

**PUBLIC INFRASTRUCTURE
DESIGN STANDARDS**



TABLE OF CONTENTS

	PAGE
DIVISION 1 – GENERAL AND PROCEDURE REQUIREMENTS.....	1-1
1.1 General.....	1-1
1.2 Preliminary Research.....	1-1
1.3 Capacity Allocations.....	1-2
1.4 Design Review Requirements for Public Works Projects.....	1-2
1.5 Construction Procedure Requirements for Public Works Projects	1-3
1.6 Approval and Acceptance of Public Works Projects.....	1-3
1.7 Right-Of-Way Use Permits.....	1-5
1.8 Approvals and Variances.....	1-5
1.9 Variances.....	1-6
DIVISION 2 - CONSTRUCTION PLAN AND MISCELLANEOUS REQUIREMENTS	2-1
2.1 Required Plan Sheets.....	2-1
2.2 Drawing Requirements.....	2-1
2.3 Graphic Standards.....	2-3
2.4 Easements.....	2-3
2.5 Utility Locations.....	2-6
2.6 Private Facility Locations (Not Including Landscaping).....	2-7
2.7 Crossings.....	2-7
2.8 Trench Safety.....	2-9
2.9 Street Lighting.....	2-9
2.10 Bench Marks.....	2-10
2.11 Residential Lots and Improvements.....	2-10
2.12 Flood Plain Management.....	2-10
DIVISION 3 - WATER SYSTEM DESIGN REQUIREMENTS.....	3-1
3.1 General.....	3-1
3.2 Overall System Layout	3-1
3.3 Water Main Sizing and Materials	3-2
3.4 Location of Water Mains	3-3
3.5 Clearance of Water Lines from Other Utilities	3-4
3.6 Depth of Cover.....	3-6
3.7 Valves.....	3-6
3.8 Fire Hydrants	3-7
3.9 Fittings and Appurtenances.....	3-9
3.10 Steel Water Pipe.....	3-9
3.11 Water Services.....	3-10
3.12 Additional Standards.....	3-11

DIVISION 4 - SANITARY SEWER DESIGN REQUIREMENTS.....	4-1
4.1 General.....	4-1
4.2 Sewer Design and Materials.....	4-1
4.3 Location of Sanitary Sewers.....	4-2
4.4 Design Requirements.....	4-3
4.5 Appurtenances.....	4-4
4.6 Service Connections.....	4-6
4.7 Non-sewered Building Site.....	4-7
DIVISION 5 - DRAINAGE DESIGN REQUIREMENTS.....	5-1
5.1 General.....	5-1
5.2 Storm Sewer Materials.....	5-1
5.3 Location of Storm Sewer.....	5-2
5.4 Construction Plan Requirements.....	5-3
5.5 Design Requirements.....	5-3
5.6 Appurtenances.....	5-6
DIVISION 6 - PAVING DESIGN REQUIREMENTS.....	6-1
6.1 General.....	6-1
6.2 Roadway Types.....	6-1
6.3 Geometric Street Design Standards.....	6-2
6.4 Pavement Structure Requirements.....	6-6
6.5 Grading and Layout Requirements.....	6-7
6.6 Traffic Control Devices.....	6-8
6.7 Sidewalks.....	6-10
6.8 Driveways.....	6-11
APPENDICIES	
Appendix C Sanitary Sewer – Peak Design Factor.....	C-1
Appendix D Mandrel Requirements.....	D-1
Appendix E Street Lighting Requirements.....	E-1
Appendix F Public Works Department.....	F-1
Typical Length of Median and Median Opening.....	F-2
Median Nose and Left Turn Bay Design.....	F-3
Roadway Tapers for Subdivision Streets.....	F-4
Geometric Street Design Standards.....	F-5
Right Turn Lane Right-Of-Way Requirements.....	F-6
Alley Paving Curb And Gutter Street.....	F-7
Standard Driveway Details.....	F-8

DIVISION 1 – GENERAL AND PROCEDURE REQUIREMENTS

- 1.1 General**
- 1.2 Preliminary Research**
- 1.3 Capacity Allocations**
- 1.4 Design Review Requirements for Public Works Projects**
- 1.5 Construction Procedure Requirements for Public Works Projects**
- 1.6 Approval and Acceptance of Public Works Projects**
- 1.7 Right-of-Way Use Permits**
- 1.8 Approvals and Variances**
- 1.9 Variances**

1.1 General

- 1.1.1 These Standards describe the general requirements for the preparation of construction plans and the supporting documents required for approval by the City of Webster. Specific design requirements, in addition to these Standards, may be required by the City of Webster.
- 1.1.2 Construction plans for public improvements within the City of Webster jurisdictional limits shall be approved by the Public Works and Engineering Department.
- 1.1.3 Construction plans for private improvements that connect to or affect the public infrastructure shall be approved by the City of Webster.
- 1.1.4 All projects that are required to conform to these Standards shall also be in compliance with all applicable ordinances in the City. The following list of ordinances is for information purposes. This list may be expanded at any time.
 - A. Subdivision
 - B. Zoning
 - C. Flood Plain Management
- 1.1.5 All construction plans and supporting documentation shall conform to the requirements of these Standards and regulations of all Federal, State, County, and Local entities having jurisdiction.

1.2 Preliminary Research

- 1.2.1 Public Works and Engineering Department personnel will be available for preliminary meetings to discuss any proposed project with the project engineer. This preliminary meeting between the City and the engineer should be scheduled with the Public Works and Engineering Department staff prior to submittal of any documents for review. The purpose of this meeting is to discuss the project concepts and to establish the status of requirements and issues that may be pertinent to the project.

1.2.2 Research all existing utility and right-of-way information with City, County, State, and other public and private utility agencies listed below:

- A. Public Works and Engineering Department
- B. Harris County Engineer
- C. Harris County Drainage District
- D. Texas State Department of Highways and Public Transportation
- E. Verizon Land Telephone Company
- F. CenterPoint Lighting and Power Company
- G. CenterPoint Gas
- H. Municipal Utility Districts
- I. Cable Television Companies
- J. Railroad Companies
- K. Pipeline Companies
- L. Others

1.3 Capacity Allocations

1.3.1 The developer will notify the City of the development's water and wastewater capacity requirements, expressed in equivalent single-family connections (ESFC). If the City determines that the development's capacity requirements will have a significant impact on the City's water or wastewater system, the City may require the developer to do additional analysis of those impacts to determine if mitigation measures are necessary by the developer in order for the City to maintain adequate levels of water or wastewater service, including flow rates, pressure, and other service characteristics, or to comply with the City's regulations, City master plans, or other governmental laws and regulations. The required additional analysis may include running hydraulic models or determining the impact to the downstream sanitary system from increased flows, as required by the City.

1.3.2 Prior to beginning construction on a project, a current commitment of drainage capacity for the proposed development, including the status of any drainage fees that may be due or have been paid, will be required.

1.4 Design Review Requirements for Public Works Projects

1.4.1 The City may require trip estimates for proposed development. The trip estimates shall be based on the latest version of the Institute of Transportation Engineers' TRIP GENERATION MANUAL. If the trip estimates are significant, the City may require a traffic impact analysis to determine necessary traffic mitigation measures to maintain the required street level of service as dictated by City regulations, the Development Code or other City requirements.

1.4.2 Submit approval letters based on the preliminary project plat from all public and private utilities and other entities affected by the project. Approval letter shall state that service will be available to the project, where appropriate, and that there is no objection to the project.

1.4.3 Confirmation in writing of preliminary approval by other governmental agencies, such as the Harris County Engineer and the Harris County Flood Control District Engineer shall be provided to the City if required.

1.5 Construction Procedure Requirements for Public Works Projects

- 1.5.1 Construction shall not begin until construction plans are signed by the City of Webster. Construction shall not begin within an existing easement or right-of-way until all permits and/or any right-of-way use agreements are negotiated between the affected parties.
- 1.5.2 Notify the Public Works and Engineering Department at least forty-eight (48) hours prior to beginning construction. The Public Works and Engineering Department staff will make periodic inspections. The Public Works and Engineering Department shall be notified at least twenty-four (24) hours prior to each time concrete is placed on the project. The Public Works and Engineering Department shall be notified at least twenty-four (24) hours prior to all pipe inspection tests and other tests that may be required by the Public Works and Engineering Department.
- 1.5.3 Notify the Public Works and Engineering Department at least forty-eight (48) hours prior to a final inspection. The Public Works and Engineering Department staff will be present during all final inspections.
- 1.5.4 After completion of the project and prior to the final inspection, the engineer shall provide the Public Works and Engineering Department one set of reproducible record drawings and one copy of the record drawings. Record drawings shall reflect the facilities constructed and all significant horizontal and vertical changes made from the approved plans during construction.
- 1.5.5 For all projects, all delivery tickets for all materials (e.g., concrete, cement stabilized sand) shall be maintained by the contractor and upon request, be made available for the review of the Public Works and Engineering Department.
- 1.5.6 Changes from approved construction plans shall be approved by Public Works and Engineering Department. The Project Engineer will submit change order requests in writing to the Public Works and Engineering Department.
- 1.5.7 Full time resident inspection by the Project Engineer may be required.

1.6 Approval and Acceptance of Public Works Projects

- 1.6.1 Public Works projects shall have final approval of the City Engineer prior to placing the facilities in service.
- 1.6.2 Final approval by the City Engineer shall be granted when the following items are complete:

- A. Construction is completed in accordance with the approved construction plans and final inspection items have been completed.
- B. All required information including record drawings are submitted to the Public Works and Engineering Department. The City Engineer shall certify the correctness of the record drawing and compliance of construction in accordance with these Standards.
- C. Street lighting plans have been approved.
- D. Appropriate improvement bonds will be in place and copies provided to the City for the specified period. Bonds shall be provided from bonding companies holding a certificate of authority as an acceptable surety on Federal Bonds (as published annually in the Federal Register). The requirements of each specific bond are defined for the City Webster in the following tables.

IMPROVEMENTS COVERED BY BOND	BOND AMOUNT	BOND TYPE	BOND RELEASE	ACCEPTANCE
Water, sanitary sewer and drainage improvements	10% of total construction cost.	Maintenance bond in the name of the City.	At acceptance by the City.	One year after construction completion
Section 1.01 Paving				
Residential Development	10% of total construction cost.	Maintenance bond in the name of the City	At acceptance by the City.	One year after construction completion
Commercial Development	10% of total construction cost.	Maintenance bond in the name of the City	At acceptance by the City.	One year after construction completion
Arterials	10% of total construction cost.	Maintenance bond in the name of the City	At acceptance by the City.	One year after construction completion

- E. All other public entities having jurisdiction have given their approval on the project.
- F. The City shall require a sealed certification from the Engineer that all materials installed in the Project are completely in place in accordance with approved plans and specifications.

- 1.6.3 Final approval by the City Engineer will be documented in writing.
- 1.6.4 Public Works projects within the jurisdiction limits of City of Webster will be subject to a minimum one (1) year maintenance period. An inspection prior to the end of the maintenance period of a Public Works project shall be conducted by the Public Works and Engineering Department and all other entities having jurisdiction. All facilities shall be operational and in good condition prior to final acceptance of a project.

1.7 Right-of-Way Use Permits

- 1.7.1 Prior to construction of any facilities, including utility crossings within a street right-of-way, easement, and/or building line, a permit must be obtained from City's Building Department and any other governmental entity having jurisdiction.
- 1.7.2 The Owner or authorized agent shall submit plans and supporting documents. The Owner or authorized agent shall be responsible for location of all facilities in the area of construction.
- 1.7.3 Private facilities permitted within a public right-of-way shall be the maintenance responsibility of the private entity. If private facilities are not maintained in good order, the permit shall be void and the facilities shall be removed at the expense of the private entity. Upon request of the City of Webster, or entity having jurisdiction, facilities shall be removed, relocated or replaced at no cost to the City of Webster.

1.8 Approvals and Variances

- 1.8.1 Approvals required in these Standards are the responsibility of the Owner. Failure to obtain appropriate approvals may be grounds for suspension of construction until appropriate approvals are granted. Specific approval is required for items that are described in these Standards. Items that do not conform to these Standards and are not allowed by specific approval shall be submitted for a variance request.
- 1.8.2 Specific approval, as required by these Standards, shall be specifically requested by the Owner prior to or at the time of submittal of review plans for the project. All specific approval items shall be granted by the Public Works and Engineering Department in writing.
- 1.8.3 Construction work related to any specific approval item that has not been approved in writing shall not begin until the Public Works and Engineering Department has granted approval in writing. Any work that proceeds without specific approval will be subject to removal and replacement in accordance with these Standards.

- 1.8.4 Materials and manufactured items used in construction of a Public Works project shall be approved by the City Engineer prior to installation. Water and sanitary sewer system appurtenances shall be subject to the approval of Public Works and Engineering Department.

Products proposed for approval by the City Engineer shall be locally available from a reputable supplier. A complete submittal of information regarding the proposed approved product and samples of the product shall be submitted to the Public Works and Engineering Department for review. The Public Works and Engineering Department shall review the product information. Final approval of the product for use in construction of public works facilities shall be provided in writing by the Public Works and Engineering Department.

1.9 Variances

Construction plans that do not conform to these Standards, not including items that allow for specific approval by staff, shall be submitted for approval of the variance. Variance requests to these Standards shall be submitted to the City Engineer. Variance requests should be submitted with pertinent construction plans, right-of-way use permit or other pertinent information. Incomplete variance requests will be rejected until all items are adequately addressed by Project Engineer and the Developer. Construction work related to the variance should not begin prior to approval of a variance. Any work related to the variance that proceeds without approval by the City Engineer of a variance shall be subject to removal and replacement in accordance with these Standards.

DIVISION 2 - CONSTRUCTION PLAN AND MISCELLANEOUS REQUIREMENTS

- 2.1 Required Plan Sheets**
- 2.2 Drawing Requirements**
- 2.3 Graphic Standards**
- 2.4 Easements**
- 2.5 Utility Locations**
- 2.6 Private Facility Locations (Not Including Landscaping)**
- 2.7 Crossings**
- 2.8 Trench Safety**
- 2.9 Street Lighting**
- 2.10 Bench Marks**
- 2.11 Residential Lots and Improvements**
- 2.12 Flood Plain Management**

2.1 Required Plan Sheets

- 2.1.1 Cover sheet.
- 2.1.2 Preliminary plat. (Recorded plat shall be included in the record drawings.)
- 2.1.3 Construction notes and legend.
- 2.1.4 Overall plans for proposed improvements.
- 2.1.5 Drainage area map.
- 2.1.6 Site grading plan.
- 2.1.7 Plan and profiles.
- 2.1.8 Specific construction details
- 2.1.9 Standard Public Works construction details.
- 2.1.10 Street Light Layout from CenterPoint Energy (shall be included in the record drawings).

2.2 Drawing Requirements

- 2.2.2 A bench mark elevation and description is required on each sheet.
- 2.2.3 Label each plan sheet as to street right-of-way widths, pavement widths and thickness, type of roadway materials, curbs, intersection radii, curve data, stationing, existing utilities type and location, etc.
- 2.2.4 Stationing must run from left to right except for short streets or lines originating from a major intersection where the full length can be shown on one sheet.
- 2.2.5 A north arrow is required on all sheets and should be oriented either upward or to the right.
- 2.2.6 Show all lot lines, property lines, rights-of-way lines, and easement lines.
- 2.2.7 A cover sheet shall be required for all projects involving three (3) or more plan and profile sheets. All plan sheet numbers should be included on the cover sheet. A vicinity map should always be included to show the project location.

- 2.2.8 If a roadway exists where plans are being prepared to improve or construct new pavement or to construct a utility, this roadway should be labeled as to its existing width, type of surfacing, and base thickness, if available.
- 2.2.9 Plans prepared for the City of Webster shall be prepared using permanent ink, photographic or other approved process on Mylar.
- 2.2.10 Do not place match lines in intersections.
- 2.2.11 Service areas shall be delineated on the cover sheet or area map.
- 2.2.12 All utility lines within the right-of-way or construction easement should be shown in the plan and profile view.
- 2.2.13 Show flow line elevations and direction of flow of all existing ditches.
- 2.2.14 Show natural ground profiles along the centerline of each right-of-way or an easement line except as required below. When there is a difference of 0.50 feet or more from one right-of-way or easement line to the other, show dual right-of-way profiles.
- 2.2.15 Resolve all known conflicts of proposed utilities with existing utilities.
- 2.2.16 Plans shall be standard twenty-four inch by thirty-six inch (24" x 36") or (22" x 34") overall dimensions.
- 2.2.17 Details of special structures not covered by approved standard drawings, such as stream and gully crossing, special manholes, etc., should be drawn with the horizontal and vertical scales equal to each other.
- 2.2.18 Plans shall be drawn to accurate scale, showing proposed pavement typical cross-sections and details, lines and grades, and all existing topography within the street rights-of-way; and at intersections, the cross street shall be shown at sufficient distance in each direction along the cross street for designing adequate street crossings.
- 2.2.19 Grades should be labeled for the top of curb except at railroad crossings. Centerline grades are acceptable only for paving without curbs and gutters.
- 2.2.20 Curb return elevations and grades for turnouts shall show in the profile.
- 2.2.21 Gutter elevations are required for vertical curves where a railroad track is being crossed.
- 2.2.22 The surface elevation at the property line of all existing driveways should be shown in the profile.
- 2.2.23 Station all esplanade noses affected by proposed construction, both existing and proposed.
- 2.2.24 Station all points of curvature, points of tangency, radius returns and grade change, points of intersection in the plan view. Station all radius returns and grade change points of intersection in the profile with their respective elevations.

- 2.2.25 The standard scales permitted for plans and profiles of paving and utility plans are as follows:
- A. Major thoroughfares or special intersections/ situations:
1" = 2' Vertical; 1" = 20' Horizontal
 - B. Minor streets:
1" = 5' Vertical; 1" = 50' Horizontal
or
1" = 4' Vertical; 1" = 40' Horizontal
(for reconstruction on minor streets, a larger scale may be required to show detail.)
 - C. The scales described above are the minimum allowable. Larger scales may be required to show details of construction.
 - D. Deviations to these scales can only be allowed with the specific approval of the City Engineer.
- 2.2.26 In addition to the plan and profile sheets described above, each set of construction drawings shall contain paving and utility key drawings indexing specific plan and profile sheets. Key overall layouts may be drawn at a scale of one inch equals one hundred feet (1" = 100') or one inch equals two hundred feet (1" = 200').
- 2.2.27 Standard City details, where applicable, shall be included.
- 2.2.28 Construction plans shall include a legend describing standard symbols that may not be described in the plans.
- 2.2.29 All property ownership and easement information will be shown in the construction plans. Harris County recording information shall be shown in the construction plans. When ownership, easement, and right-of-way recording information is not shown on the plat included in the plans, this information will be shown on the construction plan sheets.

2.3 Graphic Standards

The graphic standards for the City Webster are taken directly from the City of Houston's "General Design Requirements for Sanitary Sewers, Storm Sewers, Water Lines, and Paving". These graphic standards are provided in Appendix A.

2.4 Easements

- 2.4.1 All easements and recording information, existing and proposed, shall be shown in the construction plans in accordance with Section 2.2.29.

- 2.4.2 Storm sewer, sanitary sewer, and water line easements shall be dedicated for the specific intended use. Easements for a specific facility shall be exclusive and shall not overlap other easements, except to cross the easements.
- 2.4.3 Water line easements - the following minimum width easements are required when facilities are not located within public street rights-of-way or water line easements:
- A. Fire hydrants located outside of public rights-of-way or water line easements shall be encompassed by a ten-foot by ten-foot (10' x 10') or as required exclusive easement. Fire hydrants may not be located within any other type of easements.
 - B. Water meter easements shall be exclusive and should be located adjoining a public right-of-way or water line easement.
 - C. Two-inch (2") and smaller meters serving non-residential and multi-family developments shall be set in five-foot by five-foot (5' x 5') or as required exclusive water meter easements.
 - D. Three-inch (3") and larger meters shall be set in a minimum of ten-foot by twenty-foot (10' x 20') or as required exclusive water meter easements.
 - E. When specifically approved by the City Engineer, water mains may be located in easements not adjacent to public street rights-of-way. These water mains shall be centered in a sixteen-foot (16') wide or as required exclusive easement restricted to water only.
 - F. Water mains may be located at the center of a ten-foot (10') water line easement, provided the easement adjoins the public right-of-way.
- 2.4.4 Sanitary Sewer Easements - the following minimum easement widths are required for the type of service:
- A. Rear lot easements combining utilities with buried electric service and sanitary sewers of eight inches (8") and ten inches (10") in diameter shall have a minimum width of sixteen feet (16') or as required.
 - B. The total width of the easements as specified in paragraph A above shall be at least equal to the depth of the proposed sewer line.
 - C. The width of all exclusive sanitary sewer easements shall be equal to the depth of the sewer from finished grade plus two (2) pipe diameters. Sewer shall be located in the center of the easement. The minimum width of a sanitary easement shall be sixteen feet (16') or as required when split along a lot line, and ten feet (10') wide or as required for easements located within a single lot.

- D. Exclusive sanitary sewer easement adjoining a public right-of-way may be five feet (5') wide provided the sewer is at least five feet (5') from the edge of the easement and the sewer is no deeper than ten feet (10'). Sewers at greater depth than ten feet (10') shall be centered within an exclusive easement parallel and adjoining the right-of-way as described in Section 2.4.4 C.
- E. Exclusive easements for force mains of all sizes shall have a minimum width easement of sixteen feet (16') or as required for a single force main where the force main is not located adjacent to a public right-of-way. Where the force main is located in an easement adjacent to public right-of-way, the force main may be located at the center of a ten-foot (10') wide or as required easement.
- F. Combined storm and sanitary sewer easement shall have minimum widths as required in Section 2.4.5 for storm sewer easements. Additionally, the sanitary sewer main, trunk or force main shall be located such that the centerline of the pipe shall be at least half the width of the easement, defined in Section 2.4.4 C, but not less than seven and one-half feet (7.5'), from the edge of the easement.
- G. For combined storm and sanitary sewer easements located adjacent to public rights-of-way where the sanitary sewer is located along the outside of the easement, the centerline of the sanitary sewer pipe shall be at least half the width of the easement defined in Section 2.4.4 C, but not less than seven and one-half feet (7.5') from the outside edge of the easement.
- H. Where sanitary sewers or force mains are installed in easements separated from public rights-of-way by other private or utility company easements, the sanitary sewer easement should be extended along or across the private utility company easement to provide access for maintenance of the sewer or force main.

2.4.5 Storm Sewer Easements - the following minimum easement widths are required:

- A. The minimum width shall be twenty feet (20') with the storm sewer centered in an exclusive easement, except as specifically approved by the City Engineer.
- B. For storm sewers greater than ten feet (10') and less than fifteen feet (15') in diameter or width, the minimum width of an exclusive easement shall be twenty-five feet (25'), or as specifically approved by the Public Works and Engineering Department.

- C. For storm sewers whose depth to flow line is greater than fifteen feet (15'), add five feet (5') to the minimum easement width specified in Section 2.4.5 A and/or 2.4.5 B, above.
- D. For all easements specified in Section 2.4.5, a minimum distance of five feet (5') or as required must be maintained from the easement line to the outside edge of the storm sewer.
- E. Where approvals are granted for a special use or combination easement located along side lot or back lot, the minimum width shall be twenty-five feet (25') or as specifically approved by the Public Works and Engineering Department. The easement width shall meet or exceed all other easement requirements.
- F. For specifically approved storm sewers located in an exclusive easement adjacent to public rights-of-way, the minimum easement width shall be ten feet (10') or as specifically approved by the Public Works and Engineering Department. The easement width shall meet or exceed all other easement requirements.

2.5 Utility Locations

- 2.5.1 All utilities shall be underground with the exception of electric primary lines. The electric primary lines, defined as feeders or three phase lines, should be located around the subdivision perimeter whenever possible.
- 2.5.2 Water Main Location
 - A. All water mains shall be located within a public right-of-way or within dedicated water main easements. The location of water mains within a public street right-of-way is described in Section 3.4.
 - B. Water mains shall not be located in combination easements without the specific approval of the Public Works and Engineering Department.
- 2.5.3 Sanitary Sewer Location
 - A. Sanitary sewer laterals less than ten inches (10") in diameter and less than eight feet (8') deep may be located within the back lot easement as described in Section 2.4.5.
 - B. Sanitary sewers of twelve inches (12") or larger in diameter are usually located within a public right-of-way or an easement adjoining the right-of-way. Large sanitary sewers shall be located within the public street right-of-way in accordance with Section 4.3.1. Sanitary sewers may be located in an exclusive or combination easements provided the easement widths comply with Section 2.4.5.

- C. Sanitary sewers shall not be located in side lot easements without the specific approval of the Public Works and Engineering Department.
- D. Sanitary sewers should be located within the right-of-way between the property line and the back of curb on the opposite side of the right-of-way from the water main.

2.5.4 Storm Sewers

- A. Storm sewer shall be located in the public street right-of-way in accordance with Section 5.3.
- B. All storm sewer lines shall be located within public rights-of-way or approved easements. Placement of a storm sewer in side lot and back lot easements is discouraged. Specific approval of the Public Works and Engineering Department for the use of side lot or back lot easements for storm sewers should be obtained prior to plan preparation.
- C. For boulevard paving sections with esplanades, the storm sewer is usually located in the center of the esplanade.

2.6 Private Facility Locations (Not Including Landscaping)

- 2.6.1 Installation of private facilities, including utilities, in public road rights-of-way and their adjoining easements shall be approved by the City of Webster.
- 2.6.2 Private facilities shall not conflict with other facilities in the right-of-way and shall not be located in exclusive easements as required in these Standards. All structures within the public right-of-way shall be approved by the Public Works and Engineering Department and shall be located so as to not interfere with existing or proposed public facilities.
- 2.6.3 All facilities in the right-of-way shall be located at least two feet (2') behind the curb and all underground facilities in the right-of-way shall be located at least two and one-half feet (2.5') below the top of curb on a public street unless approved by the City Engineer.
- 2.6.4 Private facilities shall be constructed in accordance with construction plans approved by the Public Works and Engineering Department.
- 2.6.5 Landscaping within the public right-of-way or adjoining easements shall not affect public utilities or traffic visibility.

2.7 Crossings

- 2.7.1 Highway Crossings - All State and County Roads
 - A. State Highway crossings shall be constructed in conformance with the requirements of the Texas Department of Transportation.

- B. A water main shall be encased in a steel pipe casing extending at least five feet (5') from outside edge of each service road or outside edge of pavement, across the right-of-way to a similar location on the other side of the highway. For highway or roadway crossings with open ditches, the casings shall extend from right-of-way to right-of-way.
- C. Where additional right-of-way has been acquired or will be required for future widening, the casing, where required, should be carried to within ten feet (10') of each future right-of-way line.

2.7.2 Street Crossings

- A. All water main and sprinkler line crossings under major thoroughfare boulevards shall be encased using a minimum of P.V.C. pipe, SDR 26, as shown on the City of Webster construction detail for "Water Main Encasement". Welded steel pipe may be substituted on street crossing, when specifically approved by the Public Works and Engineering Department.
- B. Conduits and sewers that do not carry liquid under pressure may be bored and jacked into place without an encasement pipe or as specifically approved Public Works and Engineering Department.
- C. Crossings under existing concrete streets, other than major thoroughfares, shall be constructed by boring and jacking. P.V.C. pipe shall be jacked into place using equipment designed for that purpose. Water may be used to facilitate the boring and jacking operations. Jetting the pipe main into the place will not be permitted. When conditions exist that warrant open cut across an existing street, the Public Works and Engineering Department shall specifically approve the crossing.
- D. All open cut installations across existing or proposed streets shall be backfilled as shown in the City of Webster Construction Details. Cement stabilized sand backfill shall meet the requirements of Section 4.2.3.
- E. All street crossings shall be constructed in accordance with construction plans approved by the City. All street crossings shall be inspected by the Public Works and Engineering Department. All street crossings shall meet the requirements of these Standards.

2.7.3 Railroad and Pipeline Crossings

- A. For railroad crossings, the carrier pipe shall be encased in steel pipe casing extending from right-of-way to right-of-way.
- B. All construction within the railroad or pipeline right-of-way shall conform to minimum requirements set out in the agreement with the owner of the right-of-way.

2.7.4 Ditch and Stream Crossings

- A. Crossing under a stream or ditch is preferred by the City. The top of the carrier pipe shall be designed to provide a minimum clearance of at least four feet (4') below the ultimate flow line and sides of the ditch and with sufficient bottom length to exceed the ultimate future ditch sections.
- B. Where existing or proposed bridges have sufficient space and structural capacity for installing water mains or conduits (twelve inches (12") or smaller) under the bridge, but above the top of the bent cap elevation, such installation will be permitted upon specific approval of the construction plans. In all cases, the water main or conduit shall be above the bottom chord of the bridge and eighteen inches (18") above the 100-year water surface elevation. All conduits attached to a bridge shall be constructed using steel pipe and shall extend a minimum of ten feet (10') beyond the bridge bent or to the right-of-way line, whichever is greater. All conduit attached to a bridge shall be maintained by the owner of the conduit or will be subject to removal.
- C. Separate, free-standing crossings across drainage ways are not allowed.
- D. All stream or ditch crossings shall be constructed of steel pipe from right-of-way to right-of-way.

2.8 **Trench Safety**

All construction within the City of Webster shall conform to the requirements for trench safety. Trench safety is required for all excavations greater than five feet (5') in depth. Adequate details for construction in accordance with applicable OSHA regulations will be required in all construction plans that are approved by the City of Webster.

2.9 **Street Lighting**

- 2.9.1 The installation of street lighting shall be mandatory along all public streets in the City of Webster. In addition, the installation of street lighting is strongly encouraged along existing or repaved streets.
- 2.9.2 The location of street lights will be designed by CenterPoint Energy formerly known as Houston Lighting and Power Company (HL&P) and reviewed and approved by the Public Works and Engineering Department.
- 2.9.3 Private lighting systems may supplement or replace all or a portion of public street lighting as long as the net result provides equivalent lighting to the standard set herein. A perpetual entity, such as an incorporated homeowners association and/or an appropriate private entity, shall notify the City of Webster of its agreement to pay for the operation, maintenance, and insurance of a private lighting system prior to installation of the system. The system shall be approved by the City Engineer.
- 2.9.4 Street lights shall be designed in accordance with CenterPoint Energy

Standards & Guidelines.

2.10 Bench Marks

- 2.10.1 A permanent bench mark shall be set in each subdivision section or at a spacing of one mile, whichever is greater. The bench mark shall have an elevation based on the National Geodetic Vertical Datum of 1929, current adjustment.
- 2.10.2 The bench mark elevation and location shall be certified by a registered public surveyor as a Texas Surveyors Association Standard and Specifications for Category 8, TSA Third Order Vertical Control Survey.
- 2.10.3 Accuracy of elevations for bench marks shall be Texas Surveyors Association Category 8, Third Order.
- 2.10.4 All bench mark locations shall be provided with ties to existing monuments including coordinates using Texas Plane Coordinate System, Central Zone.
- 2.10.5 Bench marks shall be constructed of a brass disc set in concrete as approved by the City of Webster. The concrete footing for the bench mark shall be eight inches (8") in diameter and three feet (3') deep. Concrete shall be reinforced with two number four (2 - #4) rebars.
- 2.10.6 The construction plans shall clearly identify the location of the bench mark and shall include a complete description, coordinates and elevation, with adjustment date, of the bench mark.

2.11 Residential Lots and Improvements

- 2.11.1 All residential lots shall drain to a public right-of-way directly adjoining the lot. Drainage from a residential lot to a public right-of-way at the rear, or side of a lot may be permitted provided the drainage system has been properly designed to accept the flow. Drainage from a residential lot to an adjoining greenbelt shall require a public easement for drainage purposes to be maintained by the homeowner's association or appropriate private entity. Drainage to a private easement shall require specific approval by the City Engineer. Drainage to a private easement shall be noted on the recorded subdivision plat. Drainage to a Harris County drainage easement shall be approved by the Harris County Drainage District.
- 2.11.2 A lot grading plan showing proposed minimum slab elevations will be included in the construction plans. If slab elevations do not change, a notice of minimum elevation will suffice. The minimum slab elevation shall also be shown on the subdivision plat.

2.12 Flood Plain Management

- 2.12.1 All development shall conform with the requirements of the National Flood Insurance Program, as required by the regulations of the local governing authority having jurisdiction.

- 2.12.2 Amendments to the published flood maps, map revisions and all requests for changes to the base flood elevation within the City of Webster city limits shall be submitted to the Community Development Department for approval. Technical data required by the Federal Emergency Management Agency and justification for the proposed change must be included with all requests.
- 2.12.3 All data submitted shall be prepared under the supervision of a registered professional engineer and/or a registered public surveyor and shall comply with all requirements of the Federal Emergency Management Agency.

DIVISION 3 - WATER SYSTEM DESIGN REQUIREMENTS

- 3.1 General**
- 3.2 Overall System Layout**
- 3.3 Water Main Sizing and Materials**
- 3.4 Location of Water Mains**
- 3.5 Clearance of Water Lines from Other Utilities**
- 3.6 Depth of Cover**
- 3.7 Valves**
- 3.8 Fire Hydrants**
- 3.9 Fittings and Appurtenances**
- 3.10 Steel Water Pipe**
- 3.11 Water Services**
- 3.12 Additional Standards**

3.1 General

Design requirements for water systems within the City of Webster shall base on land use.

- 3.1.1 Construction and sizing of all water mains and appurtenances shall meet or exceed the requirements of the Texas Department of Health and the Texas State Board of Insurance.
- 3.1.2 The Public Water System shall not extend beyond the water meter. All construction to the meter shall conform to the Standards. All private construction beyond the meter shall conform to the requirements of the City of Webster Plumbing Code.
- 3.1.3 Design shall conform to the City of Webster Construction Details.

3.2 Overall System Layout

- 3.2.1 Layout and size of all water mains shall be consistent with the overall layout and phasing plan of the City's water system. The overall water system shall be designed to maintain adequate pressure throughout the system.
- 3.2.2 The layout of the water mains should provide maximum circulation of water to prevent future problems of odor, taste, or color due to stagnant water.
 - A. Provide a source of fresh water at each end or at multiple points in a subdivision. Provide adequate circulation and place valves and fire hydrants, so that flushing of all mains will be simplified.
 - B. Dead-ends should be avoided. All dead-ends should be isolated with a line valve, be as short as possible, and be equipped with a fire hydrant or blow off at the end of the main as required in Section 3.3. All dead end water lines must be approved by the Public Works and Engineering Department.
 - C. In unavoidable permanent dead-end situations, reduce the sizes of pipe successively. Carry a six-inch (6") pipe to the last fire hydrant, then use

four-inch (4") PVC to the end of the line. Provide a standard two-inch (2") blow off at the end of the main.

- D. Where a water main is stubbed out for future extensions, place a valve to isolate the dead-end and provide no customer services from the dead-end until it is extended. Provide a standard two-inch (2") blow off at the end of the main.

3.3 Water Main Sizing and Materials

3.3.1 Water mains shall have a minimum size as follows:

- A. Four-inch (4") mains may serve a maximum of twenty (20) lots when supported on both ends by a larger main. A dead end four inch (4") main may supply a maximum of ten (10) lots, shall not exceed four hundred feet (400') long and shall be terminated with a blow off. Fire hydrants are not allowed on a four inch (4") main.
- B. Six-inch (6") mains shall be a maximum of nine hundred feet (900') long when supported on both ends by eight-inch (8") mains or larger and shall have no more than two (2) intermediate fire hydrants. Dead end six-inch (6") mains shall not be more than six hundred feet (600') in length and shall terminate at a fire hydrant. Six-inch (6") fire hydrant leads shall not exceed two hundred feet (200') in length. All four-inch (4") mains shall be specifically approved by the Public Works and Engineering Department.
- C. Eight-inch (8") mains are required for mains over one thousand five hundred feet (1,500') long, or when three (3) or more intermediate fire hydrants are required. Eight-inch (8") mains shall not be dead end, except as specifically approved by the Public Works and Engineering Department. If approved by the Public Works and Engineering Department, the maximum length of a dead-end eight-inch (8") main shall be three hundred fifty feet (600') and it shall be terminated with a fire hydrant.
- D. Twelve-inch (12") and larger mains will be required at locations established by Public Works and Engineering Department.

3.3.2 The length of a dead-end water main shall be measured from the intersection with a multiple feed (looped) main to the end of the main. The allowable length of a dead-end main with multiple sizes shall not exceed the allowable length of smallest main as required in Section 3.3.1.

3.3.3 Water mains shall be constructed using the following materials:

- A. Poly Vinyl Chloride (PVC) Pressure Pipe, four-inch (4") through twelve-inch (12"), shall conform to the requirements of ANSI/AWWA C900, current revision, Class 150 DR 18. Pipe shall be designed and constructed in conformance with the minimum requirements of the "Manual of Water Supply Practices", AWWA Manual No. M23.
- B. Ductile-Iron Pipe (D.I.P.), four-inch (4") through fifty-four-inch (54"), shall conform to the requirements of "Ductile-Iron Pipe, Centrifugally Cast in

Metal Molds for Sand-Lined Molds, for Water and Other Liquids", AWWA C151, (ANSI A21.51), current revision. Pipe thickness shall be the minimum specified in C151. Under special conditions, the Department of Public Works may require thickness design in conformance with the minimum requirements of "Thickness Design for Ductile-Iron Pipe", AWWA C150 (ANSI A21.51), current revision. Pipe shall be installed in conformance with the minimum requirements of AWWA C600, "Installation of Gray and Ductile Cast-Iron Water Mains and Appurtenances". Ductile-Iron Pipe shall be furnished with bituminous or cement mortar lining, AWWA C104 (ANSI A21.4). Polyethylene tube encasement shall be provided as required in Section 3.9.6 of these Standards.

- C. Steel Water Pipe, four-inch (4") and larger shall conform to the requirements of "Standard for Steel Water Pipe Six Inches and Larger", AWWA C200. Steel pipe, minimum wall thickness shall conform to the thickness shown on the City of Webster Construction Details. All steel pipes shall have coal tar coating in accordance with "Standard for Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape-Hot Applied", AWWA C203.
- D. Other pipe materials may be used for construction of water mains, when specifically approved by the Public Works and Engineering Department.
- E. Bedding and backfill shall conform to the City of Webster Construction Details.
- F. Alternate materials may be used with specific approval from the Public Works and Engineering Department.

- 3.3.4 Water mains and appurtenances are not allowed in the following sizes: three-inch (3"), ten-inch (10"), and fourteen-inch (14").
- 3.3.5 All public water mains shall be installed within a water line or public utility easement or right-of-way.
- 3.3.6 Construction of water mains shall be in accordance with approved construction plans and the City of Webster Construction Details.

3.4 Location of Water Mains

- 3.4.1 The recommended location for water mains within the right-of-way is five feet (5') inside right-of-way.
- 3.4.2 Water mains shall be placed along a uniform alignment with the right-of-way. When necessary, the water main may be deflected at a fire hydrant location to accommodate proper installation of the fire hydrant. At all locations where a water main changes alignment, the location of the water main shall be clearly shown on the construction plans. A minimum distance of two feet (2') shall be maintained from the right-of-way line to the outside edge of the water line.
- 3.4.3 For new construction, any water main, except at a flush valve, located less than five feet (5') from the road right-of-way line and within the right-of-way shall have a water line easement adjoining the right-of-way. Water line easements adjoining a right-of-way for mains smaller than twelve inches (12")

shall have a minimum width of five feet (5') or as required. For mains greater than twelve inches (12") in diameter, the easement adjoining the right-of-way shall have a minimum width of ten feet (10') or as required.

- 3.4.4 When necessary, water mains may be located within the esplanade section of boulevard type streets. Mains should be located as near the centerline as possible to avoid conflicts with future pavement widening.
- 3.4.5 Along streets with open ditch drainage, all twelve-inch (12") and smaller water mains may be located five feet (5') from the right-of-way line, and sixteen inch (16") and larger water mains shall be located subject to Public Works and Engineering Department approval.
- 3.4.6 Water mains may be located at the center of a ten foot (10') wide or as required waterline easement, provided the easement adjoins a public right-of-way.
- 3.4.7 Location of a water main in an easement not adjoining a public right-of-way shall be prohibited, except as specifically approved by the Public Works and Engineering Department. When approved, these water mains shall be centered in a sixteen-foot (16') wide exclusive easement restricted to water only or as specifically approved by the Public Works and Engineering Department.

3.5 Clearance of Water Lines from Other Utilities

Water mains shall be designed and located to conform with the regulations of the Texas Department of Health.

- 3.5.1 When a water main is placed parallel to another utility line at or near the same grade, it shall have a minimum of four feet (4') of horizontal separation. When the other utility is a sanitary sewer, a minimum of nine feet (9') of separation must be provided. In the event that a minimum of nine feet (9') cannot be maintained, the sanitary sewer must be constructed of pressure type pipe with water-tight joints as used in water main construction and the clearances must be as defined in the following sections or as specifically approved by the Public Works and Engineering Department. When a water main crosses a utility other than sanitary sewer, a minimum of six inches (6") of clearance must be maintained, and the water main shall have one joint of pipe, a minimum of eighteen feet (18') long, centered on the other utility.
 - A. Where a sanitary sewer parallels the water main, the sanitary sewer shall be constructed of ductile iron, or PVC pipe meeting AWWA specifications, having a minimum working pressure rating of one hundred fifty pounds per square inch (150 psi) or greater, and equipped with pressure type joints. The water main and sanitary sewer shall be separated by a minimum vertical distance of two feet (2'), and a minimum horizontal distance of four feet (4'), measured between the nearest outside diameters of the pipes, and the water main shall be located above the sewer.
 - B. Where a sanitary sewer crosses the water main, and that portion of the sewer within nine feet (9') of the water is constructed as described in

Section 3.4.3 A, the water line may be placed no closer than six inches (6") from the sewer. The separation distance must be measured between the nearest outside pipe diameters. The water line shall be located at a higher elevation than the sewer, wherever possible, and one (1) joint, a minimum of eighteen feet (18') long, of the new pipe must be centered on the existing line.

- 3.5.2 For water mains crossing an existing or proposed sanitary sewer or force main, the following clearances shall be provided for protection from contamination. The minimum clearances will be approved only when justified and field conditions so dictate. The latest edition of "Rules and Regulations for Public Water Systems", Texas Department of Health, Water Hygiene Division, shall be followed for minimum criteria and instructions for water line crossings.
- 3.5.3 Where water lines are installed in areas which have existing sanitary sewers, every effort should be made to maintain nine feet (9') of separation between the outside pipe diameters of the two lines. Where this separation cannot be achieved because of local conditions, which must be fully documented in any planning material submitted, the following spaces shall be observed
- A. Where a new water line is to cross or be installed in parallel with an existing sanitary sewer, and the sewer is constructed as described in Section 3.5.1, the separation distances specified in those rules shall apply as though the sewer were new.
 - B. Where a new water line is to be installed in parallel with an existing clay, truss, or concrete gravity sewer showing no evidence of leakage and the water line is installed above the sewer a minimum of two feet (2') vertically and four feet (4') horizontally, the sanitary sewer need not be disturbed. Should excavation for the water line produce evidence that the sewer is leaking, then the sewer must be repaired.
 - C. Where a new water main is to cross an existing clay, truss, or concrete gravity sewer showing no evidence of leakage, the sewer need not be disturbed if the water line is to be installed at least twenty-four inches (24") above the existing sewer. A full joint of the water line, at least eighteen feet (18') long, should be centered over the sewer crossing, in this case, so as to provide maximum protection against contamination.
 - D. Existing clay, truss, or concrete sewer pipe which shows no evidence of leakage and because of physical limitations must remain at a higher elevation than a proposed intersecting water line or closer than two feet (2') may remain undisturbed if the water line is inserted in a joint of pressure type encasement pipe at least eighteen feet (18') long and two (2) nominal sizes larger than the water line. The encasement pipe should be centered on the sewer crossing and both ends sealed with cement grout. In lieu of this procedure, that portion of the sewer within nine feet (9') of the water line may be replaced with cast iron or ductile iron pipe with watertight joints as described in Section 3.5.1.

- E. Unless sanitary sewer manholes and the connecting sewer can be made completely watertight and tested for no leakage, they must be installed so as to provide a minimum of nine feet (9') of horizontal clearance from an existing or proposed water line. Encasement of the water line in a carrier pipe as described in Section 3.5.3 D may be approved in special cases if the plans have approval of the Texas Department of Health.

3.6 Depth of Cover

Minimum depth of cover for water mains shall be as follows:

- 3.6.1 Twelve-inch (12") and smaller mains shall have a minimum cover of four feet (4') from the top of curb. For open ditch roadway sections, twelve-inch (12") and smaller mains shall be installed at least three feet (3') below the ultimate flow line of ditch or six feet (6') below natural ground at the right-of-way line, whichever is deeper.
- 3.6.2 Sixteen-inch (16") and larger mains shall have a minimum cover of five feet (5') from the top of curb. For open ditch roadway sections, sixteen-inch (16") and larger mains shall be installed at least three feet (3') below the flow line of ditch or seven feet (7') below natural ground at the right-of-way line, whichever is deeper.
- 3.6.3 Changes in grade to clear other utilities or underground features may be made by deflecting pipe joints. The maximum designed deflection shall be one-half (1/2) of manufacturers allowable deflection. If a depth greater than eight feet (8') to the top of pipe is required, a welded steel section will be used. The standard depth of cover maintained on the water main and the grade change shall be made using the welded steel section. The installation of fittings for vertical deflections or changes in grade shall not be allowed except with specific approval of the Public Works and Engineering Department.

3.7 Valves

- 3.7.1 All water system valves shall conform with AWWA standards and shall be designed as follows:
 - A. Two-inch (2") through twelve-inch (12") valves shall be resilient seated gate valves, AWWA C509, counter-clockwise opening with push-on joints. Valves shall have a complete coating on all iron parts in the valve interior to eliminate corrosion.
 - B. Sixteen-inch (16") and larger valves may be butterfly valves, AWWA C504, with complete interior coating to avoid corrosion of all iron parts, as approved by the Public Works and Engineering Department. All butterfly valves shall be installed in a vault of adequate size and construction, as approved by the Public Works and Engineering Department.
 - C. Cast iron valve boxes are required on all gate valves less than or equal to sixteen-inch (16") as noted below. Valve vaults are required on all valves larger than sixteen-inch (16").

- D. All valves shall be sized equal to the size of the main on which it is located.
 - E. Valves shall be approved by Public Works Engineering Department.
- 3.7.2 Spacing - valves shall be set at maximum distances along the main as follows:
- A. Four-inch (4") through and including twelve-inch (12") mains - one thousand five hundred feet (1,500').
 - B. Sixteen-inch (16") and larger mains - two thousand two hundred feet (2,200').
 - C. All main intersections shall have a minimum of one (1) less valve than the number of mains at the intersection.
- 3.7.3 Location - valves shall be located as follows:
- A. All mains shall be valved within the street right-of-way. Valves shall not be placed under or within two feet (2') of ultimate pavement, except as specifically approved by Public Works and Engineering Department.
 - B. Valves are normally located on the projection of intersecting street right-of-way lines or at the curb return adjoining a paved street across the main. Tapping sleeves and valves are excluded from this requirement.
 - C. All fire hydrants shall be isolated from the service main with a valve located in the fire hydrant lead.
 - D. Intermediate valves not located on the projection of intersecting street right-of-way lines may be located at lot line projections or five feet (5') from fire hydrants.
 - E. Valves shall be placed at the end of all mains that are to be extended in the future, and extend main a minimum of twenty feet (20') past valve.

3.8 Fire Hydrants

- 3.8.1 Fire hydrants shall have three-way nozzle arrangement, five and one-quarter-inch (5-1/4") compression type main valve, mechanical joint boot, and conform to the requirements of AWWA C502. The pumper nozzle shall be the Houston Standard or four and one-eighth inch (4-1/8") threads and the hose nozzles shall be two and one-half-inch (2-1/2") threads. Fire hydrants shall be "Mueller" or equivalent as approved by the Public Works and Engineering Department. Fire hydrants shall have a "**Hydra-Storz**" adapter.

- 3.8.2 Spacing - fire hydrants shall be spaced along all mains six-inches (6") and larger as follows:
- A. Three Hundred Foot (300') Spacing.
 - B. Fire hydrants should be set at street intersections or as specifically approved by the Public Works and Engineering Department.
- 3.8.3 Location - fire hydrants shall be located as follows:
- A. Fire hydrants shall be located three feet (3') behind the back of curb or projected future curb and be set at the point of curvature (PC) of the intersection curb radius. A parallel tee may be used for a fire hydrant lead at the water main when specifically approved by Community Development Department.
 - B. On all State Highways and open-ditch roadways, set the fire hydrants or flushing valves within three feet (3') of the right-of-way.
 - C. Fire hydrants located between right-of-way intersections should be set at a lot line, however, this location may be adjusted five feet (5') either way to miss driveways or other obstructions, in which case the fire hydrants should not be closer than three feet (3') from curbed driveways or five feet (5') from non-curbed driveways.
 - D. Fire hydrants may be located in the esplanade section of City streets only when it is not feasible to locate them between the right-of-way line and the back of the curb. In such case, it is preferable to locate the fire hydrants seven feet (7') behind the esplanade back of curb to provide access for parkway mowers; but in no instance shall they be located closer than three feet (3') from the esplanade back of curb or five feet (5') from the esplanade edge of pavement.
 - E. All fire hydrants shall be located in protected, but easily accessible, areas behind the pavement.
- 3.8.4 Depth of Bury - the depth of bury for all fire hydrants shall be established such that the bury line on the fire hydrant is installed at the ground line at each location or at the finished ground after pavement construction is completed. The depth of bury for fire hydrants shall be shown on the construction plans. Minimum cover for fire hydrant leads shall be four feet (4').
- 3.8.5 Fire hydrants shall not be installed within nine feet (9') of a sanitary sewer system unless approved by the Public Works and Engineering Department.
- 3.8.6 Fire hydrants shall be color coded on the fire hydrant caps. The color coded paint shall be as follows:

<u>Color</u>	<u>Water Main Diameter (In.)</u>
Green	10" and Greater
Orange	8"
Red	6"

The body of the fire hydrant will be red. All paints shall conform to the City of Webster Fire Hydrant Color Code.

3.9 Fittings and Appurtenances

- 3.9.1 Fittings shall be Ductile-Iron Compact Fittings Three-Inch (3") - Twelve-Inch (12"), AWWA C153/A21.53.84, conforming to the minimum requirements of "Gray-Iron and Ductile-Iron Fittings, Twelve-Inch (12") through Forty-Eight-Inch (48)", for Water and Other Liquids", AWWA C110 (ANSI 21.10), current revision. Fittings shall be furnished with bituminous or cement mortar lined, AWWA C104 (ANSI A21.4).
- 3.9.2 All fittings shall be identified and described on the construction plans.
- 3.9.3 Fittings are not permitted in fire hydrant leads, except as specifically approved by Public Works and Engineering Department.
- 3.9.4 Normally, all water main fittings have push-on joints. Mechanical joints may be used at special locations if specifically approved by Public Works and Engineering Department.
- 3.9.5 All plugs shall be provided with retention clamps.
- 3.9.6 Polyethylene tube encasement shall conform with the minimum requirements of "Polyethylene Encasement for Gray and Ductile Cast-Iron Piping for Water and Other Liquids", ANSI/AWWA C105, current revision. Soils within the project shall be tested in accordance with Appendix A of ANSI/AWWA C105 to adequately determine the requirements for encasement.
- 3.9.7 Concrete thrust blocking shall be required on all bends, tees, plugs and combinations thereof. Refer to City of Webster Construction Details for specifications.

3.10 Steel Water Pipe

- 3.10.1 Welded steel pipe is required for all water mains with cover of less than four feet (4') or greater than eight feet (8') and for offset assemblies. Refer to the City of Webster Construction Details for offset assembly specifications.
- 3.10.2 All transitions from steel pipe to approved water main materials shall be constructed using electrically isolated flange joints.
- 3.10.3 Welded steel pipe shall be constructed in conformance with the City of Webster Construction Details.

3.11 Water Services

3.11.1 Water Service in Residential / Single Family Development

- A. Water service from the main to the curb stop shall be installed using materials approved by Public Works and Engineering Department.
- B. Minimum size water service line and fittings shall be one inch (1") for single meter connections for homes having more than three thousand (3,000) square feet of living area. For homes with less than three thousand (3,000) square feet of living area, a three-quarter-inch (3/4") diameter water service line will be permitted.
- C. Minimum size water service line shall be one inch (1") for a far side double residential meter connection for homes less than three thousand (3,000) square feet. Minimum size water service line shall be one and one-half inches (1-1/2") for a far side double residential meter connection for homes greater than three thousand (3,000) square feet.
- D. Water service lines shall be placed at a minimum depth of thirty-six inches (36") below final paving elevation.
- E. Water meters shall be supplied and installed by the City of Webster. Payment for meters must be made prior to installation.
- F. Meter boxes shall be located just within the public right-of-way along the projection of a lot line. Location of meters on open ditch streets shall be specifically approved by Public Works and Engineering Department.
- G. All water service fittings and appurtenances for all projects shall be approved by Public Works and Engineering Department.
- H. City maintenance shall end at the water meter. The water meter box or vault shall be constructed to meet the City's requirements and will be maintained by the City.

3.11.2 Water Service in All Other Developments

- A. Detector check valves shall be required on fire lines.
- B. Service meters that are two inches (2") and smaller shall be set in a separate exclusive water meter easement with minimum dimensions of five feet by five feet (5' X 5') or as specifically approved and shall be located in easily accessible areas adjoining a public right-of-way or water line easement, but protected from traffic behind curbed sections. Meters may be located in the water main easement provided the water main easement is located such that the accessibility and protection of the meter is as specified immediately above.
- C. Service meters that are three inches (3") and larger and detector check valves shall be set in separate exclusive water meter easements with minimum dimensions of ten feet by twenty feet (10' X 20') or as specifically approved and shall be located in easily accessible areas,

adjoining a public right-of-way or water line easement, but protected from traffic behind curbed sections. Refer to the City of Webster Construction Details for details.

- D. The location of the service line tee, valve, valve box and temporary plug shall be designated on the construction plans in the appropriate location to serve the "future meter".
- E. All apartments or town homes proposed in a private street development shall have one or two master meters sized adequately to serve the entire development. Exceptions to this policy may be specifically approved by the Public Works and Engineering Department based on an unusual situation. Meters shall be installed in compliance with the City of Webster Construction Details.
- F. All large meters within the City of Webster will be installed and maintained by the City of Webster, except as specifically approved by the Public Works and Engineering Department.
- G. City maintenance shall end and include the meter and check valve vaults. The vaults shall be constructed to meet the City's requirements and will be maintained by the City.

3.12 Additional Standards

- 3.12.1 Construction Features - In conjunction with the design, the engineer shall determine the extent of, and fully exemplify on the plans, all special construction features required to complete the project in a manner of safety, convenience, and economics.
- 3.12.2 Bore and Jack – Bore and jack sections shall be clearly shown on plans by location and footage. The following criteria is generally used as a basis for jack sections:
 - A. Public Streets - All public streets are to be bored and jacked regardless of surface. Bore and jack length shall be computed as roadway width at proposed bore plus five feet (5') to either side.
 - B. Driveways - Whenever it is cost effective, concrete driveways in good condition shall be bored and jacked. Bore and jack length shall be computed as driveway width at bore plus one foot (1') to either side. Where driveways cross culvert pipe sections along open ditch streets and the proposed water main is in close proximity and parallel to the culvert pipe, the length of bore shall be the same as the length of culvert pipe.
 - C. Sidewalks - When the water line crosses under a sidewalk four feet (4') or more in width and in good condition, the sidewalk shall either be bored and jacked or the sidewalk shall be removed and replaced to the City of Webster criteria, whichever is cost effective. Bore and jack length shall be at least the width of the sidewalk. The proposed type of construction shall be noted on the plans.

- D. Trees - When saving trees and shrubs in a previously developed area is a consideration, all trees six inches (6") and larger in diameter within ten feet (10') of the centerline of the water main must be noted on the plans. The water main should be bored and jacked within the drip line of any tree larger than six inches (6") in diameter.
 - E. Bore Pits - Bore pits shall be at least three feet (3') from back of curb and five feet (5') from back of curb on a major thoroughfare. Bore pits in highway, county road, or railroad right-of-way shall conform to these requirements and to the requirements of the crossing permit and/or use agreement. All bore pits shall be shored in accordance with OSHA requirements. Bore pits and/or receiving pits to be located in street or driveway paving, shall be shown on plans.
- 3.12.3 Open Cuts - Where open cuts are required in street paving, plans should call for steel plate covers to be installed and maintained over the cut during periods when contractor is not actively engaged in work at the site. Streets that are open cut shall be "saw cut".
- 3.12.4 All existing developed areas shall be restored to original condition after construction.
- 3.12.5 Proper barricading and signage, conforming to the latest revision of the Texas Manual of Uniform Traffic Control Devices, must be required on all projects. Adequate signage for vehicular and pedestrian traffic will be installed.

DIVISION 4 - SANITARY SEWER DESIGN REQUIREMENTS

- 4.1 General**
- 4.2 Sewer Design and Materials**
- 4.3 Location of Sanitary Sewers**
- 4.4 Design Requirements**
- 4.5 Appurtenances**
- 4.6 Service Connections**
- 4.7 Non-sewered Building Site**

4.1 General

- 4.1.1 Sanitary sewers within the City of Webster jurisdiction shall allow for orderly expansion of the system and shall conform with the comprehensive water and sewer plan for the City of Webster.
- 4.1.2 Sewers shall be sized based on the minimum requirements set out in this standard and the standard wastewater flow rates as established by the City of Webster.
- 4.1.3 All sewers shall conform to the minimum requirements of the Texas Department of Health, "Design Criteria for Sewerage Systems".
- 4.1.4 Sewers shall be separated from water lines by a minimum of nine feet (9'). Where the minimum separation is not maintained, refer to Section 3.4 for allowable clearances. Sewers crossing utilities other than water, a minimum of six inches (6") of clearance must be maintained.
- 4.1.5 The public sanitary sewer, as maintained by the City of Webster, shall be defined as all sewers, including stacks and service leads that serve more than one sewer connection, that are located in public easements or street rights-of-way, and that are installed in accordance with these Standards.
- 4.1.6 Design shall conform to the City of Webster Construction Details.

4.2 Sewer Design and Materials

- 4.2.1 Minimum design criteria for determining the size of a sewer shall be as follows:
 - A. Wastewater flows shall be based on the current, approved utility phasing plan for the area. The average day flow for the design of sanitary sewers shall be based on a minimum set by the plan in gallons per day per single family connection for residential areas. Commercial, industrial, and office areas shall be designed for an average daily flow that can be anticipated from the contributing area.
 - B. The peak design flow for sewers shall be four (4) times the average day flow of the fully developed service area. Sewers larger than eighteen-inch (18") may be sized using a peaking

factor of less than four (4) with approval of the Public Works and Engineering Department. The minimum allowable values for the design peak factor are presented in Appendix C of these Standards.

- C. Minimum size public sewer shall be eight-inch (8").
- D. Minimum size sewer service lead shall be six-inch (6") and shall not serve more than two (2) residential services.
- E. Commercial sewer service lead shall be six-inch (6") pipe or larger and shall not serve more than one (1) commercial connection. Specific approval shall be required for lines less than six inches (6").

4.2.2 Sewers will be constructed of materials approved by the Public Works and Engineering Department.

4.2.3 Cement Stabilized Sand for Bedding and Backfill:

- A. Portland Cement, Type I, ASTM C150.
- B. Clean, durable sand, with less than 0.5 percent clay lumps, ASTM C142; with less than 0.5 percent lightweight pieces, ASTM C123; with organic impurities, ASTM C40, not showing a color darker than standard color and a plasticity index of less than six (6) when tested in accordance with ASTM D423 and ASTM D424.
- C. Compact to ninety-five percent (95%) Standard Proctor Density (ASTM D2922-78 and ASTM D3017-78) in lifts of eight inches (8") thick. Actual testing may be required as deemed necessary by the Public Works and Engineering Department.
- D. The cement-sand mixture shall consist of at least one and one-half (1-1/2) sacks of cement per cubic yard of sand. The cement-sand mixture shall have a minimum unconfined compressive strength of one hundred pounds per square inch (100 psi) in forty-eight (48) hours, when compacted to ninety-five percent (95%) of Standard Proctor Density (ASTM D2922-78 and ASTM D3017-78), without additional moisture control, cured and tested in accordance with ASTM C31

4.3 Location of Sanitary Sewers

4.3.1 Street Right-of-Way

Sanitary sewers with a maximum depth of ten feet (10'), measured from finished grade, shall be placed within the right-of-way at least five feet (5') from the right-of-way line, except as provided herein. All sewers that are deeper than ten feet (10') shall be centered in an exclusive easement parallel and adjoining the right-of-way or as required by Public Works and Engineering Department. Where required in accordance with Section 2.4.5, additional easement shall be provided adjoining the right-of-way to provide required clearances.

4.3.2 Easements

- A. Sanitary sewers placed in easements shall conform to the requirements of Section 2.4.5.
- B. The maximum depth of sewer in a rear yard public utility easement shall be eight feet (8'). All sanitary sewers in easements shall conform to the requirements in Section 2.4.5.

4.4 **Design Requirements**

4.4.1 Allowable Depths

Sewers shall be designed to meet or exceed the pipe manufacturer's recommendations for depth.

4.4.2 Minimum depth of a sewer shall be four feet (4') below finished grade or top of curb, whichever is lower.

4.4.3 Sewer bedding will be cement stabilized sand, as required in Section 4.2.3, or approved granular material. Bedding shall be compacted to ninety-five percent (95%) Standard Proctor Density to the spring line on sewer lines shallower than eight feet (8') and six inches (6") over pipe for sewer lines eight feet (8') deep and greater, prior to backfilling the trench. In water bearing sand, washed shell or other approved granular material will be required. Black poly wrap will be required for water bearing soil as shown in the City of Webster Construction Details. When water-bearing sands are encountered, the City of Webster shall be notified immediately.

4.4.4 A mandrel test shall be performed prior to acceptance of all installed P.V.C. pipe. The initial mandrel test shall be performed thirty (30) days after the trench has been backfilled. The mandrel must move freely inside the pipe and will be pulled by hand from the upstream end of the pipe to the downstream end. Test equipment shall conform to the requirements set out in Appendix D. A second mandrel test, after settlement has occurred, may be required by the Public Works and Engineering Department to determine long term deflections. Deflections in P.V.C. pipe shall not exceed five percent (5%).

4.4.5 Hydraulic Requirements

- A. Design velocity in a gravity sewer flowing full shall be a minimum of two feet (2') per second. Where sewers are anticipated to flow less than one-half full, consideration should be given to increasing the slope of sewer to provide two feet (2') per second velocity in the pipe for the anticipated flow rate.

B. Minimum acceptable slopes in sewers shall be:

Size of Pipe (Inches)	Fall in Feet <u>Per 100 Feet of Sewer</u>
6	0.5
8	0.40
10	0.25
12	0.20
15	0.15
18	0.11
21	0.09
24	0.08

C. Sewers are to be designed so that the crowns of the pipes are matched at manholes. The upstream sewer may be designed so that the flow line of the upstream sewer is higher than the flow line of the downstream sewer. When the flow line of the upstream sewer is raised more than three feet (3') above the flow line of the downstream sewer, a drop manhole connection is required, except as specifically approved by the City Engineer.

D. Sanitary sewer service leads shall be laid at seven-tenths percent (0.7%) slope.

4.4.6 Alignment

A. Sewers should be laid in a straight alignment, where possible. Curved sewers may be allowed with specific approval of the City Engineer.

4.5 Appurtenances

4.5.1 Manholes

A. Manholes should be placed at points of changes in alignment (except along a curved sewer), grade, or size of sewers, at the intersection of sewers and at the end of all sewers. Clean-outs will not be permitted on public lines.

- B. Manholes should be spaced at a maximum distance of four hundred feet (400') apart.
- C. Manholes at the end of sewers in rear lot easements should be placed in street rights-of-way.
- D. Sewers laid in easements shall have a manhole in each street crossing.
- E. Manholes should be located to eliminate the inflow of storm water into the sanitary sewer. The top of manhole rim elevation shall be shown on the plans for all sanitary manholes, except in the paved area. Sealed manholes may be permitted, within the 100-year flood plain, when specifically approved by the City Engineer.
- F. Manholes shall be constructed in accordance with the City of Webster Construction Details.
- G. A drop manhole should be constructed for any sewer twelve-inch (12") diameter or less that enters a manhole of greater than thirty-six inches (36") above the invert of the manhole. Sewers larger than twelve inches (12") shall be designed to accommodate a drop at the manhole using standard pipefittings.
- H. Steps in manholes will not be permitted.
- I. Manhole covers shall be cast iron, traffic bearing type ring and cover with the words "City of Webster - Sanitary Sewer" cast into the cover.
- J. All manhole adjustments shall be made with pre-cast concrete rings.

4.5.2 Stacks

Stacks shall be constructed for connections to sewers that are more than eight feet (8') below finished grade. Stacks shall be provided during the initial construction of the sewer.

4.5.3 Lift Stations

Lift stations shall be designed in conformance with the "Texas Department of Health Design Criteria for Sewerage Systems". Lift stations should be considered only when a gravity system cannot be achieved. All lift stations shall be specifically approved by the City Engineer. The Design Engineer shall provide design requirements and pertinent data with construction plans for review. A preliminary design meeting is recommended. Lift stations shall be designed as follows:

- A. Pumps shall be sized to operate at optimum efficiency. Minimum acceptable efficiency at the operating point will be sixty percent (60%), unless specifically approved by City Engineer.

- B. Operation and maintenance should be considered in the design of the station and the location of the station.
- C. Wet well working volume should be sized to allow for the recommended pump cycle time of six (6) minutes for each pump.
- D. Controls and equipment shall be approved by the City Engineer. Pumps shall be manufactured by Gorman Rupp or equal. Pump controls shall be from a manufacturer approved by City Engineer.
- E. Emergency operations should be considered. Provide fittings and a blind flange that will be readily accessible for emergency bypass pumping. Back up power generators must be included with the lift station sized to operate all pumps and controls.
- F. All new lift stations shall have a means of emergency back up operation, i.e. diesel powered generators or pumps.

4.6 Service Connections

- 4.6.1 Sewer service leads shall not exceed one hundred feet (100') in length. Near side double sewer service leads shall not exceed five feet (5') in length and shall be located within a public right-of-way or easement.
- 4.6.2 Single-Family Residential Lots
 - A. Far side service connections shall be installed at the time of construction of the sewer. Double sewer service leads shall be located within a public right-of-way or easement.
 - B. Service connections shall be constructed of materials as described in Section 4.2.2.
 - C. Service connections should be installed at a manhole, when possible.
- 4.6.3 Multi-Family Residential, Commercial, and Office Development
 - A. Service connections shall be made at a manhole. Long service connections should be installed at the time of construction of the sewer.
 - B. Service connections shall be constructed of materials as described in Section 4.2.2.
- 4.6.4 Service Connections at Manholes
 - A. When a service connection stub-out is not provided, an opening shall be neatly cut out of the manhole at the required elevation. The service connection shall be extended into the manhole.
 - B. Service connection at a concrete manhole shall be grouted in place using non-shrink grout, Fosroc Preco-Patch, or equal.

When a hole for a service connection in a brick manhole exceeds eighteen inches (18"), the manhole shall be rebuilt above the disturbed area.

- C. Service connections at fiberglass manholes shall be drilled, uniformly, through the manhole wall. A neoprene gasket shall be installed around the pipe to provide a water-tight seal through the wall. Where required, fiberglass mat and resin shall be used, in accordance with the manufacturer's recommendations, to repair wall openings.
- D. Service connections entering a manhole three feet (3') or more above the flow line of the manhole shall include a drop pipe with fittings outside the manhole. The drop shall be installed adjoining and anchored to the wall of the manhole, unless specifically approved otherwise.

4.6.5 Provide adequate markings on site and accurate as built locations, so that the service connection stub-out can be recovered at the time that the connection to the service is made.

4.6.6 All connections to the public sewer system shall be approved by the City Engineer prior to construction. Actual connections to the public sewer system shall be inspected by a representative of the Public Works Department.

4.6.7 Service connections that are installed after initial construction of a sewer shall be constructed using a P.V.C. saddle with gasket and stainless steel straps as approved by the Public Works and Engineering Department.

4.7 Non-sewered Building Site

Sanitary sewer shall be extended to all building sites prior to development. Septic systems are not allowed, except as specifically approved by the City Engineer.

DIVISION 5 - DRAINAGE DESIGN REQUIREMENTS

- 5.1 General**
- 5.2 Storm Sewer Materials**
- 5.3 Location of Storm Sewers**
- 5.4 Construction Plan Requirements**
- 5.5 Design Requirements**
- 5.6 Appurtenances**

5.1 General

- 5.1.1 All drainage plans and construction shall meet or exceed the requirements of the City of Webster, Harris County Flood Control District, and all other entities having jurisdiction (e.g., Harris County Engineering, Texas Department of Transportation).
- 5.1.2 All drainage systems that are to become a maintenance responsibility of the City of Webster shall be enclosed storm sewers, except as specifically approved by the City Engineer.
- 5.1.3 Public storm sewers are defined as sewers and appurtenances that provide drainage for a public right-of-way, or more than one private tract, and are located in public right-of-way or easement. Private storm sewers provide internal drainage for a reserve or other tract. Private storm sewer connections to public storm sewers shall occur at a manhole or at the back of an inlet as approved by the City Engineer. All private storm sewers within the public right-of-way shall be constructed in conformance with these Standards.
- 5.1.4 All construction shall conform with the City of Webster Construction Details.
- 5.1.5 All storm sewers shall meet or exceed the requirements of the "Drainage Criteria Manual for City of Houston, Texas" and the requirements of the City of Webster.

5.2 Storm Sewer Materials

- 5.2.1 Storm sewer and culvert pipe shall be pre-cast reinforced concrete pipe, unless specifically approved by the City Engineer. Concrete pipe shall be manufactured in conformance with the requirements of ASTM C 76, "Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe", current revision. Reinforced concrete pipe shall be Class III or stronger. The design engineer shall provide for increased pipe strength when conditions of the proposed installation exceed the allowable load for Class III pipe. All concrete pipe constructed in water bearing soil or forty-two inches (42") in diameter or larger, shall have rubber gasket joints meeting the requirements of ANSI/ASTM C 443, "Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets", current revision. Concrete pipe with a diameter of less than forty-two inches (42") may be installed using pipe with tongue and groove type joints and Ram-nek, or approved equal, as a joint filler. When specifically approved by the City Engineer, reinforced concrete arch and elliptical pipe conforming to

ASTM C506 and C507, respectively, current revision, may be installed in lieu of circular pipe. Reinforced concrete box culverts shall meet the minimum requirements of ASTM C850, "Pre-cast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers", current revision. Pipe joints for arch and elliptical pipe and box culverts shall be sealed using Ram-nek or approved equal.

- 5.2.2 Storm sewer outfalls into open channels shall be constructed using corrugated steel pipe. Corrugated steel pipe shall be manufactured in conformance with the requirements of AASHTO Designation M-36-82, current revision. Pipe material shall be Aluminized Steel Type 2, meeting the requirements of AASHTO Designation M-274-791, current revision, or Pre-coated Galvanized Steel, AASHTO M-246, 10-mil coating on both sides. All pipes shall have a full double coating, Type A, in accordance with AASHTO Designation M-190, current revision. Pipe joints and fitting shall meet the minimum requirements of these specifications and shall have an O-ring gasket seal meeting the requirements of AASHTO C-361, current revision. (See the City of Webster Construction Details.)
- 5.2.3 Storm sewer outfalls shall have slope protection to prevent erosion. Slope protection may be constructed of slope paving or riprap. Slope paving shall be four-inch (4") five (5) sack concrete with six-inch by six-inch (6"x6") welded wire mesh (W14 x W1.4) or three-eighths-inch (3/8") steel rebar on twenty-four-inch (24") centers, each way. Riprap shall be a minimum of six-inch (6") broken concrete rubble with no exposed steel or well-rounded stone and shall be a minimum of eighteen inches (18") thick put on geo-textile fabric Mirah 500. Slope protection texturing shall be required where public access likely. Refer to the City of Webster Construction Details for minimum dimensions.
- 5.2.4 Alternate materials may be used with specific approval of the City Engineer.

5.3 Location of Storm Sewer

- 5.3.1 Public storm sewers shall be located within a public street right-of-way or a storm sewer easement, dedicated to the public and adjoining a public street right-of-way.
- 5.3.2 Recommended alignment within a public street right-of-way.
 - A. Boulevard pavement section with median – along centerline of the right-of-way.
 - B. Undivided pavement section – five feet (5') inside the right-of-way.

For all storm sewer located in a public street right-of-way, a minimum distance of two feet (2') shall be maintained inside the right-of-way line to the outside edge of the storm sewer unless otherwise accompanied by an adjacent easement.
 - C. Alternate locations for a storm sewer may be permitted by the City Engineer.

- 5.3.3 Recommended alignment within an exclusive storm sewer easement.
- A. Storm sewers placed in easements shall conform to the requirements of Section 2.4.6.
 - B. Storm sewers within easements shall be placed no closer than five feet (5') measured from the outside edge of the pipe to the edge of an easement, except when adjoining another easement or public right-of-way where the distance may be reduced to two feet (2'). The storm sewer shall be placed in the center of the easement. When the storm sewer easement adjoins a public right-of-way, the easement may be reduced to a minimum of ten feet (10') and the storm sewer may be aligned closer to the right-of-way line, as long as required clearances are met, with specific approval of the City Engineer.

5.4 Construction Plan Requirements

- 5.4.1 A drainage map shall be included in the construction plans. The drainage area map shall include:
- A. Drainage areas, including areas draining from off-site onto or adjoining the project.
 - B. Design storm runoff.
 - C. 100-year storm runoff.
 - D. Route of overland flow including the overflow to a drainage way sized to accommodate the 100-year flow.
 - E. Elevations for the 25-year and 100-year storms in the outfall channel.
 - F. Flow per inlet.
 - G. Maximum 100-year ponding elevation.
- 5.4.2 Detailed drainage calculations shall be submitted with the construction plans.
- 5.4.3 The hydraulic gradient for the design storm shall be shown on the construction drawings. Calculations for the elevation of the hydraulic gradient shall be provided with the design storm drainage calculations.

5.5 Design Requirements

- 5.5.1 Minimum depth of a storm sewer (measured to the top of pipe) shall be twenty-four inches (24") below top of curb or finished grade, whichever is lower. Minimum size storm sewer for main and inlet lead shall be twenty-four inches (24").

5.5.2 Storm sewers shall be bedded using cement-stabilized sand (See specification in Section 4.2.3.) as shown in the City of Webster Construction Details.

5.5.3 Pipe Requirements

A. Reinforced concrete pipe, as described in Section 5.2.1 shall meet or exceed the following minimum requirements:

<u>Pipe Class</u>	<u>Maximum Cover (Ft.)</u>
III	15'
IV	30'

Reinforced concrete pipe installed at a depth greater than thirty feet (30') shall be designed by the engineer for the specific installation and approved by the City Engineer. Reinforced concrete pipe shall be designed in accordance with the American Concrete Pipe Association, "Concrete Pipe Design Manual". Maximum cover on the pipe shall be measured from the top of pipe to the ultimate finished grade or natural ground, whichever is greater.

B. Corrugated steel pipe shall have a minimum thickness as follows:

<u>Pipe Size (Inches)</u>	<u>Corrugations</u>	<u>Minimum Thickness (Inches)</u>
24	2-2/3" X 1/2"	0.052
30- 48	2-2/3" X 1/2"	0.064
54- 72	3" X 1" or 5" X 1"	0.064
78-102	3" X 1" or 5" X 1"	0.079

Bedding for corrugated steel pipe shall be cement stabilized sand (See specification in Section 4.2.3.) and shall have a minimum density of ninety-five percent (95%) Standard Proctor. Corrugated steel pipe less than or equal to fifty-four inches (54") in diameter and less than thirty feet (30') deep shall have the minimum thickness given above. Corrugated steel pipe larger than fifty-four inches (54") in diameter and greater than thirty feet (30') deep shall be designed by the engineer for the specific installation and approved by the Public Works and Engineering Department. Corrugated steel pipe shall be designed in accordance with the American Iron and Steel Institute, "Handbook of Steel Drainage and Highway Construction Products".

5.5.4 Storm sewers shall have a minimum clearance of six inches (6") from all other utilities. The clearance shall be measured from the outside wall of the pipe.

5.5.5 Design storm runoff shall be calculated in accordance with the "Drainage Criteria Manual for City of Houston, Texas".

5.5.6 Hydraulic Requirements.

- A. Storm sewers shall be designed to have a minimum velocity of three feet per second (3 fps), when flowing full. Manning's formula should be used to compute the size of the storm sewer. Manning's coefficient, n, is 0.013 for concrete pipe and 0.024 for corrugated metal pipe.
- B. Minimum acceptable slopes in reinforced concrete pipe storm sewers shall be:

Size of Pipe (Inches)	Fall in Feet Per 100 Feet of Sewer
24	0.17
30	0.13
36	0.10
42	0.08
48	0.07
54	0.06
60	0.05
66	0.045
72	0.040
78	0.036
84	0.033
90	0.030
96	0.028

- C. Inlet capacity for the design storm shall be computed using a maximum water surface elevation equal to the top of curb at the inlet. Design capacity for a Type B-B or H-2 inlet with a six-inch (6") standard curb shall be five (5) cubic feet per second. Design capacity for a Type B inlet shall not exceed two and one-half (2.5) cubic feet per second.
- D. Design storm flow in a street shall not exceed the capacity of the street, for the water surface equal to the top of curb, and shall not exceed the inlet capacity. Design storm flow shall meet City of Houston criteria.

- E. For any public street, the top of curb elevation shall be at or above the 100-year flood plain elevation. For any public street, the maximum public street ponding and flow levels for the street for the extreme event analysis is the lowest of the following: (1) one foot above the natural ground or abutting lots; (2) one foot above top of the street curb; or (3) one foot below the lowest slab elevation of buildings on abutting lots. The City may approve an exception to the drainage requirements if the City approves development with reduced building setbacks and the imposition of the above drainage requirements would result in the streets, sidewalks, or public parking violating federal or state disabled accessibility requirements. In that case, if the underground storm drainage system is correspondingly increased in size to handle that maximum street ponding and flow levels, the City may allow: (1) maximum public street ponding and flow levels that are at least five inches below the lowest building slab elevations on abutting lots; and (2) regardless of any other provision of the Design Standards, building slab elevations on abutting lots that are at least one foot above the adjacent gutter.
- F. All bridges must be a minimum of eighteen inches (18") above the 100-year water surface elevation or in accordance with the Federal Emergency Management Agency (F.E.M.A.) regulations, latest revisions, whichever is greater.
- G. The internal storm drainage system for a regional mall retail development shall be sized for a conduit capacity capable of maintaining hydraulic design conditions below parking lot elevations during a twenty-five (25) year storm with a thirty (30) minute time of concentration.

5.5.7 Storm sewers less than forty-two inches (42") in diameter shall be constructed on a straight horizontal and vertical alignment between manholes. Storm sewers greater than or equal to forty-two inches (42") in diameter may be laid along a curve using manufactured bends of less than or equal to 11-1/4°. Camera inspection may be required on storm sewers constructed along a curve.

5.6 Appurtenances

5.6.1 Manholes

- A. Manholes shall be placed at all changes in alignment, grade and size of storm sewers; at the intersection of two or more storm sewers; at all inlet leads; and at the end of all storm sewers.
- B. Maximum spacing between manholes shall be six hundred feet (600').
- C. Manhole covers shall be cast iron, traffic bearing, type ring and cover with the words "**CITY OF WEBSTER - STORM SEWER**" cast into the cover.

5.6.2 Inlets

- A. Curb inlets shall be spaced and sized to intercept the calculated runoff for the design storm. The water surface elevation at the inlet shall be less than or equal to the top of curb for the design storm flow.

- B. Maximum travel distance of water in the street to a curb inlet shall be three hundred feet (300') on a major thoroughfare and in a commercial area. The maximum travel distance of water in the street permitted in a single-family residential area shall be six hundred feet (600').
- C. Curb inlets should be located on the intersecting side street at an intersection with major thoroughfare. Locations on the major thoroughfare at intersections shall be specifically approved by the Community Development Department.
- D. Grated inlets will not be permitted in an open ditch.
- E. Back slope swale interceptors shall be placed in accordance with the requirements of City of Houston.
- F. H-2 curb inlets are required on all streets that do not access residential lots. B-B curb inlets may be used on streets with access to residential lots. B-B type curb inlets must have grate inlet lids.
- G. Inlets must be backfilled with 1.5 sacks per cubic yard of cement-stabilized sand placed to the top of first stage inlet.

5.6.3 Safety End Treatments (SET)

Safety End Treatments (SET) must be placed on drainage culverts for commercial driveways, public streets, and residential driveways that cross open ditches located in the public right-of-way that are adjacent to and parallel to the public street. Safety End Treatments (SET) specifications shall meet Texas Department of Transportation requirements.

DIVISION 6 - PAVING DESIGN REQUIREMENTS

- 6.1 General**
- 6.2 Roadway Types**
- 6.3 Geometric Street Design Standards**
- 6.4 Pavement Structure Requirements**
- 6.5 Grading and Layout Requirements**
- 6.6 Traffic Control Devices**
- 6.7 Sidewalks**
- 6.8 Driveways**

6.1 General

- 6.1.1 All paving plans and construction shall be approved by City Webster for all streets within the jurisdictional limits of City of Webster.
- 6.1.2 All streets shall be concrete curb and gutter.
- 6.1.3 Street design should conform to all applicable planning tools, such as the City of Webster Subdivision Ordinance, the Texas Manual on Uniform Traffic Control Devices, major thoroughfare plans, master plans, etc. Other considerations for design should include street function, street capacity, service levels, traffic safety, pedestrian safety, and utility locations. These additional considerations may effect the minimum requirements set forth herein. Refer to the City of Webster Major Thoroughfare Plan.
- 6.1.4 Design shall conform to the City of Webster Construction Details.

6.2 Roadway Types

A Standard hierarchy of roadways in City of Webster ranges from Freeways, Highways, Major Arterials, Minor Arterials, Major Collectors, Minor Collectors and Local Roads.

Freeways: Freeways are State roads, which generally are suitable for substantial statewide, or interstate travel, with access controlled and restricted to certain area via on and off ramps. An example of a limited access highway in the City of Webster is IH-45

Highways: Highways are State roads, which generally are suitable for substantial statewide travel, but allow less restrictive access. These are generally heavily traveled routes with multiple lanes and signalized control at key intersections. An example of a limited access highway in the City of Webster is SH 3, FM 270.

Major Arterials (PA): Major Arterial roads accommodate trips of moderate length and distribute travel to smaller geographic areas than the freeways of highways. Arterials place more emphasis on land access and offer lower traffic mobility than highways. These facilities generally do not penetrate neighborhoods. An example of a limited access highway in the City of Webster is Nasa Parkway.

Minor Arterials (MA): Minor Arterial roads accommodate trips of moderate length and distribute travel to smaller geographic areas than the Major Arterials. Unlike Major

Arterials, the length of the trips and degree of access management is less restrictive. An example of a limited access highway in the City of Webster is Texas Avenue.

Major Collectors (PC): Major Collectors are roads that serve to collect traffic from smaller local roads and commercial area and link these areas to locally important traffic generators and larger roads. Major Collectors shown in the City of Webster thoroughfare plan are generally two lanes, are undivided by esplanades. Unlike arterials, their operation is not always dominated by traffic signals. An example of a limited access highway in the City of Webster is Kobayashi Road.

Minor Collector (MC): Minor collector roads serve to collect traffic from smaller local and residential areas and link these areas to locally important traffic generators and large roads. Minor collectors shown in City of Webster thoroughfare plan are generally two lanes, undivided and provide direct access to residential driveways. An example of a minor collector access highway in the City of Webster is Blossom Street.

Local Roads (LR): The primary functions of these roads are to provide access to abutting land and connection to the collector roads. Through traffic is deliberately discouraged on these roads. They are generally neighborhood streets.

- 6.2.1 PA6D – Principal Arterial, Six (6) Lanes, Divided, may be used for major thoroughfare streets.
- 6.2.2 PA4D – Principal Arterial, Four (4) Lanes, Divided, shall be used for major thoroughfare streets.
- 6.2.3 MA4D – Minor Arterial, Four (4) Lanes, Divided, shall be used for minor thoroughfare commercial or industrial streets.
- 6.2.4 MA4U – Minor Arterial, Four (4) Lanes, Undivided, shall be used minor thoroughfare commercial or industrial streets.
- 6.2.5 PC4D – Major Collector, Four (4) Lanes, Divided, shall be used for major collector multi-family, commercial, or industrial streets and secondary streets.
- 6.2.6 PC4U - Major Collector, Four (4) Lanes, Undivided, shall be used for major collector multi family, commercial or industrial streets and secondary streets.
- 6.2.7 PC2U - Minor Collector, Two (2) Lanes, Undivided, shall be used for minor collector single-family residential streets or local multi-family residential, commercial, or industrial streets and secondary streets.
- 6.2.8 LR2U – Residential, Two (2) Lanes, Undivided, shall be used for local single-family residential streets.

6.3 **Geometric Street Design Standards**

- 6.3.1 Minimum geometric street design standards for number of lanes, lane widths, right-of-way widths, median widths, and parkway widths shall conform to Appendices F-5 and F-6 of the Design Standards.
- 6.3.2 The design speeds shall conform to Appendix F-5 of the Design Standards. The design speed does not necessarily indicate the posted speed.

- 6.3.3 The maximum grade refers to the vertical slope of the street and shall conform to Appendix F-5 of the Design Standards.
- 6.3.4 Vertical curves shall be designed when algebraic difference in grades exceeds one percent (1%). Elevations shall be shown on the construction plans at ten-foot (10') intervals through vertical curves. The gradient for tangents to vertical curves at railroad crossings shall be a maximum of three and one-half percent (3.5%). All crest vertical curves shall be determined by sight distance requirements for the design speed. The minimum design speed on any vertical curve shall be based on the street classification.
- 6.3.5 Intersections and curves shall be evaluated for adequate sight distances.
- A. Minimum sight distances shall conform to Appendix F-5 of the Design Standards.
 - B. Right-of-way clips shall be established at all intersections. Unless larger clips are indicated at a particular intersection, a fifteen-foot by fifteen-foot (15' X 15') triangular public open space corner clip, measured at the property line, is required on corner lots at the intersection of two streets.
 - C. Sight distance triangles shall be shown in the plans.
- 6.3.6 Horizontal curvature is defined as the centerline radius of the street right-of-way.
- A. Horizontal curvature shall conform to Appendix F-5 of the Design Standards. Horizontal curvature may be reduced with specific approval from the Community Development Department.
 - B. Major thoroughfares with a centerline radius of the right-of-way less than two thousand feet (2,000') shall be designed considering recommendations for super elevation in accordance with the American Association of State Highway and Transportation Officials, "A Policy on Geometric Design of Highways and Streets", 1984. Signage and design speed shall be considered for all curved thoroughfares. A maximum rate of super elevation should be 0.04 for urban conditions.
 - C. Collector and local street horizontal curves shall be designed without super elevation.
 - D. The minimum curvature for a local street less than two thousand feet (2,000') long shall be three hundred feet (300'). The minimum curvature for a local street two thousand feet (2,000') long or longer shall be four hundred and fifty feet (450'). Lengths shall be measured along the centerline of the road right-of-way between the centerline of the collector or thoroughfare pavement, the center of the right angle intersection, and/or the center of the cul-de-sac.
 - E. Right angle intersections may be used on local streets. The minimum centerline radius shall be fifty feet (50') and the angle of intersection shall be ninety degrees (90°) plus or minus ten degrees (10°).

- 6.3.7 Each street shall be evaluated for adequate clearances from obstructions. Such obstructions could include retaining walls, abutments or bridge columns, signposts, large trees, or head walls. Refer to Appendix F-5 for minimum vertical and horizontal clearance requirements. Vertical clearances down to two feet (2') from the face of curb or two feet (2') beyond the edge of the paved shoulder may be considered for landscaping with specific approval.
- 6.3.8 Tangent length is defined as the distance between the point of tangency and the point of curvature of two adjacent curves along the centerline of the street right-of-way. The minimum tangent length between reverse curves shall be one hundred feet (100').
- 6.3.9 Intersections:
- A. Curb radii, measured from the face of curb, shall be twenty-five feet (25') minimum on local residential streets and thirty feet (30') minimum on residential major thoroughfares. The minimum curb radii shall be fifty feet (50') or more, depending on an evaluation of vehicular types and volumes in commercial or industrial areas. Minimums should be increased at skewed intersections.
 - B. Streets and traffic lanes shall be properly aligned across an intersection. Proposed streets shall be aligned with existing streets.
 - C. When turnouts are provided at an existing street, the ultimate cross section is required to the end of curb return. Pavement transition is required to reduce the pavement width to the existing cross section.
 - D. Intersections should be designed as a high point in the drainage system, when possible.
 - E. Streets intersecting major thoroughfares shall maintain a minimum of three hundred feet (300') of separation. Separation is defined as the distance from pavement face of curb to face of curb. Streets intersecting collector streets shall maintain a minimum of two hundred and fifty feet (250') of clearance. Local streets shall maintain a minimum separation of two hundred and forty feet (200'). Collector and local street separation may be reduced with specific approval from the City Engineer.
 - F. Offset intersections are not permitted on any arterial if the offset distance (or clearance between streets) is less than three hundred feet (300'). The minimal allowable offset shall be two hundred and fifty feet (250') on collector streets and eighty feet (80') on local streets.
 - G. Lane drop tapers shall extend 50 feet (50') to 100 feet (100') beyond the intersection.
 - H. Except where existing conditions will not permit, all streets, major and minor, shall intersect at a ninety-degree (90°) angle. Variations of more than ten degrees (10°) on secondary and local streets and more than five degrees (5°) on arterials may be allowed with specific approval from the City Engineer.

- I. Right turn lanes at arterial and collector intersections shall be designed and built in accordance with Appendices F-5 and F-6.
 - J. Where local streets intersect arterial streets, the local street must have a minimum radius of 35 feet and a minimum width of 37 feet, measured from the back of each curb or as specifically by the City Engineer.
- 6.1.10 Pavement width transitions shall conform to Appendix F-4 of the Design Standards. Minimum transition lengths shall meet or exceed requirements of the Texas Manual of Uniform Traffic Control Devices.
- 6.3.11 Left turn lanes must conform to Appendices F-2, F-3, and F-4 of the Design Standards. The City may require that the specified minimum bay storage lengths be increased based on traffic analysis. Middle block median openings to serve private driveways shall include left turn lanes in accordance with Appendices F-2 and F-3.
- 6.3.12 Median openings shall conform to Appendices F-2, F-3, and F-4 of the Design Standards. On major thoroughfares, when areas adjoining the right-of-way are not planned for immediate development, esplanade openings may be spaced one thousand feet (1,000') apart when specifically approved by the City Engineer. Entrance medians on local roads used for landscaping purposes only may be modified with specific approval by Community Development Department.
- 6.3.13 Cul-de-sac pavement
- A. Single family residential - pavement radius measured to the face of curb shall be forty feet (50').
 - B. Multi-family residential, commercial, and industrial – pavement radius measured to the face of curb shall be fifty feet (50').
 - C. The minimum pavement width for the cul-de-sac bulb without a median shall be forty feet (50') for single family residential areas and fifty feet (50') for multi-family residential, commercial, and industrial areas. Right-of-way radius shall be clear of permanent obstructions.
 - D. The distance from the face of curb of a cul-de-sac to the right-of-way line shall be a minimum of ten feet (10').
 - E. Curb radii at the transition to the cul-de-sac shall have a minimum radius of twenty-five feet (25') in single-family residential areas and thirty-five feet (35') in other areas, measured at the face of curb.
 - F. The length of a cul-de-sac street is defined as the distance from the centerline of the intersecting pavement to the center of the cul-de-sac bulb measured along the centerline of the street right-of-way. Maximum length of cul-de-sac streets for residential subdivision shall be one thousand feet (1,000') or serve a maximum of twenty-four (24) residential lots, whichever is less. Maximum length of cul-de-sac streets for commercial or industrial developments shall be six hundred feet (600'). A traffic analysis may be required in commercial or industrial areas to determine high traffic volumes that may be generated from the development,

thereby reducing the maximum length of cul-de-sac allowed.

6.3.14 Guidelines for permitting on-street parking are given in Appendix F-5.

6.4 Pavement Structure Requirements

- 6.4.1 Local residential streets shall have a minimum thickness of six inches (6") with number four (#4) rebar spaced at twenty-four inches (24") measured center to center of the rebar.
- 6.4.2 Residential, collector streets and all streets in multi-family residential, commercial, or industrial areas shall have a minimum thickness of seven inches (7") with number four (#4) rebar spaced at twenty-four inches (24") measured center to center of the rebar.
- 6.4.3 Major thoroughfares shall have a minimum thickness of seven inches (7") with number four (#4) rebar spaced at eighteen inches (18") measured center to center of the rebar.
- 6.4.4 The pavement structure for each roadway shall be designed based on soil data from the site and based on the anticipated traffic volume, loading and service life of the proposed pavement structure. The design engineer is responsible to insure that the pavement structure is designed to withstand the anticipated loads that are expected on the roadway.
- 6.4.5 Hot-mix asphaltic concrete pavement shall be designed for each individual project based on a geotechnical analysis prepared by a registered engineer. Minimum requirements shall include two inches (2") of surface course, six inches (6") of base, and six inches (6") of lime stabilized sub grade.
- 6.4.6 Sub grade shall be stabilized with a minimum six percent (6%) lime by weight, six inches (6") thick and compacted to ninety-five percent (95%) standard proctor density. Alternative sub grade stabilization may be substituted when specific recommendations are made by the geotechnical engineer for the project and when specifically approved by the City Engineer.
- 6.4.7 Concrete pavement thickness design is required for all pavements within industrial areas and on major thoroughfares. Concrete pavement thickness design shall be based on American Association of State Highway and Transportation Officials design procedures for rigid pavements.
- 6.4.8 Horizontal dowels or saw cutting to expose existing steel are required to create a minimum ten-inch (10") overlap of reinforcing steel when making a connection of a proposed street to an existing concrete street or drive. When the existing concrete street has no exposed steel the following shall apply:
- A. Dowels should be number four (#4) bars, twenty-four inches (24") long, embedded twelve inches (12") and epoxied, and spaced in accordance with this section.

- 6.4.9 Dead-end streets or ends of concrete slabs designed to be extended in the future shall have paving headers and fifteen inches (15") of reinforcing steel exposed beyond the pavement, coated with asphalt and wrapped with burlap or paving headers and Dowel type expansion joint for future pavement tie.
- 6.4.10 Pavement extensions shall connect to the existing pavement with a pavement undercut and a minimum steel overlap of ten inches (10"). Refer to City of Webster Construction Details.
- 6.4.11 All concrete to be removed shall be removed either to an existing joint or a sawed joint. Sawed joints shall meet the requirements set out in Section 6.4.8 B.
- 6.4.12 Materials:
 - A. Concrete - five (5) sacks cement per cubic yard concrete; 3,000 psi, unconfined compressive strength at twenty-eight (28) days.
 - B. Reinforcing steel - Grade 40, ASTM A615, current.
 - C. All materials and workmanship shall conform to the Texas State Department of Highways and Public Transportation Standard Specifications, 1982, and the Texas Manual on Uniform Traffic Control Devices, 1980, and any revisions thereto.
 - D. All special, non-standard materials, such as bomanite or concrete pavers, and special signage that are installed by the developer shall be specifically approved by the City Engineer and shall be maintained by the developer or his assigns. Any maintenance of non-standard items by the City of Webster will be done using standard materials and methods.

6.5 Grading and Layout Requirements

- 6.5.1 Minimum gradient on gutter shall be 0.30 percent. For special conditions where the gutter must be placed at a flatter grade, the minimum grade may be 0.25 percent with specific approval of the City Engineer.
- 6.5.2 Inlet spacing as defined in Section 5.6.2.
- 6.5.3 Maximum cut measured from finished grade at the right-of-way line to top of curb shall be 1.75 feet. The recommended maximum slope for driveways shall be ten (10) to one (1) slope. Variation of this requirement may be allowed with specific approval of Community Development Department.
- 6.5.4 Minimum grade shall be one percent (1%) fall around intersection turnout for a minimum radius of twenty-five feet (25'). Grade for larger radius shall be determined on an individual basis.
- 6.5.5 All streets must have at least a six-inch (6") high concrete curb.
- 6.5.6 Minimum slope for the gutter of a cul-de-sac or of the long radius of an L-type street shall be 0.60 percent.

- 6.5.7 The amount of cross slope over the pavement section should be shown on the plans. The usual cross slope is three-eighths-inch (3/8") per foot from the curb line to quarter point, and one-fourth-inch (1/4") per foot from quarter point to centerline, and one-eighth-inch (1/8") per foot for left turn lanes.
- 6.5.8 When connecting to an existing curbed street, the gutter lines for the proposed and existing streets shall be matched.
- 6.5.9 Proposed top of curb elevations should be designed to match the top of the curb at an existing inlet.
- 6.5.10 Top of curb elevations shall be shown on the construction plans.
- 6.5.11 Gutter elevations are required for vertical curves where a railroad track is being crossed.
- 6.5.12 Where railroad crossings are not at right angles to the pavement slab, vertical curves should be calculated for each curb line and should be posted at ten-foot (10') intervals in the profile.
- 6.5.13 Roadway connections to existing roadways shall be accomplished using a "Metropolitan Intersection", except as specifically approved by Community Development Department. Refer to detail in the Design Standards.

6.5 Traffic Control Devices

- 6.6.1 Type III barricades must be permanently installed at the end of all dead-end streets not terminating in a cul-de-sac and at all turnouts. Barricades must meet the requirements of the Texas Manual of Uniform Traffic Control Devices for Type III barricades. Type III barricades must be Scotchlite brand (or approved equal) high intensity sheeting on a nominal two-by-eight inch (2" x 8") non-pressure treated #2 pine wood, painted white with latex enamel paint.
- 6.6.2 Traffic and street signage locations shall be shown on the paving site plan in the construction plans. Traffic signs shall conform to the requirements of the Texas Manual of Uniform Traffic Control Devices as adopted by the City of Webster. Prior to final approval of a construction project, all signage shall be installed in accordance with the approved construction plans.
- 6.6.3 Traffic Signs
 - A. Standard sign blanks must be aluminum conforming to ASTM B209; alloy 5052-H38. Preparation of aluminum sign blanks must conform to specification MIL-C-5541C. The coating material must be included on the OPL-81706-10 list or subsequent additions thereto. Sheeting for signs must be Scotchlite (or approved equal). Visual Impact Performance (VIP) Diamond Grade Sheeting must be used on all signs on all roadways classified as Arterial or greater. Scotchlite brand (or approved equal) High Intensity Sheeting is required on all other road signs. Signs must be mounted on 2-3/8 inch diameter by twelve-foot (12') long galvanized tubular posts with vandal-proof mounting brackets.

- B. Street name signs must be at least nine-inches (9") in length. The sign sheeting color type must be white, electrocut film #1175. The sign sheeting must be Scotchlite brand sheeting (or approved equal). Visual Impact Performance (VIP) Diamond Grade must be used on all street names for arterial streets. High Intensity sheeting is required on all other roads. All signs must include three-inch (3") size hundred blocks and abbreviated roadway classifications. All three-inch numbers and letters must be 7/16" stroke width. "No Outlets" signs, where required or used, must be incorporated into street name signs and the yellow background with black three-inch (3") size lettering must be at the end of the sign pointing towards the "No Outlet".

The nine-inch (9") street name sign blanks must be aluminum conforming to ASTM B209; alloy 5052-H38 or 5154-H38. Preparation of aluminum sign blanks must conform to specification MIL-C-5541C. The coating material must be included on the QPL-81706-10 list or subsequent additions thereto. The sign blanks must be extruded aluminum and must be installed on tubular sign supports with a minimum sign length of thirty inches (30") and a maximum length of forty-eight inches (48"). When a "No Outlet" is included, the maximum length sign is fifty-four (54"). Letters must be white six inch (6") upper and four inch (4") lower case with Helvetica medium, font #H0907 letter style. The six-inch (6") upper case letters must have a stroke width of 1-1/4 inch and the lower case four-inch (4") letters must have a stroke width of 1-1/16 inch. To accommodate longer street names, alternative stroke widths may be approved.

Overhead street name signs are required on all traffic signals. Overhead street name signs must be fourteen inch (14") with blue electrocut film #1175. Signs must be Scotchlite brand (or approved equal) VIP sheeting and the aluminum must be 0.125 gauge with radius corners. Preparation of aluminum sign blanks must conform to specification MIL-C-5541C. The coating material must be included on the QPL-81706-10 list or subsequent additions thereto. All signs must include four-inch (4") size hundred blocks and abbreviated roadway classifications. All four-inch numbers and letters must be 13/16-inch stroke width. The 14" signs must include a 3/4 inch white border on the outside edge of sign. Letter sizes must be eight-inch (8") upper case with a 1-11/16 inch stroke width and six-inch (6") lower case with a 1-1/2 inch stroke width.

- C. All permanent and temporary (construction zone) traffic control devices must conform to the MUTCD, TMUTCD and TX DOT standards (where applicable), latest revision.
- D. All posts must be mounted in concrete eighteen inches (18") deep with a minimum of six inches (6") in diameter of concrete surrounding the post. All sign poles and signs must remain in their natural condition with no painting or coating allowed.
- E. All references to roadway classifications are based on the City of

- 6.6.4 Pavement markings must be shown on the approved construction plans. All pavement markings must be retro-reflective material applied to the road surface in a molten state by screed/extrusion, suspended extrusion or spray means, with a surface application of glass beads. For lane delineation, reflectors must be used on all roadways classified as a Collector Street or greater. The Department may approve variations of types of materials due to phasing, temporary construction, etc. All pavement markings must comply with the MUTCD and TMUTCD, latest revision and meet TxDOT standards. .
- 6.6.5 No multi-way stop signs shall be warranted in new developments, unless specifically approved by the City Engineer.
- 6.6.6 Developer shall install traffic control devices as warranted by a traffic study.
- 6.6.7 Traffic Signal hardware for mast arms and other appurtenances must be designed to meet Texas Department of Transportation (TX DOT) load requirements. Traffic signals, hardware/software and other appurtenances must conform to and be compatible with the City's existing Traffic Management System. For acceptable mast arm style, hardware/software equipment and appurtenances refer to the City of Houston Approved Products List or as approved by the City Engineer.

6.7 Sidewalks

- 6.7.1 Sidewalks not less than four feet in width are required on each side of all local streets abutting residential zoning districts and on each side of all major thoroughfares abutting nonresidential zoning districts. Construction of a sidewalk across a lot may be deferred until a lot is improved if specifically approved by the City Engineer.
- 6.7.2 All sidewalks must meet the Americans With Disability Act requirements. Sidewalk wheelchair ramps shall be required at all intersections and driveways. Sidewalks and ramps shall be located within the right-of-way at the crosswalk area.
- 6.7.3 Sidewalk construction in an esplanade: Transverse concrete sidewalk, six inches (6") thick with black or dark colored finish, shall be constructed in all esplanades as a pedestrian stacking area. All concrete sidewalks in esplanades shall be a minimum of six feet (6') wide as measured from the esplanade nose. Patterned concrete or brick may be used with specific approval of the City Engineer.
- 6.7.4 All sidewalks are to be constructed in accordance with the City of Webster Construction Details.
- 6.7.5 Sidewalks shall be located two feet (2') within the street right-of-way or in adjacent dedicated easement as approved by the City.

6..8 Driveways

- 6.8.1 The location and the width of all non-residential driveways that will connect to a public street must be reviewed and approved by the City prior to construction. All driveways, residential and non-residential, must be installed in compliance with the City of Webster Construction Details.
- 6.8.2 Driveways serving non-residential and multi-family tracts that connect to a street classified as an arterial, highway, or freeway must be 35 feet wide. Other non-residential driveways must be 25 to 35 feet wide. Single-family residential driveways shall be a minimum of ten feet (10') wide and a maximum of 24 feet wide at the right-of-way line.
- 6.8.3 It is the City's policy to minimize whenever practicable the number of non-single family residential driveways on all arterial and collector streets in order to reduce the number of conflict points and facilitate traffic flow. To facilitate that policy, driveways shall be placed no closer than the following distances from adjacent streets and driveways (measured from the projected curb line of the existing intersecting street or driveway to the projected curb line of the proposed driveway). More than one driveway is allowed as long as it meets the following criteria:

<u>Roadway Classification</u>	<u>Minimum Separation</u>
Highways/Freeways Intersecting Highways/Freeways	200', or greater as determined by Traffic Impact Analysis
<u>Highways:</u> S.H. 3, FM 270	200'
<u>Arterial:</u> As indicated on Thoroughfare Plan	150'
<u>Major Collector:</u> As indicated on Thoroughfare Plan	150'
<u>Minor Collector:</u> As indicated on Thoroughfare Plan	150'
<u>Local Street</u>	75'
<u>Cul-de-sac</u>	50'

- 6.8.4 If the separation requirements for non-single family residential driveways cannot be met because of the location of existing driveways on adjoining tracts, joint access driveways or access easements across adjoining tracts should be used. When minimum separation requirements cannot be met with the existing private driveway on the adjacent property and joint access cannot be obtained, the controlling factor shall be to maximize the distance between the subject property's private driveway and the public cross street.
- 6.8.5 On streets classified as collectors, arterials, and highways that do not contain medians, non-residential driveways must align with driveways on the opposite side of the street or meet the minimum separation requirements.
- 6.8.6 At a signalized intersection in which one public street terminates at the intersection of a connecting cross street, a driveway shall not be placed on the cross street as to be in alignment with the terminating street. If the

requirements for driveways otherwise allow the placement of a driveway at that location, the driveway width must match the cross-section of the intersecting public street. All driveway connections to the public street shall be approved and inspected by the City of Webster.

- 6.8.7 Single access driveway radii shall not extend beyond the projection of a property corner to the back of curb.
- 6.8.8 Driveways shall be located and designed so as to have adequate sight distances along the intersecting street.
- 6.8.9 Non-residential minimum driveway radii accessing a highway or greater shall have a radii of 35 feet (35'). Radii for driveways on other roadways shall be a minimum of 25 feet (25'). Refer to City of Webster Construction Details for further information.

APPENDIX C

SANITARY SEWER – PEAK DESIGN FACTOR

All gravity sewers will be designed to accommodate the peak flow from the contributing drainage area. The peak flow will be computed using the appropriate peaking factor, F, multiplied by the average day flow for the contributing area. For non-residential areas, the peak flow should include consideration of flow characteristics from the anticipated development. In all cases, the design peaking factor, F, shall meet or exceed the values as follows:

An equivalent population less than 5,000 persons,

$$F = 4$$

An equivalent population greater than or equal to 5,000 persons,

$$F = (14 / (3.316 + P^{0.5})) + 1.5$$

For, P = equivalent population in thousands

Additional consideration of peak flow shall be given for design of pumping stations. The impact of pumping stations on the upstream and downstream sanitary sewer system shall be evaluated. The peak flow for design of a pumping station shall be based on the flow into the station. A reduced peak flow, based on the peaking factor presented above, may be used for design of larger pumping stations provided a detailed hydraulic analysis is performed on the sanitary sewer system. Specific approval by the Community Development Department shall be required prior to use of a reduced peak flow for the design of a pumping station and related sanitary sewer system.

APPENDIX - D

MANDREL REQUIREMENTS

All gravity sanitary sewers, constructed using P.V.C pipe, shall be tested using a Mandrel that will measure five percent (5%) deflection in the pipe. ASTM 3034, current, provides diameters for seven and one-half percent (7-1/2%) deflection. Five (5%) deflection requirements are listed below.

P.V.C. PIPE – SDR – 35

Nominal Pipe Size (IN.)	Average Inside Diameter (IN.)	Base Inside Diameter (IN.)	5% Deflection Mandrel (IN.)
6	5.893	5.742	5.45
8	7.891	7.665	7.28
10	9.864	9.563	9.08
12	11.737	11.361	10.79
15	14.374	13.898	13.20

P.V.C. PIPE – SDR – 26

Nominal Pipe Size (IN.)	Average Inside Diameter (IN.)	Base Inside Diameter (IN.)	5% Deflection Mandrel (IN.)
6	5.764	5.612	5.33
8	7.715	7.488	7.11
10	9.644	9.342	8.87
12	11.480	11.102	10.55
15	14.053	13.575	12.90

For P.V.C. pipe sizes larger than fifteen inch (15") diameter, specific requirements for the Mandrel will be established by the Community Development Department.

APPENDIX E

STREET LIGHTING REQUIREMENTS

<u>Street Type</u>	<u>Pavement Width</u>	<u>Right-of-Way Width</u>	<u>Minimum-Maximum Distance</u>	<u>Lumens</u>
Minor / Local	28'	≤ 60' (50' w/ utility easements)	Note 1	Note 2
Collector / Commercial	36' – 48'	60' – 80'	Note 1	Note 2
Divided Roads	25' – 37' (2 each)	≥ 80'	Note 1 Note 4	Note 2 Note 5

NOTES:

1. Distances shall be measured along the centerline of road. Minimum – Maximum Distance shall be as per approved layout from the lighting company (CenterPoint).
2. All lighting shall be High Pressure Sodium Vapor with elliptical lighting pattern.
3. Where practical, lights shall be located on alternating sides of roadway.
4. Distance applies to each side of a divided roadway, i.e. double the number of lights.
5. For boulevard streets, double-arm steel standards in the median may be utilized. Light standards and electrical conduits shall not conflict with other City/County/State facilities in the right-of-way.
6. All street light fixtures shall be full cut-off fixtures to minimize light pollution.

PUBLIC WORKS DEPARTMENT



THE GUIDELINES PRESENTED IN THIS DOCUMENT INCLUDE THE MOST OFTEN REQUESTED INFORMATION REGARDING GEOMETRIC DESIGN OF SUBDIVISION STREETS. DESIGNATED MAJOR THOROUGHFARES (I), AND COLLECTOR STREETS (1) WITHIN SUBDIVISIONS, SHALL BE CONSIDERED FOR SPECIAL DESIGN FEATURES AND MAY REQUIRE HIGHER DESIGN CRITERIA THAN SHOWN HEREIN. ALSO, DESIGN FEATURES NOT SHOWN IN THESE GUIDELINES SHOULD BE CONSIDERED SPECIAL DESIGN FEATURES.

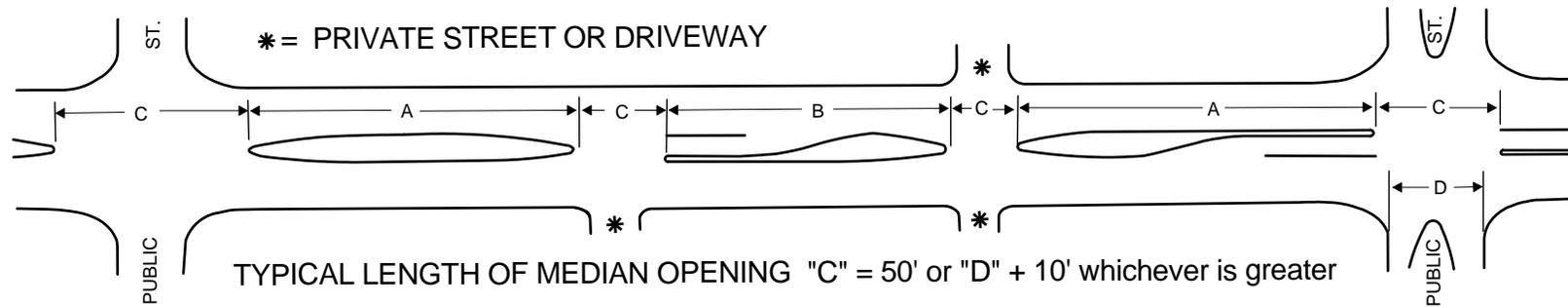
IT IS ADVISABLE TO CONSULT WITH THE APPROPRIATE AGENCIES AND REVIEW THE MOST RECENT EDITION OF THE FOLLOWING PUBLICATIONS TO DETERMINE ADEQUATE THOROUGHFARE REQUIREMENTS AND SPECIAL DESIGN FEATURES.

- RECOMMENDED GUIDELINES FOR SUBDIVISION STREETS, INSTITUTE OF TRANSPORTATION ENGINEERS.
- GUIDELINES FOR URBAN MAJOR STREETS DESIGN, INSTITUTE OF TRANSPORTATION ENGINEERS.
- A POLICY OF GEOMETRIC DESIGN OF HIGHWAYS AND STREETS, AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS.
- TEXAS MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES (TMUTCD), TEXAS DEPARTMENT OF TRANSPORTATION.

(1) DESIGNATED ROADWAY APPEARING ON THE MAJOR THOROUGHFARE AND FREEWAY PLAN, HOUSTON CITY PLANNING COMMISSION.

NOTE: ALL REFERENCES TO HARRIS COUNTY AND CITY OF HOUSTON SHALL BE REFERRED TO CITY OF WEBSTER, COMMUNITY DEVELOPMENT DEPARTMENT.

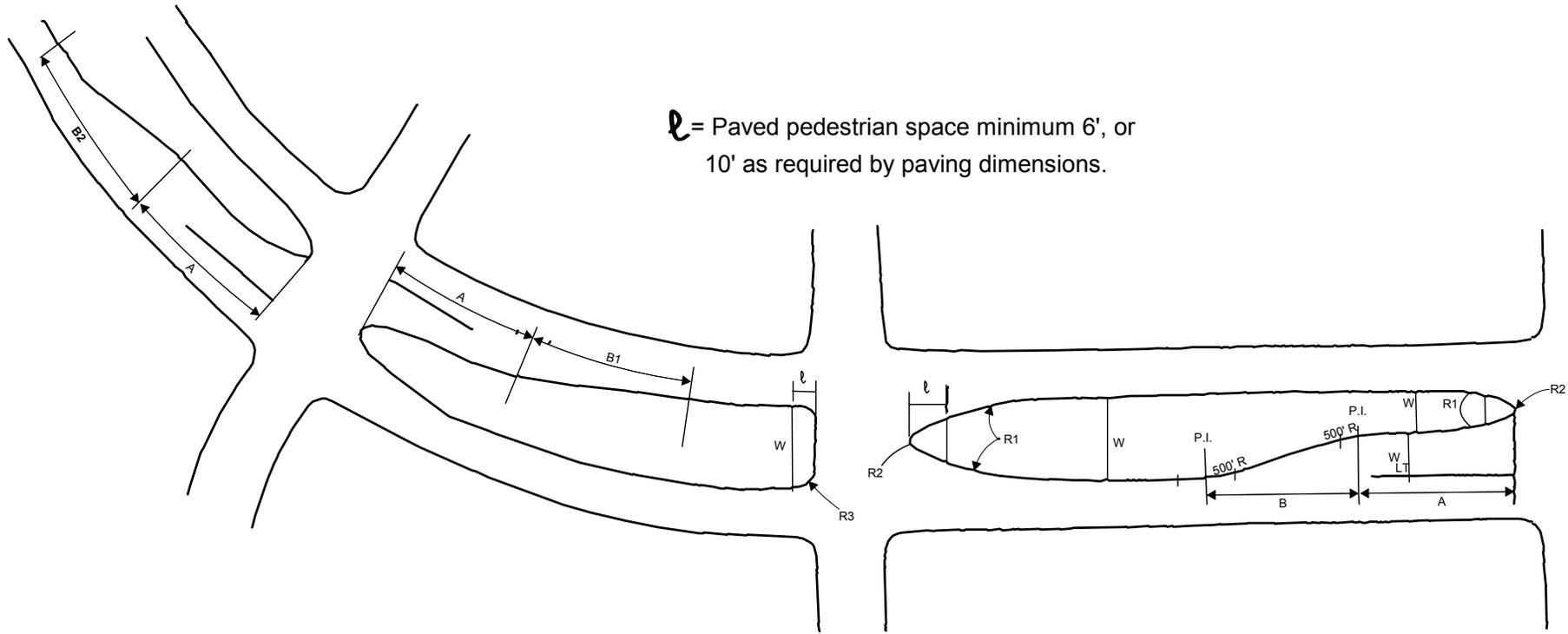
TYPICAL LENGTH OF MEDIAN AND MEDIAN OPENING



MINIMUM ACCEPTABLE MEDIAN LENGTH FOR TYPE OF STREET

IF PLANNED DIVIDED STREET IS:	PURPOSE OF MEDIAN INTERRUPTION			
	MAJOR STREET/ THOROUGHFARE (A)	COLLECTOR STREET (A)	LOCAL STREET (A)	PRIVATE STREET OR DRIVEWAY (B)
MAJOR STREET/THOROUGHFARE	350'	300'	300'	300'
COLLECTOR STREET	300'	250'	250'	250'
LOCAL STREET	250'	250'	250'	250'

MEDIAN NOSE AND LEFT TURN BAY DESIGN



l = Paved pedestrian space minimum 6', or
 10' as required by paving dimensions.

MEDIAN DIMENSIONS			
W	R1	R2	R3
≤ 10'	NONE	W/2	NONE
> 10'	90'	W/5	NONE
< 40'	NONE	NONE	15'

LEFT TURN BAY DIMENSIONS

A = 150' minimum at intersections of two major streets.
 = 100' minimum at all other intersections.

B = 100' minimum on straight roadway.

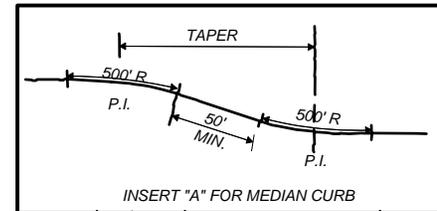
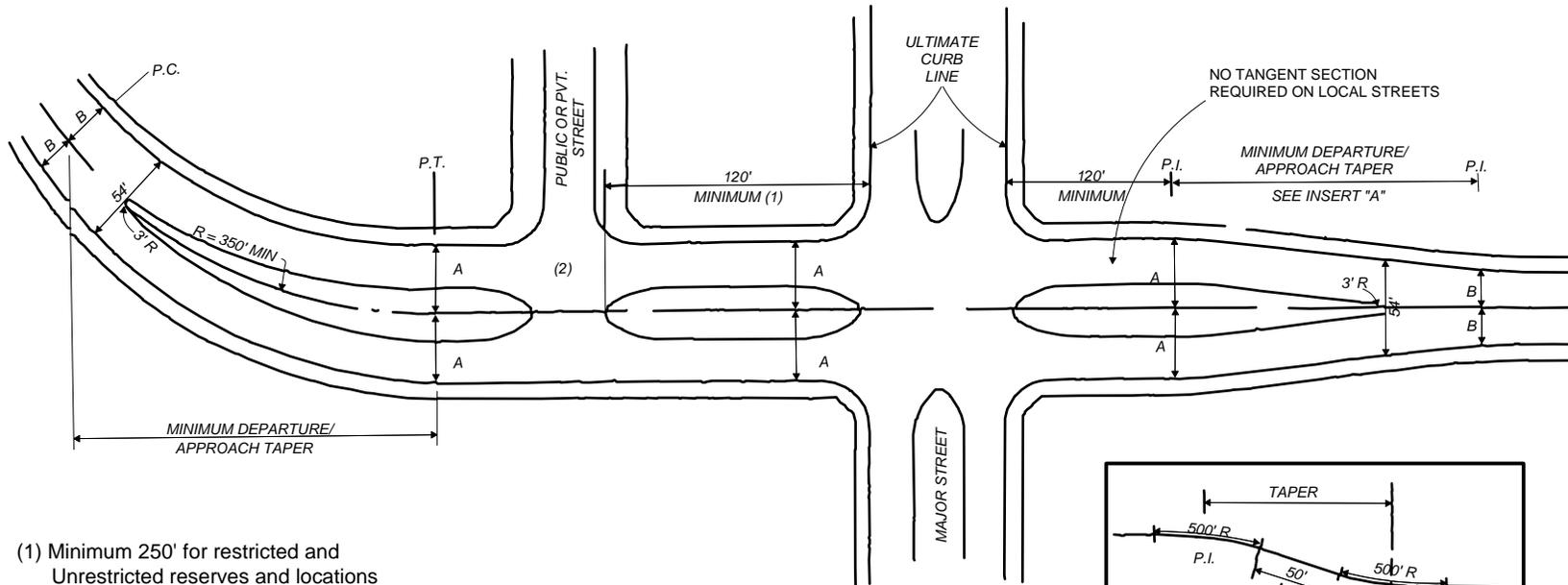
B1 = Taper length may be shorter if it is on a horizontal curve to the left.

B2 = Taper length may be longer if curve is to the right.

W (LT) = 10' minimum

Note: Dimensions may be adjusted as determined by Community Development Department
 The above lengths required are minimum distance and may require adjusting to comply with
 acceptable engineering practices or an approved traffic Impact Analysis.

ROADWAY TAPERS FOR SUBDIVISION STREETS



Notes: (1) Minimum 250' for restricted and Unrestricted reserves and locations Where a left turn lane may be required.

(2) Median opening may not be allowed if median becomes less than 250' in length on major street.

(3) Approach and Departure Taper Requirement:

$L = ws^2/60$ Where L = length in feet
 S = speed in m.p.h.
 W = lateral offset in feet

For S < 40 & S = 30 m.p.h. Minimum design speed for subdivision streets.

$W = A - B$

(4) 350' minimum centerline radius for horizontal curve with approach or departure tapers.

(5) Approach and departure taper requirements:

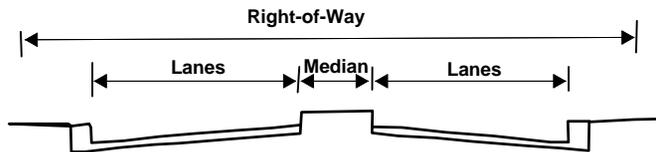
S > 45
 L = SW

QUICK REFERENCE GUIDE

ROADWAY CROSS SECTION (FEET)		TAPER $L=WS^2/60$ (FEET)
A + A	B + B	
80	60	150
80	40	300
80	27	400
70	40	225
70	27	325
60	40	150
60	27	250
40	27	100

GEOMETRIC STREET DESIGN STANDARDS

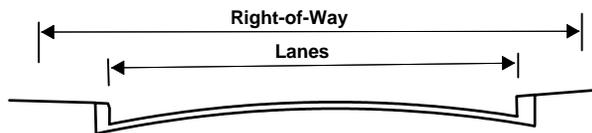
Minimum Standards



DIVIDED ROADWAYS

Arterials

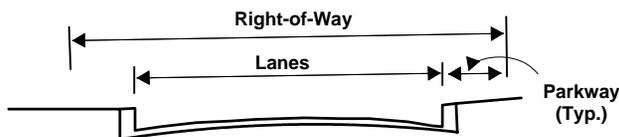
- PA6D -- Major Arterial, 6 Lanes, Divided
- PA4D -- Major Arterial, 4 Lanes, Divided
- MA4D -- Minor Arterial, 4 Lanes, Divided
- PC4D -- Major Collector, 4 Lanes, Divided



UNDIVIDED ROADWAYS

Arterials -- Collectors

- MA4U -- Minor Arterial, 4 Lanes, Undivided
- PC4U -- Major Collector, 4 Lanes, Undivided
- PC2U -- Minor Collector, 2 Lanes, Undivided



LOCAL STREETS

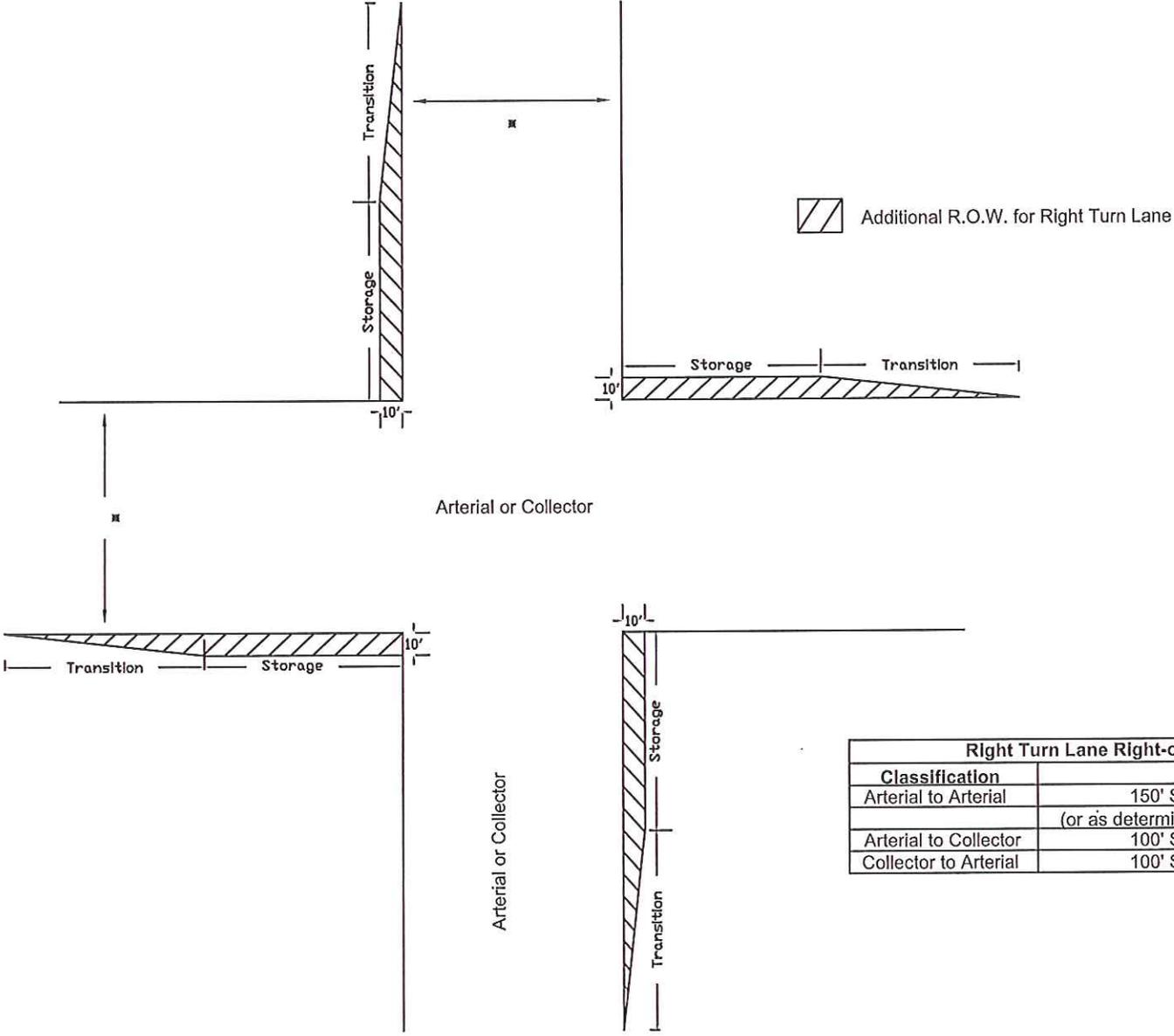
- LR2U -- Residential, 2 Lanes, Undivided

Design Element	Roadway Type							
	PA6D	PA4D	MA4D	MA4U	PC4D	PC4U	PC2U	LR2U
Number Traffic Lanes	6	4	4	4	4	4	2	2
Lane Width (Ft.)	12	12	12	11	12	11	36'-40' F-F	36' F-F
R.O.W. Width (Ft.)	120	100	80	60	80	60	60	60
Design Speed (MPH)	40-50	40-50	35-45	35-45	30-40	30-40	30-40	20-30
Max. Grade (%)	6	6	6	6	8	8	8	10
Stopping Sight Distance (Ft.)	325-525	325-475	250-400	250-400	200-325	200-325	200-325	125-200
Horizontal Curvature Min. Radius (Ft.)	2000	2000	1050	1050	850	850	600	500 or 300*
Vertical Clearance (Ft.)	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5
Lateral Clearance (Ft.)	6	6	6	6	6	6	6	-
Min. Median Width (Ft.)	28	28	-	-	-	-	-	-
Parking Permitted	No	No	No	No	No	No	Some	Yes
Parkway Width (Ft.)	10	12	12	11	12	10.5	10	11.5

* For local streets less than 2000' long.

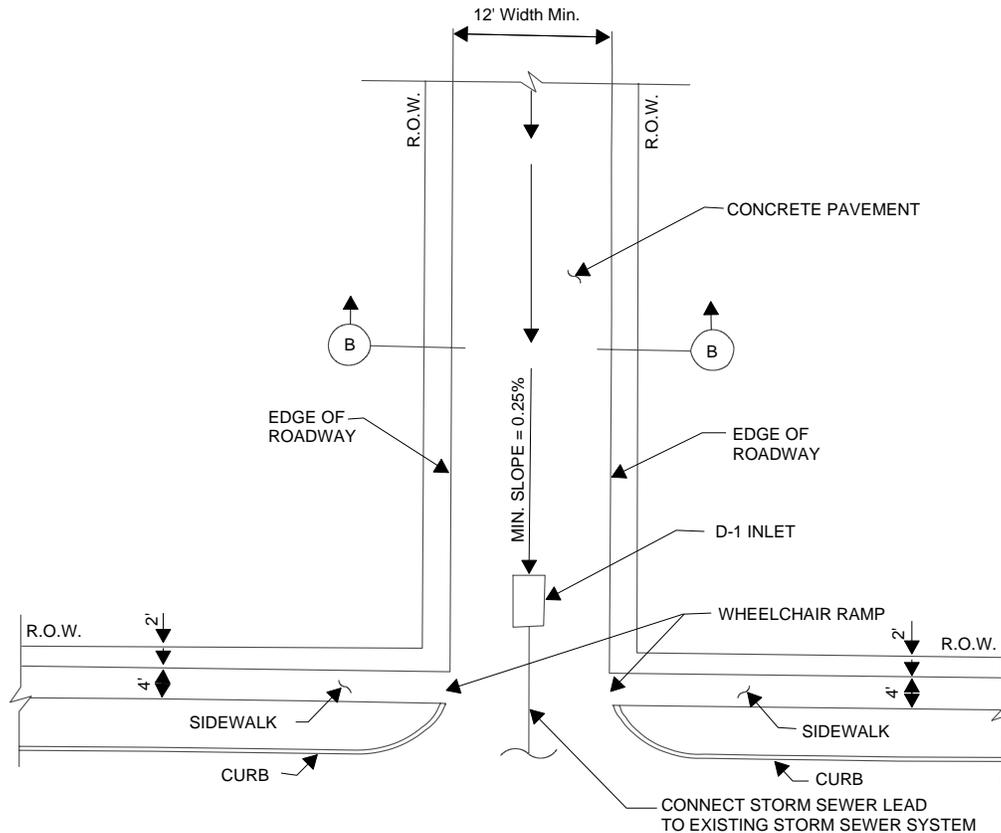
RIGHT TURN LANE RIGHT-OF-WAY REQUIREMENTS

Drawing prepared on 05/14/2009
 By: City of Webster
 H:\A\03\0515\0171\11010225\0515.dwg
 V:\11010225\0515.dwg

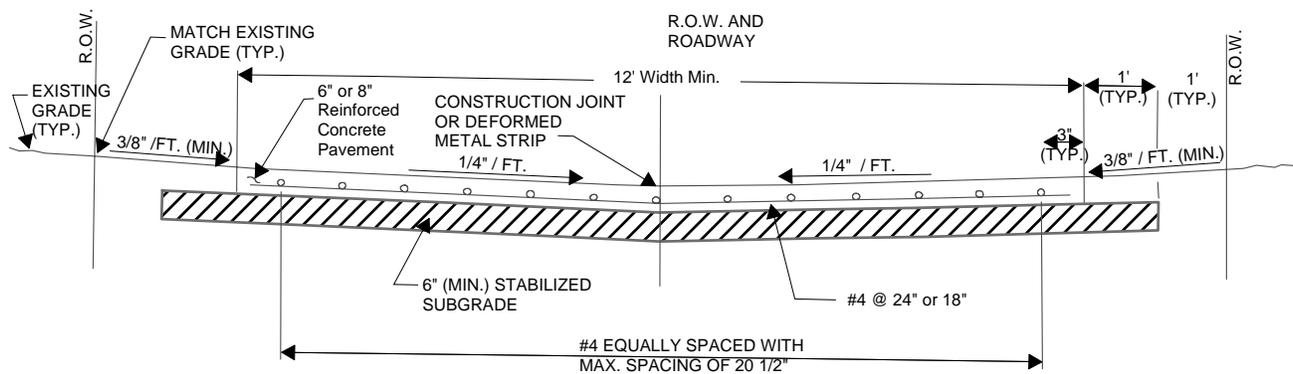


Right Turn Lane Right-of-Way Dimensions	
Classification	Dimensions
Arterial to Arterial	150' Storage; 150' Transition
	(or as determined by a thoroughfare study)
Arterial to Collector	100' Storage; 150' Transition
Collector to Arterial	100' Storage; 100' Transition

ALLEY PAVING CURB AND GUTTER STREET



PLAN VIEW

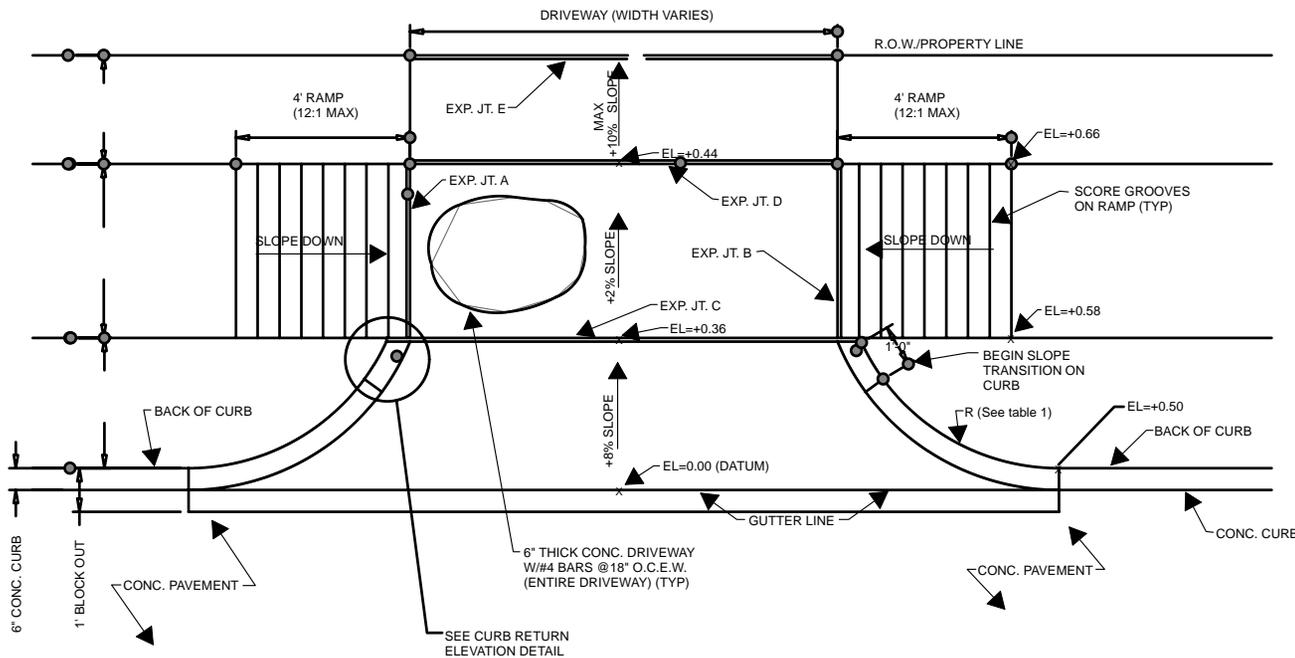


SECTION B-B

STANDARD DRIVEWAY DETAILS

Community Development Department

City of Webster, TX

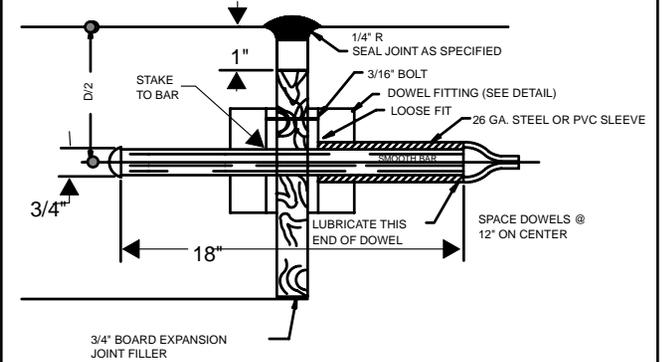


DRIVEWAY APPROACH FOR CURB & GUTTER STREETS

NTS

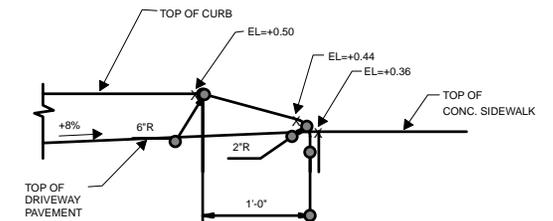
NOTES:

1. EXPANSION JOINTS A AND B SHALL BE TYPICAL DOWELED SIDEWALK EXPANSION JOINTS WITH 5/8" DIAMETER SMOOTH DOWELS PER DETAIL. DOWEL SPACING SHALL BE SAME AS SIDEWALK REINFORCEMENT SPACING (LONGITUDINAL).
2. EXPANSION JOINTS C, D AND E SHALL BE STANDARD DOWELED EXPANSION JOINTS WITH 3/4" DIAMETER SMOOTH DOWEL AT 18" ON CENTER. THESE EXPANSION JOINTS SHALL MATCH THOSE EXPANSION JOINTS INSTALLED FOR THE CONCRETE ROADWAY PAVEMENT.
3. ALL CONCRETE IN DRIVEWAY SHALL BE TYPE "D" AND SHALL HAVE A MINIMUM COMPRESSIVE STRENGTH OF 3,500 PSI AT 28 DAYS.
4. SOFT SUBGRADE SHALL BE REMOVED & REPLACED WITH ACCEPTABLE MATERIAL. ALL SUBGRADE SHALL BE COMPACTED TO 95% STANDARD PROCTOR AT +/- 2% OPTIMUM MOISTURE CONTENT.
5. A 2" COMPACTED SAND LAYER SHALL BE INSTALLED UNDER DRIVEWAY AND SIDEWALK PAVING.



DOWEL TYPE EXPANSION JOINT IN CONCRETE PAVEMENT

NTS



CURB RETURN ELEVATION

NTS

TABLE 1: RADII AND WIDTHS FOR DRIVEWAYS

	RESIDENTIAL	ALL OTHERS
"A" DRIVEWAY WIDTH		
ONE WAY	12' MIN - 20' MAX	-----
TWO WAY	12' MIN - 24' MAX	24' MIN - 36' MAX
"R" DRIVEWAY RADIUS		
CITY	5' MIN - 15' MAX	10' MIN - 15' MAX