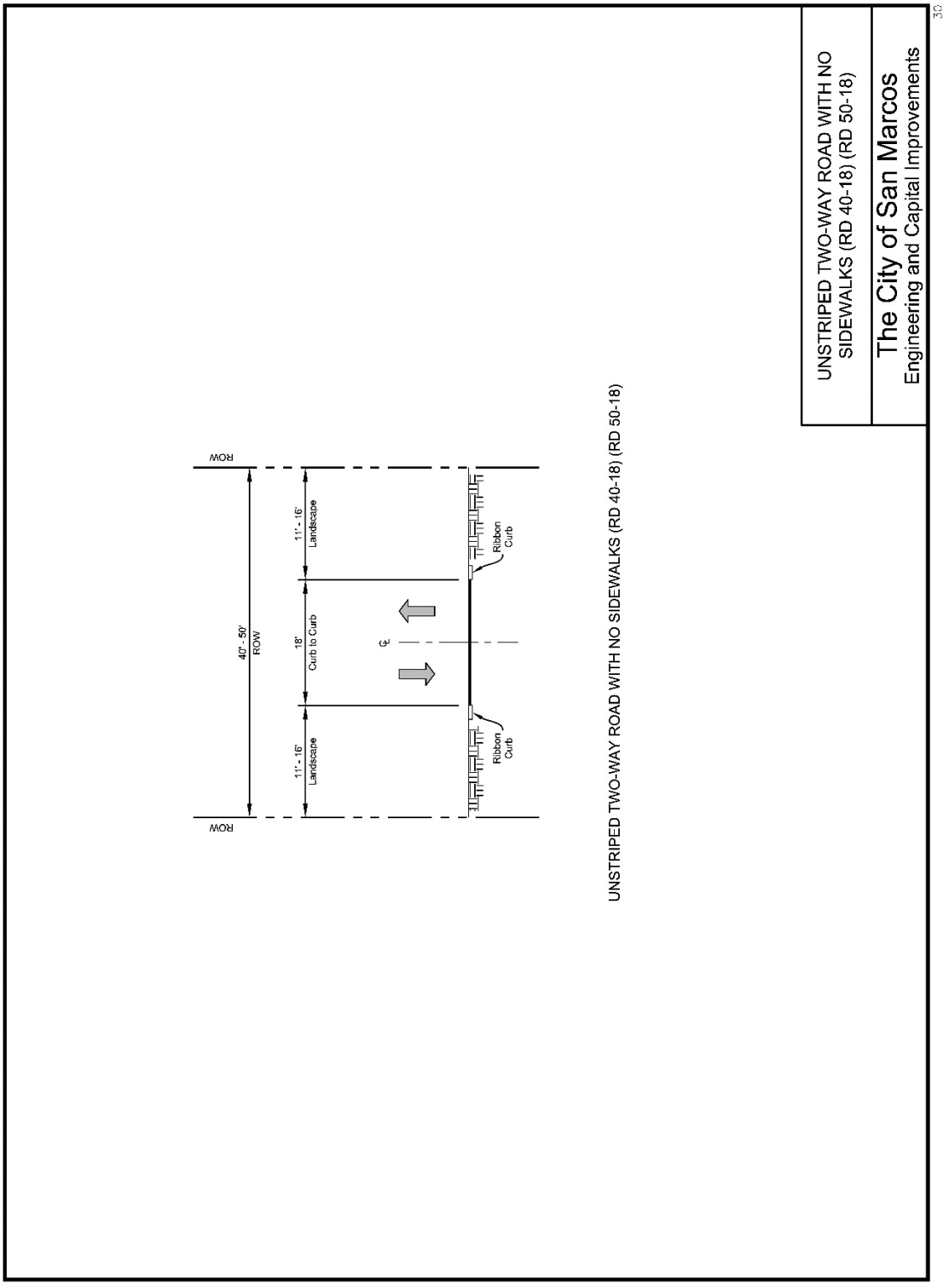


Figure 1-30: Unstriped Two Way Road (RD 40-18) (RD 50-18)

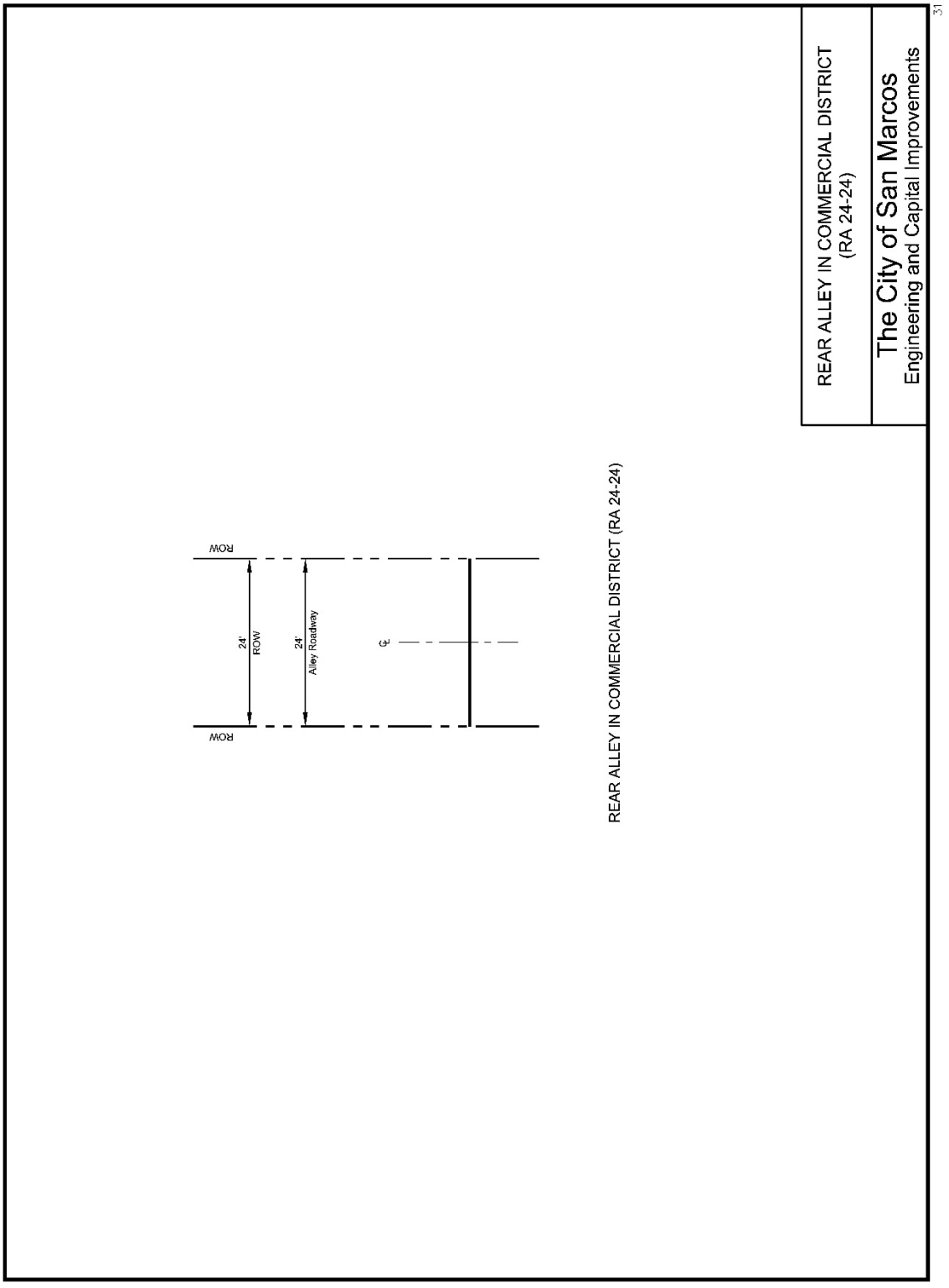


Figure 1-31: Commercial Rear Alley (RA 24-24)

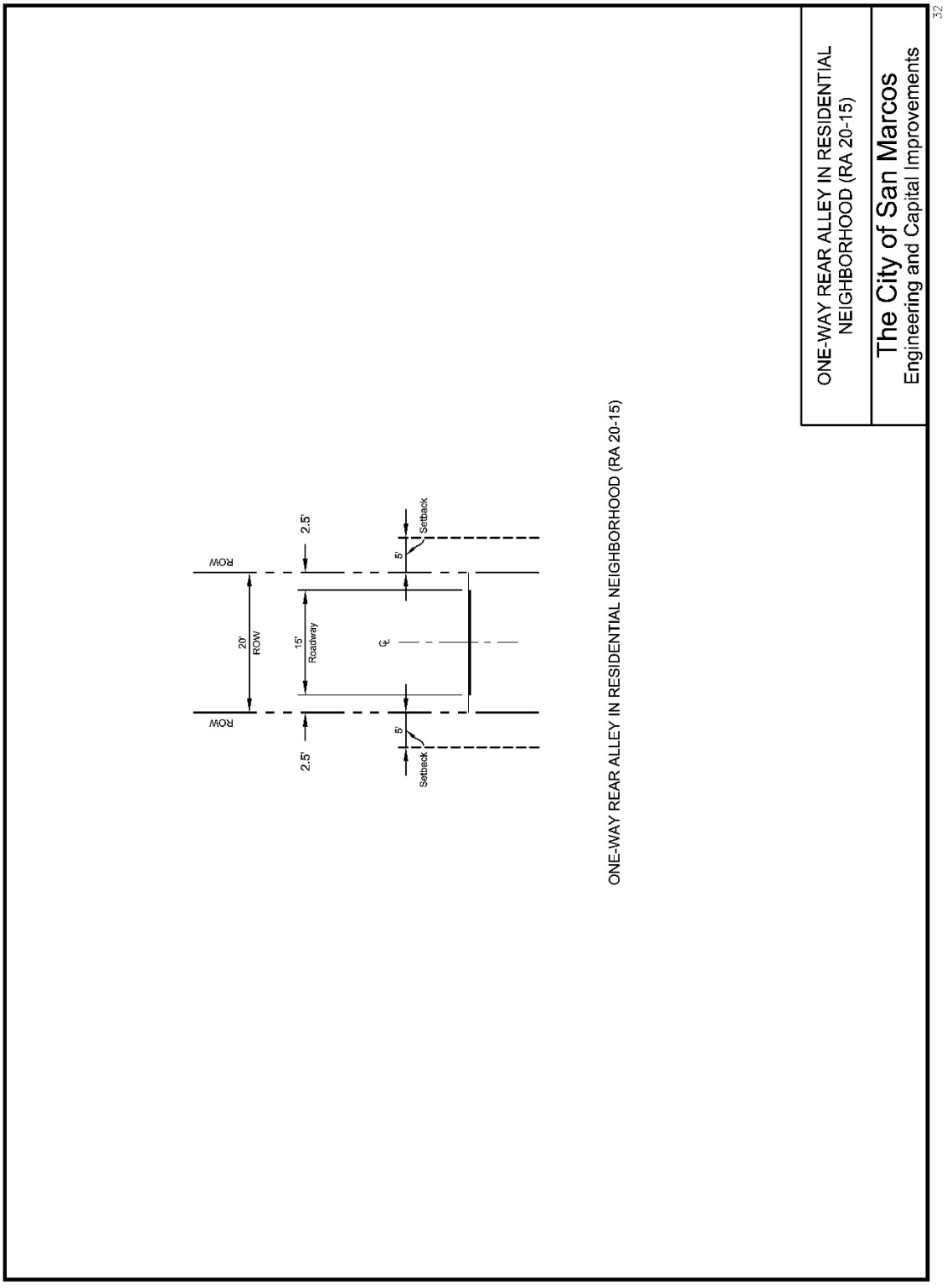


Figure 1-32: Residential Rear Alley (RA 20-15)

Table 1-1: Geometric Design Criteria - Highways

Geometric Design Criteria - Highways		
	Four Lane Parkway with Drainage and Off-Street Shared Path (HW 158-72)	**Four Lane Parkway with Off-Street Shared Path (HW 150-72)**
Cross Section Elements		
Transportation Design Criteria Manual Figure: Typical Section	1-1	1-2
Average Daily Traffic (ADT) (vehicles per day)	15,000 – 35,000	15,000 – 35,000
Target Speed (mph)	45	45
ROW Width (ft)	158	150
Pavement Width (FOC to FOC) (ft)	36	36
Median Width (FOC to FOC) (ft)	28	28
Sidewalk Width (ft)	12	12
Typical Spacing of Cross Street (ft)	1,000	1,000
Clear Zone (ft)	Minimum 14’ from the edge of travel lane	Minimum 3’ from face of curb
Horizontal Alignment		
Minimum Centerline Radius (ft)	750	750
Stopping Sight Distance (ft)	360	360
Superelevation rate “e” maximum (%)	4	4
Minimum Tangent between curves (ft) (Note 5)	150	150
Minimum Horizontal Tangent Length approaching an Intersection (ft)	75	75
Vertical Alignment		
Maximum Grade (%)	6	6
Minimum Grade (%)	0.5	0.5
Minimum Crest K-value	61	61
Minimum Sag K-value	79	79
Vertical Clearance Over/Under Roadway (ft)	16	16
Vertical Clearance Over Railroad (ft)	24	24
Intersections		
Intersection Sight Distance	See Section 1.8.3	See Section 1.8.3
Curb Return Radius	See Section 1.6.3	See Section 1.6.3
Design Vehicle Type (Note 6)	WB-62 (Interstate Semitrailer)	WB-62 (Interstate Semitrailer)

Notes:

1. This table lists the minimum design criteria. Additional guidelines i.e. AASHTO “A Policy on Geometric Design of Highways and Streets, TxDOT “Roadway Design Manual and other guidelines shall be utilized to develop design criteria. Deviations from listed criteria shall be approved by Director of Engineering or their designee.
2. Target speed shall be used for design purposes; however, the posted speed may be different

3. See bibliography for reference standards and guidelines
4. Refer to typical sections for further information
5. If superelevation is provided, the tangent length between curves shall be increased to include both transition lengths.
6. WB-67 may be required based on the typical delivery vehicle for the site.

Table 1-2: Geometric Design Criteria – Boulevards

Geometric Design Criteria - Boulevards									
	Boulevard with Cross Section								
	BV 173-110	**BV 150-72**	**BV 140-72**	**BV 125-72**	**BV 125-63**	**BV 115-71**	**BV 110-50**	**BV 100-50**	**BV 100-41**
Cross Section Elements									
Transportation Design Criteria Manual Figure: Typical Section	1-3	1-4	1-5	1-6	1-7	1-8	1-9	1-10	1-11
Average Daily Traffic (ADT) (vehicles per day)	25,000 – 40,000	25,000 – 40,000	25,000 – 40,000	25,000 – 40,000	12,000 – 30,000	12,000 – 30,000	12,000 – 30,000	12,000 – 30,000	6,000 – 15,000
Target Speed (mph)	35	35	35	35	35	35	35	35	35
ROW Width (ft)	173	150	140	125	125	115	110	100	100
Pavement Width (FOC to FOC) (ft)	24	36	36	36	31.5	31.5	25	25	20.5
Median Width (FOC to FOC) (ft)	18	28	18	18	18	8	18	17	12
Sidewalk Width (ft)	7	12	12	10.5	5	7	7	5	6.5
Typical Spacing of Cross Street (ft)	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Clear Zone (ft) (Note 1)	3	3	3	3	3	3	3	3	3
Horizontal Alignment									
Minimum Centerline Radius (ft)	350	350	350	350	350	350	350	350	350
Stopping Sight Distance (ft)	250	250	250	250	250	250	250	250	250
Superelevation rate “e” maximum (%)	6	6	6	6	6	6	6	6	6
Minimum Tangent between curves (ft) (Note 6)	100	100	100	100	100	100	100	100	100
Minimum Horizontal Tangent Length approaching an Intersection (ft)	75	75	75	75	75	75	75	75	75
Vertical Alignment									
Maximum Grade (%)	6	6	6	6	6	6	6	6	6
Minimum Grade (%)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Minimum Crest K-value	29	29	29	29	29	29	29	29	29
Minimum Sag K-value	49	49	49	49	49	49	49	49	49
Vertical Clearance Over/Under Roadway (ft)	16	16	16	16	16	16	16	16	16
Vertical Clearance Over Railroad (ft)	24	24	24	24	24	24	24	24	24
Intersections									
Intersection Sight Distance	See Section 1.8.3								
Curb Return Radius	See Section 1.6.3								
Design Vehicle Type (Note 7)	WB-62; (Interstate Semitrailer)								

Notes:

1. Minimum Clear Zone from the Face of the Curb
2. This table lists the minimum design criteria. Additional guidelines i.e. AASHTO “A Policy on Geometric Design of Highways and Streets, TxDOT “Roadway Design Manual and other guidelines shall be utilized to develop design criteria. Deviations from listed criteria shall be approved by Director of Engineering or their designee.
3. Target speed shall be used for design purposes; however, the posted speed may be different
4. See bibliography for reference standards and guidelines

5. Refer to typical sections for further information
6. If superelevation is provided, the tangent length between curves shall be increased to include both transition lengths.
7. WB-67 may be required based on the typical delivery vehicle for the site.

Table 1-3: Geometric Design Criteria – Avenues

Geometric Design Criteria - Avenues				
	Avenue with Cross Section			
	AV 100-50	**AV 100-47**	**AV 82-43A**	**AV 82-43B**
Cross Section Elements				
Transportation Design Criteria Manual Figure: Typical Section	1-12	1-13	1-14	1-15
Average Daily Traffic (ADT) (vehicles per day)	4,000 – 15,000	10,000 – 20,000	4,000 – 15,000	4,000 – 15,000
Target Speed (mph)	30	30	30	30
ROW Width (ft)	100	100	82	82
Pavement Width (FOC to FOC) (ft)	50	47	43	43
Median Width (FOC to FOC) (ft)	NA	NA	NA	NA
Sidewalk Width (ft)	8	6.5	5	5
Typical Spacing of Cross Street (ft)	500	500	500	500
Clear Zone (ft) (Note 1)	3	3	3	3
Horizontal Alignment				
Minimum Centerline Radius (ft)	250	250	250	250
Stopping Sight Distance (ft)	200	200	200	200
Superelevation rate “e” maximum (%)	None	None	None	None
Minimum Tangent between curves (ft) (Note 6)	100	100	100	100
Minimum Horizontal Tangent Length approaching an Intersection (ft)	50	50	50	50
Vertical Alignment				
Maximum Grade (%)	6	6	6	6
Minimum Grade (%)	0.5	0.5	0.5	0.5
Minimum Crest K-value	19	19	19	19
Minimum Sag K-value	37	37	37	37
Vertical Clearance Over/Under Roadway (ft)	16	16	16	16
Vertical Clearance Over Railroad (ft)	24	24	24	24
Intersections				
Intersection Sight Distance	See Section 1.8.3			
Curb Return Radius	See Section 1.6.3			
Design Vehicle Type (Note 7)	Single Unit Truck (SU) and Intermediate Semitrailer (WB-40)			

Notes:

1. Minimum Clear Zone from the Face of the Curb
2. This table lists the minimum design criteria. Additional guidelines i.e. AASHTO “A Policy on Geometric Design of Highways and Streets, TxDOT “Roadway Design Manual and other guidelines shall be utilized to develop design criteria. Deviations from listed criteria shall be approved by Director of Engineering or their designee.
3. Target speed shall be used for design purposes; however, the posted speed may be different
4. See bibliography for reference standards and guidelines
5. Refer to typical sections for further information

6. If superelevation is provided, the tangent length between curves shall be increased to include both transition lengths.
7. WB-62 may be required based on the typical delivery vehicle for the site.

Table 1-4: Geometric Design Criteria – Commercial Streets

Geometric Design Criteria – Commercial Streets									
	Commercial Street with Cross Section								
	CS 100-50	**CS 90-61**	**CS 90-40**	**CS 80-51**	**CS 70-40**	**CS 67-40**	**CS 60-36**	**CS 53-30**	**CS 44-20**
Cross Section Elements									
Transportation Design Criteria Manual Figure: Typical Section	1-16	1-17	1-18	1-19	1-20	1-21	1-22	1-23	1-24
Average Daily Traffic (ADT) (vehicles per day)	<10,000	<10,000	<10,000	<10,000	<10,000	<10,000	<10,000	<10,000	<10,000
Target Speed (mph)	30	30	30	30	30	30	30	30	30
ROW Width (ft)	100	90	90	80	70	67	60	53	44
Pavement Width (FOC to FOC) (ft)	50	61	40	51	40	40	36	30	20
Median Width (FOC to FOC) (ft)	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sidewalk Width (ft)	11	6.5	8	7.5	8	6	5	11.5	5
Typical Spacing of Cross Street (ft)	300	300	300	300	300	300	300	300	300
Clear Zone (ft) (Note 1)	3	3	3	3	3	3	3	3	3
Horizontal Alignment									
Minimum Centerline Radius (ft)	250	250	250	250	250	250	250	250	250
Stopping Sight Distance (ft)	1	200	200	200	200	200	200	200	200
Superelevation rate “e” maximum (%)	None	None	None	None	None	None	None	None	None
Minimum Tangent between curves (ft) (Note 6)	100	100	100	100	100	100	100	100	100
Minimum Horizontal Tangent Length approaching an Intersection (ft)	50	50	50	50	50	50	50	50	50
Vertical Alignment									
Maximum Grade (%)	6	6	6	6	6	6	6	6	6
Minimum Grade (%)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Minimum Crest K-value	29	29	29	29	29	29	29	29	29
Minimum Sag K-value	49	49	49	49	49	49	49	49	49
Vertical Clearance Over/Under Roadway (ft)	16	16	16	16	16	16	16	16	16
Vertical Clearance Over Railroad (ft)	24	24	24	24	24	24	24	24	24
Intersections									
Intersection Sight Distance	See Section 1.8.3								
Curb Return Radius	See Section 1.6.3								
Design Vehicle Type (Note 7)	Single Unit Truck (SU) and Intermediate Semitrailer (WB-40)								

Notes:

1. Minimum Clear Zone from the Face of the Curb
2. This table lists the minimum design criteria. Additional guidelines i.e. AASHTO “A Policy on Geometric Design of Highways and Streets, TxDOT “Roadway Design Manual and other guidelines shall be utilized to develop design criteria. Deviations from listed criteria shall be approved by Director of Engineering or their designee.
3. Target speed shall be used for design purposes; however, the posted speed may be different
4. See bibliography for reference standards and guidelines
5. Refer to typical sections for further information

6. If superelevation is provided, the tangent length between curves shall be increased to include both transition lengths.
7. WB-62 may be required based on the typical delivery vehicle for the site.

Table 1-5: Geometric Design Criteria – Residential Streets

Geometric Design Criteria – Residential Street					
	Residential Street with Cross Section				
	RS 70-24	**RS 60/70 – 30**	**RS 54-30A**	**RS 54 -30B**	**RS 54-30C**
Cross Section Elements					
Transportation Design Criteria Manual Figure: Typical Section	1-25	1-26	1-27	1-28	1-29
Average Daily Traffic (ADT) (vehicles per day)	<1,000	<1,000	<1,000	<1,000	<1,000
Target Speed (mph)	25	25	25	25	25
ROW Width (ft)	70	60-70	54	54	54
Pavement Width (FOC to FOC) (ft)	24	30	30	30	30
Median Width (FOC to FOC) (ft)	NA	NA	NA	NA	NA
Sidewalk Width (ft)	6	10	5	5	5
Typical Spacing of Cross Street (ft)	200	200	200	200	200
Clear Zone (ft) (Note 1)	3	3	3	3	3
Horizontal Alignment					
Minimum Centerline Radius (ft)	160	160	160	160	160
Stopping Sight Distance (ft)	155	155	155	155	155
Superelevation rate “e” maximum (%)	None	None	None	None	
Minimum Tangent between curves (ft)	50	50	50	50	50
Minimum Horizontal Tangent Length approaching an Intersection (ft)	50	50	50	50	50
Vertical Alignment					
Maximum Grade (%)	8	8	8	8	8
Minimum Grade (%)	0.5	0.5	0.5	0.5	0.5
Minimum Crest K-value	12	12	12	12	12
Minimum Sag K-value	26	26	26	26	26
Vertical Clearance Over/Under Roadway (ft)	16	16	16	16	16
Vertical Clearance Over Railroad (ft)	24	24	24	24	24
Intersections					
Intersection Sight Distance	See Section 1.8.3				
Curb Return Radius	See Section 1.6.3				
Design Vehicle Type	Passenger Vehicle (P) and Single Unit Truck (SU)				

Notes:

1. Minimum Clear Zone from the Face of the Curb
2. This table lists the minimum design criteria. Additional guidelines i.e. AASHTO “A Policy on Geometric Design of Highways and Streets, TxDOT “Roadway Design Manual and other guidelines shall be utilized to develop design criteria. Deviations from listed criteria shall be approved by Director of Engineering or their designee.
3. Target speed shall be used for design purposes; however the posted speed may be different
4. See bibliography for reference standards and guidelines
5. Refer to typical sections for further information

1.3 RIGHT OF WAY, STREET AND LANE WIDTHS

The minimum right of way (ROW) for each street classification is shown in **Table 1-1** through **Table 1-5**. The City may require wider widths depending on the need for additional turning lanes or variable terrain.

The minimum lane widths for each street classification is shown in **Figure 1-1** through **Figure 1-32**. The minimum lane width shall be 12 feet, when it's not shown in typical cross section. Any variance in the lane width requirements shall be approved by Director of Engineering or their designee.

1.4 SIGHT DISTANCE CRITERIA

1.4.1 Stopping Sight Distance

The available stopping sight distance on a roadway shall be sufficient for a vehicle traveling at the design speed to stop before reaching a stationary object ahead. Stopping sight distance is a sum of two distances: brake reaction time and braking distance. The brake reaction time is the time it takes for the driver to see an object ahead and apply the brakes. A value of 2.5 seconds is the default; however, this time may need to be increased depending on road conditions. The braking Distance is the distance traveled by the vehicle after the brakes are applied and before the vehicle can come to a complete stop. A vehicle deceleration rate of 11.2 ft/ s2 is the default used; however, this rate may need to be reduced depending on the road conditions. For calculating the stopping sight distance, the height of the driver's eye is estimated to be at 3.5 ft and the height of the object is estimated at 2 ft. **Table 1-6** provides the minimum required stopping sight distance for different design speeds. Although greater lengths of visibility are preferred, these minimum stopping sight distances should be maintained at every point along the roadway. These stopping sight distances are also applicable for crest and sag vertical curves.

Table 1-6: Minimum Stopping Sight Distance (SSD)

Minimum Stopping Sight Distance (SSD)	
Design Speed (mph)	**Minimum SSD (feet)**
15	80
20	115
25	155
30	200
35	250
40	305
45	360
50	425
55	495
60	570
65	645
70	730

1.4.2 Site Obstructions

On a tangent roadway, obstructions that limit the driver's view include the roadway surface at some point along a vertical crest or a physical feature outside the travel way. Therefore, all subdivision and site plans submitted to the City should be reviewed for sight distance obstructions in both the vertical

and horizontal plane. The most recent version of the AASHTO 's Green Book shall be used for measuring and recording sight distances on plans.

1.4.3 Intersection Site Distance

Refer to Section 1.12.8 for details on intersection sight triangles and sight distance requirements.

1.5 HORIZONTAL AND VERTICAL ALIGNEMENT

1.5.1 General

As vehicles move in a circular path, they undergo a centripetal acceleration that pushes towards the center of the curve. This centripetal acceleration is governed by the vehicle's weight related to the superelevation of the roadway and the side friction that develops between the vehicle's tires and the pavement surface. Limiting values for superelevation rate (e) and side friction demand (f) have been established for the design of horizontal curves and are discussed below.

1.5.2 Horizontal Alignment

Horizontal alignment shall conform to the currently adopted City of San Marcos Transportation Master Plan, Transportation Design Criteria Manual, approved ROW plans, and approved subdivision plats. Street alignment shall provide continuous alignment with existing, planned, or platted street with which they will connect.

All streets shall be extended to the property lines across the property to be developed, unless the street to be constructed has been approved by the City as a cul-de-sac or other no-outlet street.

The minimum horizontal radii for the various functional classifications are shown in Table 1-1a through Table 1-1e. Refer to the TxDOT Roadway Design Manual for further discussion of low-speed and high-speed highways with or without superelevation.

The minimum radius is calculated from the following formula:

$$\mathbf{R = V^2 / [15 \times (e+f)]}$$

Where: R = curve radius in feet
V = design speed in mph
e = superelevation rate per feet
f = side friction factor as per Table 1-3

1.5.2.1 Side Friction Factor

Horizontal curves should be designed at a side friction demand which will provide a safe and comfortable maneuver over the horizontal curve for a majority of drivers. The upper limit on side friction factor is also known as the point of impending skid, it is that point when tires begin to skid. Side friction factor shall be determined based on the type of facility being designed using the most recent version of the AASHTO's Green Book's guidelines. **Table 1-7** describes the maximum allowable side friction factors

Table 1-7: Side Friction Factors

Side Friction Factors	
Design Speed (mph)	**Side Friction Factor (f)**
25	0.23
30	0.20
35	0.18
40	0.16
45	0.15

1.5.2.2 Superelevation

The factors that limit the rate of superelevation are climatic conditions, terrain conditions, constructability, and type of area, adjacent land uses, and frequency of slow moving vehicles. If the roadway design is to include superelevation, a maximum rate of 6% is recommended for urban conditions, primarily due to narrow ROW widths, driveway grades, and ADA/TAS criteria for an accessible route within crosswalks and driveways. **Table 1-8** provides superelevation rates that should be used for design.

Table 1-8: Superelevation Rates and Applicable Conditions

Superelevation Rates and Applicable Conditions	
Superelevation Rate (%)	**Conditions**
1.5 to 2	Minimum needed for drainage Low speed urban street with constraints
4 to 6	Urban design with little to no constraints
8	Maximum allowable with approval required from Director of Engineering or their designee

1.5.2.3 Transition Design Curves

Transition design curves shall meet the design requirements set forth in the most recent version of AASHTO's Green Book.

1.5.3 Vertical Alignment

The maximum grade for the various street classifications is shown in Table 1-1a through Table 1-1e. Short grades less than 500 feet in length may be up to 2% steeper if necessary.

The minimum grade specified in Table 1-1a through Table 1-1e shall be maintained for curb and gutter streets in order to provide adequate drainage of the pavement surface.

The vertical grade line shall be designed such that proposed or future cross walks meet the requirements of an accessible route in accordance with the ADA. The vertical grade shall consider the interface between back of sidewalk/shared use path and the ultimate surface elevation just outside the ROW in order to accommodate drainage needs.

Designing a sag or crest vertical point of intersection without a vertical curve is generally acceptable where the grade difference is:

- 1.0% or less for design speeds equal to or less than 45 mph; or,
- 0.5% or less for design speeds greater than 45 mph

The maximum “K” value for vertical sag and crest curves is shown in Table 1-1a through Table 1-1e. The “K” value is used in the formula:

L = K x A

Where: L = vertical curve length in feet
K = length of vertical curve per percent change in A (see Table 1-1a through Table 1-1e)
A = algebraic difference in tangent grades in percent

The minimum vertical curve length shall be at least three times the design speed.

1.6 HORIZONTAL CLEARANCE

Roadside obstructions should be located at or near the right-of-way line and beyond the sidewalks. On urban streets with no shoulders, a clearance of 3 feet or more beyond the face of the curb should be provided.

1.7 VERTICAL CLEARANCE

Vertical clearance at underpasses for residential streets should be at least 14 feet, over the entire roadway width, with an additional allowance for resurfacing. The vertical clearance for Commercial Streets, Avenues, Boulevards and Highways should be at least 16 feet.

1.8 CROSS SLOPES

Pavement cross-slopes should be adequate to provide proper drainage. Cross-slopes should be 1.5 to 3.0 percent where there are flush shoulders adjacent to travel ways or where there are outer curbs.

1.9 STREET AND SUBDIVISION LAYOUTS

Adequate streets shall be provided within the subdivision and the arrangement, character, extent, width, grade and location of each shall conform to the comprehensive plan and shall be considered in their relation to existing and planned streets, topographical conditions, public safety and convenience and in their appropriate relationship to the proposed uses of land to be served by the streets. The street layout shall be devised for the most advantageous development of the entire neighborhood and to maintain connectivity to adjacent development.

1.9.1 Street Lighting

Lighting should be provided to improve the safety of highways or streets and the ease and comfort of operation. Properly designed street lighting will improve comfort and visibility at night. This should improve and encourage vehicular and pedestrian movement. Streetlights shall be installed within the subdivision at all intersections, at the end of cul-de-sacs and shall have no greater distance than 600 feet between them within or abutting the subdivision.

1.9.2 Utilities Assignment

All public utilities shall be contained within the public street right-of-way or abutting utility easement not less than 20’ as required by the Water/Wastewater Design Manual. It is the City's policy to locate the water, wastewater, and storm sewer utilities under the paved street section within the City’s ROW

or in an easement outside the City's ROW. Electric, natural gas, telephone, and cable television utilities shall be located between the right-of-way line and back of curb (outside the paved street section), where permissible.

The utility assignments described in **Table 1-8** And **Figure 1-34** shall be complied with for all new City streets.

Table 1-9: Utility Assignments

Utility Assignments	
Utility	**Location**
Water*	7' from back of the curb or 5' from edge of the pavement without curb
Wastewater**	Center of the outer vehicular travel lane
Storm Sewer	5 Feet Offset Street Centerline, High Side of Street
Electric***	2 Feet Inside Right-of-Way Line
Natural Gas***	7 Feet Inside Right-of-Way Line
Telecommunications***	2 Feet Inside Right-of-Way Line

Note:

Telephone, Cable and Electric (if underground) must be installed in a common trench
*as per water design criteria
**asper section 1.6 of wastewater design criteria
**typically installed in easements for new construction (development)

1.9.3 Cul-De-Sac

Cul-de-sac streets are open at one end, with the closed end constructed to allow traffic to turn around within the cul-de-sac. Single outlet streets serve a network of streets with one (1) point of access. **Figure 1-34** through **Figure 1-36** illustrates criteria for residential and non-residential cul-de-sacs, respectively.

The maximum length shall be 500 feet, measured from the centerline of the nearest intersecting street to the center point of the cul-de-sac. Lengths exceeding 500 feet, however, will required a recommendation from the City's Fire Department and approval by Director of Engineering or their designee.

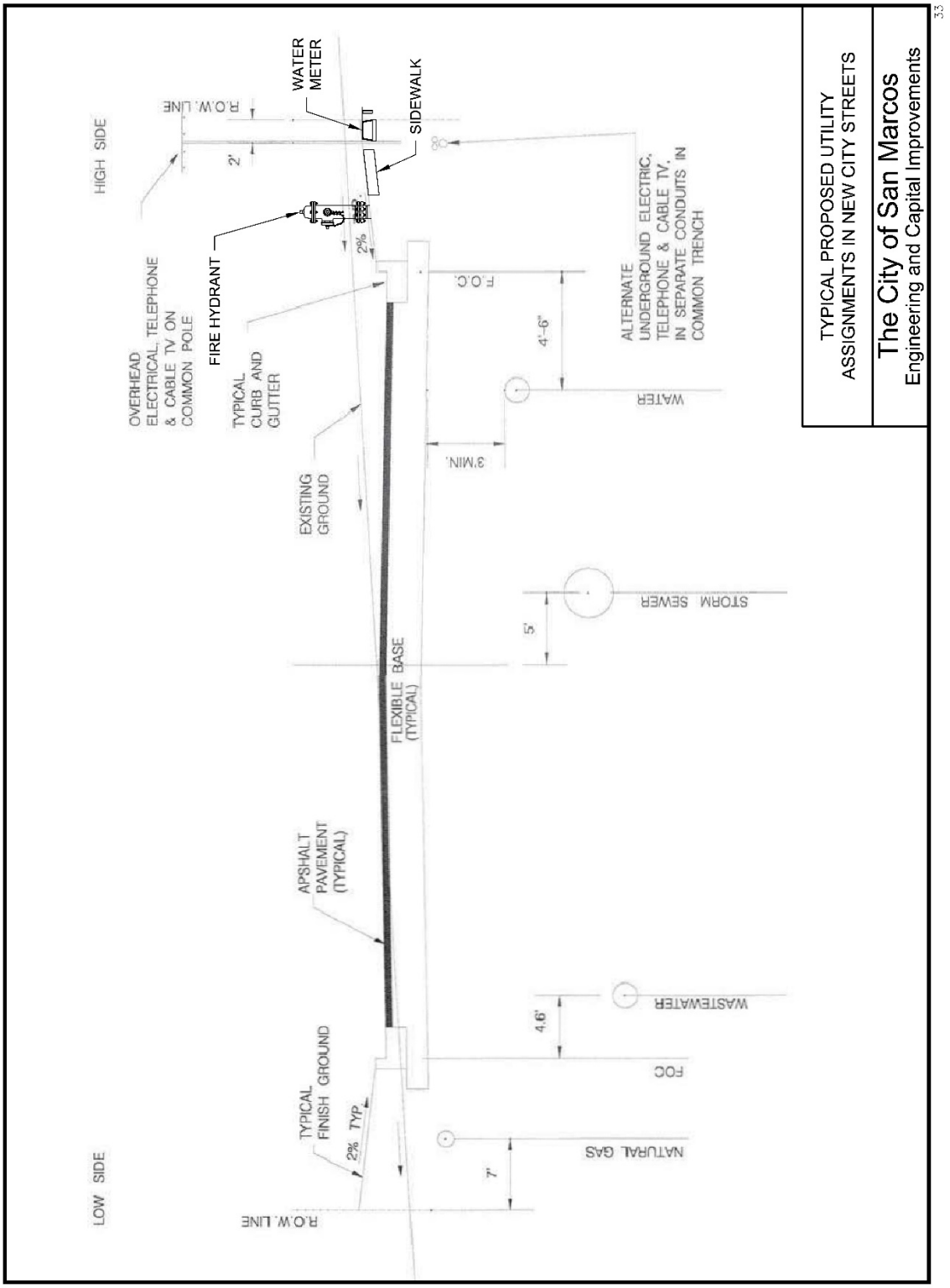


Figure 1-33: Utilities Assignment

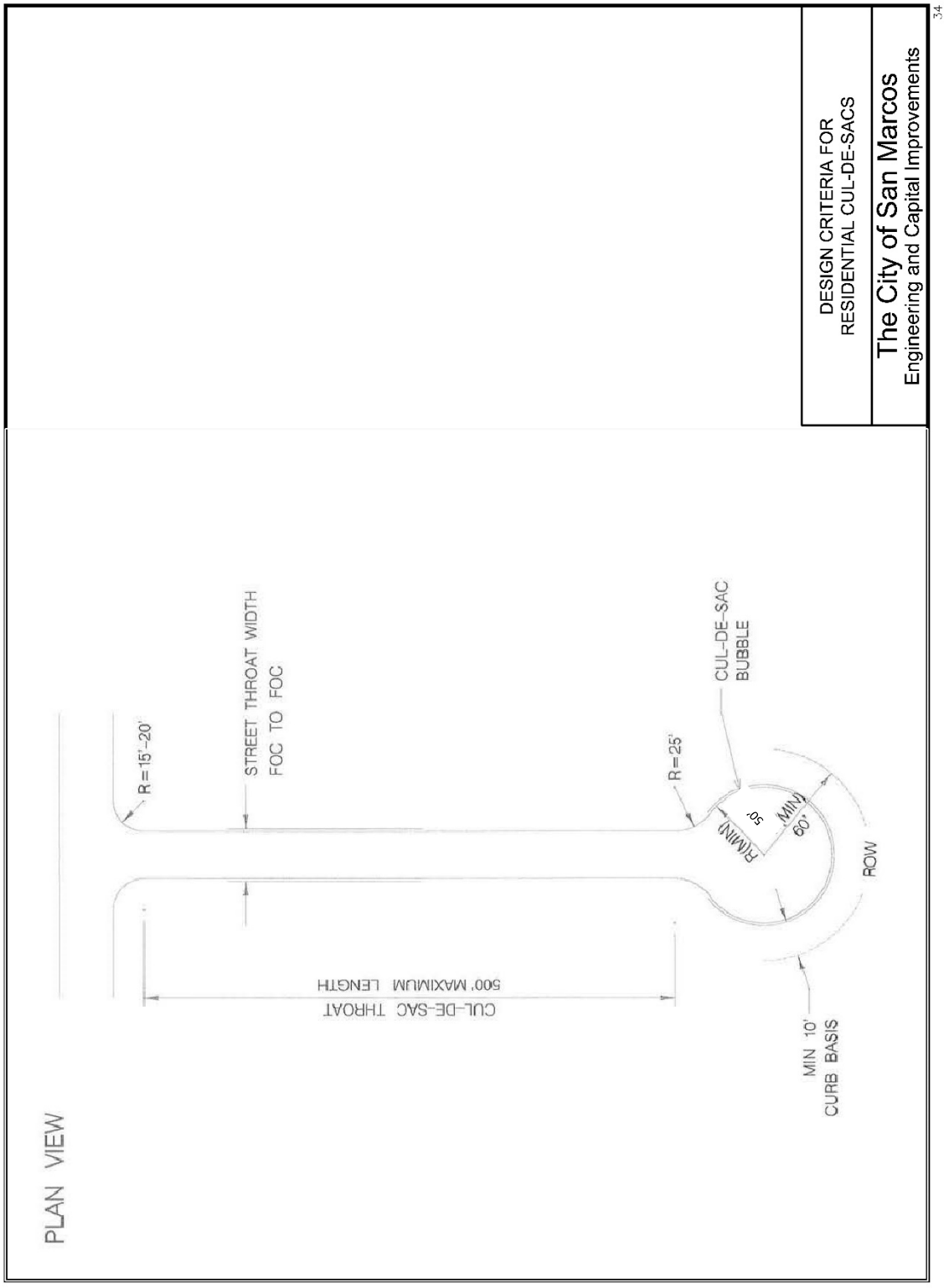


Figure 1-34: Design Criteria for Residential Cul-De-Sacs

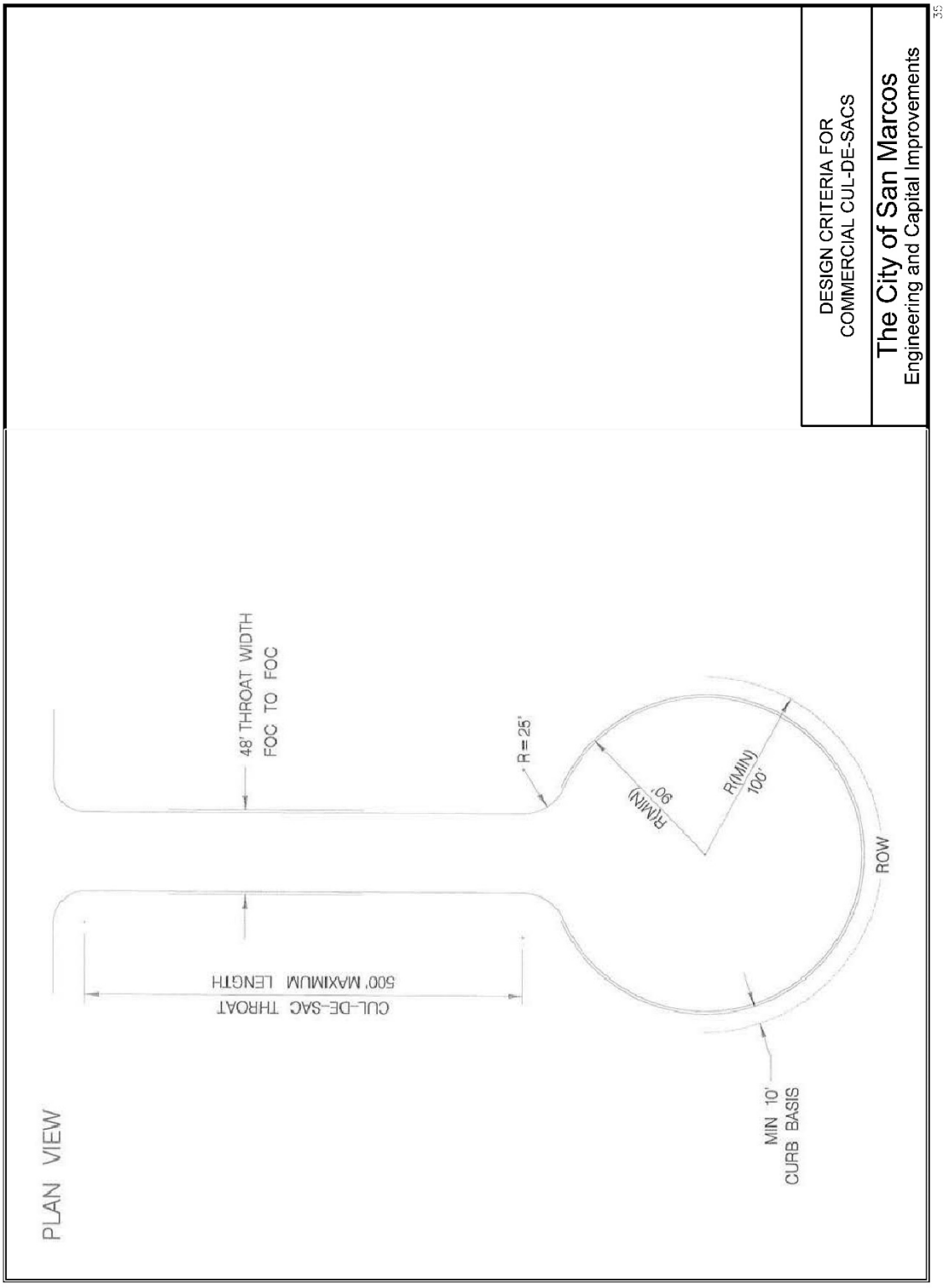


Figure 1-35: Design Criteria for Commercial Cul-De-Sacs

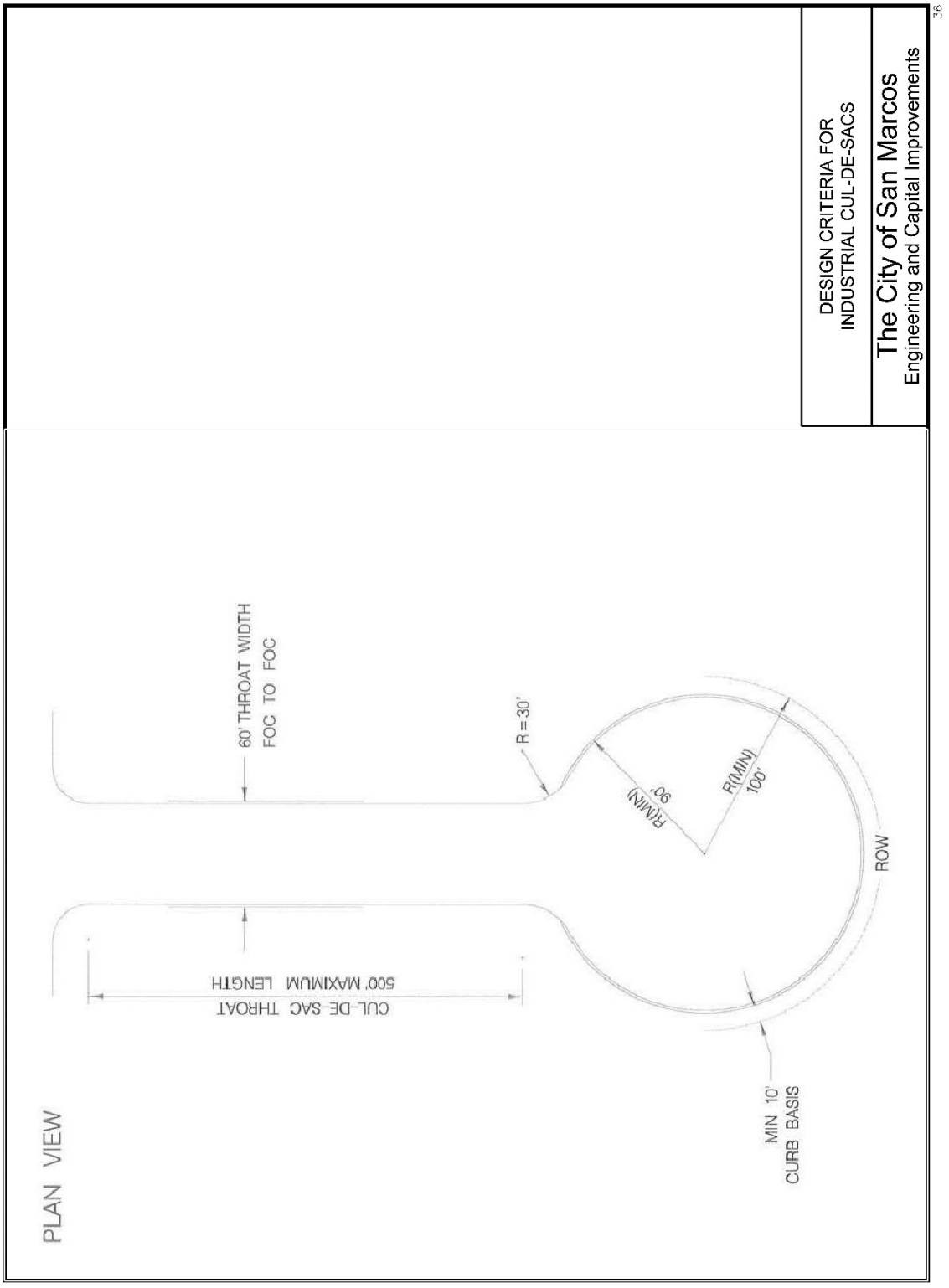


Figure 1-36: Design Criteria for Industrial Cul-De-Sacs

Only residential streets can be terminated in a cul-de-sac. Commercial Streets, Avenues and Boulevards shall not terminate in a cul-de-sac.

The minimum right-of-way radius for residential cul-de-sac shall be 60 feet with a minimum driving surface radius of 50 feet. The minimum right-of-way radius for non-residential cul-de-sac shall be 100 feet with a minimum driving surface radius of 90 feet.

Construction of cul-de-sac shall include proper signage at the entrance to inform drivers that the street is not a through street. Care shall be taken to design cul-de-sac drainage, utilities and incidentals to avoid perimeter conflicts such as curb inlets, utilities and proposed driveways.

Dead-end streets that are stubbed out for future extension to the adjacent property must terminate in an open ended cul-de-sac, unless the dead-end street is less than 150 feet long, in which case the cul-de-sac may be omitted.

Table 1-10Table 1-10: Cul-De-Sac Requirements describes minimum cul-de-sac requirements.

Table 1-10: Cul-De-Sac Requirements

Cul-De-Sac Requirements		
Design Elements	**Residential**	**Non-Residential**
Right-of-Way (ft)	60	100
Pavement Radius (ft)	50	90
Center Island Radius (ft) (if desired)	20	NA

1.9.4 Single Outlet Streets

Issues regarding single outlet streets are partially alleviated by providing mid-block turnarounds, increasing pavement widths, and utilizing divided roadways as shown in **Table 1-11**. The following single outlet street criteria are applicable to new developments. When future extensions of the street network are anticipated, which will add outlets, a temporary restriction may be placed on the amount of development allowed, until an additional outlet is available.

Table 1-11: Single Outlet Streets

Single Outlet Streets	
Average Daily Traffic Volume	**Street Width (FOC to FOC) (ft)**
<300	30’
300 – 1000	36’
1000 – 2500	40’ or 44’
2500 – 4000	2 @ 24’ w/16’ min median width
>4000	TIA Required

Source: City of Austin's Transportation Criteria Manual

** If the distance from the beginning of the single outlet street to the end of the cul-de-sac throat exceeds 2000', then the single outlet street must be designed with 2@ 24' w/ 16' min median width.*

1.9.5 Half Streets or Half Alleys

No half streets or half alleys are permitted along the boundaries of proposed subdivisions.

1.9.6 Block Lengths

Residential blocks in subdivisions shall not exceed twelve hundred (1,200) feet in length nor be less than six hundred (600) feet unless such blocks are parallel to and adjacent to a thoroughfare, in which case such blocks shall not exceed sixteen hundred (1,600) feet in length. Commercial and industrial block lengths may be up to two thousand (2,000) feet in length: provided, that the requirements of traffic circulation and utility service are met. Block lengths may be varied according to the requirements of circulation, utility service, topography and provisions of the Land Development Code and Master Plans.

1.9.7 Block Widths

Block widths in subdivisions shall be such to allow for two (2) tiers of lots back to back, except where abutting a thoroughfare to which access to the lots is prohibited, or where prevented by topographical conditions or size of the property.

1.9.8 Marginal Access Streets

Where a subdivision has frontage on a Boulevard, the Planning and Zoning Commission may require marginal access streets to be provided on both sides or on the subdivision side of the Boulevard, if the Street borders the subdivision, unless the adjacent lots back up to, side up to or front with extra depth and access off an alley and provide some other means of restricting individual access.

1.9.9 Relation to Adjoining Street System

Where necessary to the neighborhood pattern, existing streets in adjoining areas shall be continued and shall be at least as wide as the existing streets and in alignment with the existing streets.

1.9.10 Projection of Streets

Where adjoining areas are not subdivided, the arrangement of streets in the subdivision shall make provision for the proper projection of streets into the unsubdivided area.

1.9.11 Connectivity

Connectivity, an interconnected roadway network, promotes public health, safety and welfare of the city. It is necessary to ensure that all streets function in an interdependent manner to provide adequate access for emergency and service vehicles as well as improve walkability. All streets in a proposed subdivision shall be continuous and connect to existing, platted, or planned streets, unless approved by Director of Engineering or their designee.

1.9.12 Street Names

New streets in a subdivision shall be named in a way that will provide continuity of street names and prevent conflict or confusion with existing street names in the City, in the City's extraterritorial jurisdiction or in a neighboring jurisdiction. A proposed new street name is in conflict with the subsection where:

- It duplicates or sounds phonetically similar to the name of a street already in use within the city or the city's extraterritorial jurisdiction or designated as a future extension in the current thoroughfare plan;
- It differs from an existing street name in the city or the city's extraterritorial jurisdiction by the addition of an auxiliary designation including "avenue," "way," "boulevard," "etc.; or

- The street to be named is an extension of or is in substantial alignment with an existing street in the city, the city's extraterritorial jurisdiction or a neighboring jurisdiction and the proposed street name is different from the existing street name.

Renaming of existing streets shall be initiated by either a citizen petition, or by the City. This request for renaming an existing street shall be approved by the Planning and Zoning Commission and by the City Council.

1.9.13 Street Signs

Street signs shall be installed within the Subdivision at all intersections within or abutting the subdivision. These signs shall be of a type approved by the city and will be installed according to city standards.

1.9.14 Curb & Gutters

Curbs and gutters or extended curbs shall be installed in the subdivision on both sides of all interior streets and on the subdivision side of all streets forming part of the boundary of the subdivision, according to city construction standards.

1.9.15 Conformity to Design Requirements

No plat will be approved by the Planning and Zoning Commission or the Planning Director, no construction plans will be approved by Director of Engineering or their designee, and no completed improvements will be approved or accepted by the City's Engineering Department, unless they conform to the transportation design requirements and City standards.

1.10 ENVIRONMENTAL CONSIDERATIONS

All new or rehabilitated City streets shall be designed to minimize the limits of disturbance (construction) and the removal of existing trees. All existing trees to remain within the limits of disturbance shall be adequately protected by fencing or other approved means. It is recommended that the selected alignments of all new City streets be based on an on-the-ground survey of all existing trees, 12" and larger in diameter. Revegetation of the disturbed pervious areas shall be accomplished as soon as possible after paving and/or sidewalk construction is completed in order to minimize any erosion potential.

For any City street construction over the Edwards Aquifer Recharge Zone or Contributing Zone, conformance to the Texas Commission on Environmental Quality (TCEQ) regulations shall be required. Where applicable, water quality control improvements are to be provided with the street construction, and, shall be totally contained within the public street right-of-way or abutting drainage easement (on private property). The design of any City street-related water quality control improvements shall be made by a licensed Professional Engineer required in the State of Texas.

1.11 DRAINAGE ISSUES FOR ROADWAYS

The drainage designs for all new or rehabilitated City streets should comply with the objectives and goals of the City's Drainage Master Plan - one of them being "to limit the impact of storm flows on roadway inundation." In order to help meet this goal, San Marcos has developed Drainage Criteria Manual. This manual does provide adequate technical design criteria to limit flooding of roadways. Some of the design criteria includes the following:

- Drainage improvements, being curbs and gutters, inlets and storm sewers, shall be designed to intercept and convey all runoff from the 25-year frequency storm. Additionally, the 100-year frequency storm flows shall be conveyed within specifically defined rights-of- way or drainage easements.
- For bridges and culverts in residential and non-residential streets, the 100-year frequency storm runoff shall not result in a depth at the roadway greater than 12" and 6", respectively, or to the top of the upstream curb elevation, whichever is lower.
- Curb inlets and storm sewers shall be located and designed to minimize interference to traffic by reducing the depth and spread of water in the street section. The street crown will not be allowed to be lowered to obtain additional hydraulic capacity.
- For all new or rehabilitated City streets without curbing, all flows are to be totally contained within a parallel roadside channel or ditch. Additionally, all driveway and street crossing culverts shall have 6:1 end treatments in accordance with TxDOT standard details.
- Stormwater discharges from a public drainage system shall not exceed a velocity of six (6) feet per second without velocity dissipation and erosion protection measures.
- All drainage computations relating to new or rehabilitated construction of City streets shall be prepared by a Licensed Professional Engineer registered in the State of Texas.

1.12 INTERSECTIONS

1.12.1 General

An intersection is an area where two or more roadways join or cross. Intersections form an area of conflict for vehicles, pedestrians, and cyclists and should be designed to facilitate safety, efficiency, ease and convenience for pedestrians, cyclists and motor vehicles.

1.12.2 Types of Intersections

Intersections can have three-legs (T intersection), four-legs, or be roundabouts. Intersections with more than four legs are discouraged. **Figure 1-37** through **Figure 1-39** detail a three-leg intersection, four-leg intersection and roundabout.

1.12.3 Angles

Proposed public street must intersect on another at 90-degree angles or as close as possible within a range of 80 to 100 degrees. Any variance from this requirements shall be approved by Director of Engineering or their designee.

1.12.4 Spacing and Offsets

Several studies of intersection design types have shown T-type intersections to be far safer than four-leg intersections. Extensive use of “T” intersections in residential subdivisions is strongly recommended. One disadvantage, however, is “corner cutting” when inadequate offset exists between adjacent intersections. To reduce “corner cutting” due to inadequate offset distance, intersecting streets shall be offset at least 300 feet between the edges of pavement of the two streets.

Offset intersections have disadvantages when one (1) or both such streets is an Avenue or Commercial Street intersecting each other or a Boulevard, if volumes with be such to warrant traffic signals.

Operations at such location are more complicated than those for normal cross-type intersections. Therefore, other design solutions should be sought if signalization might otherwise be required. When

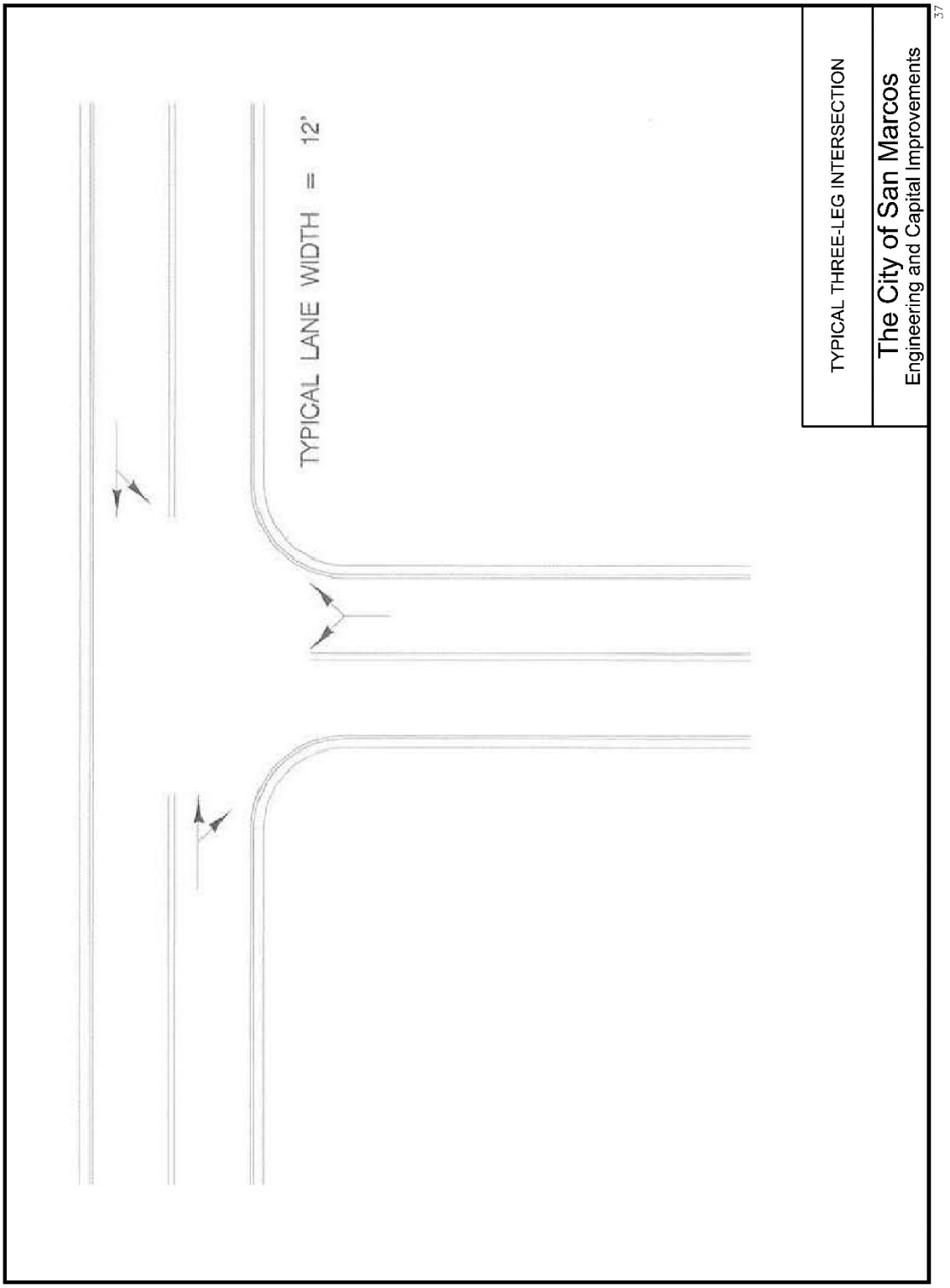


Figure 1-37: Three Leg Intersection

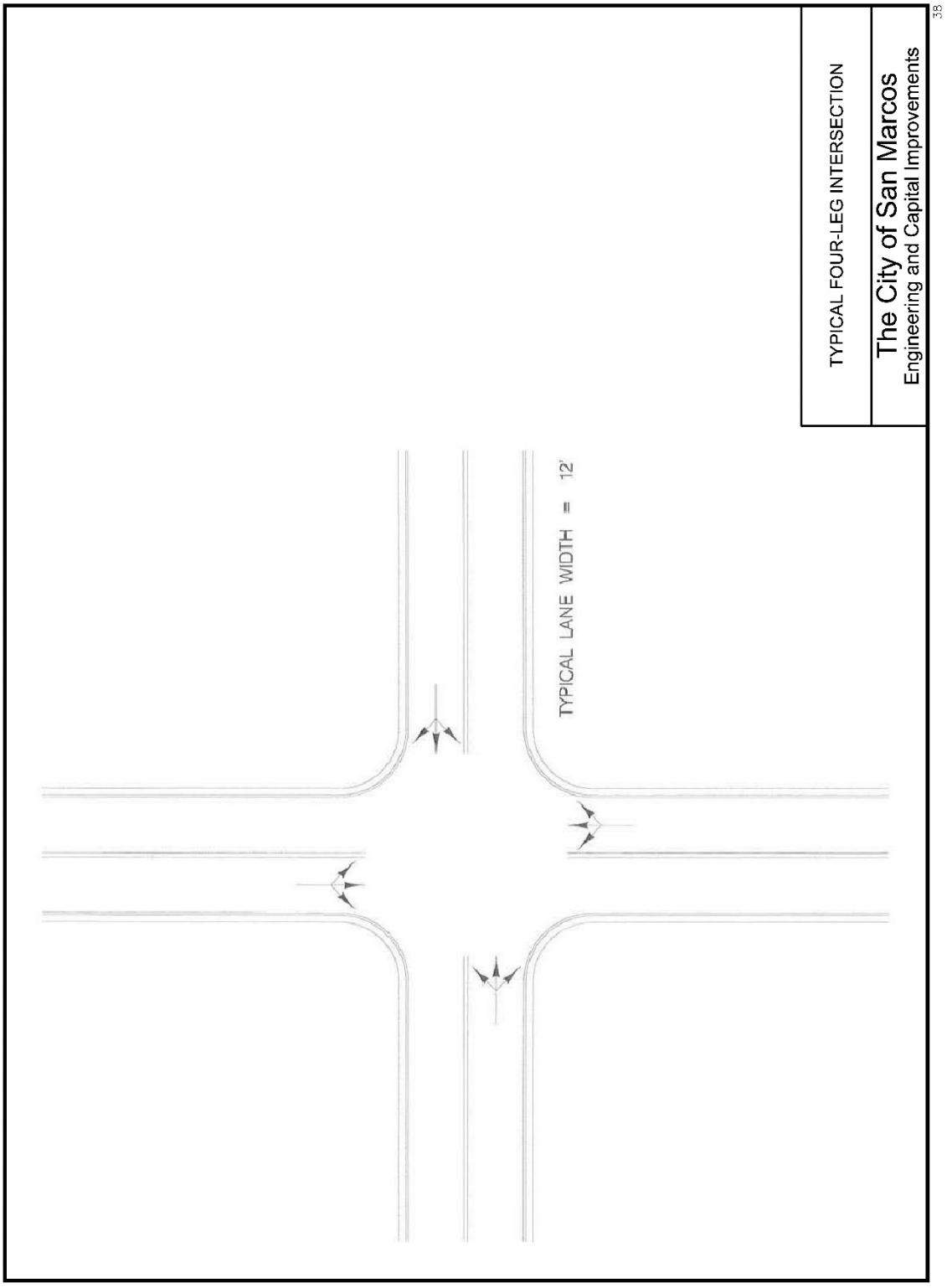
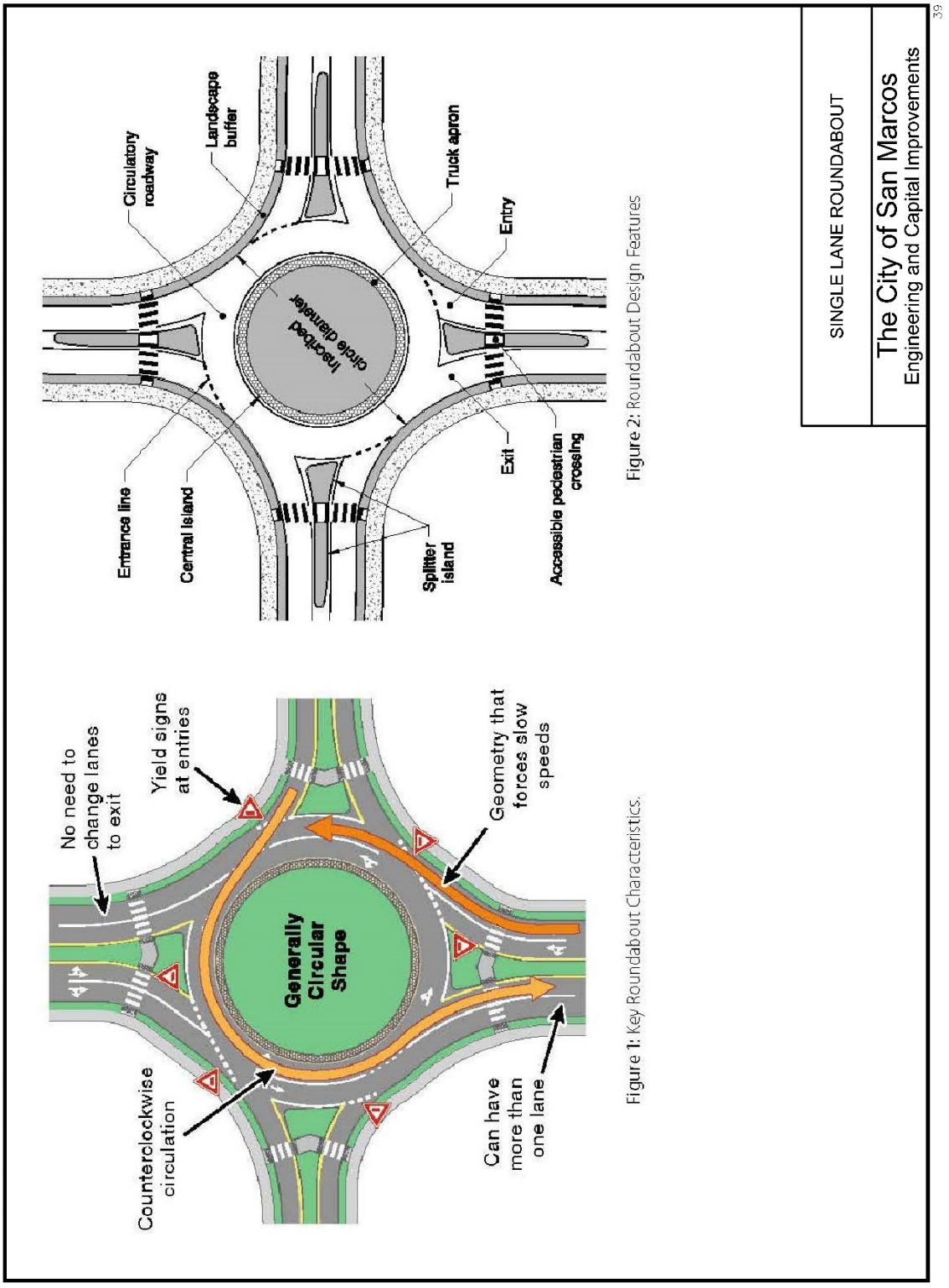


Figure 1-38: Four Leg Intersection

Figure 1-39: Single Lane Roundabout



offset intersections are used along a Boulevard, they should be located to avoid conflicting left turns (this is especially important where two (2) way, left-turn lanes are to be provided or where left-turn slots are used in a fairly narrow median). Such left-turn conflicts exist when an intersection offsets to the right rather than to the left.

Multi-leg intersections with more than four approaches shall not be allowed.

Signalized intersection shall be spaced at minimum one-half mile intervals, unless otherwise approved by Director of Engineering or their designee.

1.12.5 Corner Radii

The minimum curb radius is based on the design vehicle and the type of streets intersecting each other. Intersection corner radii shall be checked for the appropriate design vehicle using turning template software or the templates in AASHTO A Policy on Geometric Design of Highways and Streets.

Table 1-12 described minimum curb radii given the street type that are intersecting. These value have been developed assuming design vehicles illustrated in Table 1-1a through 1-1e, without lane encroachment and a 3 feet curb clearance. Corner radii shall be adjusted to accommodate a different design vehicle and other parameters mentioned above.

Table 1-12: Minimum Curb Return Radius

Minimum Curb Return Radius	
Street Classification	**Radius (ft)**
Residential – Residential Intersection	20
Residential – Commercial Intersection	25
Residential – Avenue Intersection	25
Commercial – Avenue Intersection	25
Avenue – Avenue Intersection	25
Commercial – Avenue Intersection	25
Avenue – Boulevard Intersection	30
Commercial – Boulevard Intersection	30
Boulevard – Boulevard Intersection	40

The design of the intersection shall consider the requirements of an accessible route in accordance with the ADA, placement of signal poles, location of curb ramps, and drainage patterns.

1.12.6 Vertical Alignment within the Intersection Area

Intersection areas should be designed with as flat a grade as practicable. In some cases, this may not be feasible due to terrain constraints and may be economically impractical.

The design speed and grade for the major street at any intersection shall be maintained through the intersection approaches. The minor street may be designed with a change in grade based on reduced design speeds between the maximum grade in the approach and the cross-slope of the intersected street not to exceed eight (8) percent for Residential Street and six (6) percent for Avenues and Commercial Streets. The change in grade shall be accomplished by means of a vertical curve of length

equal to the minimum length for the design speed of that approach (minimum K value). Deviations from these requirements shall require approval from Director of Engineering or their designee.

1.12.7 Horizontal Alignment within the Intersection Area

The horizontal approach to an intersection should be tangent for a length of 50 - 100 feet in accordance with the Tables 1-1a through 1-1e. Note than this tangent length is considered a minimum. Longer tangents are highly desirable. The tangent distance is measured from the curb line of one street to the first point of curvature on the intersecting street.

Variation of more than 10 degrees on Residential Streets and more than 5 degrees on Avenues, Commercial Streets and Boulevards must be approved by Director of Engineering or their designee. Approach grades should be limited to ± 3 percent. Intersections on sharp curves should be avoided since the superelevation and widening of pavements may complicate the intersections design and reduce sight distance. Deviations from these requirements shall require approval from Director of Engineering or their designee.

1.12.8 Intersection Sight Distance

Intersections form an area of conflict for vehicles, pedestrians, and bicycles. If sufficient sight distance is provided, these conflicts can be greatly reduced. Provision of sufficient sight distance provides the driver sufficient time to adjust the speed, avoid an impending collision, and decide when to enter or cross the intersecting street.

Certain areas at the corners of the intersections should be cleared of all obstructions that could limit the sight distance for drivers at the approach. These specified areas are known as sight triangles. There are two types of sight triangles: approach sight triangles and departure sight triangles.

- Approach sight triangle, as shown in **Figure 1-40**, shall be provided to allow approaching drivers to see conflicting vehicles approaching the intersection. Sufficient lengths should be provided to allow for time to slow or stop before colliding.
- Departure sight triangle, as shown in **Figure 1-41**, shall be provided to allow stopped drivers on the minor street approach sufficient time to turn left and right and enter to cross the intersection

Intersection sight distance varies with different types of traffic control. These include intersections with no control, intersections with stop control on the minor road, intersections with yield control on the minor road, intersections with traffic signal control, intersections with all-way stop, and Left tum from major road.

Intersection sight distance is based on the intersection geometry, speed, and time gap. The most recent version of AASHTO's Green Book should be consulted to obtain appropriate factors and to calculate intersection sight distance.

1.13 CLEAR ZONES AND PROTECTION

The term “clear zone” is used to describe the generally flat and unobstructed area that is provided beyond the travel lanes. The clear zone may include shoulders. The clear zone is measured from the edge of travel way for uncurbed streets, and from the face of curb for curbed streets.

Figure 1-40: Approach Sight Triangle

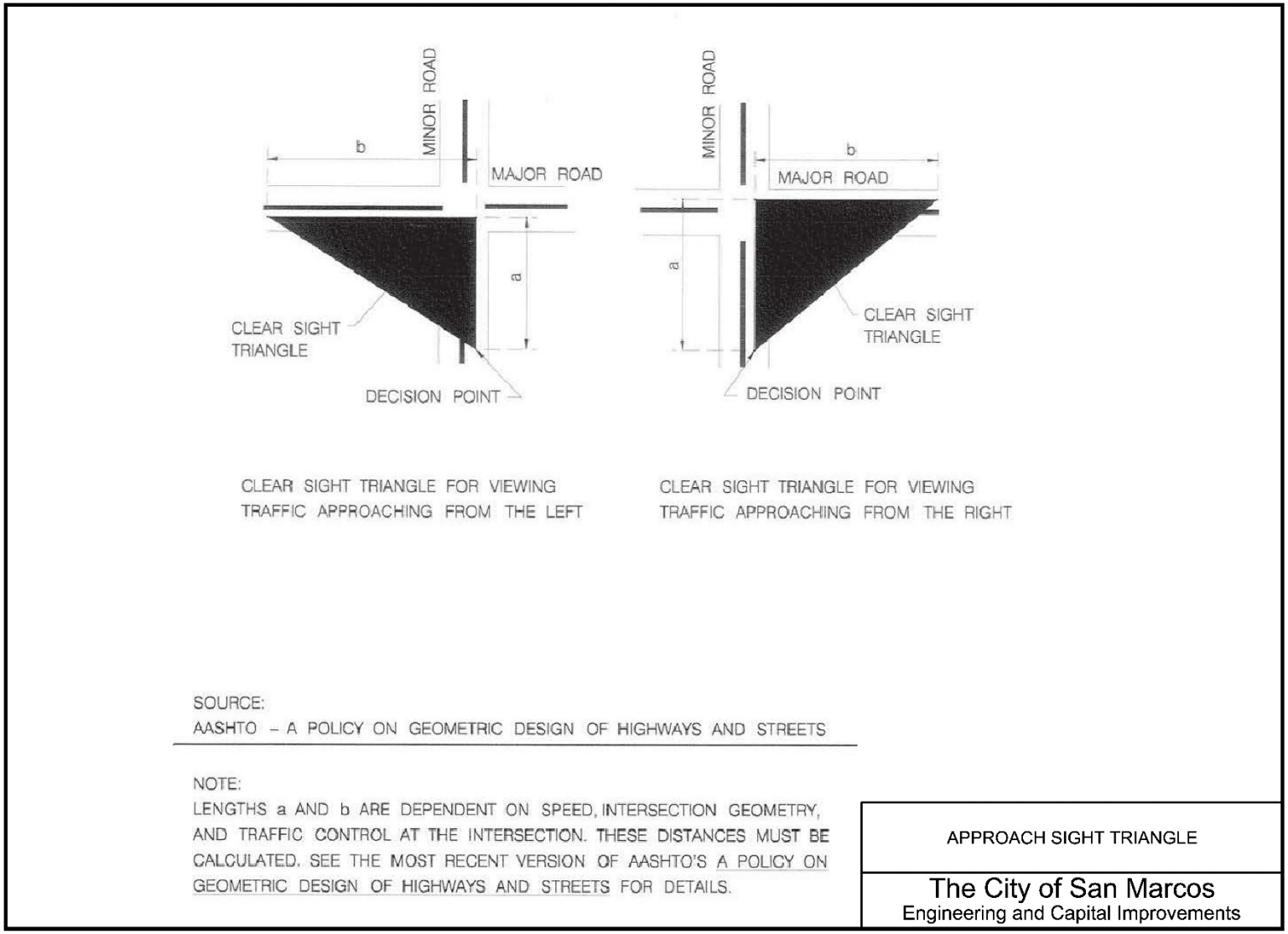
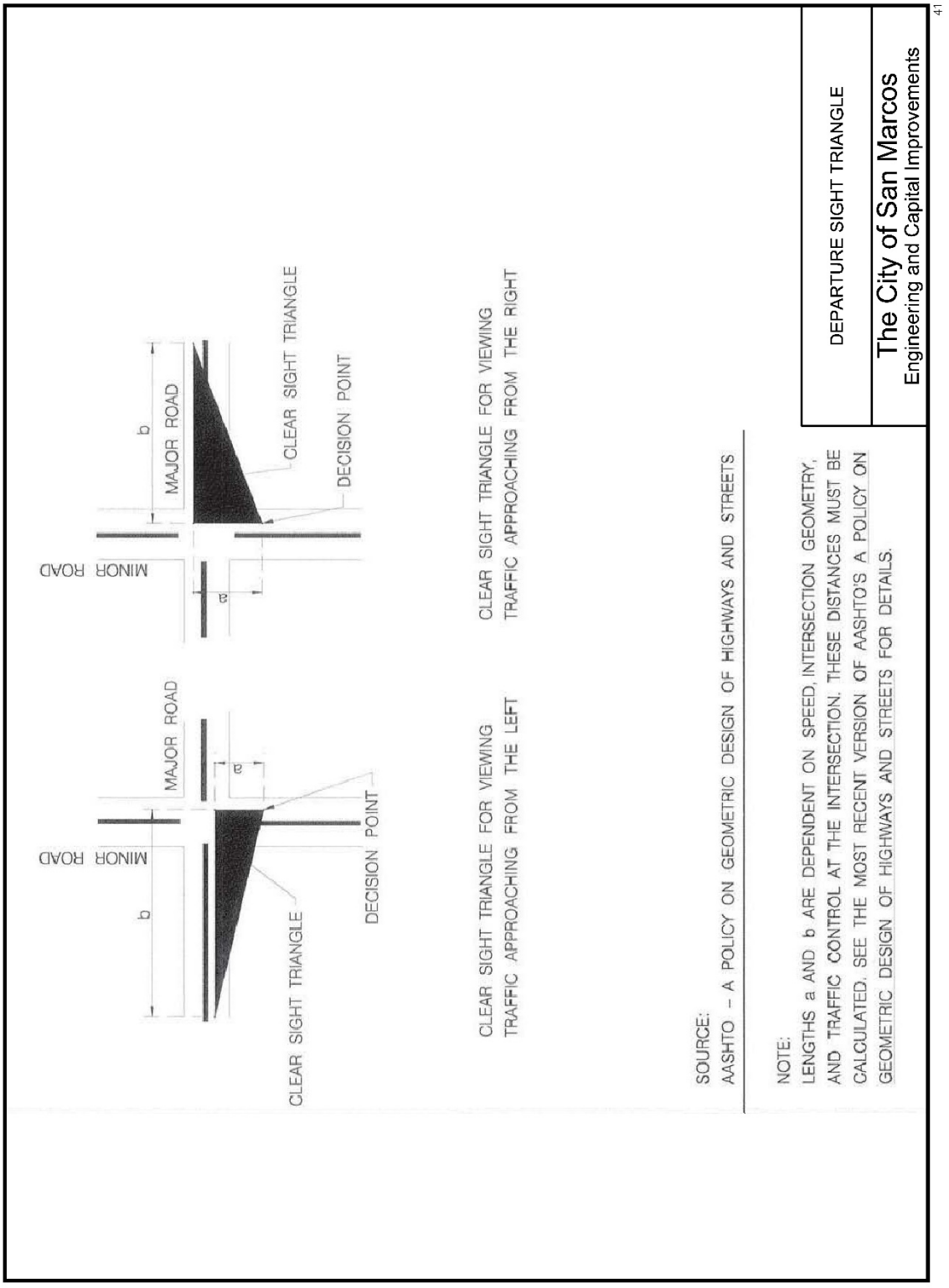


Figure 1-41: Departure Sight Triangle



1.13.1 Clear Zone Criteria

The minimum clear zone, measures from the face of curb, shall be 3.0 feet; however the clear zone may be reduced to 1.5 feet where it is not feasible to provide 3.0 feet. Any variance from this requirement shall be approved by Director of Engineering or their designee.

Curbs are not considered as an adequate barrier for redirecting vehicles. The provision of guardrails to redirect errant vehicles may only be necessary on high speed facilities with design speed greater than or equal to 45 mph. the need for guardrails on low speed facilities (<45 mph) should be based on engineering judgement, local conditions, and type of roadside hazard.

Because most curbs do not have a capability to redirect vehicles, especially at higher design speeds, obstructions should be located as far away as practical.

The minimum clear zone for rural, uncurbed roadways within the City and a design speed of 45 mph or less shall be 10 feet, however 20 feet should be provided where feasible. The most recent version of AASHTO's "Roadside Design Guide" should be used to establish clear zones along roadways within the City.

If a roadside hazard exists, treatment should be considered in the following priority:

- Eliminate the hazard;
- Redesign the hazard so that it can be safely traversed;
- Relocate the hazard outside the clear zone to reduce the likelihood that it will be struck;
- Treat the hazard to reduce crash severity, i.e. use flush or yielding designs;
- Shield the hazard with a barrier (metal beam guard fence, concrete barrier or crash attenuator); and
- Delineate the hazard if the above alternatives are not appropriate

The types of obstacles that are commonly shielded using roadside barriers are as follows:

- Slopes greater than 3:1 or vertical drop-offs;
- Bridge ends and areas alongside bridges;
- Signs, traffic signal, and luminaire supports without breakaway design;
- A concrete base extending 6 inches or more above the ground
- Retaining walls;
- Culverts;
- Street furniture;
- Rock or other natural formations;
- Trees with diameters greater than 6 inches; and
- Utilities such as cabinets, fire hydrants, or poles.

1.13.2 Types of Barriers

Metal beam guard fence (MBGF) may be used to protect most roadside obstacles, if the hazard cannot be eliminated. MBGF, end treatment, and downstream anchor terminal shall be in accordance with the

appropriate TxDOT Standards. Refer to Section 6 of Appendix A in the TxDOT Roadway Design Manual, for the procedure to calculate the Length of Need for MBGF.

MBGF shall be placed at the edge of pavement for roadways with shoulders, and at the face of curb for curbed roadways. The installation shall allow for 2'-6" (minimum) or 5'-0" (desirable) deflection behind the guardrail posts. The MBGF installation shall include a concrete mow strip.

Pedestrian rails shall be in accordance with TxDOT Standard "Pedestrian Handrail Details".

Bridge railings shall be in accordance with TxDOT Standards and the "Bridge Railing Manual".

The ends of bridge railings shall be protected with metal beam guard fence/end treatment or a crash attenuator.

Concrete safety barrier is not typically used for urban street construction but may be used, if necessary, for example, at the top of an MSE retaining wall.

1.13.3 Transportation Guidelines for Landscaping

Safety shall be the foremost consideration in the placement and selection of plant material in the City's right-of-way. The main focus of these guidelines is the prevention of traffic hazards that can be created by the placement of landscaping which restricts the sight distance or creates roadside obstacles. The following addresses acceptable criteria for landscaping and planting on roadsides, within the median, and at intersections. All dimensions specified for trunk diameter and height will include plants at maturity unless it is stated otherwise on the Drawings.

Table 1-13 lists the criteria for placement of trees within the ROW

Table 1-13: Minimum Setback Requirements

Minimum Setback Requirements for Existing & Newly Planted Trees					
Design Speed (MPH)	**Tree Diameter at Maturity (inches)**	**Roadways with Curb & Gutter**		**Roadways with Shoulders[1]**	
		Existing (feet)	**New (feet)**	**Existing (feet)**	**New (feet)**
≤45	=6	1.5 (minimum)	3	10	10 (minimum)
		3 (desirable)			20 (desirable)
	>6	4 (minimum)	6	18	25
		6 (desirable)			
>45	=6	2 (minimum)	4	10	20 (minimum)
		3 (desirable)			30 (desirable)
	>6	4 (minimum)	6	30	30
		6 (desirable)			

[1] includes roadways with side slope of 6H: 1V or flatter within the clear zone. For other side slopes please refer to AASHTO's "Roadside Design Guide".

Trees shall be set back 2 feet from the edge of sidewalk, measured from the edge of sidewalk to edge of mature trunk. Trees shall not be allowed in sidewalks less than 12 feet in width.

On roadways with shoulders having side slopes steeper than 6H: 1V, please refer to AASHTO's "Roadside Design Guide" for clear zones.

A minimum clearance height of 8 feet above the street level must be provided and maintained for all existing and newly planted trees if adjacent to a sidewalk. However, if the limbs of trees overhang the curb line or edge of travel lane of any street, a minimum clearance height of 14 feet is required.

All plantings, except ground covers with no more than 12 inches in height, shall be located greater than seventy-five (75) feet from the end of the median nose.

Ground covers with no more than 12 inches in height and trees with a mature trunk diameter of 6 inches or less is recommended in the area from a point 75 feet to 150 feet from the nose of the median. All trees shall be maintained to provide an 8 foot minimum foliage clearance height. A minimum 15 feet spacing (center-to-center) shall be provided for all trees.

Only small trees and low growing shrubs no greater than 2 feet in height are recommended within 150 feet of a school crossing to assure pedestrian safety by not restricting the sight visibility of motorists.

Only low growing shrubs no greater than a height of 2 feet and small trees are recommended within 250 feet of a railroad crossing to assure adequate sight visibility.

Landscaping shall not restrict visibility to traffic control devices such as signs and traffic signals.

No landscaping of any type shall obstruct vision within the intersection sight triangle as defined in this section of the manual. These requirements will apply to any material from a height of two (2) feet to a clearance height of eight (8) feet above the top of curb including, but not limited to, full grown trees, full-grown shrubs, fences, structures, any signs except traffic control signs, etc.

The designer shall adhere to the City of San Marcos Land Development Code (CodeSMTX) Chapter 6, Article 4: Tree and Habitat Protection as amended and adopted, if existing trees are within the public ROW, or may otherwise be impacted by construction. If existing trees are closer than the minimum distances stated above, an exception may be granted if the City determines it is preferable to preserve the tree.

Any new trees to be planted shall be as listed on the City of San Marcos approved tree list, which is available from the Planning and Development Department.

1.14 TAPERS

The following terminology is used when describing the criteria for the various tapers in roadway design:

- **STREET WIDTH TRANSITION TAPER** is a taper necessary to transition between different street widths.
- **APPROACH TAPER** is that portion of the roadway geometry from the point where all approaching traffic must shift laterally, to the beginning point of the bay taper. The taper length is a direct product of slope angle, which is most related to expected operating speeds.
- **BAY TAPER** is from the edge of the adjacent through traffic lane to the beginning of the full width of the turn storage lane.
- **STORAGE LENGTH** is the distance from the end of the bay taper to the intersection nose or stop line.
- **THE INTERSECTION NOSE** is the radius or distance from the end of the storage bay to the near edge of the cross-route exit lane for the left-turning vehicle. For left-turn bays the cross- route

exit reference is normally the centerline of an unchannelized two-way street or the far edge of the median in a channelized street

- **DEPARTURE TAPER** of a left-turn bay is from the point where through traffic beyond the intersection begins a lateral shift to the left, to the point where the through lane is adjacent and parallel to the centerline.

Refer to **Figure 1-42** and **Figure 1-43** for the illustration of the various taper lengths for a typical left turn bay configuration.

1.15 STREET WIDTH TRANSITION TAPERS

Where two street sections of different widths are to be connected, a transition taper is required between the outside traveled edges of the two sections. The length of the transition taper shall be calculated using the following equation:

L = W x S For Design Speed of 45 mph or higher

$L = (W \times S^2) \div 60$ For Design Speed of less than 45 mph

Where: L = Taper Length in feet
W = Width of Offset in feet
S = Design Speed in mph

This transition length calculation is not to be used in the design of left-turn storage lanes or speed change lanes.

When tapers are located on a curve, the separate halves of the roadway should be designed with different curve radii to create a smooth taper without any angle points in the curvature.

1.15.1 Left Turn Lanes

Refer to **Figure 1-44** for typical configuration and taper lengths of left-turn lanes. The following sections describe the criteria for each taper.

1.15.1.1 Approach Tapers

Approach tapers shall be calculated using the following formulas:

L = W x S For Design Speed of 45 mph or higher

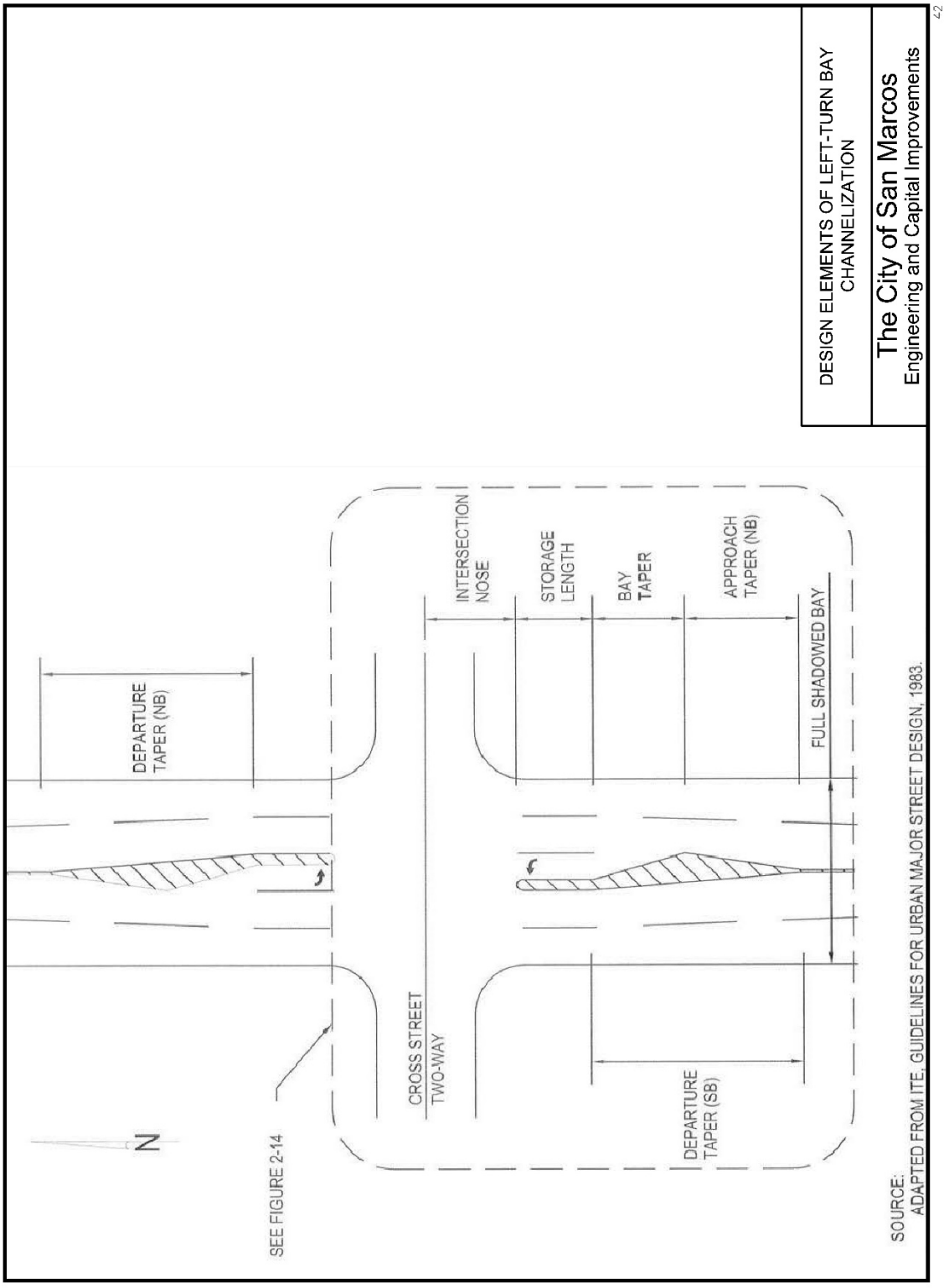
$L = (W \times S^2) / 60$ For Design Speed of less than 45 mph

Where: L = Taper Length in feet
W = Width of Offset in feet
S = Design Speed in mph

1.15.1.2 Bay Tapers

Bay tapers for left turn bays on City streets shall be designed using two reverse curves with radii equal to 300 feet each. The length of the bay taper using the symmetrical reverse curve will be approximately

Figure 1-42: Design Elements of Left Turn Bay Channelization



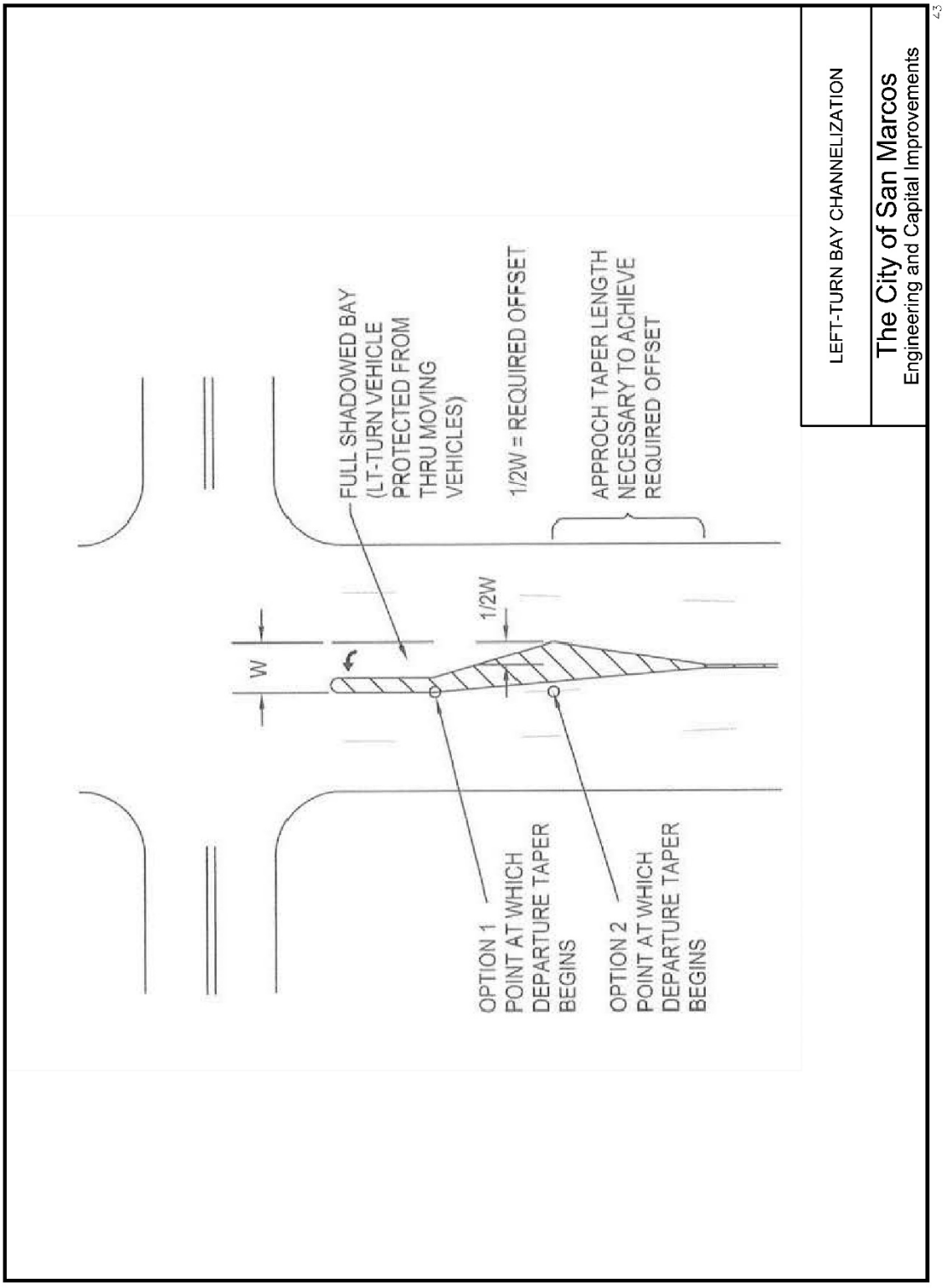


Figure 1-43: Left Turn Bay Channelization

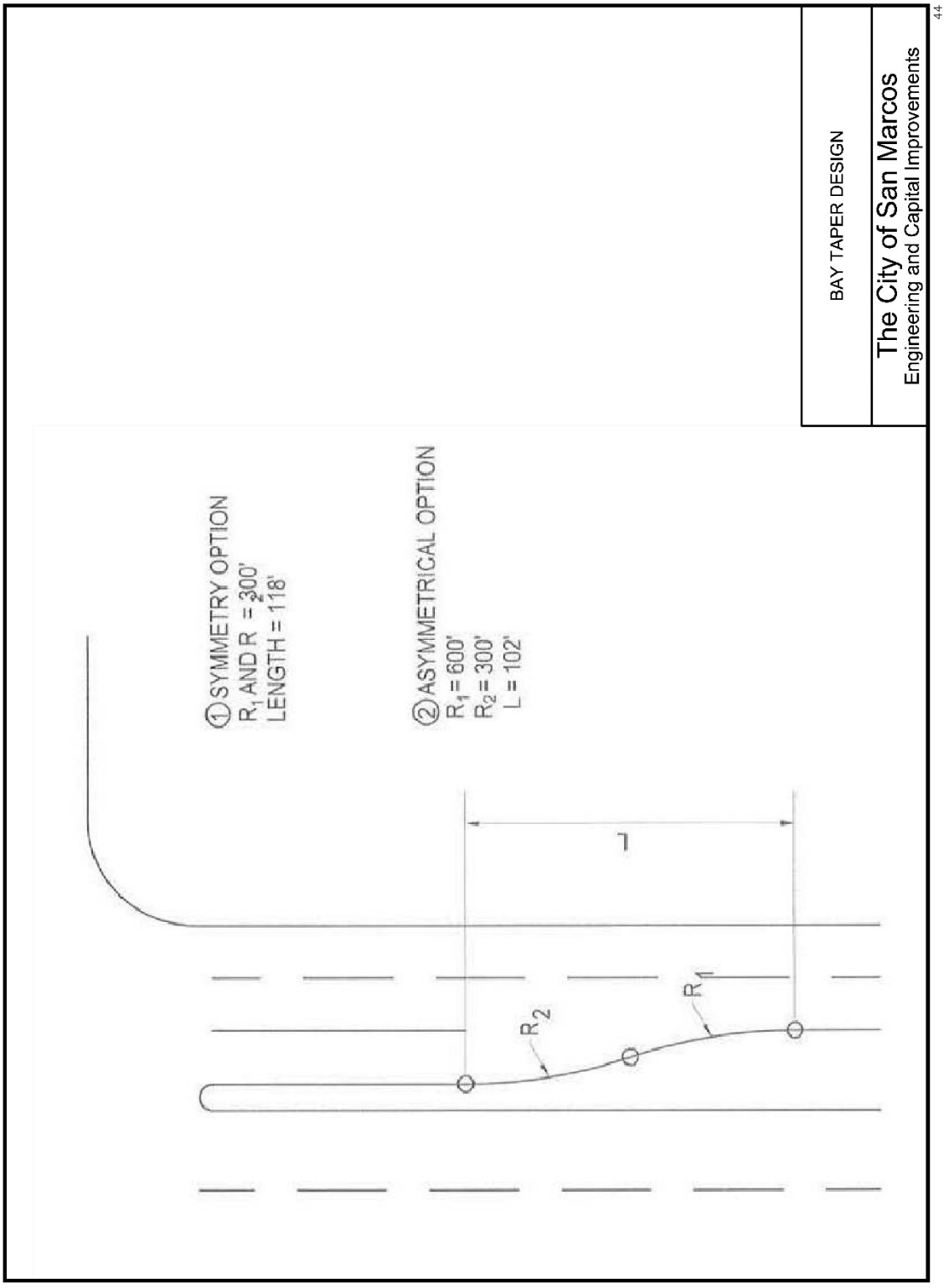


Figure 1-44: Bay Taper Design

118 feet for a twelve foot-wide turn lane. Alternatively, the bay taper may be calculated using the following formula:

L = (W x S)/3

Where: L = Taper Length in feet
W = Width of Offset in feet
S = Design Speed in mph

1.15.1.3 Deceleration Length

Deceleration length assumes that moderate deceleration will occur in the through traffic lane and the vehicle entering the left-turn lane will clear the through traffic lane at a speed of 10 mph slower than through traffic. **Table 1-14** lists the deceleration lengths for various design speeds.

Table 1-14: Deceleration Length

Deceleration Length	
Design Speed in mph	**Deceleration Length in feet**
25	110
30	160
35	215
40	275
45	345
50	425

On City streets, due to driveways and median openings, the required length of the speed change lanes may not be feasible to design. Therefore, in most cases the deceleration length can be omitted from the design. Deviation from these requirements shall require approval from Director of Engineering or their designee.

1.15.1.4 Storage Length

At a minimum, storage lengths shall be 150 feet when turning from Boulevard into another Boulevard or an Avenue or a Commercial Street, and 100 feet when turning from a Boulevard into a Residential Street.

At a minimum, storage lengths shall be 100 feet when turning from a Commercial Street or an Avenue into a Boulevard. Minimum storage length for a left turn bay into a driveway shall be 100 feet.

If a TIA or similar traffic study is required, it shall be used to document the minimum storage lengths to be provided for left turns. The minimum storage lengths stated in this section may be used if; in the City's opinion a TIA or traffic study is not needed for a particular development.

The calculated queue storage at unsignalized locations shall be based on a traffic model or simulation model, or by the following:

L = (V/30)(S)

Where: L = storage length in feet

V = left-turn vehicles per hour
S = queue storage length in feet per vehicle (see **Table 1-15**)

At signalized intersections, the turn lane should be of sufficient length to store the turning vehicles and clear the equivalent lane volume of all other traffic on the approach, whichever is the longest. This length is necessary to ensure that full use of the separate turn lane will be achieved and that the queue in the adjacent lane on the approach will not block vehicles from the turn lane. The required storage may be obtained using an acceptable traffic model such as the latest version of the Highway Capacity Manual (HCM) software (HCS), SYNCHRO, VISSIM or other approved model. Where such model results have not been applied, the following may be used:

$$L = (V/N)(2)(S)$$

Where: L = storage length in feet
V = left-turn vehicles per hour
N = number of cycles
2 = a factor that provides for storage of all left-turning vehicles on most cycles, a value of 1.8 may be acceptable on Avenues and Commercial Streets
S = queue storage length in feet per vehicle (see **Table 1-15**)

Table 1-15: Queue Storage Length

Queue Storage Length	
% of Trucks	**S (ft)**
<5	25
5 – 9	30
10 – 14	35
15 – 19	40

1.15.1.5 Departure Taper Length

The desired length for a departure taper on City streets shall begin at the end of the storage lane and end at the beginning of the approach taper.

1.15.2 Right Turn/Deceleration Lanes

Site driveways and streets shall include a right turn deceleration lane if the projected right turn peak hour volume is 50 or more vehicles per hour.

The length of a right-turn storage lane shall be a minimum of 100 feet. The storage length for a right-turn bay into a driveway shall be a minimum of 100 feet. Where a TIA has been completed, the right-turn storage length should be based on the analysis results.

Right-turn acceleration lanes typically are not used on urban streets.

1.15.3 Turn Lane Warrants

Left-turn and right-turn deceleration lanes shall be provided when required by the findings of a city-approved Traffic Impact Analysis (TIA).

Refer to the latest edition of AASHTO's A Policy on Geometric Design of Highways and Streets to evaluate left-turn lane requirements at unsignalized intersections on two-lane roadways.

1.16 CHANNELIZATION

Channelization uses pavement markings, raised islands, or other suitable means separate and regulate conflicting traffic movement into definite travel paths for safety of both vehicles and pedestrians. The objectives of intersection channelization are to ensure efficient traffic movement, increase capacity, and improve safety. Refer to the latest edition of AASHTO's A Policy on Geometric Design of Highways and Streets for channelization design.

1.16.1 Channelization Principles

The following principles shall be considered at each individual intersection when applying channelization. If disregarded, the objectives of channelization may not be achieved, resulting in a design which may be hazardous and inefficient.

- Reduce the area of conflict; large paved intersectional areas invite hazardous vehicle and pedestrian movements.
- When traffic streams cross without merging and weaving, make the crossing at or near right angles. If traffic signal control is planned, the crossing angle may be less than right angle with suitable signal design and visual clues.
- Merge traffic streams at small angles.
- The speed of a traffic stream entering an intersection may be controlled without funneling.
- Provide refuge (shadowing) for turning and crossing vehicles where possible and necessary with channelization.
- Use channelization to separate conflict points within an intersection.
- Block prohibited turns with well-delineated channelization.

Channelization may provide locations for the installation of essential traffic control devices to enhance their visibility.

1.16.2 ADA Requirements

Raised islands, including refuge and curb ramps, should meet ail requirements set forth in the TAS.

1.17 MEDIANS

A median is a part of a divided highway that separates traffic in opposite directions or in some cases lanes of traffic in the same direction. The median width for highways and boulevard shall be in accordance with the **Figure 1-1** through **Figure 1-11**, measured from face of curb to face of curb.

Medians as measured from nose to nose on highways and boulevards, shall have a minimum opening distance equal to the width of the intersecting street. The minimum width of a mid-block median opening shall be not less than 60 feet, or greater than 70 feet. The median opening shall be checked using the turning radius template for the appropriate design vehicle.

1.17.1 Median Types

Medians can be depressed, raised, or flush with regard to their adjacent traveled way. Typically, sections wider than 16 feet are depressed for drainage purpose. Raised medians allow for access control, landscaping, and a positive visual barrier, which prevents cross-traffic movements. Flush medians are generally narrow and paved. Different types of median openings are shown in **Figure 1-45** through **Figure 1-50**.

1.17.2 Median Break Spacing

The fewer the driveways on a major, urban street, the more effectively it will serve its primary function. Spacing should be maintained between driveways and intersections appropriate to the character of the driveway and roadway. **Figure 1-51** illustrates a typical median break.

Driveway spacing should allow reasonable deceleration of vehicles approaching on the street and acceleration by vehicles entering the street. Median breaks for driveways should not be contemplated unless sufficient length is available to accommodate deceleration tapers and storage lengths. **Table 1-16** reflects median and median break criteria. This criteria is based on the National Cooperative Highway Research Program (NCHRP) Report No. 93.

Full-function median openings on boulevards should be allowed only where the minimum spacing for signalized intersections are practicable. At intermediate locations along boulevards, limited-function openings may be provided at the spacing listed in **Table 1-16**.

High volume driveways on Boulevards should only be located opposite streets or other driveways when the minimum spacing requirements for signalized locations are met. Otherwise, T-intersection configurations should be designed. When driveways are located opposite street intersections the two shall have compatible design elements.

On streets other than boulevards, full-function median openings are acceptable at the spacing listed in **Table 1-16**. Access to public streets will have priority over access to private property on boulevards.

Table 1-16: Median Opening Criteria

Median Opening Criteria						
Design Speed	**Minimum Spacing* Distance 'C' from Figure 1-49**		**Minimum Spacing with 100 feet of Left Turn Storage Requirement****		**Minimum Spacing with 150 feet of Left Turn Storage Requirement*****	
	Absolute (ft)	**Desirable (ft)**	**Absolute (ft)**	**Desirable (ft)**	**Absolute (ft)**	**Desirable (ft)**
30	200	350	300	450	350	500
35	250	425	350	525	400	575
40	300	500	400	600	450	650
45	350	600	450	700	500	750
50	450	750	550	850	600	900

plus storage length based on peak hour volumes (see **Table 1-11)*
***minimum storage when turning into residential street*
****minimum storage when turning into avenue, commercial street or boulevard*

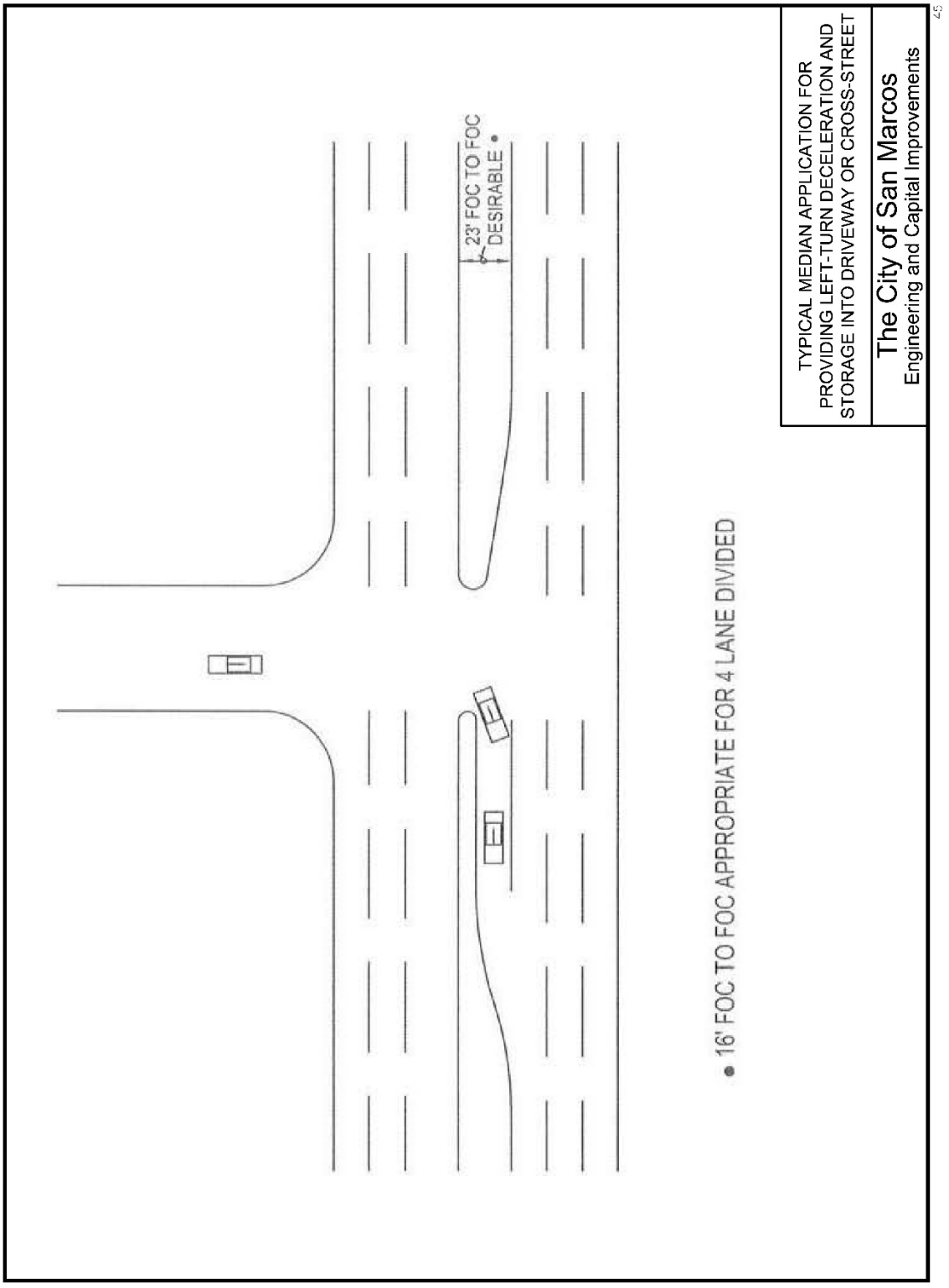


Figure 1-45: Typical Median Break for Left Turns

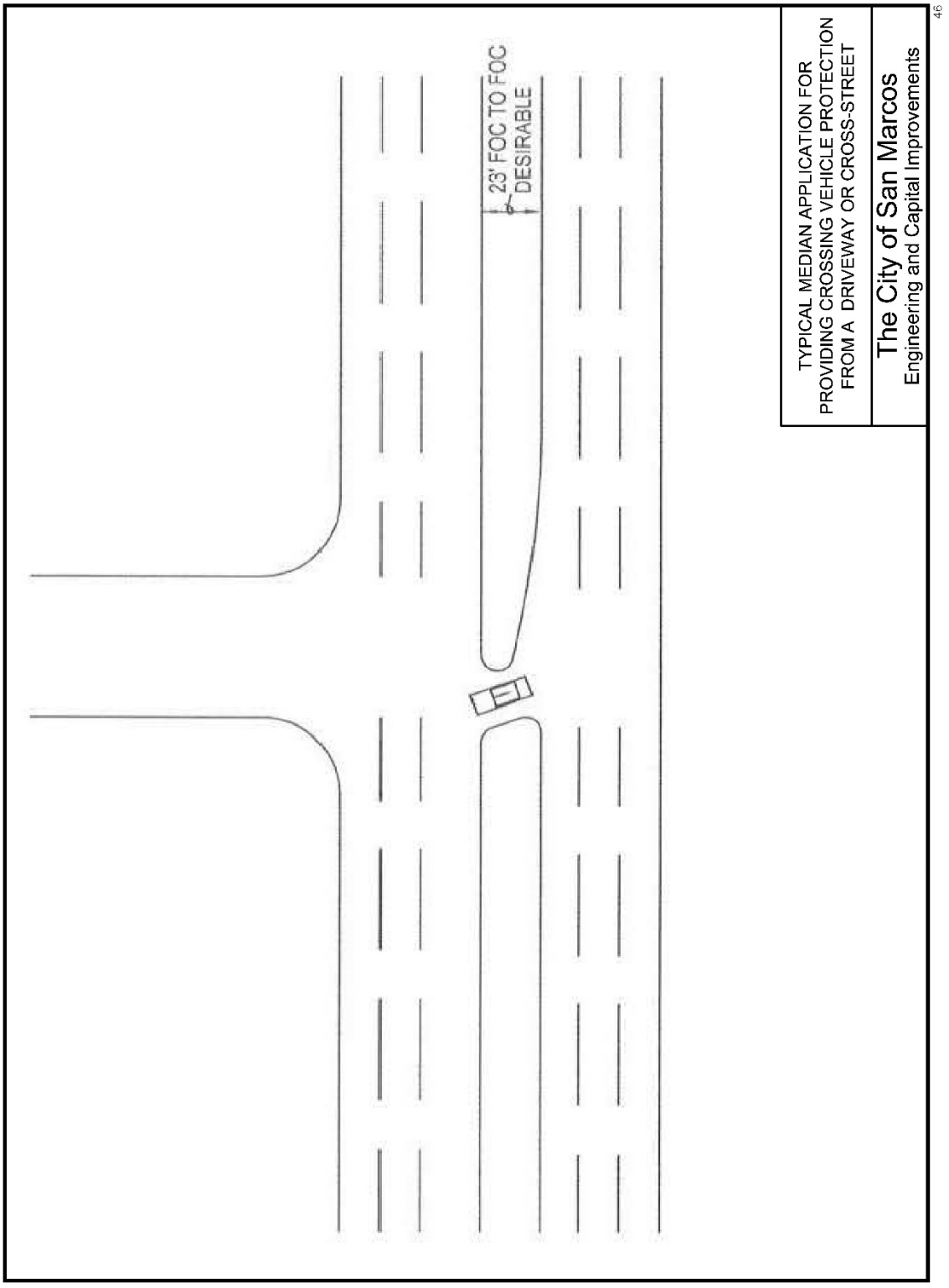


Figure 1-46: Typical Median Break for Providing Vehicle Protection

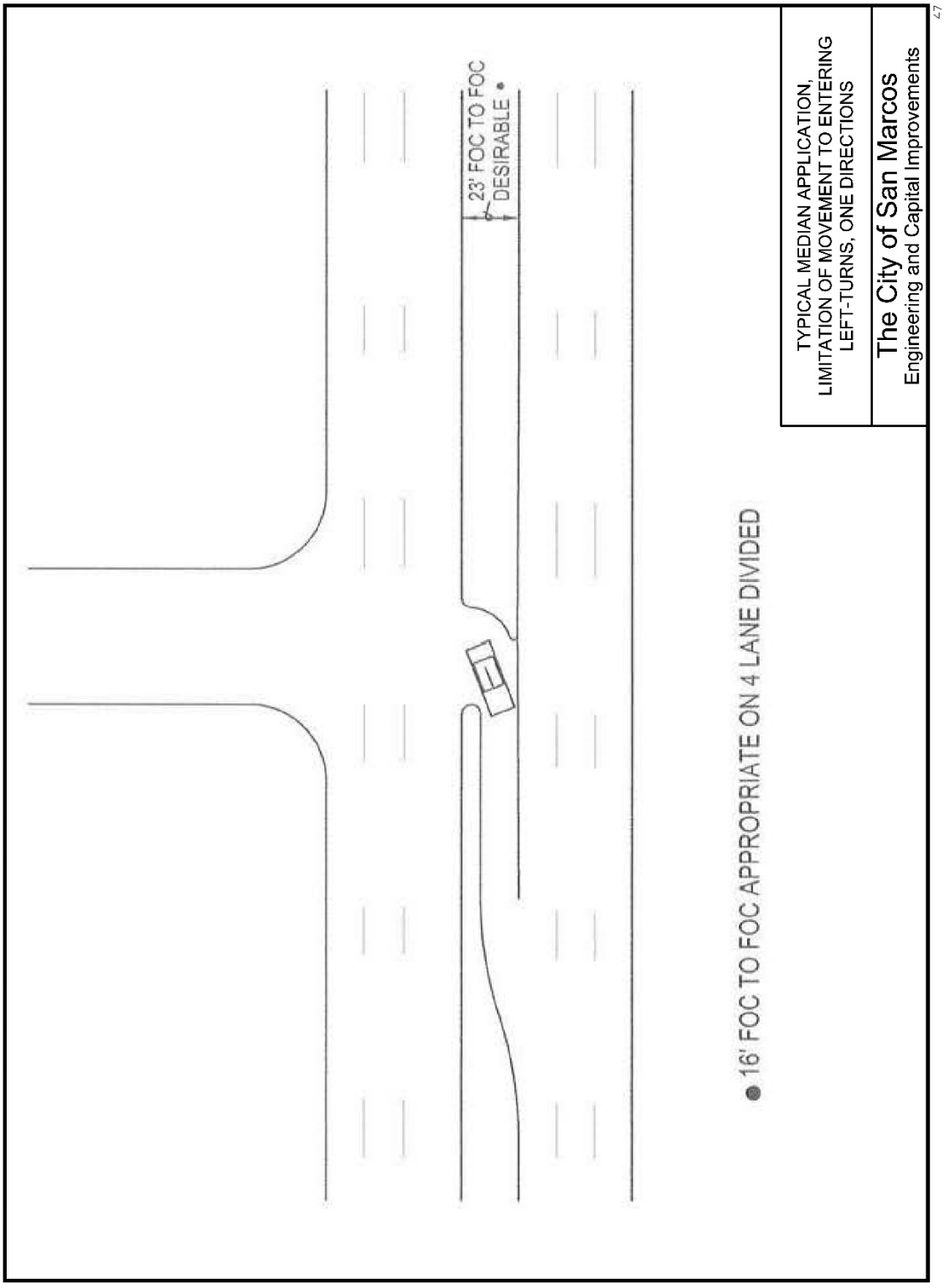


Figure 1-47: Typical Median Application for Limiting Movements

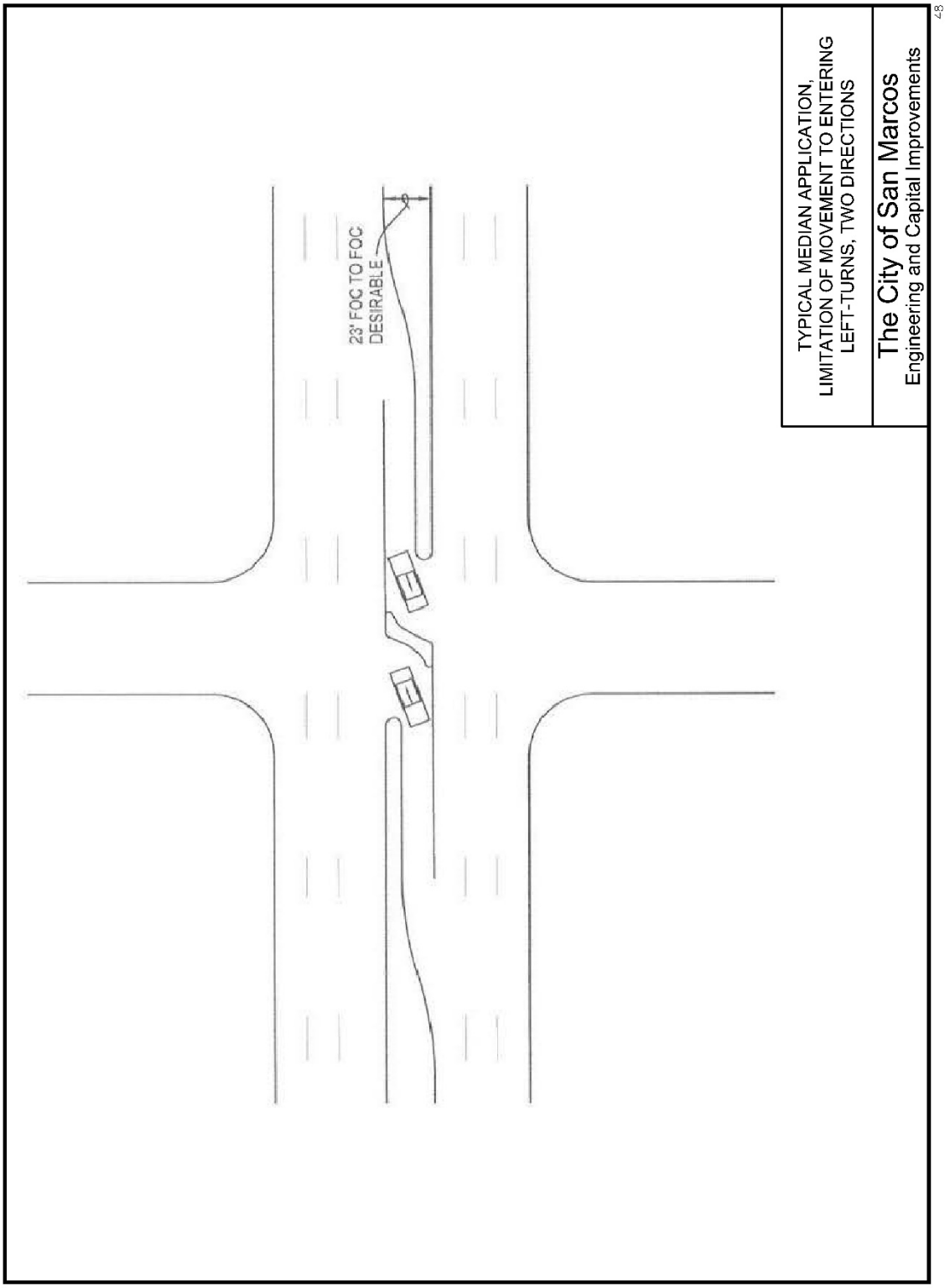


Figure 1-48: Typical Median Application limiting Left Turns from Cross Street

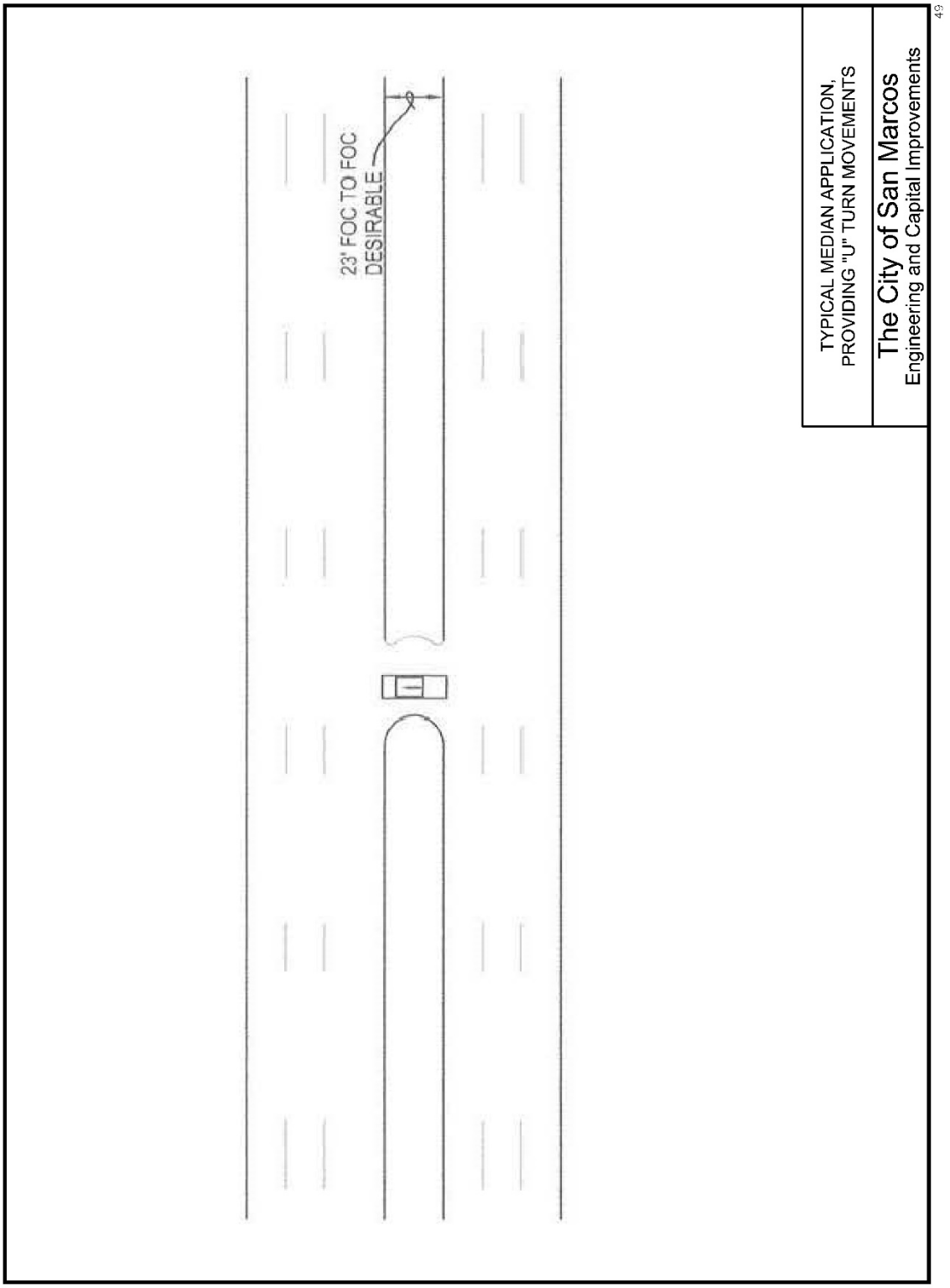


Figure 1-49: Typical Median Application for U Turns

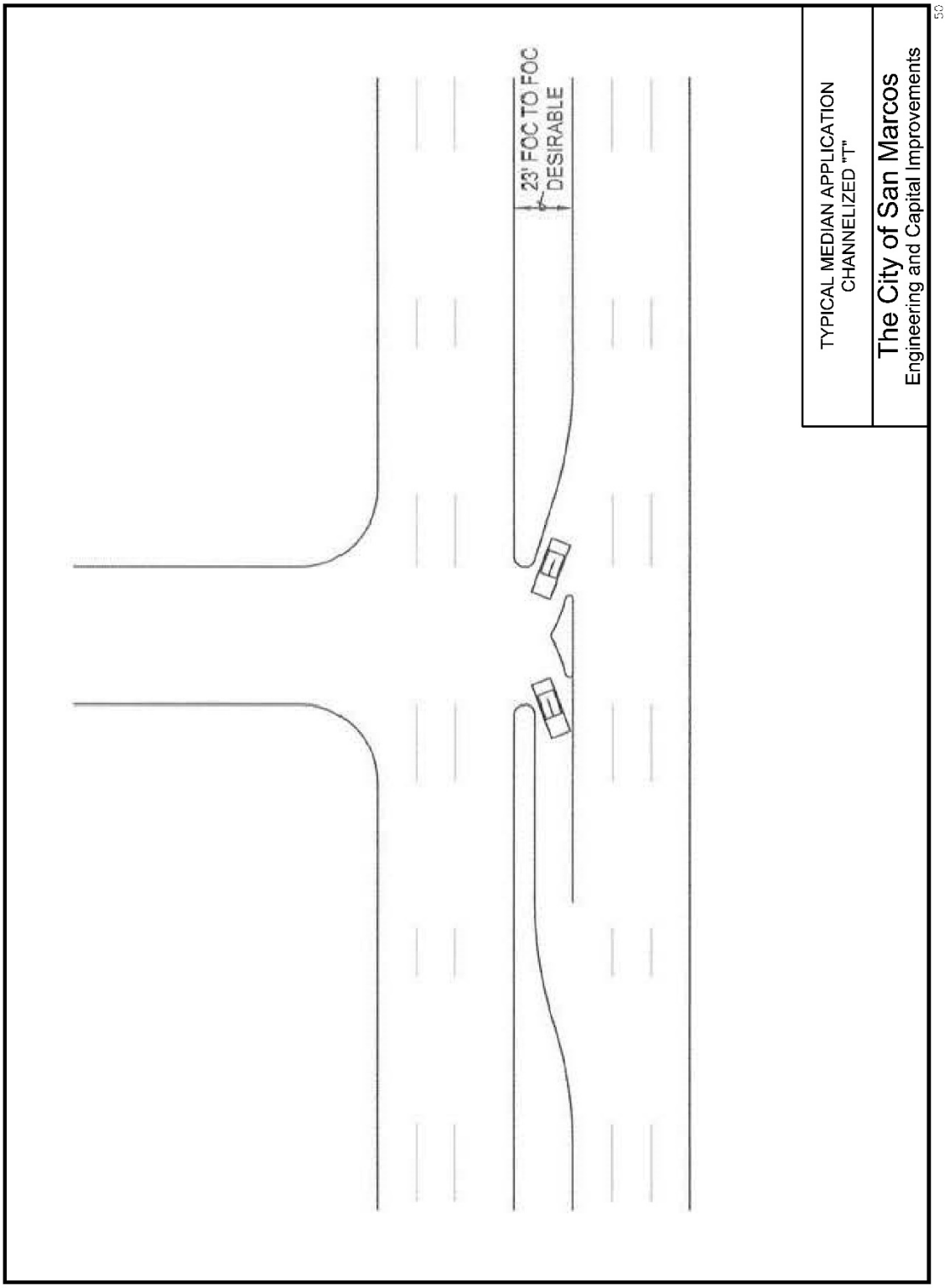


Figure 1-50: Typical Median Application for Channelized "T"

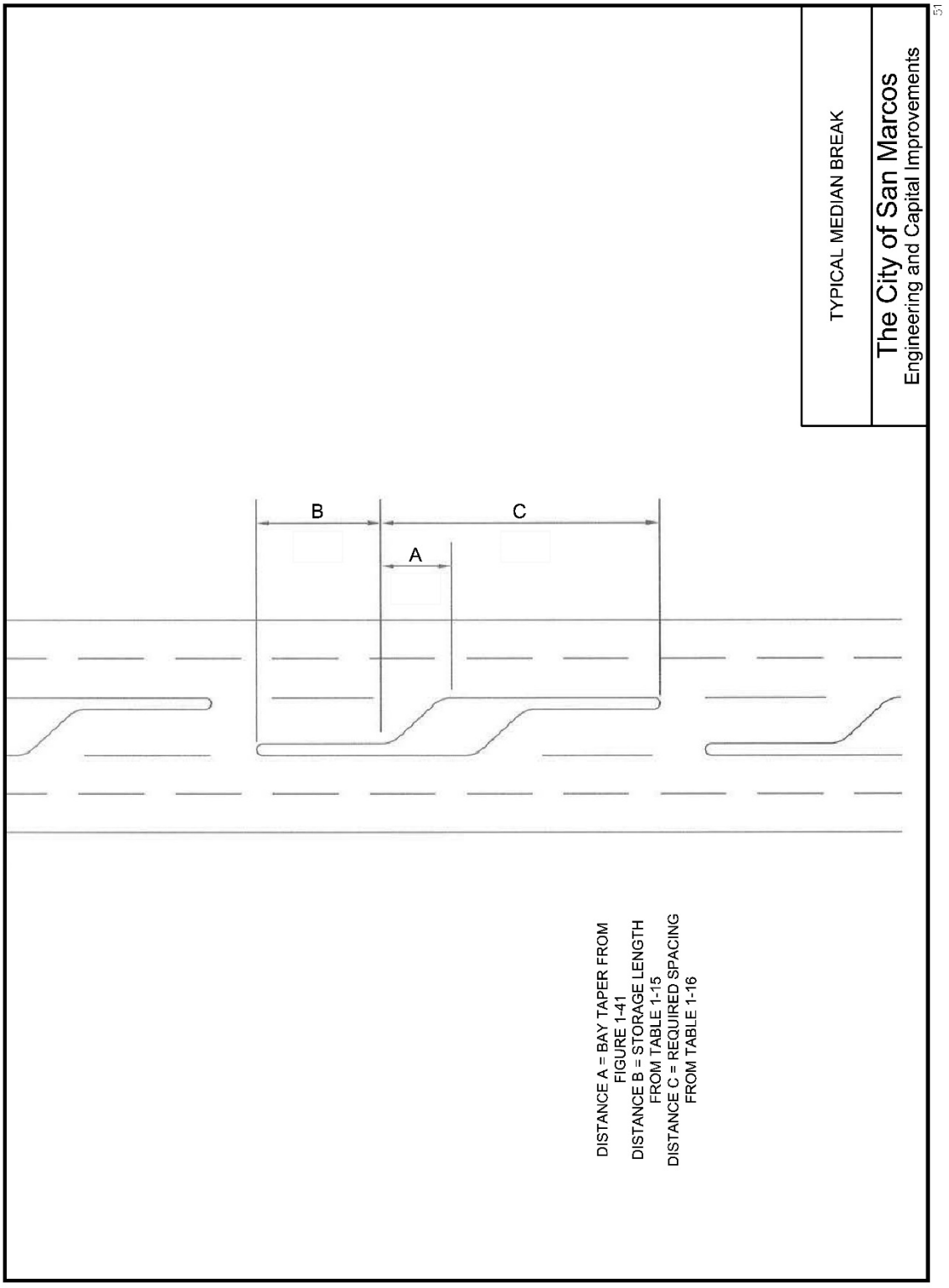


Figure 1-51: Typical Median Break

Median breaks on Boulevards for residential driveways shall not be provided unless otherwise approved by Director of Engineering or their designee. Median breaks for non-residential driveways shall only be provided if sufficient spacing between other median breaks is maintained, and there is adequate room to accommodate deceleration and storage length.

End treatment of medians at intersections should be designed to accommodate the appropriate design vehicle. Semicircular radii may be used on the noses of medians up to six (6) feet wide. Bullet-nosed medians should be used for medians of greater width. **Table 1-17** lists the required control radii for the intersection of the various street classifications and shall be used to define turning radii through intersections when designing the median opening and nose.

Medians and islands shall be landscaped with grass turf or constructed of stamped pattern concrete, brick, stone or concrete pavers, or other engraved concrete surfaces as approved by the City. Grass turf areas shall be not less than 6 feet in width. All medians and islands shall be bordered by standard curb and gutter, unless otherwise approved by the City.

Landscaping, signs, and other objects placed in the median shall comply with the minimum sight triangles described in section 1.12.8.

Table 1-17: Control Radii

Required Control Radii		
Street Classification	**Intersecting Street**	**Control Radius (Turning Radius Through Intersection) (ft)**
Boulevard	Boulevard	75
	Avenue	50
	Commercial Street	50
Avenue	Avenue	50
	Commercial Street	50
	Residential Street	50
Commercial Street	Avenue	50
	Commercial Street	50
	Residential Street	50
Residential Street	Residential Street	35

1.17.3 Islands

Isolated, small channelization islands should be avoided. Islands with at least 50 square feet are desirable but, under very restricted conditions, islands with at least 35 square feet may be used. Islands used for pedestrian refuge should be 6 feet wide, and must be in accordance with ADA/TAS requirements for an accessible route.

1.17.4 Median Width

The width of a median is its most important geometric design consideration. **Table 1-18** illustrates widths necessary to accomplish certain functions, based on the passenger vehicle for primary design of crossing protection and U-turns. The median opening shall be checked using the turning radius template

for the appropriate design vehicle Refer to the latest edition of AASHTO's "A Policy on Geometric Design of Highways and Streets" for median width design.

Table 1-18: Recommended Median Widths

Recommended Median Widths		
Function	**Minimum (ft)**	**Maximum (ft)**
Separation of Opposing Traffic	4*	6
Pedestrian Refuge and Space for Traffic Control	6*	16
Left Turn, Speed Change and Storage	14*	16
Crossing/Entering Vehicle Protection	20	24
U-Turns, Speed Change and Storage	20	24
Channelized "T", Speed Change and Storage	20	24-30

Source: City of Austin's Transportation Criteria Manual

**cannot accommodate left turn lanes*

Any raised medians and corresponding curb ramps used for pedestrian refuge and accessibility should meet requirements set forth in the Texas Accessibility Standards (TAS)

1.18 TURN LANES

The primary purpose of left-turn lanes at intersections is to provide storage space. A secondary purpose of turn lanes is to provide a location for deceleration removed from the through traffic lanes, thereby maintaining the capacity of the through roadway. Studies have demonstrated that accident experience is significantly reduced when left-turn lanes are provided at intersections of two (2) major streets, i.e., Avenues and Boulevards.

At a minimum, storage lengths should be one hundred and fifty (150) feet when turning into a Commercial Street, Avenue or a Boulevard and one hundred (100) feet when turning into a Residential Street. At any unsignalized intersections, the storage length, exclusive of taper may be based on the number of turning vehicles likely to arrive in an average two (2) minute period within the peak hour with each vehicle accounting for approximately twenty (20) feet of storage. At signalized intersections, the storage length depends on the signal cycle length, the signal phasing arrangement and the rate of arrivals and departures of left-turning vehicles. Refer to **Table 1-15** for left turn bays minimum storage lengths requirements.

Dual left turn and right turn lanes should be provided only when the volumes on the turning lanes exceed the capacity of a single lane and only if there are two receiving lanes on the cross street. For dual left and right turn lanes from a one-way street, the inside lane should be a mandatory turn lane.

Storage lengths exceeding 400 feet should be discouraged. Any deviation from the criteria will require an approval from Director of Engineering or their designee.

1.19 SIDEWALKS

Sidewalks shall be constructed in all new subdivision developments and in street redevelopment projects. Sidewalk width shall be in accordance with the Figures 1-1 through 1-29 of this manual.

1.19.1 Dimensions

Section 4.0, subsection 4.3.1 should be consulted for sidewalk dimensions

1.19.2 Obstructions

Where utility poles, fire hydrants, or other utility installations occur within the sidewalk width, the sidewalk shall be offset around the obstacle at its full width. Exceptions or modifications shall be approved by Director of Engineering or their designee prior to construction.

1.19.3 Curb Ramps

Depending upon pedestrian traffic and existing roadway geometrics at a particular intersection, curb ramps on all corners shall be constructed at the intersection. The Texas Accessibility Standards should be referred to for design details.

1.20 LIGHTING AT INTERSECTIONS

Lighting may affect the safety of highway and street intersections, as well as efficiency of traffic operations. In urban and suburban areas where there are concentrations of pedestrians and roadside and intersectional interferences, fixed-source lighting tends to reduce night time crashes. Intersections with channelization, particularly multiple-road geometrics should include lighting. Large channelized intersections need illumination because of the higher range of turning radii that are not within the lateral range of vehicular headlight beams.

Planned locations of intersection luminaire supports should be designed in accordance with current roadside safety concepts. Design guidance can be obtained from Transportation Research Board's NCHRP Report 152, Warrants for Highway Lighting, 1974 and the AASHTO Roadside Design Guide. Refer to TxDOT Austin District standards and specifications for luminaire design.

2 TRAFFIC IMPACT ANALYSIS

2.1 GENERAL

The following guidelines for a traffic impact analysis (TIA) are intended to supplement the requirements of Chapter 3, "Subdivisions" of the City of San Marcos Land Development Code. If it is determined that the development will have a significant impact on the street system. In addition the City may require any or all public improvements (or proportionate share) recommended by the above mentioned studies. The purpose of this guideline is to:

- Define various levels of TIAs
- Determine what level of TIA is required
- Determine when a TIA is required
- The process of submitting a TIA
- The format of a TIA
- Adopt assumptions consistent with the accepted standards of the Engineering and CIP department
- Ensure consistency and uniformity of Transportation Studies

2.2 PURPOSE OF TRAFFIC IMPACT ANALYSIS

A TIA is intended to coordinate the transportation requirements of a development. TIA will integrate the land use and transportation requirements and establish policies to accommodate all modes of travel along existing and proposed roadways/intersections. Further objectives include:

- Identify impacts of the proposed development on thoroughfare system capacity as well as on alternative modes of travel
- Determine the traffic (vehicular) impacts a particular development on the existing roadway network system
- Establish proportionate mitigation measures for the identified impacts
- Provide recommendations on the safest and most efficient transportation system in accordance with the City's design standards and guidelines

2.3 VARIOUS LEVELS OF TRAFFIC IMPACT ANALYSIS

2.3.1 Transportation Plan at Subdivision Concept Plat Level

A transportation plan illustrating proposed street layout within the development including proposed connections to adjacent land uses, roadways/highways shall be submitted with the subdivision concept plat. In addition a greenway and bike infrastructure plan illustrating proposed alignments within the development including proposed connections to adjacent land uses as well as other existing/proposed greenways/bike infrastructure shall be submitted with the subdivision concept plat.

Timeline for the proposed subdivision shall also be provided with the subdivision concept plan including phasing plan. Proposed entrances as well as intersections with external road network as well as ROW requirements shall be identified. Policies shall be developed to guide the proposed phasing with respect to the transportation requirements.

2.3.2 Traffic Impact Assessment at Preliminary Subdivision/Development Plat

High level traffic impacts of the proposed subdivision or development plat shall be submitted with the preliminary subdivision or development plat. Existing adjacent transportation infrastructure as well as internal road network with annual average daily traffic (AADT), number of travel lanes, and major intersections lane configuration shall be submitted with plat. Proposed development AADT shall be added to the regional transportation infrastructure; and its impacts in terms of lane requirements and intersection configuration shall be identified.

2.3.3 Transportation Impact Assessment at Final Subdivision/Development Plat

A detailed transportation impact assessment shall be submitted during the final subdivision or development plat. Transportation impact assessment will include an initial scoping meeting, study area map, existing roadway network, study intersections, specific planning horizons as well as appropriate peak hours to be used for traffic analysis. Existing and background traffic analysis, trip generation, distribution, mode choice and assignment shall be completed as per the Institute of Traffic Engineers (ITE) standards. In addition to the traffic impacts, greenways and bike infrastructure analysis shall be submitted with each subdivision or development plat. A detailed description of the existing and proposed infrastructure in the area surrounding the site for transit, pedestrians and cyclists shall be included in Active Modes Assessment.

Recommendation shall include improvement of study intersections and roadway sections, traffic control, parking requirements, provision of connecting internal network of pathways and trails/bike infrastructure to regional network and transit accommodation.

2.3.4 Traffic Impact Analysis Required with Minor Subdivision or Development Plat

A traffic impact analysis threshold worksheet shall be submitted with the minor subdivision or development plat. If the traffic generated by the proposed subdivision or development exceeds the threshold requirements (300 vpd for residential streets or 2000 vpd for all other streets) then a detailed traffic impact analysis shall be submitted with the minor subdivision or development plat.

2.4 WHEN A TRAFFIC IMPACT ANALYSIS IS REQUIRED

A TIA is required for the proposed development or redevelopment that meets the following criteria unless otherwise waived by the Engineering & CIP Department:

- Any development that generates 200 trips/peak hour
- Any development that generates 2000 trips/per day
- 200 or more dwelling units are proposed for the development
- Subdivision concept plan stage
- Preliminary and final subdivision plat stages
- Preliminary and final development plats stages
- Minor subdivision or development plat stages
- Planned development requests
- Zoning/rezoning requests
- Conditional use permit requests
- Proposed amendments to the City’s major thoroughfare plan

Please note that these are not absolute criteria but merely a guideline. Director of Engineering or their designee has the right to require a TIA as they deem necessary as per Land Development Code Chapter 3.

2.5 GENERAL REQUIREMENTS

2.5.1 Preliminary Scoping Meeting

If it is determined that a TIA is required, the developer and their traffic engineer shall schedule a meeting with the City's Engineering staff to determine the scope and requirements of the TIA. Applicable standards and methodologies shall also be identified in this meeting.

It is strongly recommended that the preliminary scoping meeting is scheduled before any work is done on the TIA. Any work completed without the City's consent or input is subject to revision at the applicant's risk without a formal review and comments.

2.5.2 Study Area & Existing Roadway Network

The study area shall include all municipal and state highways that will likely be affected by the traffic generated by the proposed development. In general a complete TIA will include all site access points, major intersections and roadway sections within 1000 ft. of the proposed development.

Please note that this is not an absolute criteria but merely a guideline. The Engineering Department reserves the right to establish study area including intersections and roadway network as deemed necessary.

2.5.3 Analysis Horizon Year

Specific planning horizons to be used in the study shall be discussed with the Engineering Department at the start of the study. In general, the horizon year for the TIA shall be the ultimate build-out of the development in accordance with the phasing plan, development scenario of the area etc.

For any interim phases of a development, additional horizon years, ranging from a minimum of two (2) years after the study date to a maximum of full build-out shall be identified in consultation with the Engineering Department.

2.5.4 Peak Hours

The design hours to be used in a TIA shall be discussed with and approved by the Engineering Department at the preliminary scoping meeting. In general, the TIA shall include morning (AM) and evening (PM) peak hour analyses in accordance with the City's standards. Other peak hours (afternoon, weekend, holidays, etc.) may also be required to determine the significance of the alternative modes as well as traffic impacts induced by the development. Consultation between the City's Engineering Department and the developer is recommended during the early planning stages of a project to determine the peak hours, which is directly associated with the peaking characteristics of the traffic within the municipality and the proposed development traffic.

2.5.5 Traffic Counts

Prior to collecting traffic counts in the field, a discussion between the Engineering Department and the Developer/Consultant is recommended to determine the level of detail required at each count site. The level of detail may include traffic count locations, period, intervals, pedestrian counts, bicycle traffic counts, vehicle classification counts, etc.

Common practice for counting traffic, pedestrian and bicycle volumes include:

- Counts shall be conducted on a typical day generally on Tuesdays, Wednesdays, or Thursdays during a week not containing a holiday and conducted in weather condition that is not abnormal
- 15 minutes counts shall be conducted during anticipated peak hours. Typically 2-hr peak flow counts will be conducted once each in the morning, afternoon and evening peaks respectively.
- Seasonal and weekend variations in traffic, pedestrian and cyclists volumes shall also be considered to factor the counts

2.5.6 Study Intersections & Traffic Control

Study intersections to be analyzed as part of the TIA shall be discussed with and approved by the Engineering Department at the preliminary scoping meeting. The existing lane configuration as well as the traffic control (stop controlled, signalized, etc.) at the study intersections shall be obtained from the City's Engineering Department before commencing any TIA work. If the information is not available, then it is the developer's responsibility to conduct a site visit to gather study intersections geometry and traffic control.

A figure illustrating the study area, existing intersections, lane configurations and traffic control shall be included in this section.

2.5.7 Existing and Background Traffic

Vehicular, pedestrian and any cyclist volumes collected at the study intersections will be used as existing traffic volumes for the proposed development. Background traffic volumes shall be obtained by applying an annual average growth rate of 3% to the existing traffic volumes. Figures illustrating existing turning movement counts as well as the background traffic volumes shall be included in this section.

If a phasing plan has been proposed for the development, background traffic shall be calculated for each phase.

2.5.8 Proposed Development

This section shall provide a detailed description of the proposed development including land use, intensities, access points, parking supply, and any other details that may have an impact on the transportation network. A figure illustrating a site plan shall be included in this section. If the application is not tied to plans, at least a concept plan shall be provided with indication of the access points.

The development shall be categorized by specific land-use type consistent with classifications contained in the ITE Trip Generation Manual. The proposed land use types, gross leasable area, units, etc. shall also be provided.

2.5.9 Trip Generation

Trips generated by the proposed development shall be calculated using the most current edition of the Institute of Transportation Engineers (ITE) "Trip Generation Manual". Methodologies provided in the Trip Generation Handbook shall be used for the calculations of internal trips, pass-by trips, etc. Consultation with the Engineering Department is suggested to ensure that appropriate and agreed upon trip generation rates are being used in the TIA.

A table shall be provided in the study report identifying the categories and quantities of land uses, with the corresponding trip generation equations (rates if no equations are provided in ITE Trip Generation

Manual) and the resulting number of trips. The table also needs to identify the pass-by and internal trip percentages and the associated number of vehicle movements.

If a phasing plan has been proposed for the development, trip generation table shall be created for each phase.

Internal trips – internal capture rates provided in the ITE Trip Generation Handbook shall be applied to calculate internal trips. A figure illustrating internal capture methodology or spreadsheet tool provided in the ITE Trip Generation Manual shall be included in this section.

If a phasing plan has been proposed for the development, internal trips shall be calculated for each phase.

2.5.10 Trip Distribution

The directions from which traffic will enter and exit the development site may depend on several factors, including, surrounding land uses, growth areas, population and employment distributions; existing traffic distribution patterns on the existing street system; size and type of the proposed development. Based on the factors mentioned above, trip distribution percentages shall be established for each driveway (enter/exit access), study intersection and adjacent road network. A figure illustrating trip distribution percentages shall be included in this section

If a phasing plan has been proposed for the development, trip distribution percentages shall be provided for each phase.

2.5.11 Mode Choice

Mode choice is the step in estimating trips generated by the proposed development, which will use other modes of travel such as walking, cycling and transit. The site traffic is split into trips using walking, cycling, transit, trips by car pool or as automobile passengers and trips by automobile drivers. To incorporate this step in any TIA, the study needs to provide a rationale in developing trips percentages for travel by different modes.

Good engineering judgment and rationale (mode choice trends in municipalities with similar population and infrastructure) is required for the reductions in automobile travel to the site to account for travel to/from the site by other modes such as walking, cycling and transit. Prior discussion with the Engineering Department is required on mode choice percentages; before reducing the automobile travel to/from the development.

A table with mode choice percentages as well as the reduced vehicular trips shall be included in this section.

2.5.12 Traffic Assignment

Traffic assignment shall be estimated using existing travel patterns, proposed development and its access points and future road network. A figure illustrating traffic assignment shall be included in this section.

If a phasing plan has been proposed for the development, traffic assignment figures shall be provided for each phase.

2.5.13 Pass By Trips

Pass-by trips are made as intermediate stops on the way from an origin to a primary trip destination. They do not affect the driveway or site access volumes but do affect the amount of traffic added to the adjacent street system. Where applicable pass-by trips shall be calculated for the land uses provided in the ITE Trip Generation Manual. A figure illustrating pass-by trips shall be included in this section.

If a phasing plan has been proposed for the development, pass-by trips shall be provided for each phase.

2.5.14 Diverted Trips

These are similar to pass-by trips but they are attracted from the traffic on roadways within the vicinity of the generator but require a diversion from existing roadway to another roadway to gain access to the site. Diverted trips add traffic to the roadways adjacent to a site. Where applicable diverted trips shall be calculated for the land uses provided in the ITE Trip Generation Manual. A figure illustrating diverted trips shall be included in this section.

If a phasing plan has been proposed for the development, pass-by trips shall be provided for each phase.

2.5.15 Combined Traffic

A summary of the future traffic demands for each peak period and horizon year, combined with the site traffic shall be provided in the report. Combined traffic for a particular time period is a summation of the background traffic and development traffic produced by the proposed development. A figure illustrating combined traffic shall be included in this section.

If a phasing plan has been proposed for the development, combined traffic shall be provided for each phase.

2.5.16 Capacity Analysis

The most current edition of the “Highway Capacity Manual”, published by Transportation Research Board shall be used for capacity analysis of study intersections and roadway sections. Capacity and level of service calculations shall be performed for each study intersections and roadway sections for following scenarios:

Without proposed development on existing roadway system:

- Existing traffic conditions (i.e., current traffic volumes)
- Future background traffic conditions (i.e., future traffic volumes in design horizon)

With proposed development without improvements:

- Existing combined traffic conditions (i.e., existing + development traffic volumes)
- Future combined traffic conditions (i.e., future + development traffic volumes)

With proposed development with improvements:

- Existing combined traffic conditions (i.e., existing + development traffic volumes)
- Future combined traffic conditions (i.e., future + development traffic volumes)

The TIA shall provide capacity analysis results in a tabular form for all study intersections, study peak hour periods, and study horizon years listing the Level of Service (LOS), delay, queues and v/c ratio for individual directional movement for the above mentioned scenarios.

In general, capacity analyses for study intersections and roadway sections shall show an overall minimum LOS 'D' as well as individual movement minimum LOS of 'D' using "Highway Capacity Manual" methodology. Improvement of study intersections and roadway sections shall be recommended where:

- Overall LOS of intersections as well as individual movement LOS is worse than 'D'.
- LOS of roadway section is worse than 'D'.
- Volume/capacity (v/c) ratios for overall intersection operations or any individual movements (through, turning or shared through/turning movements) are 0.90 or above.
- Queues for an individual movement are projected to exceed available turning lane storage based on the 95th percentile queue criteria.

2.5.16.1 Computer Programs for Capacity Analysis

Generally accepted software programs, such as VISSIM, HCS or Synchro shall be used for capacity analysis of intersections and roadway sections. Prior approval for using roundabout capacity analysis software package shall be obtained from the Engineering Department.

2.5.17 Traffic Signal Warrant Analysis

Texas Manual on Uniform Traffic Control Devices (TxMUTCD) shall be used to conduct intersection traffic signal warrant analysis. The City will not consider a traffic signal unless the warrants criteria specified in TxMUTCD are met. Meeting a traffic signal warrant does not automatically lead to the approval for the installation of a traffic signal. Copies of the worksheets (in digital format) must be included in the Traffic Impact Study final report.

2.5.18 Parking Assessment

Depending on the context and location of the proposed development, a parking assessment may be requested. Parking assessment may include a comparison of the parking supply proposed for the development with the City's code requirements. A rationale shall be included in the parking report if the proposed parking supply is less than the parking stalls required by the Code. Parking assessment requirements shall be discussed with and approved by the Engineering Department before any work is performed. Any work completed without the City's consent or input is subject to revision at the applicant's risk without a formal review and comments.

2.5.19 Active Modes & Transit Assessment

Depending on the context, location and size of the proposed development, a qualitative or quantitative active modes analysis may be requested. A detailed description of the existing and proposed infrastructure in the area surrounding the site for transit, pedestrians and cyclists shall be included in Active Modes Assessment. Barriers to walking, cycling or transit shall also be documented including, major intersections, high volume roads, lack of transit routes or stops, railroad etc. Impacts and benefits of Active Modes shall be identified and documented in this section.

The internal pedestrian, bicycle and transit connections and circulation shall be analyzed under this section. Qualitative analysis with focus on connectivity to the primary pathways and trail network, cycling network and regional pathway system shall be included in this section.

A figure illustrating the existing/proposed pedestrian, bicycle and transit network within vicinity of the proposed development shall be included in this section. The figure shall also include internal pedestrian and bicycle network connecting recreation centers, commercial, office and residential areas.

If a phasing plan has been proposed for the development, active modes plan shall be provided for each phase.

2.5.20 Recommendations

It is expected that the recommendations related to TIA for a proposed development shall include following:

- Improvement of geometry of study roadway sections & intersections
- Improvement of traffic control
- Traffic calming measures
- Parking requirements, if required
- Provision of connecting the internal network of pathways and trails/bikeways to existing bike and trail network
- Improvement of access management issues
- Improvement of other aspects recognized by the Engineering Department

2.5.21 Pro-Rata Cost Sharing

Probable cost of improvements and the developer Pro-Rata share shall be developed based on the traffic generated by the proposed development and the recommended improvements.

2.5.22 Deliverables

The consultant shall upload the final TIA complete with all supporting documentation on mypermitnow.org; for initial review and comments. The consultant shall also submit an electronic copy of all analyses contained in Appendices, such as intersection capacity analysis (VISSIM or Synchro files), roundabout capacity analysis (SIDRA, VISSIM files) roadway capacity analysis, traffic signal warrant analysis, parking analysis, etc. All TIA reports submitted must be sealed by a professional engineer licensed to practice in the State of Texas.

2.6 STUDY REQUIREMENTS FOR SUBDIVISION CONCEPT PLAN STAGE

Since the subdivision concept plan stage is an early planning process, a full blown TIA is not required at this time. The land uses as well as the proposed access points are in early stage of development; only certain tasks to be completed for application submission.

The Transportation Plan (TP) shall incorporate land use districts, which will be further refined during preliminary and final subdivision plat stages. The TP shall provide recommendation to be used to guide the development of land use patterns and a conceptual overall transportation system for the plan area. The TP shall also develop transportation policies during this process, which will guide the development

of land uses and transportation including, opportunities for alternatives to private automobile such as walking cycling and public transit.

The submission of a completed TIA trip generation worksheet is the first step in the process. The worksheet shall be filled out using the latest edition of ITE Trip Generation Manual. If the land uses are not known or are at the early stages of planning, then the developer shall make assumption to reflect the worst case scenario.

If the TIA threshold is met then following tasks are required for a complete submittal:

2.6.1 Preliminary Scoping Meeting

If it is determined that a TIA is required, the developer and their traffic engineer shall schedule a meeting with the City's Engineering staff to determine the scope and requirements of the Transportation Plan (TP). Applicable standards and methodologies shall also be identified in this meeting.

It is strongly recommended that the preliminary scoping meeting is scheduled before any work is done on the TP. Any work completed without the City's consent or input is subject to revision at the applicant's risk without a formal review and comments.

2.6.2 Study Area & Existing Roadway Network

The study area shall include all municipal and state highways that will likely be affected by the traffic generated by the proposed development. In general a complete TP will include all site access points, major intersections and roadway sections within 1000 ft. of the proposed development.

Please note that this is not an absolute criteria but merely a guideline. The Engineering Department reserves the right to establish study area including intersections and roadway network as deemed necessary.

2.6.3 Horizon Year for Analysis

Specific planning horizons to be used in the study shall be discussed with the Engineering Department at the start of the study. In general, the horizon year for the TIA shall be the ultimate build-out of the development in accordance with the phasing plan, development scenario of the area etc.

2.6.4 Annual Average Daily Traffic (AADT)

AADT along major municipal and state highways shall be obtained from the City or TxDOT. A figure illustrating major thoroughfares and corresponding AADT shall be included in this section.

2.6.5 Development Traffic

Estimate average daily trips generated by the proposed land uses described in the Plan Area. Site trips shall be calculated using the most current edition of the Institute of Transportation Engineers (ITE) "Trip Generation Manual".

2.6.6 Combined Traffic Volumes

Assign average daily trips generated from the proposed development onto the major thoroughfares as well as internal road network. Calculate the combined traffic volumes by adding the AADT and daily site trips. A figure illustrating major thoroughfares as well as internal road network and corresponding combined traffic volumes shall be included in this section.

2.6.7 External Road Network

Identify and describe the existing and proposed regional road network serving the proposed development. Identify and document the proposed access points to the plan area. Based on the traffic volumes established above, locate approximate right-of-way and related intersection/interchange areas for the regional road network. Identify lane requirements for the major thoroughfares. Develop policy guidelines to facilitate the implementation of proposed transportation network phases. A figure illustrating external road network with ROW requirements and proposed access locations shall be included in this section.

2.6.8 Internal Road Network

Identify and describe the internal road network serving the proposed development including roadway classification. Locate approximate ROW required to accommodate the internal roadways and identify lane requirements. Develop policy guidelines to facilitate the preliminary and final design of the internal road network. A figure illustrating internal road network with ROW requirements and proposed internal intersections shall be included in this section.

2.6.9 Regional Pathway Network

A detailed description of the existing and proposed pedestrian & bike infrastructure in the area surrounding the site shall be provided. The internal pedestrian, bicycle and transit connections and circulation shall be analyzed under this section. Connectivity to the primary pathways and trail network, cycling network and regional pathway system shall be described.

A figure illustrating the existing/proposed pedestrian, bicycle and transit network within vicinity of the proposed development shall be included in this section. The figure shall also include internal pedestrian and bicycle network connecting various land uses within the development.

2.7 STUDY REQUIREMENTS FOR OTHER STAGES

Since preliminary and final subdivision/development plat stage is an advanced planning process, a full blown TIA is required at this time. As the land uses as well as the location of the proposed access points are fully developed, the tasks mentioned in **Section 2.5**, i.e. “General Requirements” shall be completed for application submission.

The submission of a completed TIA trip generation worksheet is the first step in the process. The worksheet shall be filled out using the latest edition of ITE Trip Generation Manual.

3. PAVEMENT DESIGN

3.1 INTRODUCTION

3.1.1 Objective

The objective of this section is to provide the City of San Marcos (the City) Roadway Designers and Geotechnical Engineers with a pavement design overview covering the design layers, design methodology, and representative pavement sections for the various roadway classifications within the City and its jurisdiction.

This section is intended to address most pavement design considerations within the City. Deviations from the pavement design methodology or minimum design criteria set forth in this section shall be documented in the Pavement Design Report and approved by Director of Engineering or their designee.

3.1.2 Scope

The scope of this document includes design criteria and design guidance for flexible and rigid pavements constructed on city streets under the authority of the City of San Marcos, within city limits.

This document is not intended to cover design of pavement for highways under the jurisdiction of Texas Department of Transportation (TxDOT) or Hays County. For these roadways, the roadway shall refer to design manuals such as TxDOT's "Pavement Design Guide".

3.1.3 Standard of Care

The services described in this section shall be completed under the direction of an appropriately experienced Professional Engineer registered in the State of Texas. Geotechnical engineering shall be limited to address the geotechnical-related aspects of pavement design described in this section. Roles and responsibilities adopted for the purpose of this manual are provided below:

- Roadway Designer: Professional Engineer with responsible charge for completion of the design project. The Roadway Designer is responsible for developing all elements of the project (civil, roadway, geotechnical, pavement, etc.), and preparing the plans and specifications required for contractors to bid on construction of the project. The Roadway Designer is responsible for developing design traffic parameters and roadway design layouts for use by the Geotechnical Engineer and Pavement Engineer;
- Geotechnical Engineer: Professional Civil Engineer responsible for the geotechnical engineering-related aspects of pavement design, including subsurface investigation and subgrade treatment/stabilization recommendations. Depending on the project, the Geotechnical Engineer may also assume the responsibilities of the Pavement Engineer; and
- Pavement Engineer: Professional Civil Engineer responsible for the pavement design, including pavement materials selection and layer thicknesses required to support design traffic loading and life cycle cost analysis. Depending on the project, these responsibilities may be transferred to the Geotechnical Engineer.

3.1.4 References

This section has been updated significantly from the previous version of the City's Transportation Criteria Manual adopted in 2004. The bases of these updates are recent research findings presented by the Capital Area Pavement Engineering Council Initiative (CAPEC), and the more recent version of the TxDOT Pavement Design Guide (2018). Refer to the bibliography for these specific references.

3.1.5 Use of Acronyms

Commonly used acronyms in this section are listed below

ACPA	American Concrete Pavement Association
CAMPO	Capital Area Metropolitan Planning Organization
CAPEC	Capital Area Pavement Engineers Council
MSL	Mean Sea Level
NRCS	Natural Resource Conservation Service
OSHA	Occupational Safety and Health Administration
PCA	Portland Cement Association
PDR	Pavement Design Report
ROW	Right-of-Way
TxDOT	Texas Department of Transportation
USGS	United States Geological Survey

3.2

3.2.1 General Criteria

All streets shall be constructed on an engineered subgrade, stabilized lime treated, a base layer and the pavement. Pavements shall be either Hot Mix Asphaltic Concrete (HMAC) or Concrete Pavement. For the purpose of this guide, HMAC pavements are considered "flexible pavements," and concrete pavements are considered "rigid pavements".

3.2.2 Design Life

Specific to flexible pavements, the following design periods shall be used:

- Pavement Design Life: 20 years
- Time to First Overlay: 10 years and
- Time between Overlays: 10 years.

Rigid pavements to be constructed in public right-of-way (ROW) shall be designed for a minimum 30 year design life.

3.2.3 Design Methodology

The recommended pavement design methodology is a balanced approach that requires the Pavement Engineer to address the following:

- Subgrade Considerations
  - Consider environmental stresses (shrink/swell) in all soils regardless of high plasticity (High "PI") soils
  - Include Potential Vertical Rise (PVR) movement calculations
  - Consider fatigue cracking criteria in surface layers and
  - Consider thinner base layers to offset cost (e.g., components with subgrade treatment or thicker HMAC/Concrete Pavement).

- Develop Subgrade Improvement Strategies (as needed):
  - Consider subbase layers and
  - Recommend combination strategies.


REVISION IN PROGRESS


REVISION IN PROGRESS

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[illegible] Traffic Distribution

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[illegible] Pavement Traffic Inputs

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Table 3-6: Serviceability Index

Initial Serviceability Index Range	
Surface Type	Allowable Initial Serviceability Index Range
Surface Treatment	4.0
Thin HMAC (≤4")	4.0 – 4.1
HMAC >4"	4.2 – 4.5

Table 3-7: Terminal Serviceability Index

Terminal Serviceability Index		
Street Classification	Representative ESALs	Terminal Serviceability Index
Highway	[illegible]	3.0
Divided High Traffic	[illegible]	3.0
Divided	[illegible]	3.0
Divided Low Traffic	[illegible]	3.0
Avenue	[illegible]	3.0
Commercial Street	[illegible]	3.0
Residential Street	[illegible]	3.0

Design confidence level takes into account the uncertainty due to variability in estimating traffic, material strength and construction practices to ensure that the pavement will last for the design period. The confidence level shall be based on the function classification of the road. Table 3-7 shows the minimum code used by the FPDES for the design confidence level and the values to be used for the design.

Table 3-8: Required Design Confidence Level

Required Design Confidence Level				
Street Classification*	Representative ADT Range **	Representative ESALs at 20 Years **	FPDES Code	Design Confidence Level (%)
Highway	[illegible]	[illegible]	C	85
Divided High Traffic	[illegible]	[illegible]	C	85
Divided	[illegible]	[illegible]	C	85
Divided Low Traffic	[illegible]	[illegible]	C	85
Avenue	[illegible]	[illegible]	C	85
Commercial Street	[illegible]	[illegible]	B	80
Residential Street	[illegible]	[illegible]	B	80

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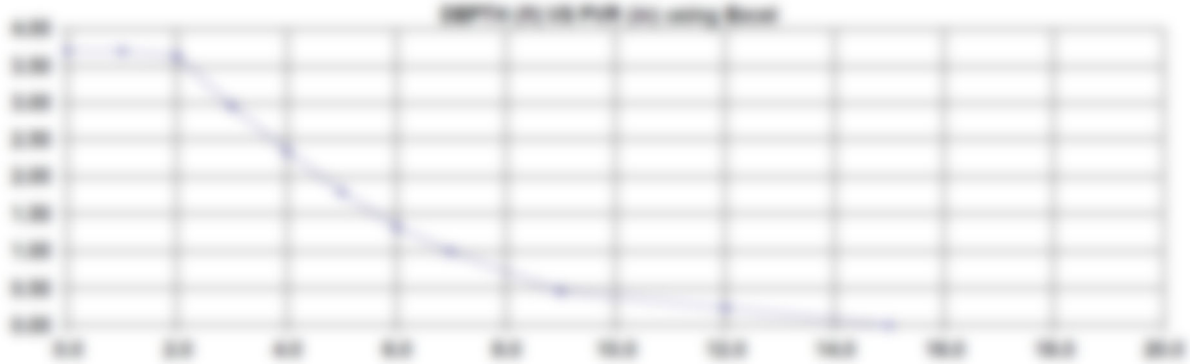

Summary of Subgrade Strength Correlations (DRAFT 2021)			
Basis of Correlation	Equation	Origin	Comment
California Bearing Ratio to [illegible]	[illegible]	Heukelom & Klomp (1962)	Only for fine grained non-expansive soils with a soaked CBR of 10 or less
	[illegible]	ICONOS 2004	A fair correlation over a wide range of values
Dynamic Cone Penetrometer Penetration Index to CBR	CBR = [illegible]	ASTM D6951	PI is penetration rate, empirical from DCP test
	CBR = [illegible]	Webster, Brown and Parker, 1994	For high plasticity clay soil (CH) PI is penetration rate, empirical from DCP test
	CBR = [illegible]	Webster, Brown and Parker, 1994	For low plasticity clay soil (CL) PI is penetration rate, empirical from DCP test
Unconfined Compressive Strength (UCS) to M_R	M_R = [illegible]	Hossain & Zaman (2014)	N/A
Texas Triaxial Classification (TTC) to M_R	M_R = [illegible]	2008 AASHTO Guide	N/A

Typical Strength Related Parameters for Various Subgrade Soils (CAPTAC 2007)					
Material (USC Class Where Appropriate)	CBR	E Value (psi)	DCP (in)	Static or Resilient Modulus (psi)	Back-Calculated Modulus Use in PCASE (psi)
Gravel or Gravelly Soils (GW, GP, GM, GC)	35—100	28,000+	0.10—0.20	21,000—28,000	Typically, 3 times the laboratory resilient modulus using field FWD testing on dynamic density.
Sandy Soils (SW, SP, SM, SC)	10—40	20,000—28,000	0.20—0.40	14,000—21,000	
Silty Soils (ML, MH)	5—15	14,000—20,000	0.40—0.80	10,000—14,000	
Clay Soils, Low Compressibility, LL<50 (CL)	5—15	14,000—20,000	0.40—0.80	10,000—14,000	
Clay Soils, High Compressibility, LL>50 (CH)	1—5	10—14,000	0.80—1.20	7,000—10,000	


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Typical Pavement Option Components			
Material Layer	Specification	Flexible Pavement	Rigid Pavement
Hot Mix Asphalt Concrete (HMAC)	TxDOT Item 340/341 CCRM Item 340	X	NA
Concrete Pavement	TxDOT Item 360 CCRM Item 360	NA	X
Base Reuse	TxDOT Item 276/247	NA	O
Flexible Base	TxDOT Item 247 CCRM Item 247	X	NA
Treated Base	TxDOT Item 275 (cement) CCRM Item 275 (cement) TxDOT Item 292 (asphalt) CCRM Item 292 (asphalt)	NA	X
Treated Subgrade • Lime • Cement • Fly Ash/Cement	TxDOT Item 260 CCRM Item 260/262/264 TxDOT Item 275 CCRM Item 275	O	O
Geosynthetics (optional)	TxDOT Item 3091 TxDOT Item 3049 6040	O	O
Reinforcement • Steel Rebar • Reinforcement (Fiber)	TxDOT Item 360 CCRM Item 360 TxDOT Item 360 CCRM Item 360/362/364	X	X
Notes 1. X = Included 2. O = May be included based on design analysis results and at Engineer's Discretion			

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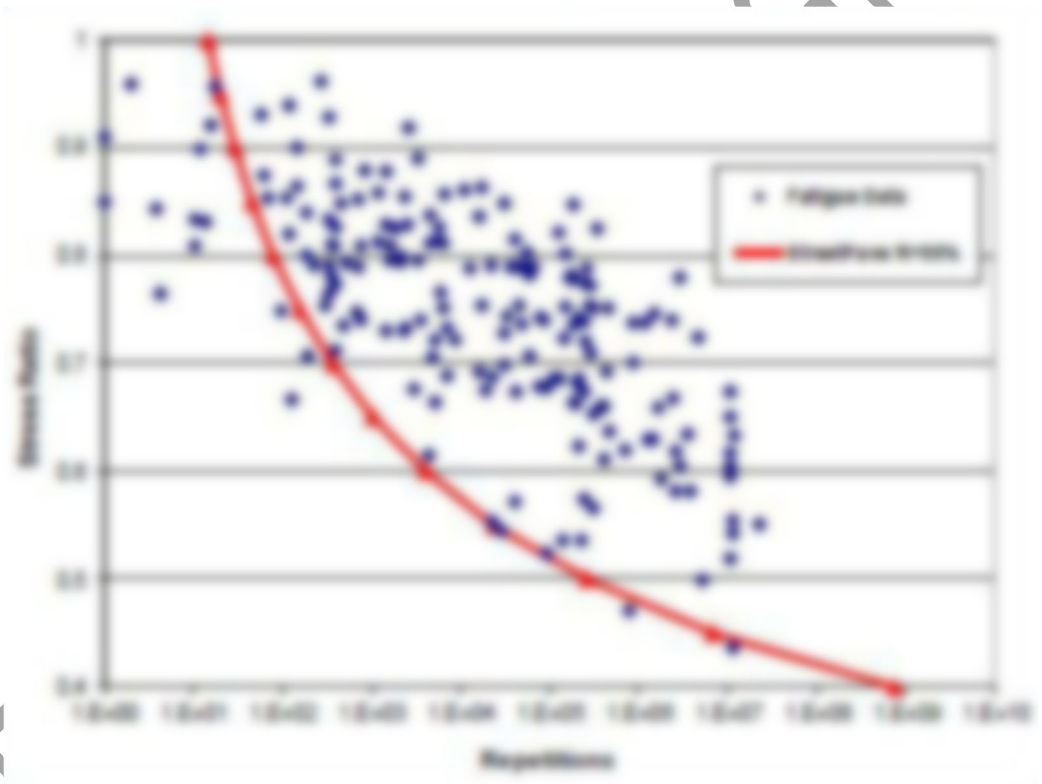


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4. SIDEWALKS, CURBS RAMPS AND BICYCLE FACILITIES

4.1 GENERAL

There is a wide range of facility improvements which can enhance bicycle and pedestrian transportation. Improvements can be simple and involve minimal design consideration (such as changing drainage grate inlets) or they can involve a detailed design (such as constructing a hike and bike trail). The major feature of the design for a bicycle or pedestrian facility is its location (i.e., whether it is on a roadway or follows its own independent alignment). Roadway improvements such as bicycle lanes depend on the roadway's design. On the other hand, multi-use paths are located on independent alignments; consequently, their design depends on many factors, including the performance capabilities of the wheeled vehicles and the pedestrians and the volume and mix of the user groups.

With proper planning and design, roadway improvements for motor vehicles can also enhance bicycle and pedestrian travel, and, in any event, should avoid causing adverse impacts on bicycling and walking. A community's overall goals for transportation improvements should, whenever possible, include the enhancement of bicycling and consider the needs for pedestrian movement.

4.2 DESIGN STANDARDS

All bicycle and pedestrian facilities should meet the minimum standards recommended by the American Association of State Highway and Transportation Officials (AASHTO) “The 2012 AASHTO Bike Guide” and National Association of City Transportation Officials (NACTO) “Urban Bikeway Design Guide”. Additional guidance for separated bicycle facilities is contained in FHWA’s “Separate Bike Lane Planning and Design Guide”. Pavement striping, signage, and signals should be in accordance with the most current Texas Manual on Uniform Traffic Control Devices (TMUTCD). Hike and bike trails and sidewalks should be accessible and traversable by physically disabled persons and should comply with the guidelines set forth by the American with Disabilities Act of 1990 (ADA), as enforced in Texas by the Architectural Barriers Section of the Texas Department of Licensing and Regulation.

4.3 SIDEWALKS AND CURB RAMPS

This section addresses sidewalk and curb ramp design for roadways within public rights-of-way (ROW) in order to provide accessible route(s) in the design and construction of City streets.

Early consideration of pedestrian facilities should be studied at the planning stages of a roadway system as later installations might be costly and/or unfeasible.

Accessible routes shall comply with Texas Accessibility Standards as administered by the Texas Department of Licensing and Regulation. Public rights-of-way and facilities are required to be accessible to persons with disabilities through the following statutes: Section 504 of the Rehabilitation Act of 1973 (Section 504) (29 U.S.C. §794) and Title II of the Americans with Disabilities Act of 1990 (ADA) (42 U.S.C. §§ 12131-12164). The laws work together to achieve this goal. When a public or private agency provides a pedestrian facility, it must be accessible to persons with disabilities to the extent technically feasible.

A SIDEWALK is a pathway constructed to provide for pedestrian traffic; such traffic is generally non-motorized and may include self-propelled wheeled vehicles and devices, if not prohibited; but may also include vehicles such as motorized wheelchairs and personal transport devices, if not prohibited. A CURB RAMP is a connection between a sidewalk and a roadway surface that is constructed with special

surface, visual, and geometric characteristics. The WIDTH of a sidewalk or curb ramp is the dimension of the surface measured perpendicular between the sides of the sidewalk or curb ramp exclusive of any abutting curb or flared sides. CLEAR WIDTH is the width of the surface and the space to a point eighty inches (80") perpendicularly above the surface that is void of obstructions or protruding objects (as per Texas Accessibility Standards).

Sidewalks and curb ramps shall be constructed to comply with Chapter 4: "Accessible Routes" of the latest edition of the Texas Accessibility Standards (TAS) of the Architectural Barriers Act Article 9102, Texas Civil Statutes; the latest edition of the Americans with Disabilities Act (ADA) Accessibility Guidelines (ADAAG) for Public Rights-of-Way; or the standards herein, whichever is more restrictive. The geometry and tolerances of the surface of a roadway between curb ramps on either side of the roadway, or of a driveway between the points where sidewalk intersects the driveway edges on either side of the driveway, shall also comply with the aforementioned standards. The "Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way", available from the United States Access Board, is also a design source for sidewalk and general pedestrian facility design.

Sidewalks and curb ramps constructed within City of San Marcos (COSM) right-of-way or sidewalk easements shall be constructed in accordance with the COSM Design and Construction Standards and adopted Standard Specifications. Construction material for sidewalk other than reinforced hydraulic cement concrete in accordance with COSM Specifications will not be allowed except through separate license agreement with COSM, to include maintenance responsibilities. Construction material for curb ramps other than reinforced hydraulic cement concrete with cast-in-place detectable warning pads, in accordance with COSM Specifications, will not be allowed except through separate agreement with the COSM.

A design variance is required whenever the design guidelines specified in the ADAAG and the TAS are not met. The Project Engineer who is sealing the construction plans is responsible for obtaining approval of design variances from the Texas Department of Licensing and Regulation (TDLR). Contact COSM Director of Engineering or their designee prior to proceeding with the variance request to obtain concurrence that specific criteria cannot be met and a request for variance is reasonable.

Sidewalk requirements are also defined in the Chapter 3: Subdivisions, Article 6, 7, and 8 of the Land Development Code of the COSM (CodeSMTX). Where discrepancies occur, these codes as adopted or amended by the City Council shall govern.

Refer to the Bibliography for reference documents pertaining to accessibility requirements and curb ramp standards.

4.3.1 Sidewalk Requirements

For the specific roadway classifications, sidewalks shall typically be constructed on both sides of the road and parallel to the roadway with a minimum width specified herein. For sidewalks constructed with a width equal to or greater than ninety-six inches (96"), the clear width may be comprised of two sections on either side of an obstruction provided that each section has a clear width no less than forty-two inches (42").

Obstructions or protrusions in or over a sidewalk shall be kept to a minimum. When unavoidable, an obstruction or protrusion in or over a sidewalk shall not be longer than twenty-four inches (24")

longitudinally along the sidewalk. The longitudinal distance between separate obstructions or protrusions shall not be less than sixty inches (60”). Detection and/or protection barriers shall be provided for objects with a height above the finished sidewalk surface greater than twenty-seven inches (27”) and less than eighty inches (80”) that protrude more than four inches (4”) into the area above a sidewalk or into the area above surfacing abutting or adjacent to a sidewalk that is not readily distinguished from the sidewalk area due to the surfacing characteristics.

The minimum sidewalk width shall be four feet (4’) for residential streets however, requires from the COSM Director of Engineering or their designee. If a sidewalk with four feet width is provided then a 5 foot by 5 foot (5’ x 5’) passing space must be provided at 200 foot intervals in accordance with TAS.

Items such as street furniture, signal poles, illumination poles, trees, utilities, and other obstructions shall be located in order to provide the minimum clear width and height per TAS/ADAAG.

Sidewalk locations shall be coordinated with the driveway design in order to provide an accessible route across the driveway. The maximum grade of the drive at the accessible route shall be 2% which corresponds to the maximum cross slope of the accessible route.

Sidewalks constructed within TxDOT’s ROW shall be as approved by TxDOT.

The width and alignment of sidewalks within the public ROW shall be as shown on the typical sections in Section 1 – Street Design Criteria and Tables 1-1a through 1-1e. For Residential Street, Commercial Street, Avenue and Boulevard, the minimum sidewalk width shall be five feet (5’) when separated by a distance of at least three feet (3’) from the curb. Sidewalks closer than three feet (3’) to the roadway shall be a minimum of six feet (6’) in width. If there are ROW limitations and the sidewalk is adjacent to the back of curb, a six foot (6’) wide sidewalk shall be used. Variances from these widths and clearances shall be approved by the COSM Director of Engineering or their designee.

4.3.2 Curb Ramp Requirements

Sidewalks shall include a curb ramp whenever an accessible route crosses a curb. Ramps shall be constructed in accordance with the COSM Design and Construction Standards, ADAAG, and TAS.

The City Standard for a detectable warning surface is a cast-in-place or surface-mounted panel with truncated domes compliant with TAS Section 705 (Detectable Warnings). Truncated dome panels shall conform to the following ASTM Standards: D 695, D 790, D570, C 1028, E 84, B 117, 1308, C 501, G 155, D 638, C 903 and C1026. Concrete pavers with truncated domes are not allowed due to maintenance requirements. The preferred alignment for new curb ramps is perpendicular to vehicular flow. All curb ramps shall be constructed perpendicular to the curb as shown on the COSM Standard Drawings for the various types of curb ramps.

The curb ramp width shall match the width of the adjoining sidewalks or shared use paths to avoid a bottleneck condition as the pedestrian or other user approaches the ramp. In no case shall the curb ramp width be less than forty-eight inches (48”). Curb ramps shall be installed at all street intersections and for every sidewalk connection to the travel surface of a roadway. Curb ramps shall not be required at driveways but may be provided if the driveway is controlled by a traffic signal. At four-way street intersections, a total of eight curb ramps shall be provided (two ramps at each intersection corner). At three-way street intersections, a total of six curb ramps shall be provided (two ramps at each

intersection corner, and two ramps on the through street each of which will be across the street from one of the intersection corners). Curb ramps shall typically be “Type 1 Perpendicular Curb Ramp” as shown in COSM Standard Detail “ADA Ramps”, sheet 1 of 4. Under special circumstances, curb ramps may be the other types shown in the aforementioned COSM Standard Detail.

Curb ramp slopes, widths and landing areas shall be as shown on the COSM Standard Detail. A five foot by five foot (5’ x 5’) landing area shall be provided at the top of the ramp.

At signalized intersections, the curb ramp location and pedestrian detector locations shall be properly coordinated. Refer to Part IV of the TMUTCD, latest edition.

4.4 SHARED USE PATH REQUIREMENTS

A shared-use path is a physically separated sidewalk from the roadway and may be located either within the street ROW, or outside in a meandering alignment or easement. City policy is to provide shared use path adjacent to Highways and Boulevards in arrordance with Section 1 – Street Design Criteria, Tables 1-1a through 1-1e, and Figures 1-1 through 1-12. Shared-use paths may be used by bicyclists and pedestrians and therefore shall meet the design requirements of a bike facility and the ADA/TAS. Minimum width for a two-way facility is ten feet (10’), however an eight foot (8’) width may be provided in rare instances, as approved by the COSM Director of Engineering or their designee.

The path shall include a two foot (2’) wide graded area at a maximum slope of 1:6 adjacent to both sides of the path. Three foot horizontal clearance shall be maintained. In addition, there should be 3 feet of horizontal and 10 feet (8 feet minimum) of overhead clearance on either side of the pavement. Refer to **Figure 4-1** for a typical section of a shared-use path.

Multi-use paths should be constructed of smooth, hard, all-weather paving such as concrete or asphalt. Although more expensive, concrete paths require less maintenance than asphalt paths, which can buckle, crack, and erode quickly, especially along waterways. Good maintenance is essential for bike paths to eliminate and avoid hazardous conditions. Compacted granular surfaces are more difficult to use for many user groups, thus should be relegated to specific jogging or other special use trails.

Multi-use path slopes should comply with current requirements of the Americans with Disabilities Act Accessibility Guidelines (ADAAG). The maximum running grade for paths is 5 percent and changes in slopes should be kept as gradual as possible, with a total change in grade of not more than 11 percent unless provided with a transition (e.g a sag curve or intermediate slope). When grades must exceed five percent, the total running slope should not exceed 8.3 percent for over 30 percent of the path and other path attributes of cross slope and width should meet desired standards. Slopes over 5 but less than 8.3 percent can be maintained to a maximum of 200 feet, before a landing of less than 2 percent slope should be provided. Very short ramps can exceed the 8.3 percent maximum slope, but are used only for severe design constraints and obstacles. Paths immediately adjacent to a roadway may match the slope of the roadway if such is the constraint, but should incorporate intermediate landings where possible and larger landings at terminal points.

Cross slopes on paved paths are generally about 2 percent for drainage, but often accommodate driveway or other crossing or terrain elements that result in steeper grades. For running grades of up to 5 percent, path cross slopes of up to 8 percent are tolerable for short distances such as across a driveway. For running grades of 8 percent, cross slopes should be kept below 5 percent. For long

distances, cross slopes should not be greater than 3 percent. Changes in cross slopes should be kept as gradual as possible, as abrupt changes can have and stabilizing impact on wheelchair users.

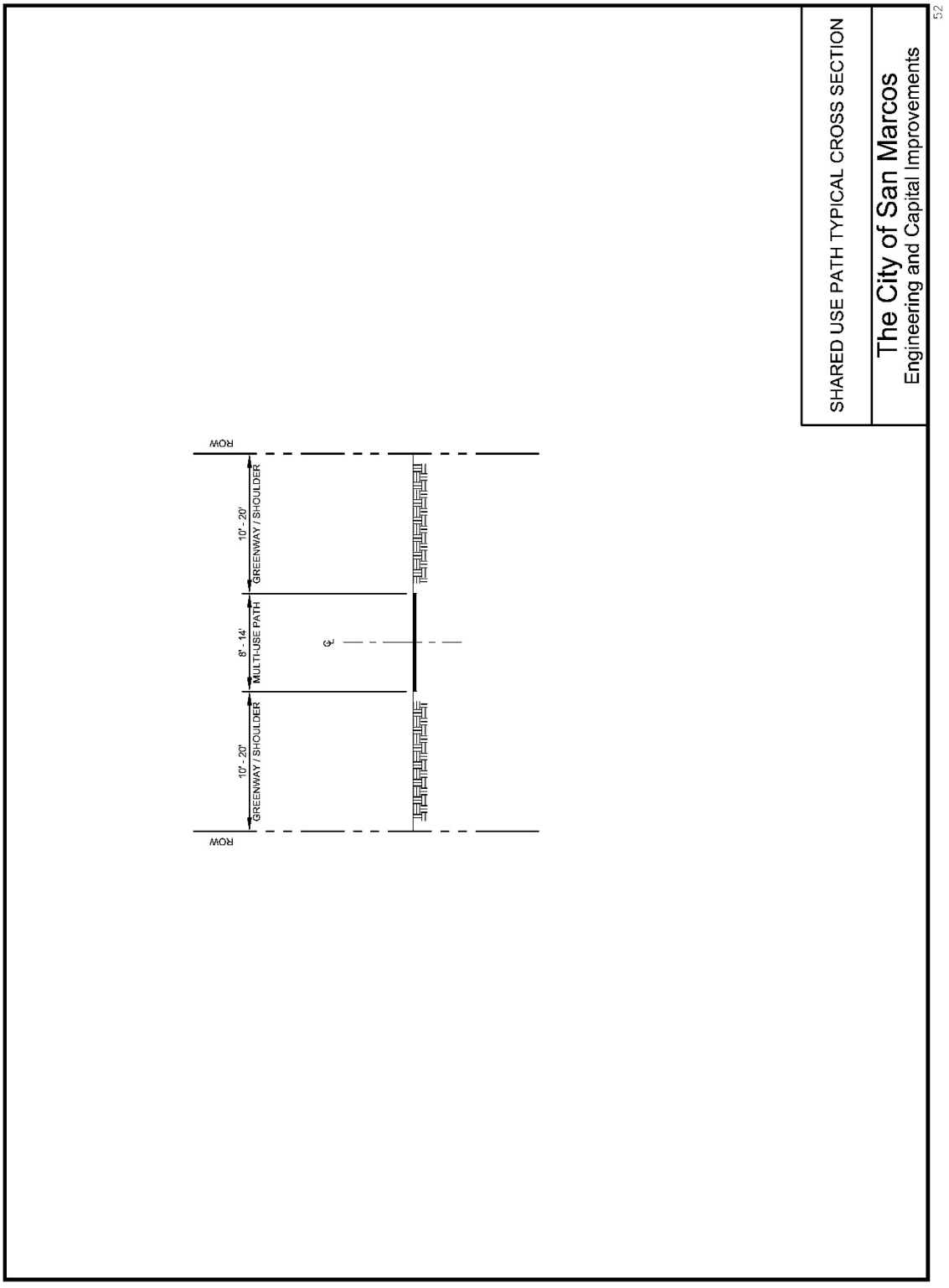


Figure 4-1: Shared Use Path Typical Cross Section

4.5 SAFETY CONSIDERATIONS

Drop-off hazards are defined as steep or abrupt downward slopes that can be perilous to pedestrians and bicyclists. The design engineer should consider shielding any drop-off determined to be a hazard. Railings or fences should be provided for vertical drop-off hazards or where shielding is required as described in this section.

The horizontal clearance for the sidewalk, shared-use path or roadway shall be maintained when designing the railing or fence. Only crash-tested barriers are allowed within the clear zone of roadways.

There are two cases that require shielding. As shown in **Figure 4-2** (Case 1), a drop-off greater than ten inches (10”) that is closer than two feet (2’) from the pedestrians’ or bicyclists’ pathway or edge of sidewalk is considered a hazard and shall be shielded. Also, as shown in **Figure 4-2** (Case 2), a slope steeper than 2H:1V that begins closer than two feet (2’) from the pedestrians’ or bicyclists’ pathway or edge of sidewalk is considered a hazard and shall be shielded when the total drop-off is greater than sixty inches (60”). Also, depending on the depth of the drop-off and severity of the conditions below, shielding may be necessary for cases other than described above.

The height of railings for bicyclists are generally the same as the minimum pedestrian railing height of forty-two inches (42”), except a minimum fifty-four inch (54”) railing or fence should be considered on bridges and retaining walls for special circumstances as identified in the commentary of the AASHTO LRFD Bridge Design Specifications Section 13.9.

4.6 Bicycle Facilities

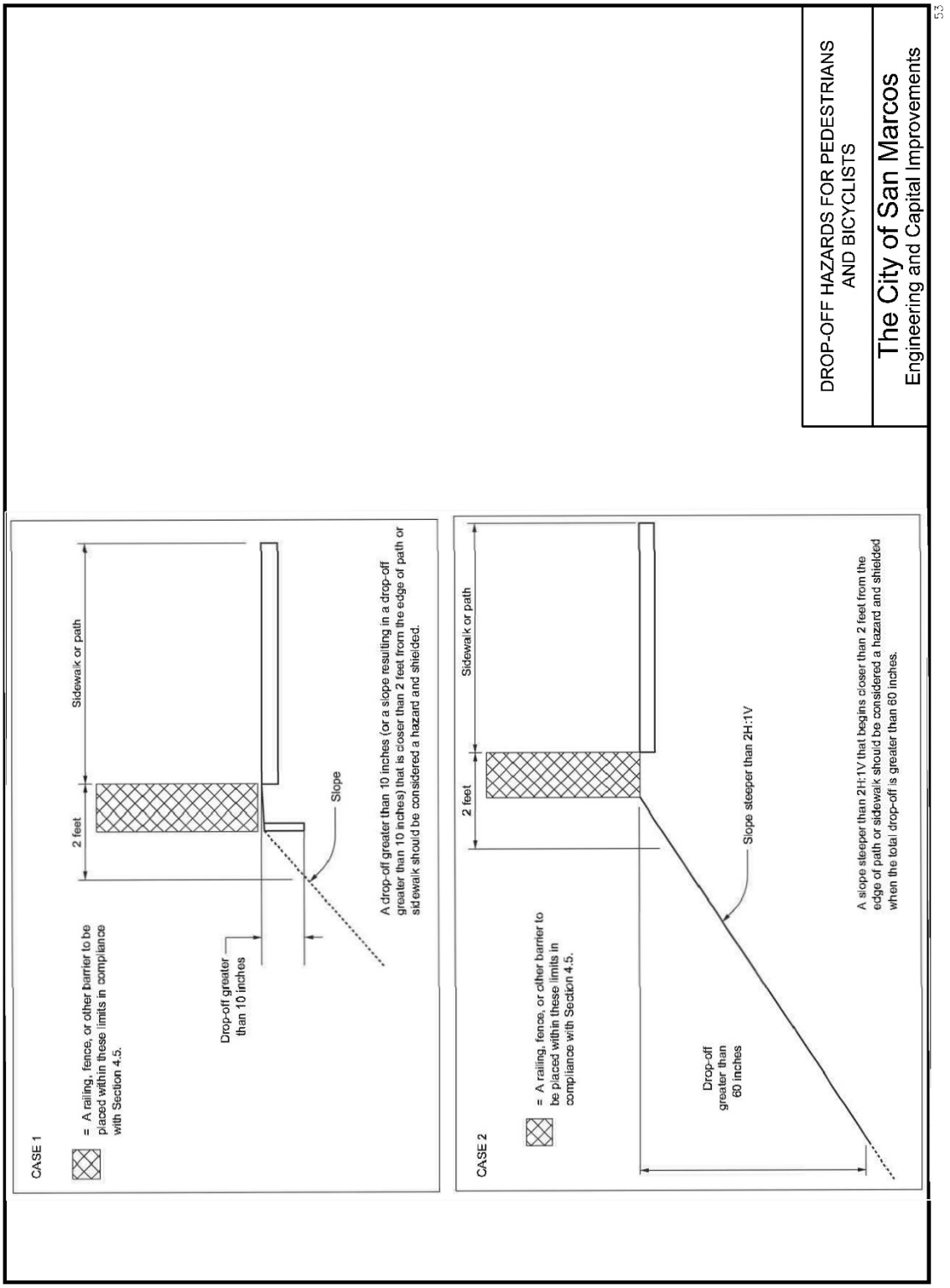
A Bike Lane is defined as a portion of the roadway that has been designated by striping, signage, and pavement markings for the preferential or exclusive use of bicyclists. A bike lane is distinguished from a cycle track in that it has no physical barrier (bollards, medians, raised curbs, etc.) that restricts the encroachment of motorized traffic. Conventional bike lanes run curbside when no parking is present, or adjacent to parked cars on the right-hand side of the street. Bike lanes typically run in the same direction of traffic. The types of facilities that may be provided for bicycle mobility include shared roadways, bicycle routes, bicycle lanes, and multi-use paths. City policy is to provide bike lanes adjacent to Boulevards, Avenues and Streets in accordance with Section 1 – Street Design Criteria, **Table 1-1** through **Table 1-5**, and **Figure 1-3** through **Figure 1-28**.

All bicycle facilities should meet the minimum standards recommended by the American Association of State Highway and Transportation Officials (AASHTO) “The 2012 AASHTO Bike Guide”, Federal Highway Administration (FHWA) “Separated Bike Lane Planning and Design Guide”, and National Association of City Transportation Officials (NACTO) “Urban Bikeway Design Guide”.

4.6.1 Types of Bike Facilities

Sharrow: Shared Lane Markings (SLMs), or “sharrows,” are road markings used to indicate a shared lane environment for bicycles and automobiles. Among other benefits shared lane markings reinforce the legitimacy of bicycle traffic on the street, and recommend proper bicyclist positioning. The shared lane marking is a pavement marking with a variety of uses to support a complete bikeway network; it is not a facility type and should not be considered a substitute for bike lanes, cycle tracks, or other separation

Figure 4-10: Drop-Off Hazards for Pedestrians and Bicyclists



treatments where these types of facilities are otherwise warranted or space permits. The TxMUTCD outlines guidance for shared lane markings in section 9C.07.

On-Street Bike Lane: On-Street bike lane is established with appropriate pavement markings and signing along streets in corridors where there is significant bicycle demand and where there are distinct needs that can be served by them. The purpose should be to improve conditions for bicyclists on the streets. Bike lanes are intended to delineate the right of way assigned to bicyclists and motorists and to provide for more predictable movements by each. On-street bike lanes also help to increase the total capacities of highways carrying mixed bicycle and motor vehicle traffic. Another important reason for constructing on-street bike lanes is to better accommodate bicyclists where insufficient space exists for comfortable cycling on existing streets.

Bike lanes enable bicyclists to ride at their preferred speed without interference from prevailing traffic conditions. Bike lanes also facilitate predictable behavior and movements between bicyclists and motorists. On-street bike lanes are striped with white paint and are often located on far right side of the road. They may be painted a separate color to draw more attention. On-street bike lane is allowed as per TxMUTCD guidelines for buffered preferential lanes (section 3D-01).

On Street Buffered Bike Lane: Buffered bike lanes are conventional bicycle lanes paired with a designated buffer space separating the bicycle lane from the adjacent motor vehicle travel lane and/or parking lane. Drivers must stay on the left side of the buffer while driving and can only cross the bike lane when making a turn or entering an adjacent property. Buffered bike lanes are conventional bicycle lanes. A buffered bike lane is allowed as per TxMUTCD guidelines for buffered preferential lanes (section 3D-01).

Cycle Track/Separated Bike Lane: A cycle track or a separated bike lane is an exclusive facility for bicyclists that is located within or directly adjacent to the roadway and that is physically separated from motor vehicle traffic with a vertical element. Separated bike lanes are differentiated from standard and buffered bike lanes by the vertical element. They are differentiated from shared use paths (and sidewalks) by their more proximate relationship to the adjacent roadway and the fact that they are bike-only facilities.

Cycle tracks may be one-way or two-way, and may be at street level, at sidewalk level, or at an intermediate level. If at sidewalk level, a curb or median separates them from motor traffic, while different pavement color/texture separates the cycle track from the sidewalk. If at street level, they can be separated from motor traffic by raised medians, on-street parking, or bollards. By separating cyclists from motor traffic, cycle tracks can offer a higher level of security than bike lanes and are attractive to a wider spectrum of the public.

4.6.2 Design Guidance: Shared Lane Markings (Sharrows)

General: The Shared Lane Marking in use within the United States is the bike-and-chevron “sharrow,” illustrated in TxMUTCD figure 9C-9. Shared Lane Markings shall not be used on shoulders, in designated bicycle lanes, or to designate bicycle detection at signalized intersections. (TxMUTCD 9C.07 03).

Typical Applications: Shared lane markings should not be considered a substitute for bike lanes, cycle tracks, or other separation treatments where these types of facilities are otherwise warranted or space

permits. Shared lane markings can be used as a standard element in the development of bicycle boulevards to identify streets as bikeways and to provide wayfinding along the route.

Desirable shared lane marking applications:

- To indicate a shared lane situation where the speed differential between bicyclist and motorist travel speeds is very low, such as:
    - On bicycle boulevards or similar low volume, traffic calmed, shared streets with a designed speed of < 25 mph.
    - On downhill segments, preferably paired with an uphill bike lane. If space permits, consider a wide downhill bike lane.
    - On streets where the traffic signals are timed for a bicycling travel speed of 12 to 15 miles per hour.

- As a reasonable alternative to a bike lane in limited circumstances:
    - Where street width can only accommodate a bicycle lane in one direction. On hills, lanes should be provided in the uphill direction.
    - Within single or multi-lane roundabouts. “The complexity of vehicle interactions within a roundabout leaves a cyclist vulnerable, and for this reason, bike lanes within the circulatory roadway should never be used.”
    - Along front-in angled parking, where a bike lane is undesirable.

- To strengthen connections in a bikeway network:
    - To fill a gap in an otherwise continuous bike path or bike lane, generally for a short distance.
    - To transition bicyclists across traffic lanes or from conventional bike lanes or cycle tracks to a shared lane environment.

- To clarify bicyclist movement and positioning in challenging environments:
    - To designate movement and positioning of bicycles through intersections.
    - To designate movement and positioning of bicyclists through a combined bike lane/turn lane.
    - To assist bicyclists in taking the lane in the presence of a double turn lanes. Double turn lanes are undesirable for bicyclists.

- Generally, not appropriate on streets that have a speed limit above 35 mph as per FHWA and TxMUTCD Section 9C.07.02.

Design: Frequent, visible placement of markings is essential. The number of markings along a street should correspond to the difficulty bicyclists experience taking the proper travel path or position. SLMs used to bridge discontinuous bicycle facilities or along busier streets should be placed more frequently (50 to 100 feet) than along low traffic bicycle routes (up to 250 feet or more). SLMs used along low volume routes can be staggered by direction to provide markings closer together.

Lateral placement is critical to encourage riders to avoid the “door zone” and to encourage safe passing behavior. TxMUTCD guidance recommends minimum placement when a parking lane is present at 11

feet from the curb face. On streets with posted 25 mph speeds or slower, preferred placement is in the center of the travel lane to minimize wear and encourage bicyclists to occupy the full travel lane.

On streets with posted 35 mph speeds or faster and motor vehicle volumes higher than 5,000 vpd shared lane markings are not a preferred treatment. On these streets other bikeway types are preferred.

If on-street vehicle parking is not present, SLMs should be placed far enough from the curb to direct bicyclists away from gutters, seams, and other obstacles. On streets with posted 25 mph speeds or slower, preferred placement is in the center of the travel lane to minimize wear and encourage bicyclists to occupy the full travel lane.

TxMUTCD guidelines shall be used for shared lane pavement markings and signage.

4.6.3 Design Guidance: On-Street Bike Lane

General: On-street bike lane is allowed as per TxMUTCD guidelines for buffered preferential lanes (section 3D-01). The desirable bike lane width adjacent to a curb face is 6 feet.

Typical Applications: Desirable on-street bike lane applications:

- Bike lanes are most helpful on streets with ≥ 3,000 motor vehicle average daily traffic.
- Bike lanes are most helpful on streets with a posted speed ≥ 25 mph.
- On streets with high transit vehicle volume.
- On streets with high traffic volume, regular truck traffic, high parking turnover, or speed limit > 35 mph, consider treatments that provide greater separation between bicycles and motor traffic such as:
    - Left-side bike lane
    - Buffered bike lane
    - Cycle tracks

Design: The desirable bike lane width adjacent to a curb face is 6 feet. The desirable ridable surface adjacent to a street edge or longitudinal joint is 4 feet, with a minimum width of 3 feet. In cities where illegal parking in bike lanes is a concern, 5 foot wide bike lanes may be preferred. As per AASHTO's "Guide for the Development of Bicycle Facilities", the recommended width of a bike lane is 5 feet from the face of the curb or guardrail to the bike lane stripe.

When placed adjacent to a parking lane, the desirable reach from the curb face to the edge of the bike lane (including the parking lane, bike lane, and optional buffer between them) is 14.5 feet; the absolute minimum reach is 12 feet. A bike lane next to a parking lane shall be at least 5 feet wide, unless there is a marked buffer between them. Wherever possible, minimize parking lane width in favor of increased bike lane width.

The desirable bike lane width adjacent to a guardrail or other physical barrier is 2 feet wider than otherwise in order to provide a minimum shy distance from the barrier.

Bicycle lane word and/or symbol and arrow markings (TxMUTCD Figure 9C-3) shall be used to define the bike lane and designate that portion of the street for preferential use by bicyclists.

Bike lane word, symbol, and/or arrow markings (MUTCD Figure 9C-3) shall be placed outside of the motor vehicle tread path at intersections, driveways, and merging areas in order to minimize wear from the motor vehicle path.

A through bike lane shall not be positioned to the right of a right turn only lane or to the left of a left turn only lane (TxMUTCD 9C.04). A bike lane may be positioned to the right of a right turn only lane if split-phase signal timing is used.

TxMUTCD guidelines shall be used for on-street bike lane pavement markings and signage.

4.6.4 Design Guidance: On-Street Buffered Bike Lane

General: On-street buffered bike lane bike lane is allowed as per TxMUTCD guidelines for buffered preferential lanes (section 3D-01). Buffered bike lanes provides greater shy distance between motor vehicles and bicyclists. The minimum bike lane width adjacent to a curb face is 5 feet. Wider bike lanes provide additional comfort and space for bicyclists and should be considered where a high volume of bicyclists is expected. Widths of 7 feet and greater are preferred as they allow for passing or side-by-side riding.

Typical Applications: Desirable on-street buffered bike lane applications:

- Anywhere a standard bike lane is being considered.
- On streets with high travel speeds, high travel volumes, and/or high amounts of truck traffic.
- On streets with extra lanes or extra lane width.
- Special consideration should be given at transit stops to manage bicycle & pedestrian interactions.

Design: Bicycle lane word and/or symbol and arrow markings (MUTCD Figure 9C-3) shall be used to define the bike lane and designate that portion of the street for preferential use by bicyclists. The buffer shall be marked with 2 solid white lines. White lines on both edges of the buffer space indicate lanes where crossing is discouraged, though not prohibited. For clarity, consider dashing the buffer boundary where cars are expected to cross at driveways.

The buffer area shall have interior diagonal cross hatching or chevron markings if 3 feet in width or wider. If used, interior diagonal cross hatching should consist of 4” lines angled at 30 to 45 degrees and striped at intervals of 10 to 40 feet. Increased striping frequency may increase motorist compliance.

The combined width of the buffer(s) and bike lane should be considered “bike lane width” with respect to guidance given in other documents that don’t recognize the existence of buffers. Where buffers are used, bike lanes can be narrower because the shy distance function is assumed by the buffer. For example, a 3 foot buffer and 4 foot bike lane next to a curb can be considered a 7 foot bike lane. For travel side buffered lanes next to on street parking, a 5 foot minimum width is recommended to encourage bicyclists to ride outside of the door zone.

Buffers should be at least 18 inches wide because it is impractical to mark a zone narrower than that. On intersection approaches with right turn only lanes, the bike lane should be transitioned to a through bike lane to the left of the right turn only lane, or a combined bike lane/ turn lane should be used if available road space does not permit a dedicated bike lane.

On intersection approaches with no dedicated right turn only lane the buffer markings should transition to a conventional dashed line. Consider the use of a bike box at these locations.

TxMUTCD guidelines shall be used for on-street buffered bike lane pavement markings and signage.

4.6.5 Design Guidance: Separated Bike Lane/Cycle Track

General: A cycle track, like a bike lane, is a type of preferential lane as defined by the TxMUTCD. Cycle track is provided as per TxMUTCD guidelines for buffered preferential lanes (section 3D-01). Cycle tracks dedicates and protects space for bicyclists in order to improve perceived comfort and safety; eliminates risk and fear of collisions with over-taking vehicles; and more attractive for bicyclists of all levels and ages. The minimum desired width is 5 feet.

Typical Applications: Desirable cycle track applications:

- Streets with parking lanes.
- Streets on which bike lanes would cause many bicyclists to feel stress because of factors such as multiple lanes, high traffic volumes, high speed traffic, high demand for double parking, and high parking turnover. While there are no US standards for the bicyclist and motor vehicle volumes that warrant cycle tracks, several international documents provide basic guidance.
- Streets for which conflicts at intersections can be effectively mitigated using parking lane setbacks, bicycle markings through the intersection, and other signalized intersection treatments.
- Along streets with high bicycle volumes.
- Along streets with high motor vehicle volumes and/or speeds.
- Special consideration should be given at transit stops to manage bicycle & pedestrian interactions.

Design: Bicycle lane word and/or symbol and arrow markings (TxMUTCD Figure 9C-3) shall be placed at the beginning of a cycle track and at periodic intervals along the facility based on engineering judgment. If pavement markings are used to separate motor vehicle parking lanes from the preferential bicycle lane, solid white lane line markings shall be used. Diagonal crosshatch markings may be placed in the neutral area for special emphasis. See TxMUTCD Section 3B.24. Raised medians or other barriers can also provide physical separation to the cycle track.

The minimum desired width for a cycle track should be 5 feet. In areas with high bicyclist volumes or uphill sections, the minimum desired width should be 7 feet to allow for bicyclists passing each other. Three feet is the desired width for a parking buffer to allow for passenger loading and to prevent door collisions. When using a parking protected pavement marking buffer, desired parking lane and buffer combined width is 11 feet to discourage motor vehicle encroachment into the cycle track. In the absence of a raised median or curb, the minimum desired width of the painted buffer is 3 ft. The buffer space should be used to locate bollards, planters, signs or other forms of physical protection.

Driveways and minor street crossings are a unique challenge to cycle track design. A review of existing facilities and design practice has shown that the following guidance may improve safety at crossings of driveways and minor intersections:

- If the cycle track is parking protected, parking should be prohibited near the intersection to improve visibility. The desirable no-parking area is 30 feet from each side of the crossing.
- For motor vehicles attempting to cross the cycle track from the Side Street or driveway, street and sidewalk furnishings and/or other features should accommodate a sight triangle of 20 feet to the cycle track from minor street crossings, and 10 feet from driveway crossing.
- Color, yield lines, and “Yield to Bikes” signage should be used to identify the conflict area and make it clear that the cycle track has priority over entering and exiting traffic.
- Motor vehicle traffic crossing the cycle track should be constrained or channelized to make turns at sharp angles to reduce travel speed prior to the crossing.

ADA Considerations: When providing accessible parking spaces alongside cycle tracks, the following general considerations are recommended to accommodate persons with disabilities in the design of one-way and two-way protected cycle tracks.

- A widened buffer space may be used to accommodate a side mounted vehicle ramp or lift so that it will not protrude into the cycle track and become a hazard to bicyclists. Additional buffer space may be challenging to achieve with limited right-of-way.
- Mid-block curb ramps may be provided near marked accessible parking spaces, or curb ramps may be provided at a consistent interval along the cycle track to provide additional egress points for wheelchair users to gain access to the sidewalk. Mid-block curb ramps may also offset inconveniences in curbside freight delivery crossing the cycle track.
- Roadway cross-slopes should be considered across the cycle track during design as slopes exceeding two percent will create difficulty for bicyclists and some disabled users.
- If significant Taxi or Paratransit service exists along the cycle track, consider providing periodic loading zones to allow the vehicles to pull out of the travel lane.
- If used, consider placement of bollards in the buffer area so as not to impede access by disabled users. Individuals with sight-impairments may lack familiarity with this roadway configuration.

TxMUTCD guidelines shall be used for cycle track pavement markings and signage.

4.7 OTHER SUPPORTING FACILITIES AND PROGRAMS

4.7.1 Bicycle Parking

Bicycle parking should be provided, by ordinance, at all public buildings which are potential cyclist destinations. Bicycle parking should be encouraged, potentially by ordinance, at privately owned facilities which are potential bicyclist destinations.

There are two basic types of bicycle parking equipment: bicycle racks and bicycle lockers. Bicycle racks may be provided where parking needs are short term and some provisions are made for security or surveillance. Lockers would be desired for all-day parking if the location is remote from the destination and where the desired level of security is higher than that provided.

The design of bicycle racks is most useful for bicyclists since the bicycle frame and wheels can be secured to the rack structure. Many types of bicycle racks are currently available, ranging from the basic wheel-engaging schoolyard type, to the more functional U-shapes or ribbon rails, to the "bike traps" with moveable segments to lock the bike in place.

Bicycle lockers are physical enclosure for bicycle, typically in individual compartments. They require a paved structure for mounting and require more physical space than a fully occupied bike rack of the same capacity.

4.7.2 Bicycle and Transit

The ability to link trips made by bicycle with bus trips provides significant expansion of the service area for bus routes and also increases the utility of bicycles as a travel mode. The City of San Marcos transit system and the university's student bus service should improve their bus fleets and bus stop facilities to accommodate bicycles. Bike racks or lockers at bus stops and bike carriers on buses will enable cyclists to combine trips by bus and bicycle, increasing the range of service area and promoting the use of both modes independently and collectively.

4.7.3 Maintenance

Bicycle and pedestrian facilities should be maintained to ensure the safety and functionality of bicycle and pedestrian flows. Periodic refurbishing and debris removal will help keep original design concepts intact. The degree of maintenance provided has a direct impact on facility service life, effectiveness, level of use, liability and community image. Poor facility maintenance coveys a feeling of lack of security and fear for personal safety, often resulting in decreased facility usage with a possible increase in bicycle and pedestrian accidents elsewhere due to the use of alternative, less safe routes.

4.7.4 Sidewalk Continuity

In the interest of providing safe and alternative modes of transportation for bicyclists and pedestrians, and to encourage the construction of continuous sidewalk throughout the City, sidewalks should be continuous. Where an undeveloped lot of not more than 500 feet of street frontage is located between two developed lots, and where the sidewalk on either side of the undeveloped lot has a length longer than 200 feet, and where the continuity of the sidewalk is desired by the City for connecting pedestrians to activity centers, then City may notify the property owner identified on the current tax roll that the owner shall be responsible for construction of the sidewalk within the ensuing two (2) years, or in lieu of the construction of the sidewalk, the property owner shall place into an interest bearing escrow account within a period of two years the amount equal to the cost of constructing said sidewalk. The City shall then use such funds to construct the sidewalk within a period of 5 years. If the sidewalk is not constructed within 5 years, the funds shall be returned to the property owner of record with interest.

5. DRIVEWAY DESIGN AND ACCESS MANAGEMENT

5.1 GENERAL

The design and location of driveways must balance the need for access to and from an abutting property with the safe, efficient flow of traffic on the adjoining street. This section provides both the design criteria for driveways and the access management policy for driveways that provide access from abutting property to streets and highways within the City of San Marcos.

The number, location, or spacing of driveways may be limited for Highways and Boulevards classifications to ensure their primary function of mobility. Conversely, the primary function of Residential and Commercial streets is to provide access, and therefore driveway spacing is less restrictive.

Site plans submitted to the City for review shall include dimensions, radii, and grades for all proposed driveways.

When a development is located adjacent to a public street, the parking facility must accommodate full internal vehicular circulation and storage. Vehicular circulation must be located completely within the property and vehicles within one portion of the development must have access to all other portions of the same development without using the adjacent street system.

Adequate storage areas must be provided for both inbound and outbound vehicles to facilitate the safe and efficient movement between the street and the development. Inbound vehicle storage areas must be of sufficient size to ensure that vehicles will not obstruct the adjacent street, sidewalk, or circulation within the facility. Outbound vehicle storage areas must be provided to eliminate backup and delay of vehicles within the development.

All site/civil and building plans shall meet the submittal requirements of the City of San Marcos Planning Department and Fire Department. The driveway and fire lane dimensions, percent grades, turning radii and design specifications, including load capacity, shall be clearly identified on the plans. The following criteria shall apply to the design of driveways and fire lanes:

- Thirteen and one-half feet (13’-6”) minimum vertical clearance;
- Existing and proposed traffic patterns of driveways, and/or proposed fire lanes identifying and labeling all physical barriers to vehicular access including, but not limited to, gates, bollards, landscaping and similar items. The driveway and fire lane must provide access to all aspects of the building within one hundred fifty feet (150’) of the fire lane;
- Fire lanes shall have a minimum unobstructed width of twenty feet (20’) for one way traffic, and twenty six feet (26’) for two-way traffic with twenty five feet (25’) inside turning radii and fifty feet (50’) outside turning radii;
- Dead-end fire lanes shall be a maximum length of one hundred fifty feet (150’);
- No grade breaks greater than seven percent (7%); and,
- Driveways and fire lanes shall have all-weather surface during and after construction.

Emergency access drives shall be at least twenty four feet (24’) in width.

These are the primary design criteria for driveway design. The Planning Department, Transportation Department, Fire Department or Director of Engineering or their designee reserve the right to modify or add design criteria as necessary to enforce the applicable life and fire safety codes during plan review or construction inspection.

5.2 TYPES OF DRIVEWAYS

There are three types of driveways used in the City of San Marcos:

5.2.1 Type I:

A concrete driveway approach intended to provide vehicular access from a roadway to a lot or parcel of land which is a location for a one (1) or two (2) family residence. Refer to **Table 5-1**: Type I Driveway Criteria for further information.

5.2.2 Type II:

A concrete driveway approach intended to provide vehicular access from a roadway to a lot or parcel of land used for any development or purpose other than one or two family residences. Refer to **Table 5-2**: Type II Driveway Criteria for further information.

5.2.3 Type III:

A temporary asphalt driveway approach intended to provide vehicular access to a lot or parcel of land, such access being from a roadway not yet constructed to permanent lines and grades or a roadway not having curb and gutter. Typically, these driveways will be reconstructed as a Type I or Type II driveway as part of a project that reconstructs the abutting street to permanent line and grade with concrete curb and gutter.

Type III driveways serving one or two-family residences shall be designed using Type I criteria. Type III driveways serving other land uses shall be designed using Type II criteria.

5.3 DRIVEWAY DESIGN CRITERIA

Please refer to **City of San Marcos driveway details (433S-A-SM)** for design criteria. Driveways constructed within public ROW shall conform to the following criteria:

A. If a curb inlet is present, the driveway shall be located such that the gutter depression is maintained and ten feet (10') of separation remains between the inlet opening and the driveway.

B. The angle of driveway approach shall be between 80 and 90 degrees for two-way driveways and 60 to 90 degrees for one-way driveways. Under special situations, a driveway angle as acute as 75 degrees will be permitted for two-way driveways.

C. On all streets and alleys where Type I driveways are not appropriate, head-in/back-out parking is generally prohibited. Such a condition requires the approval of the Director of Engineering or their designee. Other alternatives, however, should be encouraged when possible.

D. All driveways must be constructed within the street frontage of the subject property, as determined by extending the side property lines perpendicular to the curb line. Neither the driveway nor the curb returns shall overlap adjacent property frontage.
E. Joint-use (common) driveways may be approved provided that a permanent, dedicated access easement is obtained. The developer must include a plat note and provide dedication documents indicating that maintenance of the joint-use driveway shall be the responsibility of the lot owners served by the joint-use driveway. If three (3) or more residences are to be served by a single joint-use driveway, the following requirements apply:

    1. The developer must post fiscal surety for the construction of the joint-use driveway prior to plat approval and must construct the driveway during the construction of the streets within the same subdivision, or within the term of the fiscal instrument if no public or private streets are to be constructed within the subdivision. The driveway construction shall be subject to City inspection and obtain City approval before the fiscal surety will be released.
    2. The developer must construct a driveway that is designed by a Professional Engineer to have an all-weather surface and a pavement structure meeting, at a minimum, the design standards of a private street as defined in the Code of Ordinances. The driveway must be designed to have no more than nine inches (9”) of water overtopping the driveway during the one-hundred year storm event as defined in the City of San Marcos Design and Construction Standards Drainage Specifications and the Code of Ordinances, latest editions.
    3. The developer must construct a turnaround at the end of the driveway, or no further than two hundred feet (200’) from the end of the driveway, meeting City of San Marcos Fire Department Criteria.
    4. The developer must obtain, in writing, acknowledgement and approval from the area fire service providers regarding the proposed joint-use driveway.
    5. The joint-use access easement will be required to be dedicated as a public utility easement and may be required to be dedicated as a drainage easement, unless otherwise approved by the Transportation Director. In those cases where the joint-use access easement is to be combined as a public utility and drainage easement, the access agreement for the driveway must include a clause indicating that the driveway may be used by public service personnel and equipment for servicing public utilities.
    6. If the developer does not use a restrictive covenant to require homeowners to park all vehicles off the joint-use driveway surface, then the joint-use driveway surface must be at least twenty-four (24) feet wide. Otherwise, the driveway surface may be no less than twenty (20) feet wide.
    7. The developer must erect signs, approved by the City of San Marcos, indicating "private driveway" at the driveway entrance and include a plat note stipulating that maintenance of the driveway will not be the responsibility of the City.

F. Driveways may not exceed seventy percent (70%) of roadway frontage.

G. All Type II and III driveways on Boulevards shall be designed to align with opposing streets or driveways or be offset by a minimum of two hundred and fifty feet (250’), measured from edge to edge).

All Type II and III driveways on Avenues shall be designed to align with opposing streets or driveways or be offset by a minimum of two hundred feet (200’, measured from edge to edge).

Alignment of driveways with opposing streets is discouraged for signalized intersections unless approved by the Director of Engineering or their designee. When such a design is approved, the driveway approach may be constructed without an apron and the maximum driveway widths in **Table 5-2** may be increased to match the cross-section of the opposing street.

H. Driveway approaches constructed in public ROW for premises used as a drive-through bank or parking garage shall be as approved by Director of Engineering or their designee.

I. A throat depth is the length of a driveway measured from the intersecting roadway to the first intersection or driveway aisle on the site. It is important to maintain adequate throat depths for driveways so that vehicles do not backup onto the intersecting roadway. The throat lengths in **Table 5-2** may be reduced, if approved by Director of Engineering or their designee , after considering the following factors:

1. Physical constraints on the site, such as existing structures;
2. The impact upon on-site circulation;
3. Shallow lot depths or unusual lot configurations;
4. Existing or potential traffic movements which are unsafe or which have an adverse effect on traffic operations;
5. Traffic volumes and classification on the driveway and the intersecting street;
6. Alternatives to the proposed design;
7. Other information presented by the applicant; and,
8. For existing sites, the extent of redevelopment proposed.

Throat lengths in excess of those shown in Table 5-2 may be required by Director of Engineering or their designee, if justified by the findings of a city-approved TIA or queuing study.

Throat length shall be measured from the ROW line to the point of first conflict within the parking lot on the site.

J. Acceleration/deceleration lanes shall be provided along existing and proposed Boulevards, Avenues and Commercial streets when required by the findings of a city-approved TIA or per Sections 1.14, 1.15 and 1.16 of the Transportation Criteria Manual.

Additional ROW shall be dedicated by plat or separate instrument if required to accommodate acceleration/deceleration lanes or turning lanes.

For commercial and industrial sites, if it is determined that a right-turn deceleration lane is not warranted, a minimum of one driveway shall be designated as a truck delivery access drive and shall meet the minimum turning path for a WB-62 design vehicle, or another appropriate design vehicle as designated by Director of Engineering or their designee, without requiring maneuvering outside of the travel lane.

K. Driveway spacing shall conform to the dimensions shown in **Table 5-1** and **Table 5-2**. The minimum distance from a cross street to an adjacent driveway shall be fifty feet (50') for Residential Street, one hundred feet (100') for Commercial Street, two hundred feet (200') for Avenues and two hundred fifty feet (250') for Boulevards, measured from the curb line of the cross street to the edge of the nearest driveway, measured at the property line.

L. Site topography, design vehicle characteristics, traffic volume, and site circulation must be considered in the driveway design process. The maximum grade for driveways should be limited to ten percent (10%) for residential driveways and seven percent (7%) for commercial driveways.

The maximum change in grade should be limited to fifteen percent (15%) for residential driveways and seven percent (7%) for commercial driveways. If excessive grades or grade breaks are used, a tangent length between grade breaks shall be required in order to reduce the possibility of vehicle underbodies striking the pavement surface. Typically, a change in grade of three percent (3%) or less and a distance between grade changes of at least eleven feet (11') accommodates most vehicles.

Where a driveway crosses or adjoins a sidewalk, walkway, or an accessible path of travel, as defined by the ADA, the driveway grade shall not exceed two percent (2%), over a minimum throat length of three feet (3') contiguous with the sidewalk, thereby effectively matching the cross slope of the sidewalk or accessible path of travel across the full width of the driveway.

Driveways adjacent to roadways without sidewalks shall meet these criteria such that an accessible route is provided across the driveway at such time that the sidewalk is constructed.

The City of San Marcos Fire Department shall be consulted when a grade change of greater than seven percent (7%) is proposed.

Refer to Figure 5-2, Driveway Profiles, for further information.

M. Channelized islands for limited movement driveways may be utilized, provided that the applicant establishes a maintenance agreement with the City.

Where a sidewalk, walkway, or an accessible route, as defined by the Americans with Disabilities Act, crosses a limited movement driveway island, the sidewalk shall be a minimum of four feet (4') wide across the island and shall provide a continuous, uninterrupted detectable warning at the boundaries between the sidewalks and the driveways.

N. Driveway design and location shall provide safe sight distance for vehicles entering the roadway from the driveway in accordance with Section 1 of Transportation Design Manual.

O. Existing driveways may be required to conform to the standards in this Manual, including driveway closing, or sidewalk and curb construction where appropriate, as a condition of the approval of any application for zoning, rezoning, or site plan approval.

P. The most common design vehicle for driveways is the Passenger Car (P) and the Single Unit Truck (SU), however if larger vehicles will use the driveway more frequently than four (4) per hour, the larger design vehicle shall be used.

5.4 CRITERIA FOR VARIOUS TYPES OF DRIVEWAYS

Table 5-1 Table 5-2 summarize the design criteria for the various driveway classes.

Table 5-1: Type I Driveway Criteria

Type I Driveway Criteria			
	Minimum	**Desirable**	**Maximum**
Single Family			
Width[d]	10’	18’	18’
Curb Return Radius	5’	5’	5’
Throat Length[a]	Extend to property R.O.W. line as a minimum		
Spacing between Driveways[b]	Limited to one driveway per property (except where a circular driveway is approved, then the maximum is two)		
Distance from Intersecting Street[e]	50’		
Duplexes and Townhomes			
Width[d]	15’	20’	24’
Curb Return Radius	5’	8’	10’
Throat Length[a]	Extend to property R.O.W. line as a minimum		
Spacing between Driveways[b,c]	20’	-	-
Distance from Intersecting Street[e]	50’		

[a] Distance from street to first conflict point.
[b] Semicircular driveways acceptable with minimum spacing between driveway entrance and exit of thirty –five (35’). (Measured from inside edge to inside edge of driveway approach at the property line). Minimum lot width for semicircular drives is hundred feet (100’).
[c] When two (2) driveways are used (one (1) per unit; two (2) maximum), single family standards for width and curb return radius shall apply. Distances are measured edge to edge.
[d] Driveway width is the width of the paved surface exclusive of curb radii or wings.
[e] Distance from intersection measured edge to edge.

Table 5-2: Type II Commercial Driveway Criteria

Table 5-2: Type II Commercial Driveway Criteria										
Driveway Type	**Roadway Type**									
	Residential St		**Commercial St**		**Avenue**		**Boulevard**		**Highway**	
	Min.	**Max.**	**Min.**	**Max.**	**Min.**	**Max.**	**Min.**	**Max.**	**Min.**	**Max.**
One Way										
Width	12'[a]	16'	12'[a]	18'	15'[a]	20'	18'[a]	25'[b]	18'[a]	25'[b]
Curb Return Radius	5'	10'	5'	10'[c]	15'	25'[c]	20'	30'[c]	20'	30'[c]
Throat Length[d]	-	-	50'	-	50'	-	50'	-	50'	-
Distance Between Entry & Exit	50'	-	50'	-	50'	-	75'	-	75'	-
Driveway Spacing[g]	100'	-	200'	-	200'	-	250'	-	250'	-
Distance from Intersecting St[h]	100'	-	200'	-	200'	-	250'	-	250'	-
Two Way Undivided										
Width	20'	24'	20'	32'	25'	40'	30'	45'	30'	45'
Curb Return Radius	5'	10'	10'	15'[c]	15'	25'[c]	20'	30'[c]	20'	30'[c]
Throat Length[d]	-	-	50'	-	50'	-	50'	-	50'	-
Driveway Spacing[g]	100'	-	200'	-	200'	-	250'	-	250'	-
Distance from Intersecting St[h]	100'	-	200'	-	200'	-	250'	-	250'	-
Two Way Divided										
Width (each side of median)[e]	20'	24'[f]	20'	32'[f]	20'	24'[f]	20'	30'	20'	30'[f]
Curb Return Radius	5'	10'[c]	10'	15'[c]	15'	25'[c]	20'	30'[c]	20'	30'[c]
Throat Length[d]	50'	-	50'	-	50'	-	50'	-	50'	-
Median Width[e]	4'	15'	4'	15'	4'	15'	4'	15'	4'	15'
Median Length	10'	-	10'	-	10'	-	20'	-	20'	-
Driveway Spacing[f,g]	100'	-	200'	-	200'	-	250'	-	250'	-
Distance from Intersecting St[h]	100'	-	200'	-	200'	-	250'	-	250'	-

[a] Greater width may be required for Fire Department emergency access.
[b] Thirty foot (30') minimum width may be required on state highways.
[c] Radius shall be increased to accommodate appropriate design vehicle using full driveway width. Use WB-62 vehicle unless otherwise approved by Director of Engineering or their designee.
[d] Distance from the ROW to first conflict point. Provide minimum stated herein unless another value is required by the findings of a city-approved TIA.
[e] Refer to TxDOT Standards for driveways constructed on TxDOT roadways.
[f] When a divided driveway is the fourth leg of an intersection, a thirty-six foot (36') width may be permitted to match the opposing street configuration.
[g] Driveway spacing may be reduced as required due to pre-existing use or developmental conditions, as approved by Director of Engineering or their designee .
[h] Distance from intersection measured edge to edge.

5.5 ACCESS MANAGEMENT

The goal of access management is to provide adequate access to land development while simultaneously preserving the flow of traffic on the surrounding road system in terms of safety, capacity and speed. Increased development along roadways generate the demand for driveways to serve abutting properties. Without access planning and management, the roadway network will become increasingly congested and safety will be compromised.

5.5.1 Access Management for State Highways

Driveway design and location for State Highways within the City limits and extraterritorial jurisdiction is covered by current policy as described in the document: Access Management Manual for State Highways (see Bibliography). The City of San Marcos grants permits for driveways providing access to State Highways.

5.5.2 Access Management for City Streets

Single-family lots shall have only one driveway to one abutting roadway, except when a circular driveway is approved by the City.

Single-family, two-family and single-unit townhouse residences are permitted on Residential Streets and Avenues only. Residential driveways for double frontage lots and corner lots must be located on the lesser classification street. Driveways serving single-family, two-family or single-unit townhouse residences are not permitted on Commercial Streets and Boulevards unless the access is approved by Director of Engineering or their designee.

Multi-unit townhouse, multi-family and nonresidential driveways are permitted on all streets; however, the driveways must have a minimum of two hundred foot (200') spacing between driveways on Commercial Street and Avenues; and from the street centerline at an intersection.

Access to alleys requires approval by Director of Engineering or their designee. Access to and from unimproved alleys is not allowed.

Unless approved by Director of Engineering or their designee, one-way driveways shall be prohibited on two-way undivided streets. In addition, one-way driveways are limited to developments where two-way access is unfeasible because of special design considerations, such as severe site constraints, the need for circular drop-offs or other circumstances where one-way circulation may be preferred to two-way access. Examples of such developments include public and private schools, day care uses, car wash facilities and existing developments or small sites where two-way circulation is impractical. Where one-way access is proposed, developments shall be designed to promote one-way, on-site circulation in support of the one-way drives. Circular drop-offs and one-way driveways shall be designed to prevent conflicts with traffic access, parking, pedestrians, on-site circulation and fire lanes. Priority, however, shall be directed towards reducing the number of driveway approaches along Highways and Boulevards to limit conflict points and enhance traffic flows along such roadways. All one-way driveways separated by more than fifteen feet (15', measured from inside edge to inside edge) must be signed for one-way operation.

Type I driveways are to be located no closer to the corner of intersecting rights-of-way than sixty percent (60%) of parcel frontage or fifty feet (50'), whichever is less. All other driveways are to be

located no closer to the corner of intersecting rights-of-way than sixty percent (60%) of parcel frontage or one hundred feet (100') for a Residential Street, two hundred feet (200') for a Commercial Street or Avenue and two hundred fifty feet (250') for Boulevard or Highway; whichever is less. Also, driveways shall not be constructed within the curb return of a street intersection.

It is desirable to minimize the number of driveways on Highway or Boulevard to reduce the number of conflict points and facilitate traffic flow. The dimension in **Table 5-1** for spacing between driveways should be increased whenever possible so that the number of driveways can be reduced. It is recognized, however, that certain existing tracts may not be able to fully comply with these standards due to limited frontage or other constraints. When compliance with criteria stated in **Table 5-2** is precluded due to the location of driveways on adjoining properties, attempts should be made to obtain alternative access where feasible, including joint access driveways, access easements to adjoining properties or access to intersecting streets.

6. TRAFFIC ENGINEERING

6.1 GENERAL

The information provided in this Chapter was obtained from AASHTO's 2011 "A Policy on Geometric Design of Highways and Streets", TxDOT's 2011 "Texas Manual on Uniform Traffic Control Devices (TXMUTCD) and City of San Marcos "Design and Construction Guide". This section covers traffic engineering standards and requirements for the following items:

- Reference standards pertaining to traffic engineering;
- Traffic Control Request Procedures;
- Traffic Control Plans for Construction;
- Signing and Pavement Markings;
- Signalization; and,
- Street Lighting.

6.2 REFERENCE STANDARDS

The design and construction of streets and roadways shall be in accordance with this section and the applicable standards and reference documents in order to maintain uniform standards for traffic elements throughout the City. The designer shall refer to City of San Marcos, Texas Department of Transportation or related standards; however, where discrepancies occur, the City of San Marcos Design and Construction Standards shall take precedence. Director of Engineering or their designee shall make any final determinations, should there be conflicts between the City standards and other referenced standards described herein.

6.3 TRAFFIC CONTROL REQUEST PROCEDURES

6.3.1 Request for Temporary Traffic Control

Any person wishing to perform any work within the public right-of-way must submit a traffic control plan and obtain the proper permit(s) prior to starting such work.

In order to ensure proper advance planning and coordination, except in emergency situations as noted in the following section, all requests for temporary traffic controls require advance notice be given to the Transportation Department. Written notification shall be given to the City for all temporary traffic control zones. The advance notification requirements depend on the type of street closure, the activity, and the duration of the activity. The following minimum advance notifications are required for all temporary traffic control zones.

In all areas of the City the following notifications requirements shall apply:

- **Long-term stationary** - Work that occupies a location more than three (3) days. Two (2) weeks advance notice for all street types and detours;
- **Intermediate-term stationary** - Work that occupies a location from overnight to three (3) days. Three (3) working days advance notice for Boulevards, Avenues and Commercial Streets, one (1) working day advance notice for Residential Streets and two (2) weeks for detours;
- **Short-term stationary** - Daytime work that occupies a location from one (1) to twelve (12) hours. Three (3) working days advance notice for Boulevards, Avenues and Commercial Streets, one (1) working day advance notice for Residential Streets and two (2) weeks for detours;

- **Short Duration** - Work that occupies a location up to one (1) hour. Three (3) working days advance notice for Boulevards, one (1) working day advance notice for Avenues, Commercial Streets and Residential Streets; or,
- **Mobile** - Work that moves intermittently or continuously. Three (3) working day advance notice for all roadway classifications.

When Boulevards or Avenues are to be completely closed in one or both directions, portable, changeable message signs (PCMS) shall be installed a minimum of one (1) week before the closure to provide advance warning to the public. The size, location and wording shall be determined by Director of Engineering or their designee.

6.3.2 Special Events

Special events such as festivals, run/walk, block parties, street fairs, parades, school events, or film industry production, shall be planned for and properly coordinated with the City. Proper temporary traffic control shall be provided for these events. Procedures for special events are as follows:

Applicants shall make application to the City of San Marcos as required under the current Code of Ordinances, using the City's Special Event Permit Application Form. Application shall be made at least 30 days prior to the event, and shall include any required traffic control plan(s) and the application fee;

a. The City's Special Event Coordinator will distribute the application to each City Department and return any comments to the applicant. Any conditions required by the City for approval of the permit shall be noted on the permit;
b. If the event will require a road closure, a Traffic Control Plan prepared by a Professional Engineer licensed in the State of Texas is required and shall be submitted by the applicant and approved by Director of Engineering or their designee ;
c. Once the Traffic Control Plan is approved by Director of Engineering or their designee, the City's Police Department will determine how many officers will be required for the road closures.
d. The applicant is required to hire a Traffic Control company, approved by the City, to implement the Traffic Control Plan for the event. All traffic control devices shall be in accordance with the approved Traffic Control Plan and TMUTCD, latest edition.
e. The applicant is responsible for all costs associated with the Traffic Control Plan, including overtime costs for the Police Officers.

The applicant shall identify the proposed location of parking areas and the number of spaces provided for the event.

The organization or individual responsible for the special event, block party, or parade shall adhere to the requirements of the applicable City of San Marcos Ordinance.

6.4 TRAFFIC CONTROL PLANS FOR CONSTRUCTION

6.4.1 General

Temporary traffic control for construction activities on public right-of-way shall be in accordance with the TMUTCD and the guidelines contained within this manual.

A Traffic Control Plan (TCP) describes temporary traffic controls to be used for facilitating vehicle and pedestrian traffic through a temporary traffic control zone. The TCP may range in scope from being very

detailed, to merely referencing typical drawings contained in the TMUTCD, TxDOT Standard Drawings, or specific drawings contained in the contract documents. A narrative of work as well as phasing shall be provided for more complex projects. The degree of detail in the TCP depends entirely on the complexity of the situation, and TCPs shall be prepared by a Professional Engineer knowledgeable about the fundamental principles of temporary traffic control and the work activities to be performed.

If a traffic setup shown on standard detail sheets does not address the traffic controls needed for a specific site, then a TCP shall be prepared that is specific to the site. A standard detail or TCP which shows the proposed method of warning, directing and guiding traffic, shall be approved by Director of Engineering or their designee, prior to installing any devices on the right-of-way. The following information shall be provided with the standard detail or TCP:

a. Activity location, right-of-way and curb-lines, and existing traffic controls of the street sought to be closed or blocked;
b. Areas of the street to be closed or blocked;
c. Proposed pedestrian and vehicular detour routes;
d. Location and type of all barricades, signals, signs, channelizing devices, pavement markings and other warning devices to be used to direct traffic; and,
e. A schedule of construction showing each phase of work, start and completion dates for each phase, and proposed work hours.

Plans which propose to detour traffic to another roadway shall demonstrate that such impacts cannot be reasonably avoided and that impacts to the detour route have been mitigated to the extent practicable. Impacts to the detour route shall be evaluated including, without limitation, intersection level of service, traffic speed and volume in residential neighborhoods and school zones, and impacts to all modes of transportation.

All Traffic Control Plans necessary for maintenance of traffic during construction shall be prepared in accordance with the latest edition of the Texas Manual on Uniform Traffic Control, Part VI (TMUTCD) and the TxDOT Standard Drawings.

6.4.2 Time Restrictions

The Director of Engineering or their designee or their designee may restrict the hours of construction, repair or other activities affecting the free flow of traffic to nights, weekends or restricted hours due to potential congestion, other construction activities, hazards to pedestrians or motorists, etc.

Daily lane closures on Boulevards shall not be permitted during the hours of 6:00 a.m. to 9:00 a.m. and 4:00 p.m. to 7:00 p.m. Monday through Friday, except in emergencies or situations where it can be demonstrated that traffic flow or safety will not be adversely affected.

6.4.3 Special Requirements

The Director of Engineering or their designee may require that any of the following special traffic control devices, working hours, project layout and operations be imposed on any temporary traffic control zone:

a. The use of additional barricades, signals, signs, flaggers, police officers or other traffic control devices or safety procedures;

b. That the activity be performed only at certain hours during the day or night or during specified days of the week, month or year;
c. That only a specified area or not more than a specified number of traffic lanes, parking meters and/or parking lanes shall be blocked or closed at the same time or at specified times of day;
d. That material and equipment used in the activity and materials removed from any excavation be located other than in the vehicle traffic lane of such a street; and
e. Any other restrictions deemed necessary to ensure management of the rights-of-ways and the free flow of vehicular, bicycle and pedestrian traffic.

Any changes in the plan shall be approved by the Director of Engineering or their designee, in advance of the change in accordance with the Contract Documents governing the construction project.

6.4.4 Pedestrian Accommodation

Pedestrians shall be provided with a safe, convenient travel path that replicates as nearly as possible the most desirable characteristics of sidewalks. Every effort shall be made to separate pedestrian movement from both work site activity and adjacent traffic. Whenever possible, signing should be used to direct pedestrians to safe street crossings in advance of an encounter with a temporary traffic control zone. Signs should be placed at intersections so that pedestrians, particularly in high-traffic-volume areas, are not confronted with mid-block work sites that will induce them to skirt the temporary traffic control zone or make a mid-block crossing. All pedestrian passageways or routes shall comply with the requirements of an accessible route in accordance with the ADA. A covered temporary walkway shall be used in areas where pedestrians are in proximity to overhead construction.

Plans which require the closure of sidewalks or shared-use paths shall incorporate the necessary barricades, signs and other measures as needed to ensure the safety of pedestrians and bicyclists. The closure of sidewalks, bike lanes, and shared-use paths will be allowed only if impacts cannot be avoided through alternative construction methods. The detour route must be of similar width and surface type to the permanent facility, and shall meet the requirements of an accessible route in accordance with the ADA.

6.4.5 Access Requirements

Local access shall be maintained to all properties on all streets during construction and maintenance activities. The TCP shall provide for access to all sidewalks, business and residence entryways and driveways. If access cannot be maintained, the contractor, utility, department or supervisor shall notify the affected property owner, resident or tenant a minimum of one (1) week in advance of the pending work unless the work is of an emergency nature. Access shall, in all cases, be restored as soon as possible. To ensure this, the contractor or work crew shall only perform the work affecting the restricted access areas while access is not maintained.

Access to fire stations, hospitals, EMS facilities and police stations shall be maintained at all times. If work activities require some access restrictions or access cannot be maintained, the contractor or work crew shall provide a minimum of two (2) weeks' notice, to the affected emergency service facility prior to commencing the work, unless the work is of an emergency nature.

Access to schools shall be maintained at all times. If work activities require access restrictions in the proximity of a school, the contractor or work crew shall provide a minimum of two (2) weeks' notice, to

the affected school facility prior to commencing the work. Contractor shall refer to Section 6.4.4 of this Manual for safe pedestrian accommodation for work areas in proximity of schools.

For emergencies, the contractor, utility, department or supervisor shall notify the occupant of the emergency service facility of the need to restrict their access and shall as soon as possible restore access to the property with steel plates or temporary pavement repairs.

6.4.6 Traffic Control Requirements during Construction

It is the responsibility of the permit-holder for private activities or the job supervisor for public projects to ensure that all policies, procedures and requirements set forth in this Manual and the TXMUTCD are met. Each work site shall have a designated English speaking competent person responsible and available on the project site or in the immediate area to ensure compliance with the traffic control plan and the provisions of this Manual. The competent person shall be required to demonstrate sufficient training in traffic control and competency in setting traffic control devices. Training Certificates shall be provided to the Transportation Services Department prior to setting any traffic control devices. Training certificates for competent persons shall be good for four (4) years from the date of training. After such time the competent person must show that additional training or re-certification has been achieved in order to maintain competent person status. The City reserves the right to request replacement of the competent person who continually fail to demonstrate competence in setting temporary traffic controls.

Failure or refusal to comply with the provisions of this manual and/or those set by the Director of Engineering or their designee shall be unlawful and grounds for suspension or revocation of the permit for the work or activity.

A permit holder or owner shall comply with each provision of this Manual, and any other rule or regulation adopted by the Director of Engineering or their designee. No activity may take place in the rights-of-way without first obtaining a proper permit. All un-permitted activity in the rights-of-way will be halted, and work may not resume until a proper permit is obtained.

A permit holder or owner who repeatedly fails to comply with the following:

1. A permit provision;
2. A provision of this manual;
3. Traffic control plans and specifications;
4. A traffic control device inspection report; or
5. Commits a violation that may negatively impact a person's safety and welfare may be suspended from work for a period not to exceed four (4) work days.

A suspended permit holder or owner shall halt all worksite activity immediately upon receipt of the order from the Director of Engineering or their designee. The permit holder or owner is directed to remedy any immediate hazards to public safety and welfare, and may be allowed to correct the deficiency that caused the suspension. The suspension period will not commence until all the violations are addressed to the satisfaction of the Director of Engineering or their designee.

Any activity occurring within the public right-of-way, for which a valid permit cannot be produced on the site, shall be halted immediately. Work shall not resume until a permit has been produced or issued.

Notice of noncompliance shall be made on Traffic Control Device Inspection Reports and shall be issued on site to the job site supervisor, foreman or crew leader.

6.4.7 Steel Plates

Where traffic must cross trenches, the Contractor shall provide suitable bridges. For trenches less than 18 inches (18”) in width, sheet steel plates having a minimum thickness of three-quarter inches (¾”) shall be used. For trench widths from twenty-four inches (24”) to seventy-two inches (72”), sheet steel plates having a minimum thickness of one inch (1”) shall be used.

The thickness of plates for trench widths exceeding seventy-two inches (72”) shall be established in an analysis completed by a Licensed Professional Engineer registered in the State of Texas.

The sheet steel plating will be installed in a "surface placement" configuration with an asphalt taper on all sides. Long term stationary installations and/or plating installations in high-trafficked portions of roads/streets shall include consideration of "flush placement" of the plates (i.e. milling of the pavement surface is undertaken to insure that the top-of-plate elevations essentially match the existing elevations of adjacent pavement surfaces) to minimize the impact on vehicular traffic.

In either installation configuration, the sheet steel plates shall extend beyond the edge of the trench a minimum of eighteen inches (18”) but no more than thirty inches (30”) on both sides. Transition ramping shall be provided for all "surface placement" configurations by the installation of cold mix asphalt on all sides.

For safe traverse of plating installations during the term of service, the top surface of the installed plates shall be flat and free of any clips, chains, attachments, weldments or surface irregularities.

When the plate dimension in the direction of traffic flow exceeds six feet (6’), a non-skid coating, approved by the Director of Engineering or their designated representative, shall be applied to the entire surface area of all plates.

Additional methods of securing plates may be required depending on field conditions. The contractor should avoid using a long series of plates that run parallel to traffic wheel paths. If allowed, the length of a series of plates that run parallel to traffic wheel paths shall not exceed thirty feet (30’).

The use of steel plates shall be approved by the Director of Engineering or their designee prior to construction.

6.5 SIGNING AND PAVEMENT MARKINGS

6.5.1 Signing

All signing shall be designed and installed in accordance with the Texas Manual on Uniform Traffic Control Devices (TMUTCD) latest edition.

The construction plans for public streets shall include the following information:

- Location, size, and designation for all required signs;
- Type of sign mount;
- Sign details for non-standard signs;
- Provision for street name signs i.e. sign brackets on STOP signs;

- Standard details for applicable sign types; and,
- Quantities and specifications.

All new projects shall include standard street name signs on public streets. These must conform to the TMUTCD.

6.5.2 Pavement Markings

All pavement markings shall be designed and installed in accordance with the Texas Manual on Uniform Traffic Control Devices (TMUTCD).

- The construction plans for public streets shall include the following information:
- Type of pavement marking, size, color, and alignment for each marking;
- Spacing and lane widths;
- Raised pavement markings type, color, and spacing, if used on the project;
- Detail dimensions for crosswalks, lane tapers, etc;
- Standard details for pavement markings; and,
- Quantities and specifications.

6.6 SIGNALIZATION

Traffic signal warrants will need to be satisfied prior to installation of new traffic signals and/or removal of existing traffic signals. Traffic signal warrants shall be prepared in accordance with the latest edition of Texas Manual on Uniform Traffic Control Devices (TMUTCD) and submitted to the City for approval.

Mast arm signal poles shall be used for all permanent locations. Timber pole shall be used for only temporary signal poles.

Traffic signals shall be designed and installed in accordance with the latest edition of TMUTCD and City of San Marcos standards and specifications. TxDOT signal standard and specifications may be used, where City standards and specifications are not available.

Prior to designing a traffic signal, the Applicant will schedule a pre-design meeting with the Director of Engineering and City's traffic signal staff to discuss the design requirements. The items to be discussed shall include, but not be limited to, the following:

- Type of signal pole (mast arm, span wire, or special poles)
- Type of detection (loop, camera, microwave, etc)
- Signal heads and back plates (color, material, pedestrian heads, etc.)
- Type of signal controller and cabinet; location of controller and foundation
- Ground box type, location and size
- Illumination on signal poles
- Pedestrian elements (regular, accessible, count down, etc.)
- Curb ramps (shall be ADA compliant)
- Power source and location
- Connectivity to adjacent signals (fiber optic, radio, etc.)
- Pre-emption (emergency vehicles or rail)
- Signal specifications (City, TxDOT, or both)

- Other special requirements from the City (specific signal equipment product, agreements, etc.)
- Submission requirements (number of submittals to be determined by City depending on nature and size of project, plan size: 11”x17” or full size)

The design plans will be prepared by a professional engineer with experience in signal design and will include the following construction plans as a minimum:

- Title Sheet (include project location map)
- Existing Intersection Layout (include all existing utilities)
- Proposed Intersection Layout (required if intersection is modified to include pedestrian ramps, pavement marking, signing, addition of lanes, utility, etc.)
- Proposed Signal Layout
- Street name signs, signal phasing diagram, signs on mast arms and push buttons
- Wiring diagram
    - Power source
    - Type of wiring for each equipment
    - Overhead wiring or underground conduit
    - Number and size of conduits
    - Interconnections with coordinated traffic control system
- Conductor conduit schedule
- Signal elevation sheet
- Signal interconnect details, if required
- Signal foundation design and details
- Signal general notes
- Signal quantities
- Signal standards (include all applicable standards)
- Traffic control plans, if required

6.7 STREET LIGHTING

Street lights in the City of San Marcos are typically owned and operated by San Marcos Electric Utility (SMEU). Confirm utility company service areas prior to start of design.

The Developer of a new street within the City shall furnish and install street lighting along all streets including cul-de-sacs and at all intersections. The street lighting construction requirements shall be in conformance with the City of San Marcos Design and Construction Standards, and SMEU Electric Delivery Standard Details and Specifications.

Luminaires, foundations, ground boxes, and conduit materials and installation methods shall comply with the applicable articles of the National Electrical Code (NEC), City of San Marcos Design and Construction Standards, SMEU Electric Delivery Standard Details and Specifications, National Electrical Manufacturers Association (NEMA), and the American Association of the State Highway and Transportation Officials (AASHTO) criteria.

An illumination plan for all streets within the Plat shall be filed with the Construction Plans. The plan shall show the proposed location of the street lights and any electrical facilities, including service locations, within the street ROW or public utility easements. All poles shall be identical along an entire

continuous street or throughout a subdivision with public roadways. The illumination plans shall include a photometric layout and appropriate calculations to demonstrate that the design criteria in this section have been met.

The street lighting facilities shall be complete and operational prior to acceptance of the Public Improvements.

The proposed streetlight design shall be as approved by the Director of Engineering or their designee, and San Marcos Electric Utility (SMEU).

Streetlights shall be provided at or near intersections and at or near the end of cul-de-sacs. Luminaires shall be provided as part of the traffic signal pole assembly for signalized intersections.

The City must obtain the approval from TxDOT; for all lighting systems to be installed on state facilities. Such installations must be in accordance with municipal maintenance agreements and TxDOT Standards and Specifications. Any agreement between the City and TxDOT for lighting must be accompanied by an ordinance, passed by City Council.

Street light wattage and spacing for the roadway classifications are summarized below in **Table 6-1**, and shall be used as the basis of design. The photometric analysis and layout shall be submitted and approved by the Director of Engineering or their designee prior to finalizing the street lighting design.

Table 6-1: Street Lighting Space and Height

Street Lighting Space and Height			
Road Classification	**Wattage**	**Luminaire Height (ft)**	**Maximum Spacing Allowed**
Residential Street	100	25	300
Commercial Street	150	30	300
Avenue	150	30	300
Boulevard	250	30	250
Highway	250	30	250

To determine the required illumination levels for roadways, use **Table 6-2** of this chapter, the AASHTO Roadway Lighting Design Guide, or ANSI/IES RP-8-14, Roadway Lighting. An illumination program capable of calculating luminance or illuminance levels is required to determine if adequate illumination levels have been achieved.

All illumination shall be designed in accordance with the latest requirements of the Illuminating Engineering Society of North America: “American National Standards Practice for Roadway Lighting”. **Table 6-2** provides the minimum design criteria for illumination and uniformity ratio for all streets:

Table 6-2: Illuminance and Luminance Design Values

Illuminance and Luminance Design Values (TxDOT Highway Illumination Manual; Chapter 6, Section 2)							
Roadway Classification	**Area Classification**	**Illuminance Method**			**Luminance Method**		
		Avg. Maintained Illuminance (E_{avg})	**Minimum Illuminance E_{min}**	**Illuminance Uniformity Ratio E_{avg} / E_{min}**	**Average Maintained Luminance**		
		R2			**L_{avg}**	**Uniformity**	
		(foot-candles) (min)	**(foot – candles)**	**avg/min (max)**	**cd/ m^2 (min)**	**L_{avg}/ L_{min} (max)**	**L_{max}/ L_{min} (max)**
Highway	Commercial	1.6	0.2	3:1 or 4:1	0.4 to 1.0	3.5:1	6:1
	Intermediate	1.2	0.2	3:1 or 4:1	0.4 to 0.8	3.5:1	6:1
	Residential	0.8	0.2	3:1 or 4:1	0.4 to 0.6	3.5:1	6:1
Boulevard	Commercial	1.6	As uniformity ratio allows	3:1	1.2	3:1	5:1
	Intermediate	1.2		3:1	0.9	3:1	5:1
	Residential	0.7		3:1	0.6	3.5:1	5:1
Avenue	Commercial	1.1		4:1	0.8	3:1	5:1
	Intermediate	0.8		4:1	0.6	3.5:1	6:1
	Residential	0.6		4:1	0.4	4:1	8:1
Commercial St	Commercial	1.1		4:1	0.8	3:1	5:1
	Intermediate	0.8		4:1	0.6	3.5:1	6:1
	Residential	0.6		4:1	0.4	4:1	8:1
Residential St	Commercial	0.8		6:1	0.6	6:1	10:1
	Intermediate	0.7		6:1	0.5	6:1	10:1
	Residential	0.4		6:1	0.3	6:1	10:1
Alleys	Commercial	0.6		6:1	0.4	6:1	10:1
	Intermediate	0.4		6:1	0.3	6:1	10:1
	Residential	0.3		6:1	0.2	6:1	10:1

Notes:

- Meet either the Illuminance design method requirements or the Luminance design method requirements and meet veiling luminance requirements for both the Illuminance and Luminance design methods.
- There may be situations when a higher level of illuminance or luminance is justified. The higher values may be justified when deemed advantageous by the agency to mitigate off-road sources.
- Physical roadway conditions may require adjustment of spacing determined from base levels of illuminance or luminance indicated above.

7. BUS STOPS

7.1 GENERAL

All bus stops shall be fully accessible with a concrete landing and access to a sidewalk or pathway. Bus boarding and alighting areas shall provide a clear length of 96 inches, measured perpendicular to the curb or vehicle roadway edge, and a clear width of 60 inches, measured parallel to the vehicle roadway in accordance with the ADA accessibility standard 810.2.2

Bus stop boarding and alighting areas shall be connected to streets, sidewalks, or pedestrian paths by an accessible route complying with ADA accessibility standard 402.

Bus shelters shall provide a minimum clear floor or ground space complying with ADA accessibility standard 305 entirely within the shelter. Bus shelters shall be connected by an accessible route complying with ADA accessibility standard 402 to a boarding and alighting area complying with ADA accessibility standard 810.2.

7.2 BUS STOP SPACING

7.2.1 Design Considerations

Bus stop spacing is based on several factors including customer convenience, ridership demand, and service type.

Customer convenience involves a tradeoff between proximity to stops and bus travel time. Closely spaced stops reduce customer walking distance but result in slower bus speeds. Few stops spaced further apart increase walking distance but result in faster, more reliable service.

Sufficient ridership demand is necessary to support the investment of stops. Details on ridership thresholds that warrant amenity investments are in Section 7.5, Amenities.

Specific service types such as limited stop, rapid, and express require increased stop spacing to maintain higher speeds, while radial and crosstown services have frequent stops to maximize ridership potential and convenient access to local activity centers and/or residences.

Table 7-1 lists recommended spacing for bus stops and is included to serve as a guide for planning bus routes. Spacing and location of bus stops shall be as approved by the Director of Engineering or their designee.

Table 7-1: Recommended Minimum Distance between Bus Stops

Recommended Minimum Distance Between Bus Stops	
Area Type	**Bus Stop Spacing (ft) (min – max)**
Regular local stops in Downtown or on Avenues & Commercial St	800 – 1,800
Suburban and Other Low-Density Areas	1,200 – 3,000

7.3 BUS STOP LOCATION

7.3.1 Design Considerations

Bus stop placement involves a balance of customer safety, accessibility, and operational efficiency. All bus stops shall be fully accessible with a concrete landing and access to sidewalk or pathway. Bus stops shall be compatible with adjacent land use and minimize adverse impacts on the built and natural environment.

Bus stops shall optimally be placed at intersections to maximize pedestrian safety; however, infrastructure considerations that can affect bus stop placement may include:

- Right-of-way availability;
- Cost of installation and maintenance;
- Potential future changes to stop location
- City, County, State or Federal laws and regulations;
- Other operational reasons;
- Infrastructure considerations for bus stop placement include lighting, topography; and
- Roadside constraints such as driveways, trees, poles, fire hydrants, etc.

Near-side and far-side stops are generally preferred over mid-block stops. Specific ridership generators may determine the placement of a bus stop.

7.3.2 Near-Side Stops

Near-side stops, which are located immediately before an intersection, allow passengers to board and alight closer to intersection crosswalks, which may facilitate better transfers. Near-side stop provides following benefits:

- Minimizes interference when traffic is heavy on the far side of the intersection
- Passengers access buses closest to crosswalk
- Intersection available to assist in pulling away from curb
- No double stopping
- Buses can service passengers while stopped at a red light

7.3.3 Far-Side Stops

Far-side stops, which are located immediately after an intersection, are preferred at intersections in which buses make left turns and intersections with a high volume of right turning vehicles. Far-side stops are also preferred on corridors with transit signal priority. Far-side stop provides following benefits:

- Minimizes conflicts between right turning vehicles and buses
- Provides additional right turn capacity by making curb lane available for traffic
- Minimizes sight distance problems on approaches to intersection
- Encourages pedestrians to cross behind the bus
- Requires shorter deceleration distances for buses
- Gaps in traffic flow are created for buses re-entering the flow of traffic at signalized intersections

7.3.4 Mid-Block Stops

Mid-block stops shall be considered when pedestrian crosswalks are present. If pedestrian crossings are not present, the City of San Marcos will work with appropriate entities to address the potential of installing treatments like flashing pedestrian beacons to accommodate this issue. Key constraints include:

- Mid-block stop requires additional distance for no-parking restrictions
- Encourages patrons to cross street at mid-block (jaywalking)
- Mid-block stop Increases walking distance for patrons crossing at intersections

Table 7-2 lists recommended location for bus stops and is included to serve as a guide for planning bus stop location.

Table 7-2: Stop Placement Guidelines

Stop Placement (NACTO Bus Stop Guidelines)	
Situation	**Preferred Placement**
Any signalized intersection where bus can stop out of travel lane	Far side
If bus turns at intersection	Far side
Intersection with many right turns	Far side
Complex intersections with multi-phase signals or dual turn lanes	Far side
If nearside curb extension prevents autos from trying to turn right in front of bus	Near side
If two or more consecutive stops have signals	Alternate nearside and far side (starting nearside) to maximize advantage from timed signals
If obvious, heavy single-direction transfer activity	One nearside; one far side to eliminate crossing required to transfer
If blocks are too long to have all stops at intersections	Midblock*
Major transit generators not served by stops at intersections	Midblock*
Midblock pedestrian-crossing defined by refuge island and/or striping	Midblock*
Transit center	Off-street
Major transit generator that cannot be served by on-street stop, or where ridership gain will far outweigh inconvenience to passengers already onboard	Off-street
* Midblock bus stops are generally less desirable than stops at intersections, however they must be considered when suitable nearside and far side options are unavailable.	

7.4 SIGNAGE

7.4.1 Design Considerations

Well-designed bus stop signage has the opportunity to provide useful customer information while simultaneously marketing transit service. Route signage should be limited to one design to minimize inventory and materials costs.

7.4.2 Signage Requirements

Bus stop signage shall include the following:

- Transit logo
- Unique panels or stickers with route number/name/endpoint
- Unique stop identification number, which can be used to access schedule information
- Appropriate sign color indicating route as provided by the City
- Route and schedule display panel

7.5 AMENITIES

7.5.1 Design Considerations

Bus stop amenities improve customer comfort, convenience, and safety. They also have the potential to increase ridership. Bus stop improvements promote system-wide equity. All amenities are considered optional; however, the City of San Marcos may require that the following amenities are included in design and construction scope of work and will determine this on a case-by-case basis.

7.5.2 Shelters

Ridership data shall be used as the primary criterion for determining shelter placement warrants. Several additional criteria shall also considered when ridership figures do not support shelter placement.

- Preferred for stops with 50 or more boardings per weekday
- Infrequent service – minimum of 35 daily boardings on routes where peak headways are greater than seventeen minutes
- Lift usage – minimum of 15 weekday boardings and 4% lift usage
- Proximity to senior housing and a minimum of 20 daily boardings
- Shelters funded and maintained by others
- Development of large new activity centers adjacent to transit where ridership is projected to meet criteria
- Consolidated bus stops – combined ridership totals increase likelihood of shelter placement

If a bus stop meets shelter criteria it may be considered for bus shelter placement. Meeting these criteria does not guarantee shelter installation and shall be approved by the Director of Engineering or their designee. Existing site conditions and pedestrian infrastructure, public right-of-way availability, accessibility and safety issues, and other concerns must be reviewed and addressed before future bus shelter are designed and constructed.

For bus shelter placement and orientation the following should be maintained:

- Five feet of pedestrian pass-by, including clearance between poles, hydrants and other obstacles.
- ADA landing pad adjacent to sign and outside of shelter.
- Clear pathway from the ADA waiting area inside the shelter to the ADA landing pad.
- Clear pathway from the rear door landing area to the pedestrian path.

A variety of bus shelter shapes and sizes are available to address site restrictions and opportunities, and ridership needs. Please see **Table 7-3** for descriptions.

Table 7-3: Shelter Types

Shelter Types (NACTO Bus Stop Guidelines)				
Shelter Type	**Dimension (in feet)**	**Minimum required setback (from edge of the curb, in feet)**	**Minimum Daily Boarding**	**Other**
B	8.5 x 4.5 x 8	11	50	Basic and most common shelter; sited in business and retail districts, residential neighborhoods, industrial and manufacturing areas, etc
A	8.5 x 2.5 x 8	9	50	Narrow version of B shelter; pursued when a B shelter is warranted but rightof-way is limited
BX	12 x 4.5 x 8	11	100	Longer version of B shelter; option at stops with strong usage
AX	12 x 2.5 x 8	9	100	Rarely used; a possibility at stops with strong usage and limited setback
BB	16 x 4.5 x 8	11	150	Double length shelter; only used at stops with significant ridership and likely only at activity centers.
High Capacity	Varies	Varies	>200	Special shelters for extremely high usage areas e.g., transit centers, light rail stations and high transfer points.

7.5.3 Seating

Bench placement can be considered at any stop where:

- Accessibility is provided
- Placement does not compromise safety (it is too close to the street, causes a tripping hazard, etc.)
- Placement does not compromise accessibility (bench partially blocks the sidewalk, infringes on the ADA or rear landing pad, etc.)

Benches can generally be sited like bus shelters; however, they should not be placed closer than three-and-a-half feet from the curb or six feet from the curb when a travel lane exists immediately adjacent to the curb. The same clearance requirements placed on shelters apply here. Benches should be oriented towards the street or the direction of the approaching bus. Refer to NACTO Bus Stop Guidelines for reference.

7.5.4 Trash Can

Trash cans are only placed at sheltered bus stops. High ridership, transfer locations and places where the potential for accumulating trash is apparent influence the decision to place cans, but expansion of the program is limited due to maintenance liabilities and public misuse. Placement must not infringe

upon the ADA pad or pedestrian pathway. It must not compromise direct access between the ADA waiting area and the ADA landing pad or access between either ADA area or the sidewalk.

7.5.5 Bus Pull Outs and Bus Pads

A bus pullout's primary function is to move buses out of travel lanes where they might impede traffic flow. Although there are scenarios where this is a valuable function, the placement of bus pullouts at regular bus stops reduces the efficiency of transit service. City of San Marcos will consider bus pull-outs:

- at bus layovers (where buses park for several minutes)
- at selected bus stops on roads with at least two of the following:
    - posted speed limit at or above 40 mph
    - ridership above 35 daily boardings (or six (6) daily lift boardings)
    - potential safety issues

Concrete bus pads are often incorporated in pullout designs but are also used at curbside bus stops. Bus pads are considered on a case-by-case basis but are generally found at stops with frequent service, significant ridership, or where heavy bus braking and acceleration is necessary.

Pull-out stops are typically 90 feet long when located near-side, and 100 feet when located far-side. Bus pull-out design options are shown in **Figure 7-1**

7.5.6 Amenity Restrictions

Circumstances that might preclude installation of amenities at a bus stop that otherwise meets the threshold warrant are as follows:

- Amenities would threaten pedestrian or operational safety;
- Adequate right-of-way is not available;
- Regulations enforced by City, County, State, or Federal government;
- Service to the location is subject to potential changes;
- Installation and maintenance costs are excessive; and,
- Other circumstances that would negatively impact operations or service

It is the Project Engineer's responsibility to ensure that the design and placement of amenities will not restrict or obstruct pedestrian sidewalk flow. For minimum requirements on boarding and alighting areas, please refer to United States Access Board, Public Right-of-Way Accessibility Guidelines.

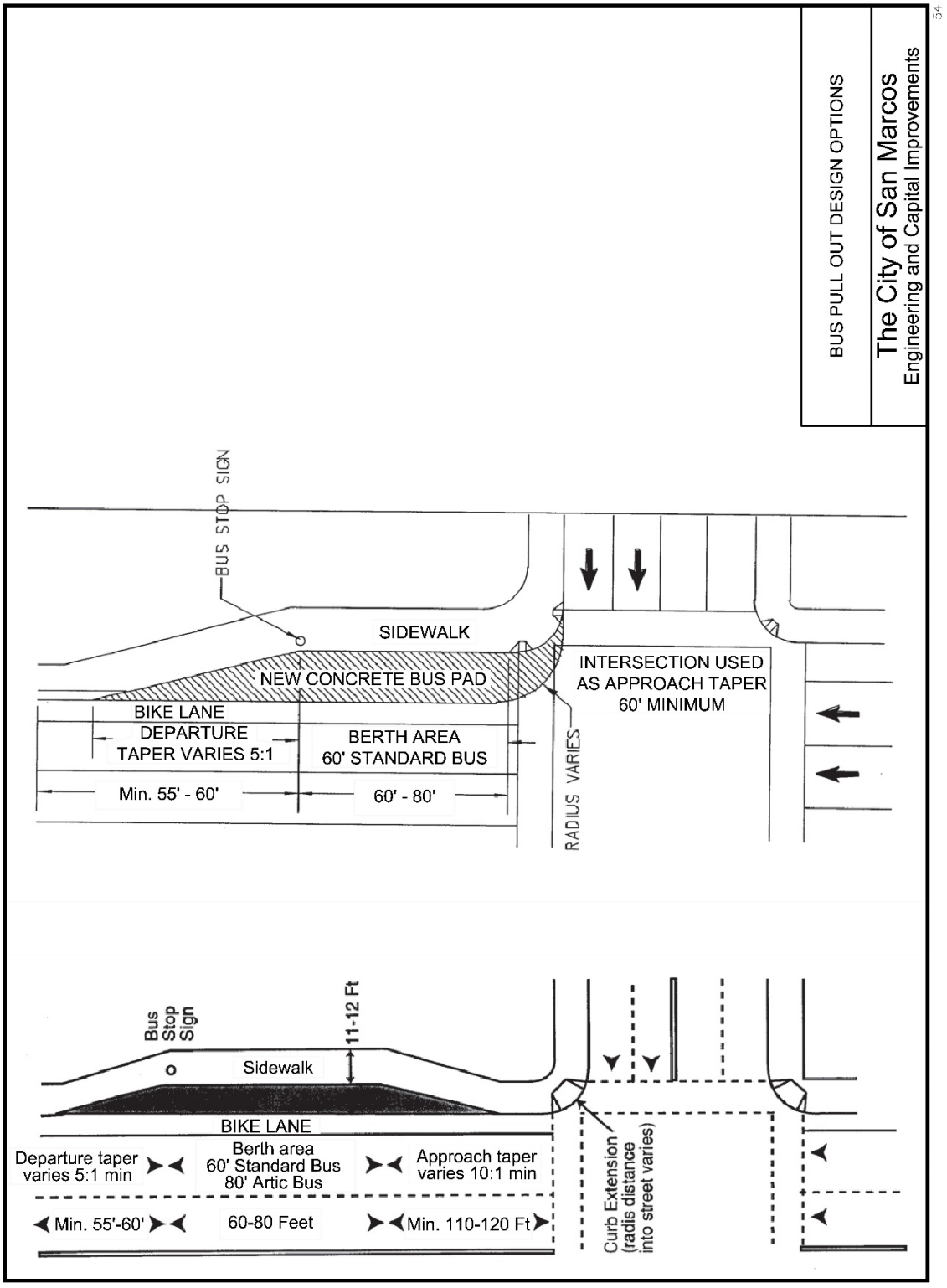


Figure 7-1: Bus Pull Out Design Options

8. PLAN PREPARATION AND PROJECT AUTHORIZATION

8.1 INTRODUCTION

Plans are defined as construction drawings prepared and approved by the Project Engineer, defined here as the Engineer of Record, that clearly show the location, character, dimensions, and details of all proposed work to be performed by the contractor. These plans, along with a project manual, are part of the plans, specification, and estimate (PS&E) assembly. The PS&E assembly shall be prepared by the Project Engineer and submitted to the City of San Marcos (COSM) upon the completion of design for each roadway project.

These plans shall be prepared using the guidelines provided in this chapter. Following these guidelines will produce plan sheets that are accurate, neat, and presentable that will reproduce legibly. An accurate and well-organized plan set shall be created to give potential bidders an opportunity to prepare as accurate a bid as possible, to allow efficient overseeing of construction performance, and to form a record copy for future construction reference. Inaccurate or unclear plans, however, may result in an increase in costs due to incorrect interpretations or omission of the plan information. Therefore, it is important that well-organized and efficient plan assemblies be prepared on all projects.

It is recognized that the level of design needed will vary by project. Therefore, the City and the Project Engineer will determine the need for Schematic Design and other design review submissions at a pre-design meeting. This will ensure an appropriate development of the design with corresponding reviews by the City.

8.1.1 References

The publications listed in this section provided much of the fundamental source information used in the development of this section. This list is not all-inclusive and there are numerous manuals, documents, and journals that explain the techniques and formats required to prepare accurate, clear, and presentable construction plans. Note that the publications, the standards, and the specifications included here are not static documents, but are expected to be revised continually. Therefore, Project Engineers shall always check the appropriate website for the most recent versions.

Federal Highway Administration (FHWA):

- Project Development and Design Manual (PDDM)

Texas Department of Transportation (TxDOT):

- PS&E Preparations Manual
- Project Development Process Manual

PS&E assemblies prepared for roadway projects in the COSM shall be produced in accordance with the criteria, guidelines, and data requirements included herein. Where discrepancies occur between the information provided herein and any of the above references, the following descending order of priority shall govern: (1) City of San Marcos Design and Construction Standards, (2) TxDOT's Project Development Process Manual, and (3) FHWA's Project Development and Design Manual. For additional guidance not covered in this chapter, refer to TxDOT's PS&E Preparations Manual.

8.2 QUALITY CONTROL/ QUALITY ASSURANCE FOR CIP PROJECTS

Quality Control (QC) is the process of quality checks and reviews performed on all project deliverables prior to submitting to the client to check the conformance, accuracy, scope, and style of a project deliverable. This includes detailed checking of plans, calculations, specifications, reports, and studies for accuracy and consistency, detecting and correcting design omissions and errors, confirming product meets the required level of completeness for the phase/milestone being submitted, and assessing and verifying compliance with design criteria, applicable computer aided design and drafting (CADD) standards and requirements, and other project requirements.

Quality Assurance (QA) is the process of reviewing the quality control process for use and effectiveness at preventing mistakes and ensuring compliance. This process includes designing and using guidelines, procedures, roles, and responsibility assignments to ensure that approved quality control practices are properly and consistently implemented, executed, and monitored. The QA is the final quality review completed on project deliverables to assure that all other required quality checks and reviews have been completed and resulting comments have been resolved and verified.

The purpose of the QA/QC plan is to prevent errors from being introduced to the engineering, design, plans, and cost estimates and to ensure decisions are supported by comprehensive studies and sound engineering judgment. The plan shall also identify key individuals and their unique methods and experience that reflect best quality control practices and the application of those methods uniformly across the design process.

The Project Engineer will submit a project-specific QA/QC plan for review within 30 days of the notice to proceed (NTP) or executed work authorization. This plan must outline the measures that will be employed to ensure that the City will receive an accurate product that matches industry quality standards. At a minimum, the submitted plan shall define the following:

- General project description and scope;
- The major components of the approved project scope and deliverables,
- Typically, deliverables will be submitted at the 30%, 60% and 90% design completion stage prior to 100%, or final, submission;
- The QA/QC responsibilities of individuals;
- The components of QA and QC required to develop this City project;
- The frequency of specific QA activities and QC reviews;
- The methods of documenting QA/QC activities/reviews and individual accountability including, but not limited to the submittal of redline markups at each subsequent submittal level; and,
- The relationship of these procedures with project milestones and schedule.

8.3 SCHEMATIC PREPARATION

The submission of schematic layouts shall include the basic information necessary for the proper review and evaluation of the proposed improvement. On some projects, and only with written approval from the City, schematic submissions may be substituted for 30% plans. Due to the varied agency approval processes for preliminary projects, it is essential that schematics contain the required basic information for review. Schematics shall include the following:

- General project information, including project designation, project limits, length, design speed, description, and functional classification;
- Title section on both ends of the schematic roll;
- Existing and proposed roadway and bridge typical sections;
- Locations of interchanges, main lanes, grade separations, frontage roads, turnarounds, ramps, intersections, major driveways, bridges, side streets, water bodies rail crossings;
- Existing and proposed profiles and horizontal alignments of main lanes, ramps, and crossroads at proposed interchanges or grade separations (frontage road alignment data does not need to be shown on the schematic; however, it shall be developed in sufficient detail to determine right-of-way (ROW) needs);
- All proposed roadway alignments shall increase stationing from south to north and west to east unless there is a need to match existing stationing;
- Lane lines and/or arrows indicating the number of lanes;
- Sequence of work outline for traffic control showing basic concept of traffic handling during construction, including preliminary phasing;
- Existing and proposed ROW limits;
- Bridges, bridge class culverts, and other drainage features;
- Geometrics (i.e. pavement cross slope, superelevation, lane and shoulder widths, slope ratio for fills and cuts) of the typical sections of proposed roadway main lanes, ramps, frontage roads, and cross roads;
- Location of retaining walls and/or noise walls;
- Existing and proposed traffic volumes and, as applicable, turning movement volumes;
- Existing and proposed control of access lines (if applicable);
- Direction of traffic flow on all roadways;
- Location and width of median openings (if applicable);
- Geometrics of speed change and auxiliary lanes;
- Existing roadways and structures to be closed or removed;
- Existing or proposed railroad lines;
- Edwards Aquifer Recharge/Contributing/Transition Zones;
- Environmental Constraints; and,
- 100 Year Flood Plains.

8.3.1 Schematic Checklist

A checklist is required with each schematic submittal on all projects. All items on the checklist shall be checked or labeled as N/A with an appropriate explanation. The Project Engineer must complete, sign, date and submit the checklist along with each schematic submittal. All unchecked items are considered missing. Refer to the checklist provided in **Table 8-1**.

8.4 PLAN PREPARATION

Construction plans for roadway and bridge projects in the City of San Marcos must be prepared in accordance with the sheet sequence, content, and guidelines indicated in the subsequent sections utilizing 11” x 17” sheet size.

8.4.1 Organization and Content of Plans

The plan set can be divided into main sections to reflect the elements of the proposed work.

Standard drawings and standard details cover various design elements that have been approved by agencies, such as TxDOT, incorporated cities, or other local government agencies, for use within their jurisdictional limits. These standard drawings have a fixed format and each drawing has its own unique identification number. If changes are made, they cannot be used as a standard drawing. Instead, they become special details.

Special details are plan sheets detailing various project elements and shall follow each corresponding section of the plan set (i.e. roadway, drainage, structures, utility, erosion control, etc.). These drawings are generated by the Project Engineer and shall include all details necessary to construct the project elements.

Standard drawings, standard details, and project-specific special details shall be incorporated into the plan set and not issued as a separate booklet. The standard drawings, standard details, and special details shall be arranged in an order that best clarifies the work to be accomplished. Typically, these sheets shall follow the plan drawings of the project.

Following is a list of these sections in sequential order. Unless directed otherwise, the Project Engineer shall follow this section sequence and adhere to the guidelines regarding the content of each section and each plan sheet within the section.

Refer to the checklist in the Appendix for a summary of items that shall be included in each section.

- **8.4.1.A Title Sheet**
- **8.4.1.B Index of Sheets**
- **8.4.1.C Project Layout**
- **8.4.1.D Typical Sections**
- **8.4.1.E General Notes**
- **8.4.1.F Survey Data/Project Control Points**
- **8.4.1.G Alignment Data Sheets**
- **8.4.1.H Estimate And Quantity Sheets**
- **8.4.1.I Summary Sheets**
- **8.4.1.J Traffic Control Plan / Construction Sequence**
- **8.4.1.K Roadway Plans (Plan View and Profile View)**
- **8.4.1.L Drainage Plans**
- **8.4.1.M Utility Plans**
- **8.4.1.N Structural Plans**
- **8.4.1.O Traffic Signals And Illumination**
- **8.4.1.P Pavement Markings And Signing Plans**
- **8.4.1.Q Erosion Control – Permanent / Temporary and SW3P**
- **8.4.1.R Cross Sections**
- **8.4.1.S Other**
- **8.4.1.T Traffic Control Plan Standards & Details**
- **8.4.1.U Roadway Standards & Details**

- **8.4.1.V Drainage Standards and Details**
- **8.4.1.W Utility Standards & Details**
- **8.4.1.X Structural Standards & Details**
- **8.4.1.Y Traffic Signal And Illumination Standards & Details**
- **8.4.1.Z Pavement Markings And Signing Standards & Details**
- **8.4.1.AA Erosion Control Standards And Details**

8.4.1.A Title Sheet

The purpose of the Title Sheet is to establish the project location, describe the nature of the proposed work, identify the funding authority and Project Engineer, and show agency and utility approvals.

A complete Title Sheet shall contain the following:

- Proper title and project designation;
- Statement of the project length;
- City logo;
- Roadway classification, design speed, and traffic data;
- Vicinity map;
- Signature blocks for approving officials;
- Governing specifications and date of adoption;
- Copyright statement;
- Exceptions, equations, and railroad crossings; and,
- Registered Accessibility Specialist (RAS) inspection note.

The project designation includes the project name, project number, and the roadway name and number, if applicable. The limits of the proposed construction in relation to the nearest county or state roadway shall also be shown in miles to the third decimal place if the project is contiguous. Plans for multiple-site projects shall refer to, and include, plan sheets showing the locations or a single exhibit with each site designated by an alpha-numeric label and legend to all designators. A description of the proposed work shall also be included under the project designation.

The project length shall be shown in feet to two decimal places. The project length shall also be shown inclusive and exclusive of the bridge length and any equations, exceptions, or railroad crossings shall be listed by station numbers and lengths. Show as “NONE” if not applicable.

The vicinity map shall be of suitable size showing the project location in relation to nearby highways, nearest towns, railroads, and major streams. County and city boundaries, applicable scale, and north arrow shall also be shown. The beginning and ending stations shall be clearly identified.

Signature blocks are required for approving officials to sign and date the plans. Signature blocks for the Project Engineer and the City of San Marcos shall be provided as a minimum. Signature blocks shall also be provided for local utility interests, where applicable.

Projects that include sidewalks and other pedestrian facilities with an estimated construction cost of $50,000 or more will require an RAS inspection. The following note shall appear on the Title Sheet:

"Registered Accessibility Specialist (RAS) Inspection

Required TDLR No. _____ ."

Any governing specifications or specification reference applicable to the project shall also be stated on the Title Sheet. The following copyright statement shall also be added to the Title Sheet:

8.4.1.B Index of Sheets

The index includes the sheet number and title as they appear on each sheet contained within the plan set. All sheets are to be listed, including omitted sheet numbers.

8.4.1.C Project Layout

The project layout shall depict the proposed and existing project features. A suitable scale shall be utilized to clearly show project features, such as the beginning and the end of the project, sheet numbers, street names, baseline stations, horizontal alignment data, existing and proposed ROW, or any other pertinent information not shown elsewhere in the plan set. The project layout shall not be smaller than 1"= 400' scale.

The station and coordinates of the beginning and ending project points shall be labeled.

8.4.1.D Typical Sections

Roadway typical sections provide a general illustration, by cross sectional view, of the nature of construction in every segment of the project. The objective is to present all the elements and dimensions of the roadway for every change of existing features or proposed roadway in as simple a way as possible. These sections shall be specific enough to describe the elements of the proposed work, their location, and the material to be utilized. Underground utilities shall also be included in roadway typical sections.

All plans shall show typical sections for the project, including bridge plans. On projects requiring more than one typical section, the limiting stations for each section shall be shown and may require additional plan sheets for clarification.

The existing typical section shows the approximate widths, depths, and station limits of the existing roadway included in the project. Proposed sections illustrate the depths, dimensions, and station limits for every type of material in the proposed pavement structure. Features, such as ramps, detours, crossroads, barrier, and metal beam guard fence (MBGF), must also be included. Other applicable items with limits that may be shown on the typical sections are retaining walls, curb and gutter, and topsoil and seeding.

Identify all functional elements of the typical section to a relative scale. Show widths in feet, thickness or depth in inches, pavement cross slopes in percent, and side slopes in horizontal to vertical ratios. Show the thickness of each element in the pavement structure in inches. Use notes or tables on the typical section sheet to cover where different pavement structure layers are necessary due to different soil conditions.

For phased construction projects, identify the ultimate typical section. Clearly distinguish the work to be performed under the contract and future construction work. Typical sections reflecting construction phasing shall be shown on the sequence of construction/traffic control plans.

Necessary control points, such as the project baseline and centerline, the roadway centerline, pavement cross slope, and superelevation pivot point, shall be clearly identified on the typical section. Existing and proposed typical sections shall show existing and proposed ROW.

Every typical section shall contain a set of section limits to which it corresponds along the roadway. These limits are shown through station ranges. The entire project shall be checked to ensure that a typical section has been shown for every segment of the roadway.

Additional information, such as the following, may also be shown on the typical section sheet(s):

- Location of predominant utility lines and their approximate depths;
- Location of storm sewer trunk lines.

8.4.1.E General Notes

Included in General Notes are items such as construction notes, utility notes, erosion control, tree protection notes, concrete surface finish, traffic notes and special conditions, material testing notes, and project specific notes. The City of San Marcos maintains general construction notes, which the Project Engineer can use for a specific project.

Quantities for supplementary items shall be shown, and when shown, labeled, “For Contractor’s Information Only.” The wording of all general notes needs to be clear, concise, and have only one meaning for uniform interpretations.

8.4.1.F Survey Data

Survey data sheet(s) will be required on all projects where an actual field survey has been performed. The survey data includes reference to and description of the horizontal and vertical control used on the project.

Reference to the horizontal coordinate system and the vertical datum used shall be stated. The following statement along with the combined scale factor shall be added:

All distances and coordinates shown are grid/surface values and may be converted to surface/grid by multiplying with/dividing by a combined scale factor of_____.

Coordinates, elevation, and descriptions of all project control points shall be included. Description and elevation of all bench marks used to establish project elevations shall also be added to the survey data sheet.

On small projects, the survey data may be included on the project layout sheet. On large projects, it may be beneficial to show the construction alignment or survey alignment in relation to the control points and bench marks on separate sheets. The project Registered Professional Land Surveyor (RPLS) seal, signature, and date are required.

8.4.1.G Alignment Data Sheets

Alignment data sheets shall (at a minimum) include the following information:

- Curve data (if applicable):
  - PC, PI, PT station and coordinates;
  - Curve radius and degree of curve;
  - Deflection angle;
  - Tangent bearings and lengths.
- Stations and station equations (if applicable);
- Station/offset information (in relation to other alignments within the project limits);
- Project Engineer's seal, signature, and date.

8.4.1.H Estimate And Quantity Sheets

The Estimate and Quantity (E&Q) sheet provides a list of all pay items and estimated quantities in the contract. Sheet numbers, item numbers, descriptive codes, special provision numbers, item descriptions, units of measurement, and bid alternates are also shown. This sheet is prepared using the Project Quantity Spreadsheet as defined in Section 8.4.1.I.

An E&Q sheet also summarizes the work to be done, if there is more than one project in the plans or if local participation is required to be quantified separately. They also simplify the plans by showing the total quantities of each item of work involved in the construction of the roadway. The Project Engineer’s seal, signature, and date are not required.

8.4.1.I Summary Sheets

These sheets tabulate, combine, and summarize quantities of the various construction items. This summary informs prospective bidders of where to locate work within the plan sheets, the difference between plan quantities and bid schedule quantities, if any, and expands on contract bid schedule information. It also serves as a helpful checklist to the designer to ensure that all elements of the design receive consideration. The Project Engineer shall use a tabulation format that presents the work items in a clear and concise manner that can be easily checked and verified.

Summary of quantity sheets may also show item numbers, descriptive codes, special provision numbers, item descriptions, units of measurement, and bid alternates. In the preparation of the summary sheets, bid items shall be described exactly as shown in the COSM standard item description.

Summary sheets will be prepared using a Project Quantity Spreadsheet in Microsoft Excel to tabulate the various pay items. All of the pay items are to be listed in numerical order and identified by appropriate descriptions. Show any pertinent information by use of remarks or footnotes at the bottom of the summary plan sheet. The engineer’s seal, signature, and date are not required on summary sheets.

8.4.1.J Traffic Control Plan / Construction Sequence

A traffic control plan (TCP) is a special drawing that graphically portrays all traffic control measures required to assure safe passage of traffic and pedestrians through and/or around a specific project

construction zone. It also ensures the safety of construction personnel, provides protection to construction equipment, and minimizes the accident level within the project limits.

TCP's may range from simple line diagrams for low-volume rural roads to complex plan sheets detailing every stage of the project work on high-volume urban roadways. Refer to the Transportation Criteria Manual Section 6 for guidance on TCP content and layout.

If different construction stages or intricate traffic movements are needed, then suggested sequence of work sheets shall be provided. In addition, in order to clarify the work zone widths and traffic handling methods, typical cross sections shall be provided for each construction phase. Barricade and construction standard sheets shall also be included within the plan sets.

A narrative summarizing the general traffic operations and general construction operations for all phases shall be provided. The steps within each phase shall also be included for the suggested sequence of construction. All applicable traffic control and work sequence general notes shall be added, including the working hours. Per Sec. 14.011 in the Code of Ordinances 2015-21, working hours in the public right-of-way are generally limited to the hours between 7:00 a.m. and 6:00 p.m. construction noise, declared a nuisance under City ordinance, is not permitted between 9:00 p.m. and 7:00 a.m. except under special permit

The Sequence of Construction shall include construction staging plans that detail the recommended phasing of project improvements. Staging should maximize mobility and safety during construction, while considering ease of construction.

Detours may be required to maintain traffic during certain construction stages. The Sequence of Construction shall consider safe operation for pedestrians and bicyclists in all stages of construction as well as continuous, safe access to all properties. Construction markings, traffic control devices, and barriers should be designed with this goal.

Detailed layout and arrangement of work zone signs, work zone pavement markings, traffic control devices, and drainage facilities should be provided for each construction stage.

TCP's shall be prepared in accordance with TMUTCD Chapter 6, "Temporary Traffic Control." The Project Engineer's seal, signature, and date are required.

8.4.1.K Roadway Plans

Roadway plans are also known as the plan and profile (P&P) sheets. The objective of P&P sheets is to show the existing topographic features, the horizontal and vertical alignment of the proposed roadway, and the location and limits of the proposed work. The plan and profile are typically shown on the same sheet, unless impractical, in which case they may be presented on separate sheets. If the profile is modified, provide P&P sheets for connecting roadways and driveways.

P&P sheets shall be prepared at a scale that is adequate to show the necessary details as governed by the topography and the complexity of the work. A scale of 1" = 40' is typically used for roadway plans. Depending on the plan size and amount of information required for the project, varying graphic scales may be utilized. Profiles usually have the same horizontal scale as the plan, but the vertical scale shall be

5 to 10 times the horizontal scale. Where elevation differences are large, a vertical scale of 2 times the horizontal may be more appropriate.

At a minimum, the following shall be shown on the plan portion of the P&P sheets:

- North arrow, scale, and legend;
- Boundary, county, and city lines, if applicable;
- Control of access lines, if applicable.
- Bodies of water, such as streams, lakes, swale, estuaries, or creeks;
- Beginning and ending points and their respective stations;
- Centerline or baseline stationing with labels and tick marks every 100’;
- Horizontal curve and point of intersection data if not shown on the project layout;
- Existing and proposed ROW lines and widths at each break within the project limits;
- Property lines and property ownership;
- Easement lines and widths;
- Full superelevation, normal crown, transition locations and limits with stations;
- All drainage structures with reference numbers;
- Existing and proposed underground utilities, if applicable;
- Intersection stations of all driveways and connecting roadways;
- Proposed radii at intersection with driveways and connecting roadways;
- Retaining wall locations, if applicable;
- Existing roadway and roadway width;
- Proposed roadway, curb and gutter, sidewalks, shoulders, including proposed widths;
- Pavement removal (separate sheets for large projects);
- Limits of Milling (separate sheets for large projects);
- Demolition of structures (separate sheets for large projects);
- Location of borings, test pits, or other sites where subsurface investigations have been made;
- Summary of items and estimated quantities, including excavation, embankment, MBGF, and terminus, which are not detailed on other sheets.

At a minimum, the following shall be shown on the profile portion of the P&P sheets:

- Stations along the bottom and elevations along the sides;
- Proposed profile grade and existing ground lines with labels;
- Points of vertical intersection and vertical curve data;
- Gradients in percent to two decimal places for the PGL;
- K values for each vertical curve;
- Proposed and existing elevations at appropriate intervals to two decimal places;
- Culverts, structures, or other proposed facilities;
- Utilities with elevation or depth dimensions, if known, and over and under clearances;
- Existing and proposed bridges and major structures with appropriate reference notation;
- Clearances for railroads, highways, and streambeds under proposed and existing structures.

In order to improve the clarity of P&P sheets, some of the aforementioned information, such as the intersection and driveway details that show pavement contours, sidewalks, shared-use paths, pedestrian ramps, pavement structure, and grades, may be placed on additional sheets.

Driveway quantities shall be tabulated and summarized by driveway, indicating the corresponding plan sheet number, driveway designation number, station, radius, width, dimensions, elevations and quantities. Pavement, roadway incidentals, pavement markings, bridges, retaining walls, erosion control, and all other pay items shall be tabulated and summarized on the appropriate plan sheets. These plan sheet quantities shall then be included in the Project Quantity Spreadsheet summary tabulation of the various pay items. The Project Engineer is requested to submit this spreadsheet for assistance in the review process at the 90% and 100% submittals. The Project Engineer's seal, signature, and date are required.

8.4.1.L Drainage Plans

Drainage plans generally consist of four elements: (1) drainage area map and hydrologic and hydraulic (H&H) data, (2) hydraulic computations, (3) culvert or drainage structure layouts, and (4) drainage plan and profile sheets. Following is a brief content and format discussion for each of these elements.

Drainage Area Map and Hydrologic & Hydraulic Data:

The size and location of watersheds within the project area are documented on this sheet and used to develop the design flow, which in turn will determine the size of the proposed drainage structures and appurtenances. The contents of an area map include major tributaries or streams being crossed, major highways and streets, and drainage area limits. Each drainage area needs to be labeled for runoff table cross-referencing and the location of structures and/or stream crossings.

Hydraulic Computations:

This sheet is used to verify the structure design and to present calculations. Culvert hydraulic calculations consist of a runoff table and a culvert computation table. Additional tables shall be shown for storm sewer runs, inlet computations, and ditch capacity/velocity calculations. In general, runoff computations shall indicate the method used (Rational or United States Geological Survey (USGS), the intensity values, runoff coefficients, and the design storm. Projects containing ditches shall include a listing by station of ditch depth, capacity, and velocity calculations for all proposed ditches. Including the computer generated analysis results in the plans is preferred for culvert sizing, storm sewer runs, and inlet computations.

For major stream-crossing bridge structures, the hydrologic and hydraulic (H&H) computations are summarized in a drainage report, also referred to as the H&H Report. The results of the study are also summarized on a drainage area map that is included in the plans. One drainage area map sheet is required per structure. This sheet shall include a drainage area map showing the location and limits of the watershed, a typical stream cross section, a bridge summary table showing peak discharges and water surface elevations, a cross section summary table, gage station analysis and summary (if applicable), design storm frequency, hydraulic software utilized, and runoff computation method used.

Culvert or Drainage Structure Layouts:

Each proposed crossing culvert, including bridge-class culverts, shall have a cross section/profile showing the work to be done and the description of the culvert. Bridge-class culverts, which are culverts with a width of 20 ft. or more along centerline of the roadway, must include a National Bridge Inventory (NBI) number. This sheet is also referred to as the culvert layout. Below is a list of items that shall be shown on the culvert layout sheet.

- North arrow and horizontal and vertical scales;
- Existing ground and proposed grade lines;
- Direction of flow and flow line elevations;
- Centerline of roadway, structure centerline, and skew angle;
- Beginning and ending stations of the structure with flow line elevations;
- Structure slope and upstream and downstream channel slopes;
- Length of structure;
- Type of end treatment including details;
- Roadway cross section along culvert, roadway width and clear zone dimension;
- Description of existing and proposed structure with appropriate standards;
- Hydraulic data (headwater and tail water elevations for 25 year and 100-year events);
- ROW and easement lines

Drainage Plan and Profile Sheets:

The drainage plan and profile (P&P) sheets are required mainly on roadways with storm sewers. The drainage P&P sheets are typically prepared at the same horizontal and vertical scales of the roadway plans. The plan view shall show the location of inlets, storm sewers, culverts, and ditches, while the profile view shall show the storm sewer run information, such as length, size, and type. Existing ground, proposed grade lines, 25 year and 100-year hydraulic grade line (HGL), existing utilities, and trench excavation protection limits shall also be shown on the profile view. The Project Engineer's seal, signature, and date are required.

8.4.1.M Utility Plans

Include existing utilities on roadway P&P sheets, unless proposed utilities are needed, then separate utility plan sheets should be considered. Utility P&P sheets shall be prepared at the same scale as the roadway P&P sheets. The Project Engineer's seal, signature, and date are required.

8.4.1.N Structural Plans

Structural plans are required on all projects with proposed structures. Proposed structures include either retaining walls or bridges.

Retaining Walls:

Structural plans for retaining walls include wall layouts, typical sections, geometry data, and details. Retaining wall layouts shall include plan and profile views prepared typically at 1" = 20'. utilizing a vertical scale factor of 2:1. The profile view shall show the front face of wall. All applicable items mentioned below for the bridge layouts shall be considered in the preparation of the retaining wall

layout sheets. In addition, wall layouts shall include top of wall elevations as well as existing and proposed ground lines and elevations.

Typical sections for retaining walls shall include information such as pavement and graded slopes and widths, barrier or rail type and location, and proposed roadway reference. Geometry data sheets for retaining walls shall include sufficient information to enable the contractor to construct the walls. For mechanically stabilized earth (MSE) type walls, this information shall include tieback identification and location, wall height, panel width and length, and panel area.

Details for retaining walls may include structural, drainage, or miscellaneous drawings detailing the design and construction of these elements. The Project Engineer's seal, signature, and date are required.

Bridges:

Structural plans for bridges consist of bridge layouts, typical sections, foundation data, bearing seat elevations, and structural details. Each bridge shall have a bridge layout sheet that includes a plan view and a profile view (elevation). Bridge layouts shall be prepared at 1" = 20'. scale with 2:1 vertical scale factor. The following is a list of items that shall be included on the bridge layout plan view:

- Centerline or PGL (bearing and location)
- Structure's beginning and ending stations and elevations
- All bent stations and bearings
- Armor joint type, location, and size of seal (if needed)
- Width of roadway and shoulders
- Approach slab and curb returns
- Direction of traffic and/or stream flow
- North arrow and plan scale
- Identification and location of test holes
- Horizontal clearances (i.e. for structures, utilities, railroad tracks, etc.)
- ROW (if applicable)
- Horizontal alignment data (if applicable)
- Cross slope and/or superelevation (if applicable)
- Limits of riprap and block out around column
- Skew angle(s) of structure and/or bents
- Railing type (specify rail type and show nominal face of rail)
- Exterior beam line numbers (consistent with span details)
- Pedestrian / bicycle accommodation (if applicable)
- Features being crossed
- Utility identification and locations
- Summary of bid items and estimated quantities (can be a separate sheet)
- Railroad Exhibit (if applicable)

The profile view of the bridge layout shall have the following:

- Overall length of structure;
- Lengths and types of units/spans;

- Overall length, limits of payment, and type of railing (rail post spacing if needed to clear slab joints);
- Vertical curve data and grade;
- Beginning and ending structure stations and elevations;
- Fixed/expansion conditions at all bents;
- Beam ends marked doweled or open;
- Minimum calculated vertical clearances and other clearances as required (e.g. structures, utilities, railroad tracks, etc.);
- Existing and proposed ground lines clearly marked;
- Appropriate hydraulic data (if applicable);
- High-water elevation (if applicable);
- Scour information (if applicable);
- Datum elevations and stations;
- Column heights;
- Number, size, length, and type of foundations;
- Test holes, data, and information;
- Bent numbers clearly marked;
- Clearance sign(s) and any other needed signs attached to bridge(s);
- NBI number or the permanent structure number (PSN);
- Limits and type of riprap;
- Design speed, ADT, and functional classification.

Bridge typical sections shall include an overall roadway width, shoulder width, curbs, concrete medians, sidewalks, cross slopes, and railings. The section shall also include reference to its location and shall highlight the main elements of the structure, such as the beams, deck, railing, and barrier.

Structural details pertain to drawings detailing the design and construction of abutments, bents, slabs, footings, framing plans, and wing walls.

Applicable TxDOT standard drawings may be used in lieu of preparing structural detail sheets. The Project Engineer's seal, signature, and date are required.

8.4.1.O Traffic Signals, Illumination & Traffic Management Systems

This section includes proposed project elements in the following three main areas: (1) traffic signals, (2) electrical and illumination work, and (3) traffic management systems (TMS). The following is a brief discussion and a list of the plans that shall be included for each of these areas.

A traffic signal plan shall be prepared for each intersection or approach that includes the following proposed traffic signal elements:

- Signal layout sheet (e.g. signal pole and mast arm locations, conduit runs, loop detectors, traffic lanes, signal head arrangements, etc.);
- Signal elevation sheet (e.g. elevation views from all directions showing signal head arrangement, signal pole types, and appendances);
- Signal wiring and signal phasing sheet;

- Summary sheet.

Similar drawings will be required for temporary traffic signals required during the various construction phases. Signal layouts shall be prepared utilizing 1” = 40’ scale.

Electrical and illumination layout sheets shall include:

- Layouts of lighting pole and luminaire;
- Lighting details;
- Electrical service;
- Conduit run locations.

These plans shall be prepared at the same scale as the roadway plans. On small projects, the proposed electrical and illumination elements can be shown on the pavement markings and signing plans. A quantity summary with sheet totals shall be included on each sheet. Voltage drop calculations for the various circuits will be a requirement at the 60%, 90%, and 100% submissions.

Traffic Management Systems plans, if needed, denote surveillance and control system items, such as traffic cameras, changeable message signs, vehicle detection, conduit runs, and any other intelligent transportation system. These plans shall also be prepared at the same scale as the roadway plans. The Project Engineer’s seal, signature, and date are required.

8.4.1.P Pavement Markings & Signage Plans

The pavement markings and signage plans depict the location, type, color, dimensions, and standard number of all proposed markings and signs. These plans shall include both pavement marking and signage elements on the same plan and shall be prepared at the same scale as the roadway plans. On large and complex projects, the pavement markings and signs may have to be placed on separate plans for clarity and simplicity.

In addition to the pavement marking and signage plans, this section shall also include overhead sign and elevation details, bridge sign details, large and small sign details, and miscellaneous sign details. These details shall show the location, size, and dimension of the panel, support, mounts, and accessories of all proposed sign structures as necessary. These details shall be developed at a scale sufficient to clearly show the proposed elements and labels.

All pavement markings and sign plans shall be in accordance with the latest edition of the TMUTCD. SignCAD software shall be used to create customized signs not included in the Standard Highway Sign Designs for Texas. The Project Engineer’s seal, signature, and date are required.

8.4.1.Q Erosion Control

The plan sheets for the erosion control plan, including the Storm Water Pollution Prevention Plan (SW3P), are drawings that detail the measures required to protect resources and to comply with environmental permit stipulations. These drawings shall be prepared in accordance with the City’s Stormwater Management Program and MS4 Permit, and shall be in compliance with the stipulations in the Texas Pollutant Discharge Elimination System (TPDES) permit.

These sheets address temporary erosion control measures during project construction as well as any permanent erosion controls that are required. An SW3P sheet and erosion control plans are required for any project with soil disturbance. As a minimum, the first sheet of the erosion control plan is the SW3P, which is the narrative portion, and any additional sheets would show the locations and types of any erosion control features needed. Erosion control plans shall be prepared at the same scale as the roadway plan. The SW3P shall comply with the approved Water Pollution Abatement Plan (WPAP), if applicable.

While not a required plan sheet, a WPAP is required for any regulated (i.e. construction) activity conducted in the Edwards Aquifer Recharge Zone. A WPAP is a detailed plan that outlines best management practices (BMPs) that will be implemented in order to protect water quality when a regulated activity is conducted in the Edwards Aquifer Recharge Zone. The WPAP must be submitted and approved by Texas Commission on Environmental Quality (TCEQ) prior to construction for any project located over the Edwards Aquifer Recharge Zone.

8.4.1.R Cross Sections

Sufficient information shall be shown on each of the sections to accurately determine the extent of the proposed work. A scale of 1" = 20' is typically used for cross sections. The horizontal to vertical scale is typically 2:1 resulting in a vertical scale of 1" = 10'. If this scale is unsuitable, use more appropriate scale to show the extent of the proposed work.

Cross sections shall be cut at 50' intervals and at all cross streets. Earthwork quantities on all projects shall be based on cross sections spaced at 50' maximum.

Cross sections shall also show the existing and proposed grade lines depicting the slopes, widths, and depths of proposed material. Offsets and elevations of all critical segment points shall also be shown. ROW and easement lines shall be clearly marked. Underground utilities shall also be included in cross sections

8.4.1.S Other

Additional plan sheets may be required to address issues, such as material source rehabilitation, disposal or borrow area restoration, intersection details, special landscaping plantings, and other enhancements. If there is a substantial amount of demolition work to be done, separate plan sheets (removal layouts) showing the proposed demolition work shall be utilized.

8.4.1.T Traffic Control Plan Standards & Details

Special traffic control details may include drawings detailing construction phasing, traffic control device applications, temporary shoring, or slope treatments.

8.4.1.U Roadway Standards & Details

Special roadway details may include drawings detailing grade crossings, turnouts, disposal and borrow site grading treatments, material source locations, removal plans, intersection details, and driveway details. The Project Engineer's seal, signature, and date are required.

8.4.1.V Drainage Standards and Details

Special drainage details may include drawings detailing inlet modifications, pipe bedding, reinforced concrete pipe connections, flume, or channel details. The Project Engineer's seal, signature, and date are required.

8.4.1.W Utility Standards & Details

Special utility details may include drawings detailing water and wastewater pipe connections, thrust blocks, joints and other appurtenances. The Project Engineer's seal, signature, and date are required.

8.4.1.X Structural Standards & Details

Special structural details may include drawings detailing pre-stressed concrete panels, permanent metal deck forms, and concrete riprap for embankment slopes under bridge ends. The Project Engineer's seal, signature, and date are required.

8.4.1.Y Traffic Signal And Illumination Standards & Details

Special traffic signal details may include drawings detailing signal pole foundation, signal support structures (single mast arm assembly), and electrical details-conduit.

8.4.1.Z Pavement Markings And Signing Standards & Details

Special pavement marking and signing details may include drawings detailing delineators, object markers, pavement markings, pavement markers, sign mounting, and signs.

8.4.1.AA Erosion Control Standards And Details

Special erosion control details may include drawings detailing sediment control fence, rock filter dams, and tree protection. Additional special details may be necessary to detail grading, wetland restoration, and vegetation replacement for projects with wetland impacts or/and mitigation.

Commitments for environmental mitigation features, which are contained in the environmental documentation, shall be detailed as necessary and included in the project plans as special details and/or shown at the end of the Erosion Control Standards and Details section. The Project Engineer's seal, signature, and date are required.

8.4.2 Sealing Plans

All original final plan drawings, except for Estimate and Quantity, Summary, and Standard sheets, are to be signed, sealed, and dated by a registered Professional Engineer (P.E.) or a registered Professional Land Surveyor (RPLS) as appropriate under current Texas law.

Either an original signature or an electronic signature will be accepted as detailed in Statutes' Regulation of Engineering, Architecture, Land Surveying, and Related Practices.

All interim submittals shall include a preliminary stamp with the registered professional name and license number along with the submittal date. This stamp shall state the preliminary nature of the plans and that they shall not be used for bidding or construction.

Any changes made to the plans prior to letting will have to be coordinated between the City and Project Engineer, approved by the Project Engineer, and plans shall be signed, sealed, and dated as stated above. The Project Engineer shall be aware of any necessary changes made to the plans after letting;

however, the Project Engineer will not be liable for any changes made to the plans without his/her consultation.

8.4.3 Copyright Data

As mentioned previously, the County copyright statement shall be added to the Title Sheet:

© 20xx by City of San Marcos, Texas. All rights reserved.

On all other sheets, except for the standard plan and standard detail sheets, an abbreviated form of the copyright statement can be used:

© 20xx City of San Marcos, Texas.

8.4.4 Plan Review Checklist

A checklist is required for each PS&E submittal on all projects, which is provided by the City. A sample design review checklist is provided in **Table 8-1**. All items on the checklist shall be checked or labeled as N/A with an appropriate explanation. All unchecked items are considered missing.

8.4.5 PS&E Package

A PS&E package shall be submitted for each project at various submittal levels. The PS&E package is to be prepared by the Project Engineer and shall include the following (refer to corresponding checklists):

Plans – Refer to Transportation Criteria Manual Section 8.4.1 for more information. Plans shall be signed and sealed for the Final PS&E submittal.

Technical Specifications – The Project Engineer is responsible for the preparation of all special contract requirements, including special specifications and modifications to standard specifications relating to an individual project.

Project Manual – The Project Engineer shall obtain the current project manual and bidding documents from the City for use in the preparation of the final PS&E package. The template indicates where project information is inserted by the Project Engineer. No other revisions to standard bidding documents are to be made by the Project Engineer.

Project Engineer's Cost Estimate – The Cost Estimate shall be prepared for construction quantities covering all items of the proposed work. The Cost Estimate shall include, according to bid item order, a separate line for each item, and a total block at the end of the last page. The total block shall include a summary of each of the section subtotals and a grand total. The item line shall include the item code, item description, unit, quantity, estimated unit cost, and total item amount. Cost Estimates shall include appropriate non-bid items, including force account items. The Project Engineer is not required to estimate costs for preliminary engineering, construction engineering, utility relocation, or ROW acquisition.

Geotechnical Engineering Report – Use acceptable standard practices in performing and documenting the geotechnical engineering work for all City roadway projects. These practices include field surveys, field operations, soil and rock classifications, wall and structure design, soil stability, and undercutting recommendations (refer to the Transportation Criteria Manual Section 8 and TxDOT's Geotechnical Manual for more detailed information regarding geotechnical engineering). The geotechnical

engineering report shall also include pavement design for the project. Refer to Transportation Design Manual Section 3 for detailed information on required design effort.

Drainage Report – Use acceptable standard practices in performing and documenting the hydrology and hydraulics used to design drainage structures and systems throughout the project. These practices include data collection, field surveys, hydrologic and hydraulic analysis, and a summary of conclusions and recommendations. Refer to the TxDOT Hydraulic Design Manual for more detailed information regarding drainage reports.

8.4.6 Bid Documents

In addition to the PS&E package, the Project Engineer will provide assistance to the City's project manager in preparing the Project Manual (Bid Documents) including:

- Cover Page (signed and sealed)
- Bid Addenda (refer to Section 8.5.1.1)
- Bid Form
- Technical Specifications
- Plan Drawings
- Geotechnical Report (refer to Section 8.4.5)

A typical Project Manual's Table of Contents will include the following, at a minimum:

Bid Documents

1. Invitation for Bid
2. Instructions to Bidders
3. Prevailing Wage Rate Schedule
4. Notice to Contractor of Tax Exempt Status of Owner
5. General Conditions
6. Supplementary Conditions
7. Project Schedule

Bid Forms

8. Bid Form
9. Bid Schedule
10. Bid Bond
11. Statement of Bidder's Qualifications
12. Subcontractors List Form
13. Mailing Label

Contract Forms

14. Owner-Contractor Agreement
15. Payment Bond
16. Performance Bond
17. Insurance Instructions
18. Notice to Proceed

19. Affidavit of Payment

Project Documents

20. General Conditions
21. Supplement to General Conditions
22. Technical Specifications (refer to Section 8.4.5)
23. Plans, Details and Notes (refer to Section 8.4.1)
24. Easements and Temporary Work Space Licenses

8.5 PROJECT BIDDING PHASE

The purpose of this section is to outline the basic steps that must be taken in preparation for the advertising, bid opening, and awarding of City projects.

8.5.1 Process

After the PS&E assembly is deemed complete and the City gives approval to advertise the project, the following steps must be taken:

8.5.1.1 Advertisement

The City will notify the Project Engineer of the scheduled pre-bid meeting and bid opening date. The Project Engineer must attend the pre-bid meeting. The Project Engineer shall bring one (1) set of bid documents (plans and project manual) and be prepared to respond to Contractor questions. The Project Engineer will prepare addenda as needed.

8.5.1.2 Bidding

The Project Engineer shall attend the bid opening and receive one (1) copy of each bid submitted.

8.5.1.3 Award

The Project Engineer shall review the bids and check for errors or obvious imbalances. The Project Engineer shall also prepare and submit the bid tabulation and written recommendation regarding award of the contract to the City.

8.5.1.4 Post Award/Pre Construction

The Project Engineer will attend the pre-construction meeting with the Contractor if requested by the City and shall be prepared to answer any questions the Contractor may have regarding the bid documents.

8.5.1.5 Construction

The Project Engineer will review submittals and shop drawings on request. The Project Engineer will respond to Requests for Information (RFI) submitted by the Contractor in a timely manner and prepare requested plan revisions.

For projects requiring a WPAP, Project Engineer will be required to inspect BMPs and provide a certification letter as required by TCEQ when Construction is complete.

Table 8-1: Engineering/CIP Plan Review Checklist

Engineering/CIP Plan Review Checklist						
Project Name:						
Date Reviewed: 30% -		**60% -**		**90% -**	**99% -**	**100% -**
Instructions: X = Task Complete; ? = Need More Details; N/A = Not Applicable; F = To be Completed with Future Phase						
30%	**60%**	**90%**	**99%**	**100%**	**Descriptions**	**Comments**
30%	**60%**	**90%**	**99%**	**100%**	**Internal Coordination – To be Completed by City PM**	
					Check City's 5-Yr Transit Plan for bus stops and include improvements, if within project limits	
					Check the 5 Year Sidewalk Plan for conflict	
					Check Wastewater Master Plan for conflict	
					Check Transportation Master Plan for conflict	
					Check Water Master Plan for conflict	
					Check Drainage Master Plan for conflict	
					Check 5 Year Mill & Overlay Plan for conflict	
					Check CIP Plan for conflict	
30%	**60%**	**90%**	**99%**	**100%**	**External Coordination - To be Completed by Design Engineer**	
					Map Request Submitted to Charter	
					Map Request Submitted to Grande	
					Map Request Submitted to CenturyLink	
					Map Request Submitted to American Tower	
					Map Request Submitted to Texas State	
					Map Request Submitted to PEC	
					Map Request Submitted to Crystal Clear	
					Map Request Submitted to CenterPoint Energy	
					Map Request Submitted to other utilities in the project limits	
30%	**60%**	**90%**	**99%**	**100%**	**GIS Quality Control Check**	
					Submit Plans to COSM GIS Technician to perform QA/QC - ***See GIS Submittal Checklist***	
30%	**60%**	**90%**	**99%**	**100%**	**General Construction Plans**	
					Sheet shall be designed on 11"x 17"	
					Scale shall be 1"=40' (Horizontal) and 1"=10' (Vertical) on 11"x17"	
					North Arrow	
					Scale (graphic scale with descriptive text of scale)	
					Street names, if any part of a street is shown	
					Property Address, Owner Name & R-value shown for all parcels	
					Legend shown and includes all symbols	
					Design follows COSM design criteria	
					Engineer's opinion of probable construction cost	
					Proposed easements shown (temporary and permanent)	
					100-Year Floodplain Boundary	
					For aerial installations the plans clearly show and differentiate between existing poles and new poles	
					Location of the highway crossing clearly shown (if applicable)	

Engineering/CIP Plan Review Checklist						
Project Name:						
Date Reviewed: 30% -		**60% -**		**90% -**	**99% -**	**100% -**
Instructions: X = Task Complete; ? = Need More Details; N/A = Not Applicable; F = To be Completed with Future Phase						
30%	**60%**	**90%**	**99%**	**100%**	**Descriptions**	**Comments**
					Label all Abandoned Water, Wastewater, and Stormwater Utilities (Show Limits)	
					Match Marks - All Match Marks need to be match Roadway Match Mark location. On Utility Plans, show both Roadway Match Mark and Utility Match Mark	
					Right of Way Line	
					Limits of Construction	
					Construction specifications signed and sealed by a PE licensed in Texas	
					Construction plans signed and sealed by a PE licensed in Texas	
					Existing utilities shown:	
					Water	
					Wastewater	
					Stormwater	
					Gas	
					Electric (overhead and buried)	
					Communications (overhead and buried)	
					Location and information of all SUE work (Show marker on plans)	
					Easements - Show and label all existing, proposed, and temporary easements shown and labeled:	
					Minimum easement width is 20'. Needs to be wider for deeper mains.	
					Verify if you need any Temporary Workspace License Agreement (TWLA)	
					All construction within LOC or in the ROW or within an easement - verify easements with Acquisition Specialist	
					TCEQ (If in recharge zone)	
					Edwards Aquifer Recharge, Transition, and/or Contributing Zone Boundaries (if applicable)	
					Edwards Aquifer Recharge features (if applicable)	
					Sensitive feature Protection Zone Boundaries (if applicable)	
					Water Quality and Buffer Zones per Ch.5 (will be Ch. 6 of Codes SMTX) {if applicable}	
					TCEQ Construction Notes (if applicable)	
					WPAP Permit	
					SCS Permit	
30%	**60%**	**90%**	**99%**	**100%**	**Cover Page**	
					City of San Marcos Logo	
					Project Name, limits, length and description	
					Location map with the limits of the project clearly defined with major street or highway names/designations	
					Signature blocks for all relevant personnel	

Engineering/CIP Plan Review Checklist						
Project Name:						
Date Reviewed: 30% -		**60% -**		**90% -**	**99% -**	**100% -**
Instructions: X = Task Complete; ? = Need More Details; N/A = Not Applicable; F = To be Completed with Future Phase						
30%	**60%**	**90%**	**99%**	**100%**	**Descriptions**	**Comments**
					Names/Logos of each design firm responsible for plans	
					Design Engineers Seal	
					TDLR number (if required)	
					Index of all sheets ***(or separate index sheet)***	
30%	**60%**	**90%**	**99%**	**100%**	**General Notes**	
					CIP general Construction Notes dated 1-17-2012	
					Provide a sequence of Construction List (if there is no separate Phase Plan)	
30%	**60%**	**90%**	**99%**	**100%**	**Quantity Table**	
					Overall quantity sheet with breakdown by sheet (or bid quantities shown on each sheet)	
					Spec reference shown?	
30%	**60%**	**90%**	**99%**	**100%**	**Project Layout & Survey**	
					Survey control points shown in plan view?	
					COSM monuments shown?	
					Geotechnical Bores shown, if any where obtained?	
					Table of Northing, Easting and Elevation listed for each control point	
30%	**60%**	**90%**	**99%**	**100%**	**Typical Section**	
					Dimensions shown from lip of gutter to lip of gutter?	
					Existing and Proposed ROW/Easements shown?	
					Paving base shown extending 3' from back of curb?	
					Paving thickness in front of curb add up to an even 6"?	
30%	**60%**	**90%**	**99%**	**100%**	**Tree Mitigation (If Required or Show on E&S Plans)**	
					Existing Tree List. Indicate if saved or removed list. Show size and species.	
					Tree Mitigation List (trees proposed in landscape plans or E&S plans)	
30%	**60%**	**90%**	**99%**	**100%**	**Erosion & Sedimentation Controls**	
					Show tree protection/removal with details	
					Tree Removal List. Show size and species. ***(if no tree mitigation section)***	
					Temporary fencing necessary to turn cattle if applicable called out along entire LOC	
					Temporary Sedimentation Ponds (per TCEQ permit) for disturbed drainage areas greater than 5 acres. See permit for exceptions.	
					Show existing and proposed storm structures	
					Existing contours and proposed flow arrows	
					TPDES Stormwater Pollution Prevention & EPIC Sheet - Use TXDOT template	
					Seeding with soil retention blankets or sod. Match existing where required (verify seeding with any easement agreement)	
					Irrigation requirements specified for establishing grass	

Engineering/CIP Plan Review Checklist						
Project Name:						
Date Reviewed: 30% -		**60% -**		**90% -**	**99% -**	**100% -**
Instructions: X = Task Complete; ? = Need More Details; N/A = Not Applicable; F = To be Completed with Future Phase						
30%	**60%**	**90%**	**99%**	**100%**	**Descriptions**	**Comments**
30%	**60%**	**90%**	**99%**	**100%**	**Construction Phasing (Traffic Control Narrative)**	
					Simple Plan - no section needed; shown with General Notes	
					Detailed Phasing needed - must coordinate with TCP	
30%	**60%**	**90%**	**99%**	**100%**	**Traffic Control Plan – Detailed Version**	
					Show typical section for each phase	
					Verify 10.5' minimum (11' preferred) width for all lanes	
					4' Pedestrian route accounted for?	
					If low profile concrete barriers (LPC) are used, need to include 1' contingency from LPC to edge of travel lane	
					Did you drive all detours to confirm they are acceptable? No one ways or road too narrow?	
					Overall key map required for each phase?	
					Detailed layout required for each phase?	
					Include COA or TxDOT details; as referred to in the TCP.	
30%	**60%**	**90%**	**99%**	**100%**	**Removal**	
					Call out non-standard curb limits on plans (Catch is standard)	
					If Mill and Overlay, must construct ADA compliant ramps	
					Location and Identification number clearly identified for all TxDOT highways	
					Horizontal layout points, bearings and distances, curve data	
					Roadway base shall be 3' behind back of curb. Verify quantities are correct.	
					Sidewalk and/or hike and bike trail locations and dimensions for proposed and existing curb, etc.	
					Verify intersections sight distance (horizontal and vertical) are compliant	
					Cross-slope shown as minimum of 1.5%; not 2%.	
					PROFILE:	
					Existing & proposed centerline elevations	
					Existing right-of-way elevations and 10' - 30' past right-of-way, as required	
					All crosswalks cross slopes at 1.5%	
					Check placement of crown in road also catch or spill curbs and drainage area	
					Vertical curve data with appropriate K value per speed limit	
30%	**60%**	**90%**	**99%**	**100%**	**Grading Plans for Intersections**	
					Intermediate top of curb elevations along street	
					Directional flow arrows - interior of lots	
					Corner of lot elevations	
30%	**60%**	**90%**	**99%**	**100%**	**Driveways**	
					Driveway table or P&P for all driveways on reconstruction projects	

Engineering/CIP Plan Review Checklist						
Project Name:						
Date Reviewed: 30% -		**60% -**		**90% -**	**99% -**	**100% -**
Instructions: X = Task Complete; ? = Need More Details; N/A = Not Applicable; F = To be Completed with Future Phase						
30%	**60%**	**90%**	**99%**	**100%**	**Descriptions**	**Comments**
					Verify slope in profile meets requirements shown in standard details (433S-A-SM)	
					A copy of a TxDOT permit is provided for each proposed driveway on TxDOT roadway(s)	
30%	**60%**	**90%**	**99%**	**100%**	**Drainage**	
					Hydraulic calculations for 25 yr storm event (detailed calcs such as routing program computations not included on construction plan sheet)	
					Drainage way calculations for areas immediately upstream or downstream of project limits (Offsite Drainage Area Map)	
					Headwall and energy dissipaters showing outflow velocity	
					Existing topography with minimum 2' contour intervals including total watershed	
					Proposed topography with 1' contour intervals on plan sheets	
					Area, runoff coefficient, time of concentration, rainfall intensity, and peak runoff for each subarea (rational method, or SCS as appropriate Ref. COA DCM)	
					Curb/Grate Inlet sizing calculations per Austin drainage manual section 4.4.3	
					Area inlet - do not use grate; need to specify raised 4 sided inlet. PS approval required for using grate inlet	
					Pipe sizing calculations, pipe specifications, and hydraulic grade line calculations for 25 storm event (ref COA DCM)	
					Open channel sizing calculations for 100 year event	
					Culvert calculations for culverts immediately upstream or downstream of project limits	
					Stage-storage-discharge relationships for detention facilities	
					Drainage flow arrows including breakpoints for streets	
					All structures and pipes labeled	
					CN values TR - 55/20 (SCS method) Drainage Report	
					Show FEMA Floodway and Floodplain Boundaries (ref. FIRM panel No. and date and any CLOMR or LOMR file numbers)	
					Show Water Quality and Buffer Zones	
					Show Ordinary High Water Mark	
					Max. 500' between Junction boxes	
					Detention Basin Inlet Structure (headwall/energy dissipaters)	
					Detention Basin Outlet Structure showing stage outflow elevations for 2, 25, and 100 year storm events. Required internal rock baffle per section 5.1.1.2(a)(9) of Code	
					Drainage areas delineated (including sub drainage areas for inlets)	
					Study discharge points shown	
					Profile shown for all lines:	

Engineering/CIP Plan Review Checklist						
Project Name:						
Date Reviewed: 30% -		**60% -**		**90% -**	**99% -**	**100% -**
Instructions: X = Task Complete; ? = Need More Details; N/A = Not Applicable; F = To be Completed with Future Phase						
30%	**60%**	**90%**	**99%**	**100%**	**Descriptions**	**Comments**
					Show 25 and 100 year HGL in storm sewer profile and tail water if applicable.	
					Show Pipe size, material, Length and slope	
					Manhole stations & top of rim elevation called out	
					Invert elevation called out; include Direction and In/Out at each callout.	
					Top of existing and proposed ground shown	
					Elevations shown on all grade breaks	
30%	**60%**	**90%**	**99%**	**100%**	**Structural**	
					Structural Plans Required?	
30%	**60%**	**90%**	**99%**	**100%**	**Retaining Walls**	
					Retaining walls with top of wall and bottom of wall elevations	
					Verify footing does on conflict with utility crossing	
					Any special finishes on the wall; if so, special provision included?	
					Details for each retaining wall design included?	
					Control point for off-set indicated on the detail?	
					Pay limits indicated on detail?	
					If footing is used as sidewalk; did you clarify how payment will measured?	
30%	**60%**	**90%**	**99%**	**100%**	**Water Main**	
					Existing utilities, all connections to, and crossings of existing utilities shown	
					Meter size, type, and location listed on the plans	
					Verify no existing meters are installed in the sidewalk; if so, add note requiring meter to relocated outside sidewalk.	
					Existing meter sizes labeled with irrigation or residential use (Irrigation meters require Backflow Preventer)	
					Lines shall be looped or an Automatic Flush Valve will be installed	
					Stations called out for Hydrants, Tee's, Valves, Crosses, Bends, etc. (angle of bends included)	
					Bold and label all proposed lines	
					Label all that are to be abandoned	
					Station equation given from street centerline with offset at Match Marks	
					If bores included, show stationing at each end and size of encasement	
					Air Release Valve on 12" or larger lines at all high points	
					Are drain valves needed on 12" or larger lines at all low points?	
					Field verify service size and type.	
					Water department to verify all valves are working. City PM to coordinate	

Engineering/CIP Plan Review Checklist						
Project Name:						
Date Reviewed: 30% -		**60% -**		**90% -**	**99% -**	**100% -**
Instructions: X = Task Complete; ? = Need More Details; N/A = Not Applicable; F = To be Completed with Future Phase						
30%	**60%**	**90%**	**99%**	**100%**	**Descriptions**	**Comments**
					Restrained Lengths - Call out all pipe mechanical restraints and provide calculations - required on water lines at all bends and intersections points in accordance with manufacturer recommendation (Ford Uniflange and EBBA Iron Megalugs). May show in profile or plan view.	
					Valves located in an open field need Valve Location Markers (detail included?)	
					All legs of the main at a tee or cross shall have a valve (excludes FH)	
					MUST use cut-in tee if connecting to line of equal size	
					Transmission lines needs a temporary sample port at least every 1000 ft.	
					Fire hydrants located on property line (between properties)	
					Fire Hydrant Spacing Verified: See 4.4.8 of Water Design Manual	
					300 feet for commercial	
					500 feet for residential	
					Every portion of every building (in city limits) within 500 feet of fire hydrant	
					Profile shown for all lines 12" and larger:	
					Top of existing and proposed ground shown	
					Crossing shown of existing and proposed utilities	
					Size, slope, and class of pipe labeled and shown on profile	
					Elevations shown on all grade breaks	
30%	**60%**	**90%**	**99%**	**100%**	**Wastewater Main**	
					Wastewater Main to be SDR 26, minimum 8" diameter, 150 PSI Pressure Rating **(Do Not Specify ASTM 3034; only ASTM 2241)**	
					Wastewater Lateral (Service) to be SDR 26, minimum 6" diameter, 150 PSI Pressure Rating **(Do Not Specify ASTM 3034; only ASTM 2241).**	
					Wastewater Lateral (Service) to be replaced to property line with new cleanout per detail	
					Check location of cleanout boxes (Not in sidewalk or driveway)	
					Service laterals are not permitted on lines 15" or larger	
					Show existing utilities, all connections, and crossings	
					Station equation given from street centerline with offset at Match Marks	
					Manhole Ring and Cover; do you need to specify bolt down if needed - Detail included	
					Any existing wastewater sample ports within project limits? Check with PM if needed.	
					Stub-out past paving from last manhole if future project planned	
					If tying into existing manhole, include pay item	
					Flow arrows in plan view	

Engineering/CIP Plan Review Checklist						
Project Name:						
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Instructions: X = Task Complete; ? = Need More Details; N/A = Not Applicable; F = To be Completed with Future Phase						
30%	**60%**	**90%**	**99%**	**100%**	**Descriptions**	**Comments**
					Bold and label all proposed lines	
					Label all lines that are to be abandoned	
					Manholes located in an open field need location markers (detail included?)	
					Maximum Manhole spacing of 500'	
					Manhole Vent Detail - only for manholes outside of pavement and when several watertight MH are installed; if vent needed for manhole in pavement, need to revise detail with bollards, possible easement area for vent, etc. Max unvented length of main is 1500 feet.	
					By-pass pumping required? If yes, show locations of route of by-pass pumping and include pay item.	
					Profile shown for all lines:	
					Profile - Show Pipe size, material, Length and slope	
					Manhole stations & top of rim elevation called out	
					Invert elevation called out; include Direction and In/Out at each callout.	
					Top of existing and proposed ground shown	
					Elevations shown on all grade breaks	
					If bores, show stationing and size of encasement at each end	
					Capacity and velocity shown for peak wet weather flow shown in profile per section ***1.5 Determination of Pipe Size and Slope*** of the wastewater design manual.	
					Flow rate and velocity for peak dry weather flow in pipes less than 18" shown in profile	
					Line sizing calculations submitted and approved	
					Drop manhole required where incoming pipe invert is more than 18" higher than outgoing pipe invert (Verify large diameter drops will fit) Max. 8 feet. External drop manhole is standard	
					If requesting internal drop MH; have you received COSM approval?	
30%	**60%**	**90%**	**99%**	**100%**	**Force Main**	
					Existing utilities, all connections to, and crossings of existing utilities shown	
					Bold and label all proposed lines	
					Label all that are to be abandoned	
					Station equation given from street centerline with offset	
					If bores included, show stationing at each end and size of encasement	
					Air Release/Vacuum Valve required?	
					Restrained Lengths - Call out all pipe mechanical restraints and provide calculations - required on water lines at all bends and intersections points in accordance with manufacturer	

Engineering/CIP Plan Review Checklist						
Project Name:						
Date Reviewed: 30% -		**60% -**		**90% -**	**99% -**	**100% -**
Instructions: X = Task Complete; ? = Need More Details; N/A = Not Applicable; F = To be Completed with Future Phase						
30%	**60%**	**90%**	**99%**	**100%**	**Descriptions**	**Comments**
					recommendation (Ford Uniflange and EBBA Iron Megalugs). May show in profile or plan view.	
					Valves located in an open field need Valve Location Markers (detail included?)	
					Force Main Valve required by TCEQ?	
					Profile shown for all lines:	
					Top of existing and proposed ground shown	
					Crossing shown of existing and proposed utilities	
					Size, slope, and class of pipe labeled and shown on profile	
					Elevations shown on all grade breaks	
30%	**60%**	**90%**	**99%**	**100%**	**Reclaimed Water**	
					Existing utilities, all connections to, and crossings of existing utilities shown	
					Bold and label all proposed lines	
					Label all that are to be abandoned	
					Station equation given from street centerline with offset	
					If bores included, show stationing at each end and size of encasement	
					Air Release/Vacuum Valve required?	
					Restrained Lengths - Call out all pipe mechanical restraints and provide calculations - required on water lines at all bends and intersections points in accordance with manufacturer recommendation (Ford Uniflange and EBBA Iron Megalugs). May show in profile or plan view.	
					Valves located in an open field need Valve Location Markers (detail included?)	
					Force Main Valve required by TCEQ?	
					Profile shown for all lines 12" and larger:	
					Top of existing and proposed ground shown	
					Crossing shown of existing and proposed utilities	
					Size, slope, and class of pipe labeled and shown on profile	
					Elevations shown on all grade breaks	
30%	**60%**	**90%**	**99%**	**100%**	**Lift Stations**	
					Follows COSM Design Criteria Manual on COSM website	
					Pump specification	
					Pump & Guiderail Installation Details	
					Site Plan	
					Erosion Control Plan account for work in Lift Station?	
					Odor Control Analysis	
					Power Supply Analysis	
					Wet & Dry Flow Analysis	

Engineering/CIP Plan Review Checklist						
Project Name:						
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Instructions: X = Task Complete; ? = Need More Details; N/A = Not Applicable; F = To be Completed with Future Phase						
30%	**60%**	**90%**	**99%**	**100%**	**Descriptions**	**Comments**
					Bid item for SCADA equipment from COSM supplier (coordinate with Bruce Noel)	
					Comments received from PS Lift Station Maintenance Team (coordinate with Bruce Noel)	
					Electrical line drawings	
					Instrumentation & Control drawings	
30%	**60%**	**90%**	**99%**	**100%**	**Electric Underground**	
					Show existing and proposed pole placement	
					Show primary and secondary pull boxes, transformers	
					Plan and profile of duct bank	
					Duct Bank Detail with backfill shown	
30%	**60%**	**90%**	**99%**	**100%**	**Electric - Mechanical**	
					Mechanical Plan required?	
30%	**60%**	**90%**	**99%**	**100%**	**Electric - Lighting**	
					Photometric Plan	
					Show existing and proposed pole placement	
					Show pull boxes - no more than 360 degree for bends allowed between pull boxes	
					Typical section showing trench	
					Light fixture approved by SMEU	
30%	**60%**	**90%**	**99%**	**100%**	**Traffic Signals**	
					Ped crossing? If yes, APS required	
					Opticom required	
					Contractor must program signal	
					Provided timing and phasing plan	
					Need temporary signals?	
					If yes, provided timing and phasing plan	
					Use TXDOT Specs; not COSM. See Modifications TXDOT 680.	
30%	**60%**	**90%**	**99%**	**100%**	**Signage and Pavement Markings**	
					Make sure you include both Type 1 & Type 2 Striping; see the Modifications (871S)	
					Crosswalk striping matches detail?	
					Sign standard and signs per MUTCD	
					Do we need a detailed striping plan?	
30%	**60%**	**90%**	**99%**	**100%**	**Utility Layout**	
					Utility layout required?	
					Color coded?	
					Label all utilities; proposed and existing.	
30%	**60%**	**90%**	**99%**	**100%**	**Landscaping**	
					Irrigation system approved by Parks?	
					Tree/Plans approved by Parks?	

Engineering/CIP Plan Review Checklist						
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Instructions: X = Task Complete; ? = Need More Details; N/A = Not Applicable; F = To be Completed with Future Phase						
30%	**60%**	**90%**	**99%**	**100%**	**Descriptions**	**Comments**
					Do you a have a service drop or will SMEU need to install one?	
					Plans clear on how power and water will be connected?	
					Are you including a 2 year maintenance requirement and pay items?	
30%	**60%**	**90%**	**99%**	**100%**	**Cross Sections**	
					Every 50'?	
					At driveways? Unless you have details profiles	
					Utilities shown in cross-section	
					ROW/Easement Shown	
30%	**60%**	**90%**	**99%**	**100%**	**Details**	
					All details included in plans; ***fill out checklist on COSM website under "Standard Details"***	
30%	**60%**	**90%**	**99%**	**100%**	**Bid Items**	
					Curb & gutter vs. driveways - don't include C&G area in driveway; curb & gutter paid thru the dwy by LF as laydown. Review Detail 433S-A-SM	
					Wet Connection pay item for all water tie ins? (510S)	
					Service paid by LF and connection by EA OR by Relay Long & Short? Check the Modifications (510S)	
					Which FH pay item was used? Check the Modifications (511S)	
					Asphalt/Concrete/Base quantities follow dimensions of appropriate trench repair detail	
					Bid items list proper thickness corresponding to trench repair detail.	
					If different thickness used; need to modify trench repair detail.	
30%	**60%**	**90%**	**99%**	**100%**	**Miscellaneous**	
					Mail Boxes - addressed in plans	

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Notes:

All references to published documents, reference manuals, and software programs shall refer to the latest edition or version.