

CITY OF LA MARQUE, TEXAS

CHAPTER 3

WATER SYSTEM DESIGN CRITERIA

CHAPTER 3 – WATER SYSTEM DESIGN

3.1 WATER SYSTEM DESIGN GENERAL

- 3.1.1 Criteria for the design of water service and water distribution lines are herein established. All water lines constructed within the City of La Marque or its Extraterritorial Jurisdiction (ETJ) shall follow these criteria.
- 3.1.2 Design, construction and sizing of all water mains and appurtenances shall meet or exceed the requirements of the Texas Commission of Environmental Quality (TCEQ) as per 30 TAC Chapter 290 and the Texas Board of Insurance (TBI).
- 3.1.3 The public water system shall not extend beyond the individual water meter. All water line construction in public rights-of-way up to and including construction to the water meter shall conform to these standards.
- 3.1.4 Design and construction shall conform to the City of La Marque standard details and specifications.

3.2 DEFINITIONS

- 3.2.1 Water line – Closed conduit designed to distribute potable water to various locations for human consumption, and to provide fire protection. Line size and fire protection accessory locations are dependent on distance from primary source and quantity of demand.

3.3 DESIGN REQUIREMENTS

- 3.3.1 Easements: The following minimum easements are required when facilities are not located within public street rights-of-way:
 - 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'x10'), exclusive, easement. Fire hydrants shall 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 located inside rights-of-way, water line easements, or in a minimum 5-foot by 5-foot (5'x5') exclusive water meter easement.
 - D. Three-inch (3") and larger meters shall be set in a minimum of ten-foot by twenty-foot (10'x20') exclusive, water meter easements.

- E. Water lines may be located in easements not adjacent to public street rights-of-way. These water lines shall be centered in a fifteen foot (15') wide exclusive easement restricted to water only.
- F. For new construction, any water line, except at a fire hydrant, located less than five feet (5') from the 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 shall have a minimum width of five feet (10').
- G. Water lines should be located at the center of a ten-foot (10') water line easement, provided the easement adjoins the public right-of-way.

3.3.2 Water Lines:

- A. Locate water lines within street rights-of-way, public utility easements, or dedicated water line easements:
 - a. No less than a 4-inch water line is allowed.
 - b. A dead end 4-inch line may supply a maximum of 10 lots, shall not exceed 400 feet in length, and shall terminate with a blow off or loop back. Fire hydrants are not allowed on a 4-inch line.
 - c. Six-inch interconnected/looped mains shall be a maximum of 800 feet long, and shall be supported on both ends by an 8-inch main or larger. Dead end 6-inch lines shall not be more than six hundred feet (600') in length and shall terminate with a blow-off valve. Only one fire hydrant or flushing valve is allowed on any length of 6-inch diameter line.
 - d. Except when 4-inch and 6-inch diameter lines are permitted under the above criteria, all water lines shall have a minimum diameter of 8-inches.
 - e. Ten-inch diameter water line is not permitted.
 - f. Pipe with a minimum 12-inch diameter should be used for lines greater than 2000 feet in length as determined by the Professional Engineer of Record and the City of La Marque.
 - g. Dead-end lines:
 - (1) Dead-end lines should be avoided whenever possible, and may only be considered when a looped or interconnected water main system is not nearby.
 - (2) The design of all water distribution systems should include the opportunity for future looping or interconnect of any approved or

proposed dead-end line. Waterline line shall be extended to the boundary of the development along public right-of-way as required for future connection.

- (3) Dead-end lines within public right-of-way:
 - (a) On permanent dead-end lines not serving residential cul-de-sacs, the line shall be 8 inches in diameter and shall not exceed more than 700 feet in length from the closest interconnection main line and shall terminate with a fire hydrant, flushing valve or blow-off valve.
 - (b) In temporary dead-end situations or if the possibility for future extension of the water line exists, do not reduce pipe sizes successively. Carry 8-inch diameter pipe to the last appurtenance or the plug. Place the last service as near as possible to the end and install a standard blow off valve and box at the end of the 8-inch diameter line. The maximum length of such a line shall be 700 feet.
 - (c) In unavoidable permanent dead-end situations, reduce the sizes of pipe successively. Carry a 6-inch pipe to the last fire hydrant, then use 4-inch pipe to the end of the line (400' maximum). Install a 2-inch blow-off valve at the end of the 4-inch diameter line.
- (4) Water lines located in a public easement on private property in multi-family residential applications with 1 or more fire hydrants or flushing valves shall be 8-inch diameter with an interconnection to at least 2 supply sources when possible.
 - (a) Appropriately sized domestic service shall be taken from the 8-inch lines.
 - (b) If requested, the design engineer shall submit water/hydraulic modeling data to the City Engineer demonstrating that adequate water pressures can be maintained given projected water demand in non-single family residential applications.
 - (c) The design engineer shall submit water/hydraulic-modeling data to the City Engineer demonstrating that fire flow capacity is available for the non-single family residential applications.
- h. Side lot water line placement is discouraged. Where side lot water line placement is unavoidable, install water line in continuous steel casing

pipe, centered in a 20-foot wide dedicated water line easement. Extend the casing uninterrupted from right-of-way to right-of-way. No horizontal or vertical deflections are allowed. Construct encased water line of ductile iron or restrained joint bell and spigot pipe to prevent lateral movement. Provide and install casing spacers and end seals. This item shall only apply to publicly maintained lines.

- B. Layout and size of all water lines 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 operating pressure throughout the system.
- C. Chlorination: All newly installed water lines shall have to pass bacteriological testing before being accepted for maintenance by the City of La Marque. All costs associated with the testing shall be the responsibility of the owner.
- D. Pressure Testing: All newly installed water lines shall be flushed and pressure tested before being accepted for maintenance by the City of La Marque. All costs associated with the testing shall be the responsibility of the owner.
- E. Material: Water lines shall be constructed of AWWA C-900 DR-18 or approved equal.

3.3.3 Location

- A. Locate water lines within street rights-of-way.
- B. Boulevard streets: Water lines shall not be located within the esplanade.
- C. Locations within an easement: Locate water lines in the center of exclusive dedicated water line easements.
- D. When a water line is placed parallel to any other proposed or existing utility line, other than a sanitary sewer, the water line shall have a minimum of 4 feet horizontal clearance from the outside wall of the existing utility to the outside wall of the proposed water line.
- E. A minimum distance of 4 feet shall be maintained from the right-of-way or easement line to the outside edge of the water line.

3.3.4 Depth of Cover (See Table 3.1)

- A. Provide the minimum depths of cover shown in Table 3.1 from the top of finished grade behind the curb for curb-and-gutter streets, or from the lowest elevation of the nearby ditch bottom for roadside ditch street sections, whichever is applicable.

- B. Whenever possible, changes in grade or alignment to clear utilities or underground features should be accomplished by deflecting pipe joints. The maximum designed deflection shall be ½ of the manufacturer’s allowable deflection. The use of regular bends for any change of grade shall not be allowed.
- C. If a depth greater than 8 feet or less than 4 feet to the top of the pipe is proposed, use restrained joint pipe, ductile iron, or other comparable high hoop strength material pipe, and continue for all areas where the depth of cover exceeds 8 feet or is less than 4 feet.
 - a. All transitions from ductile iron pipe to other water line material shall be constructed using electrically isolated flange joints.
 - b. Ductile iron or other comparable high hoop strength material pipe shall be pressure class 350.

Table 3.1 DEPTH OF COVER FOR WATER LINES		
SIZE OF LINE	DEPTH OF COVER*	
	TOP-OF-CURB	OPEN-DITCH
8-INCH & SMALLER	4 FEET	4 FEET below ultimate flow line
12-INCH & LARGER	5 FEET	5 FEET below ultimate flow line

*When crossing easements whose owning or governing agency has stricter depth of cover criteria than that shown in Table 3.1, the more stringent of the two shall apply.

3.3.5 Appurtenances

- A. Do not place appurtenances in pavement when the appurtenance would be covered in whole or in part by pavement. Gate valves may be placed in sidewalks provided that the top of the valve box is flush with the finished elevation.
- B. All water system valves shall conform with AWWA standards and shall include:
 - a. Cast iron valve boxes are required on all valves less than or equal to 16 inches. Valve vaults are required on all valves 20 inches and larger.
 - b. All valves shall be sized to equal the size of the water main on which it is located.
- C. Valves
 - a. Spacing – set at maximum distances along the water line as follows:
 - (1) 8” & Smaller – 1000 feet.

- (2) 12" & Larger – 2000 feet.
- (3) The total number of valves at any water line intersection shall equal the total number of lines leading out from the intersection point minus one.
- (4) Refer to standard specifications for tapping sleeve & valve.

b. Location

- (1) Valves must be located at street intersections along the street right-of-way lines projected across the water line where possible. Tapping sleeve and valves are excluded from this requirement.
- (2) Isolate fire hydrants and flushing valves from the service main with a valve located in the fire hydrant or flushing valve lead. This valve should not be located in the slope or flow line of roadside ditches.
- (3) Intermediate valves, not located on the projection of the right-of-way line, shall be located on lot lines or 5 feet from fire hydrants, but shall not be set in a driveway.
- (4) Locate valves a minimum of 10 feet horizontally away (either direction) from any sanitary sewer crossing.
- (5) Valves located near reducers shall be located on the smaller diameter pipe.
- (6) All water mains shall be valved within the street right-of-way or dedicated water line easement. Valves shall not be placed under or within 2 feet of ultimate pavement, when it is known that the street will be widened in the future.
- (7) Valves shall be placed at the end of all water mains that are to be extended in the future and the main shall be extended a minimum of two pipe joint past the valve.
- (8) All valve shall be right close.

c. Valve Type

- (1) 16" & smaller – Gate Valve
- (2) 20" & larger – Butterfly Valve

D. Fire Hydrants

a. Spacing

- (1) Single family residential development – 500 foot maximum spacing.
- (2) All other development – 300 foot spacing.

b. Location in or along street right-of-way

- (1) Locate fire hydrants primarily at or near street intersections.
- (2) Locate fire hydrants at the end of a curb radius of a street intersection, 3 feet behind back of curb or projected future curb in a curb & gutter road construction.
- (3) On streets with roadside ditches, set the fire hydrants within 5 feet of rights-of-way lines. Fire hydrant lead valves should not be located in the slopes or flow lines of ditches.
- (4) Set fire hydrants not located at intersections or block corners at mid-lot or on lot lines, as extended to pavement, when located between right-of-way intersections. These locations may be adjusted 5 feet either way to avoid driveways or obstructions. In either case, do not locate fire hydrants closer than 5 feet from driveways.
- (5) Fire hydrants are not allowed in esplanades of streets.
- (6) On all Texas Department Transportation (TXDOT) rights-of-way, the fire hydrant and flushing valve set-backs from the edge of right-of-way shall adhere to TXDOT criteria.

c. Location of fire hydrants or flushing valves outside street rights-of-way and in public easements:

- (1) City review and approval is required for all submitted locations of fire hydrants and flushing valves in all developments within the City of La Marque and its ETJ.
- (2) Locate fire hydrant and flushing valves in protected, easily accessible areas behind curb lines.
- (3) For fire hydrants or flushing valves that are located adjacent to water lines constructed in 10 foot wide water line easements, the fire hydrant or flushing valve shall be centered in a

minimum 10 foot by 10 foot separate easement.

(4) For non-residential developments in the City of La Marque, provide isolation valves at each end of fire loops requiring on-site fire hydrants.

- d. Fire hydrant leads shall be designed to have a minimum 4 foot bury where possible. Bends may be used on the fire hydrant branch to maintain a 4 foot bury or a 3 foot back of curb set-back.
- e. Do not install fire hydrants within 10 feet vertically or horizontally of sanitary sewers and force mains.

E. Fittings

- a. Fittings shall be Ductile Iron.
- b. Use plugs with retention clamps and carrying the designation "plug and clamp." Thrust blocking is required for dead-end lines that are plugged.
- c. Concrete thrust blocking shall be required on all bends, tees, plugs, and combinations thereof.
- d. All fittings and fire hydrants to be tied together with $\frac{3}{4}$ inch stainless steel all threads and I-bolts or with restrained joint fittings.
- e. All water main joints shall be push on joints. Mechanical joints may be used for above ground water line installations.
- f. All fittings are to be double wrapped in 6 mil plastic.

F. Ductile Iron Pipe

- a. Ductile iron pipe shall be provided with polyethylene encasement. Provide minimum 2 wraps of 8-mil polyethylene, or
- b. 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 C-105, current revision. Soils within the project shall be tested to adequately determine the requirements of the encasement. Appendix A of ANSI/AWWA C-105 shall be consulted where questions regarding soil conditions and encasement arise.

3.3.6 Water Meter Service

- A. All water meters shall be installed by the City of La Marque.

- B. A water meter permit must be obtained from the City of La Marque prior to installation.
- C. Stub outs for future water service are not allowed except where part of a preapproved master plan, site plan development plan or tract development plan.
- D. In new residential developments, water service lines shall be provided for all lots on the opposite side of the street. Services shall normally be at lot lines with a $\frac{3}{4}$ inch minimum size to serve a single lot and 1 inch minimum for two lots. Lines shall be SDR-9 polyethylene. The City of La Marque Building Inspector should be consulted to ensure the properly sized meter is selected for any proposed service.
- E. Water service leads from the water main to the water meter shall be placed at a minimum 4 foot below final paving elevations.
- F. Water Meter Service for Lines in or Along Rights-Of-Way
 - a. Meters 2 inches and smaller: Locate inside rights-of-way, water line easements, or in a minimum 5-foot by 5-foot exclusive water meter easement. Provide concrete meter boxes for meters located in sidewalks. Meters shall be located in areas with easy access and protection from traffic.
 - b. Meters 3 inches and larger: Locate in minimum 10'x20' separate water meter easement:
 - (1) Meters shall be located in areas with easy access and protection from traffic, and adjacent to rights-of-way whenever possible.
 - (2) Meters shall not be located in areas enclosed by fences.
 - c. Separate taps and service leads shall be designed for each meter. Meter, line size, and appurtenances shall conform to the latest edition of the Uniform Plumbing Code.
- G. Meter boxes shall be located just within the public right-of-way if possible. Location of meters in the ditch of open ditch streets shall be avoided. Meter boxes shall be installed no more than 2 inches above grade.
- H. For proposed multi-family developments, provide one master meter sized for the entire development. An above-ground, reduced pressure, zone-type backflow preventer shall be installed on the water line downstream from the meter.

- I. For commercial developments with private on-site water mains for fire protection (i.e. not in a dedicated water line easement), provide fire service meters adjacent to the public right-of-way. If a dual (fire and domestic) feed is desired, both feeds shall be metered. An above-ground, reduced pressure, zone-type backflow preventer shall be installed on the water lines downstream from the meters.

3.3.7 Water Line Crossings within the City of La Marque

- A. Public and private utility crossings other than sanitary sewer: Where a water line crosses another utility other than a sanitary sewer, a minimum of 12 inches of clearance must be maintained between the outside wall of the water line and the outside wall of the utility.
- B. Stream or ditch crossings
 - a. Elevated crossings
 - (1) Water lines shall be steel, ductile iron pipe, or other comparable high hoop strength material and shall extend a minimum of 15 feet beyond the last bend or to the right of way line, whichever is greater.
 - (2) Elevated crossings are preferred to underground crossings.
 - (3) Crossings attached to vehicular bridges are preferred to separate elevated water line structures.
 - (4) For new vehicular bridge construction, include provisions for attaching a water line.
 - (a) Adequate structural capacity shall have been calculated and provided for, including considerations for pipe deflection and all applicable loading.
 - (b) Clearance for maintenance purposes above bent cap elevation shall be provided where elevated water lines are to be run under bridges.
 - (5) For new water line crossings near existing vehicular bridges, a separate elevated water line structure shall be constructed.
 - (6) Design all elevated crossings with the elevation of the bottom of the water line 2 feet above the 100-year water surface elevation in the channel.
 - (7) Create a high point in the elevated stream or ditch crossing and

provide an air release valve at that highest point of the water line.

- (8) Provide sufficient span length to accommodate the cross section of future widening of the stream or ditch to ultimate cross section.
- (9) Base the columns' support designs on soil capacity, spacing, loading, and all pertinent structural requirements.
- (10) Spacing of supports shall consider effect of support on channel hydraulics and be subject to city approval.
- (11) Provide pedestrian pipe guards on elevated crossings.

b. Underground Crossings

- (1) Provide a minimum 5 foot clearance from the top of the pipeline to the ultimate flow line of the ditch.
- (2) Provide sufficient length to exceed the ultimate future development of the stream or ditch.
- (3) Water lines shall be Class 150, C-900 or ductile iron pipe and shall extend a minimum of 40 feet beyond the last bend or to the right of way line, whichever is greater.
- (4) Restrained Joints shall be used.
- (5) Locate valves on each side of the crossing.
- (6) Where other agencies have review authority or jurisdiction and have different underground crossing requirements, the more stringent of the two shall apply.

C. State Highway and County Road Crossings

- a. Extend steel casing pipe from 5' on each side beyond the edge of pavement.
- b. The approval of the design by the appropriate governmental agency shall be demonstrated to the City of La Marque before plans will be approved.
- c. Where additional right-of-way has been acquired for future widening, the casing shall extend to the future right-of-way line.

D. Railroad Crossings

- a. For main line and spur line railroad crossings, the water line shall meet the requirements of the governing agency and such requirements shall be followed from 5 feet beyond each right-of-way line and across the right-of-way itself. Any deviation must be approved by the railroad companies.
- b. Where there is no railroad but a railroad owned easement or right-of-way, as a minimum, extend a steel casing from right-of-way to right-of-way line.
- c. The approval of the design concept by the railroad involved must be obtained and demonstrated to the City of La Marque before plans will be approved.

E. Additional Requirements

- a. Use isolated flange joints for transitions between two dissimilar metallic pipes. Isolate water lines from casing with spacers and supports.
- b. The carrier pipeline shall extend a minimum of 1-foot beyond the end of the casing to allow flanged joints to be constructed if necessary.

F. Oil and Gas Pipeline Crossings

Use PVC pipe when crossing a non-service transmission pipeline regardless of depth. All non-service transmission pipeline crossings must have the approval of the company whose lines are being crossed. Maintain a minimum 2 foot vertical separation between the pipeline and the water line.

G. Fire flow Water line Loops within Non-Residential Developments

For non-residential developments inside the City of La Marque requesting on-site water mains, comply with the following requirements to allow maintenance and future repair operations if the City of La Marque will be the entity maintaining the water main:

- a. Avoid laying any new water lines under proposed or existing pavement, but where unavoidable, provide minimum 10 foot expansion joints (free joints) in the easement over the water line.
- b. Fire flow water line loops within non-residential developments that are to be maintained by the City of La Marque shall be placed in a 20-foot wide water line easement that shall be dedicated to the City.
- c. There shall be no structures or equipment pads constructed over a publicly maintained water line.

3.3.8 Auger Construction: Use the following general criteria for establishing auger, bore and jack, or microtunneling sections when site conditions require their use. Identify the sections on the construction drawings.

- A. Improved streets – Use auger or microtunneling construction to cross a street regardless of surface. Auger or microtunneling length shall be computed as roadway width at the proposed bore location plus a minimum of 10 feet to either side of roadway.
- B. Driveways – Use auger or microtunneling construction to cross improved driveways. Bore and jack, auger or microtunneling length shall be a minimum of the driveway's width.

3.3.9 Circulation and Flushing for Water Quality: The layout of the water distribution system shall provide for maximum circulation of water.

- A. Provide a source of fresh water at each end or at multiple points of a subdivision or development. Provide ways to create circulation and place valves and fire hydrants to allow simple flushing of lines.
- B. Where stubs are provided for future extensions, isolate the stubs with a valve and no service connections will be allowed beyond the valve before the line is extended. Place two full joint of pipe between the valve and the plug.

3.3.10 New Water Lines Constructed Near Sanitary Sewers, Force Mains and Manholes

- A. New Water Lines Parallel to Sanitary Sewer and Force Mains: Locate water lines a minimum of 10 feet horizontally, outside wall to outside wall, when parallel to sanitary sewers and force mains. Use the following procedure when site conditions prohibit achieving 10 feet of separation:
 - a. When a new water line is to parallel an existing sanitary sewer force main or gravity sewer and the 10 foot minimum separation cannot be achieved, the existing sanitary sewer shall be replaced with lined ductile iron pipe, SDR-26 with pressure gaskets, or PVC C-900 150 psi pipe or better and equipped with pressure type joints.
 - b. The water lines and sanitary sewer shall be separated by a minimum vertical distance of 2 feet and at least 4 feet horizontally (per 30 TAC 290.44) measured between the nearest outside walls of the pipes, where the water line shall always be located above the sewer.
- B. New Water Lines Crossing New and Existing Sanitary Sewers and Force Mains

- a. No protection is required if the sanitary sewer is 10 feet below the water line.
 - b. Use the protective requirements given in Table 3.2 and 3.3 for sanitary sewer crossings not 10 feet below the water line.
- C. Sanitary Sewer Manholes: Provide a minimum 10 foot horizontal clearance from outside wall of existing or proposed manholes, make manholes and connecting sewers watertight and test for leakage. If a 10 foot clearance cannot be obtained, the water line may be located closer to the manhole when prior approval has been obtained from the City Engineer by using one of the procedures below; however, in no case shall the clearance be less than 4 feet.
- a. The City of La Marque may require the water line to be encased when site conditions dictate or when the water line is within 5 feet of a manhole. The carrier pipe shall be a minimum of 1 joint of 150 psi pressure class pipe at least 20 feet long and two nominal sizes larger than the water conveyance pipe.
 - b. The water line may be augured, bore & jacked, or microtunneled past the manhole with at least one 20 foot section of 150 psi pressure pipe installed centered about the existing sanitary manhole with pressure grouting of the annular space using a bentonite/clay mixture or other commercial grouts.

Table 3.2 WATER LINE – SANITARY SEWER CROSSINGS

PRIMARY CONDITION	PROPOSED WATER EXISTING SANITARY				PROPOSED WATER PROPOSED SANITARY OR EXISTING WATER PROPOSED SANITARY			
	WATER OVER SANITARY		WATER UNDER SANITARY		WATER OVER SANITARY		WATER UNDER SANITARY	
IF THE CLEARANCE IS	Less than 2'	Greater than 2' but less than 10'	Less than 2'	Greater than 2' but less than 10'	Less than 2'	Greater than 2' but less than 10'	Less than 2'	Greater than 2' but less than 10'
*Protection Requirement	1	2	3	4a or 4b	5	6a	3	6b & 6c

*PROTECTION REQUIREMENTS FOR SANITARY SEWER CROSSINGS (All clearances shall be measured from outside wall to outside wall)

1. One 20-foot joint of C-900 or C-905 PVC, 150 psi centered over sanitary sewer; 12-inch minimum clearance.
2. If no evidence of sanitary sewer leakage, center one joint of water line over sanitary sewer; 24 inch minimum clearance. If the sewer line is leaking, the sewer line shall be replaced with 150 psi lined ductile iron pipe or other approved pressure pipe with appropriate adapters on all portions of the sanitary sewer within 10 feet of the water line.
3. Not allowed.
4.
 - a. Auger, bore & jack or microtunnel 10 feet minimum each side of sanitary sewer. Place one 20-foot joint of C-900 or C905, 150 psi, centered under sanitary sewer. Fill bore hole with bentonite/clay mixture or grout; 2 foot minimum clearance. OR
 - b. Replace the existing sanitary sewer with 150 psi lined ductile iron pipe, C-900 or other approved pressure pipe with appropriate adapters on all portions of the sanitary sewer within 10 feet of the water line.
5. Minimum 20 foot joint of sanitary sewer, 150 psi lined ductile iron pipe, C-900 or other approved pressure pipe centered at the water line, 6 inch minimum clearance. Also center an 20 foot joint of water line over the sanitary sewer line. The sanitary sewer line shall be embedded in cement stabilized sand for one pipe segment plus 1 foot beyond each joint.
6.
 - a. Center a minimum 20 foot joint of sanitary sewer, 150 psi, lined ductile iron pipe, C-900 or other approved pressure pipe on water line.
 - b. Use cement stabilized sand backfill for all portions of the sewer within 10 feet of the water line, as measured perpendicularly from any point on the water pipe to the wastewater pipe (minimum 2.5 sacks cement per cubic yard of sand). The cement-stabilized sand bedding shall start at a point 6 inches below the bottom of the sanitary sewer to 6 inches above the top of the sanitary sewer and one quarter of the pipe diameter on either side of the sewer.
 - c. Center a minimum 20 foot joint of water line on the sanitary sewer line.

Table 3.3 PROTECTION REQUIREMENTS AT WATER LINE – FORCE MAIN CROSSINGS

PRIMARY CONDITION	PROPOSED WATER EXISTING FORCE MAIN				PROPOSED WATER PROPOSED FORCE MAIN OR EXISTING WATER PROPOSED FORCE MAIN			
	WATER OVER FORCE MAIN		WATER UNDER FORCE MAIN		WATER OVER FORCE MAIN		WATER UNDER FORCE MAIN	
IF THE CLEARANCE IS	Less than 2'	Greater than 2' but less than 10'	Less than 2'	Greater than 2' but less than 10'	Less than 2'	Greater than 2' but less than 10'	Less than 2'	Greater than 2' but less than 10'
*Protection Requirement	1	2	3	4a or 4b	5	6a	3	6a & 6b

*PROTECTION REQUIREMENTS FOR FORCE MAIN CROSSINGS (All clearances shall be measured from outside wall to outside wall)

1. Construct water line with a 20-foot ductile iron section with all related appurtenances centered above the force main; 6-inch minimum clearance.
2. Construct water line with one 20 foot joint of C-900 or C-905 150 psi PVC centered above the force main.
3. Not allowed.
4. a. Auger, bore & jack or microtunnel 10 feet minimum each side of force main. Place one 20-foot joint of C-900 or C905, 150 psi, centered under sanitary sewer. Fill bore hole with bentonite/clay mixture or grout; 2 foot minimum clearance. OR
 - b. Replace the existing force main with 150 psi lined ductile iron pipe with appropriate adapters on all portions of the force main within 10 feet of the water line.
5. Center a minimum 20 foot joint of force main, 150 psi lined ductile iron pipe under water line and use cement-stabilized sand backfill for all portions of the sanitary sewer force main with 10 feet of the water line as measured perpendicularly from any point on the water pipe to the sanitary sewer force main pipe (minimum 2.5 sacks cement per cubic yard of sand). The cement-stabilized sand bedding shall be from a point 6 inches below the bottom of the sanitary sewer force main to 6 inches above the top of the sanitary sewer force main and one quarter of the pipe diameter of the sanitary sewer force main on either side of the sanitary sewer force main.
6. Minimum 20 foot of sanitary sewer force main, 150 psi lined ductile iron pipe centered at the water line.

3.4 QUALITY ASSURANCE

3.4.1 Prepare calculations and drawings prepared under the supervision of a Texas Professional Engineer trained and licensed under the disciplines required by the nature of the drawings. The final design drawings, must be sealed, signed and dated by the Professional Engineer responsible for development of the drawings.

3.4.2 For Elevated Stream and Ditch Crossings: Prepare design calculations for support columns and column spacing.

3.5 RECLAIMED WATER

3.5.1 Reclaimed water facilities shall meet or exceed the requirements of the TCEQ, as per 30 TAC Chapter 321, Subchapter P.