BRYAN / COLLEGE STATION

UNIFIED DESIGN GUIDELINES

~~2012~~
2016

Domestic Water

Sentences and/or paragraphs that are double underlined indicate revisions that were made from the ~~2009~~ 2012 manual.

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GENERAL:

The purpose of this manual is to establish certain minimum criteria for the design of water distribution mains in the Cities' jurisdiction. It is intended to be used by the city staff and private consulting engineers for all new utility construction, replacements and modifications to the existing systems. Unusual circumstances or special designs requiring exception from the standards in this manual must be approved by the City Engineer.

This manual is intended to be used in conjunction with all current American Water Works Association (AWWA) and Texas Commission on Environmental Quality (TCEQ) requirements. Additionally, all design should be in accordance with the adopted version of the International Fire Code. In the case of a conflict between this manual and either or both of these other requirements, the most restrictive will govern.

The criteria outlined in this manual are also intended to be used in conjunction with the Cities' Unified Technical Specifications.

For the purpose of this manual, water distribution mains are those mains of 12 inches in diameter or smaller. Larger diameter mains are considered to be transmission mains and are subject to additional design criteria and review.

Submittal Requirements

The design engineer shall submit the following information with all water system designs:

- Plan and profile sheets containing all information necessary to review, construct and inspect the proposed improvements. This shall include a traffic control plan as applicable.
- Water Design Report showing that the design of the proposed improvements meets the requirements of this manual (such as fire flows, pressure, maximum run lengths, velocities, etc.)
- Copy of information provided to TCEQ in compliance with TCEQ submittal requirements (TAC290) for City records purposes. If the project is exempted from TCEQ submittal, this submittal to the City is also exempted.
- Certification that plans meet all requirements except where noted.
- Erosion Control Plan (project limits)
- All engineering documents required to be submitted to the City for Review (i.e. Reports, Construction documents) shall be complete, conform to local, state, and federal regulations, and bear a seal of a Professional Engineer with Signature and date

unless the proposed improvements are below the threshold specified in the Texas Board of Professional Engineers.

Special Designs

The City Engineer may, upon request, approve an alternative design, unusual circumstance, or construction methodology that differs from the requirements in this manual on a case by case basis if the City Engineer determines that: (1) the alternative design or construction methodology is equivalent to, or superior to, the methodology required in this manual, and (2) the alternative design or construction methodology is sufficient to ensure public health and safety.

Connections

All connections and service leads shall be installed to both sides of all roads and alleys at the time of main line installation.

Service connections to 16" or larger water mains shall not be allowed.

PIPE SELECTION:

Pipes shall be selected, sized and designed to provide a safe, efficient and maintainable system for the conveyance of domestic water from existing supplies and systems to new or existing users.

Pipe Materials

The following pipe materials may be specified for water distribution mains:

- Ductile iron pipe (DIP) per ANSI/AWWA C151/A21.5 pressure class 350 for sizes 6 through 12 inches, pressure class 250 for 18 inch, and pressure class 200 for 24 inches and greater. Where excessive depths are encountered (greater than 10 feet), the design engineer shall specify an appropriate thickness class to be approved by the City Engineer.
- Polyvinyl chloride pipe (PVC) shall be DR14 (meeting current AWWA C-900 standards) for sizes 4 through 12 inches; and DR 14 (meeting current AWWA C-905 standards) for pipe sizes greater than 12 inches. PVC pipe will not be permitted for aerial crossings. DI fittings shall be used with PVC pipe. Fittings shall be wrapped with eight-mil polywrap and sealed on the edges with an approved tape.

- Type 'K' soft copper tubing shall be used for all service lines 2 inches and smaller.

Changes in pipe material shall only occur at valves or fittings with the exception of short replacements of water lines needed to meet TCEQ separation requirements.

For material information on pipe encasements refer to "Encasements" on Page 10.

Pipe Sizing

Pipes and pipe systems shall be designed to provide the service criteria listed below.

Standard Pipe Sizes

The standard pipe sizes for water distribution mains are 4, 6, 8, 12, 16, and 18 inches in diameter. For Commercial and Industrial zoned areas, minimum pipe size shall be 8 inches. As discussed in the "Maximum Lengths for Water Mains" Section, the smaller lines have restrictions for use. Standard size service lines within the right of way shall be 1, 1½, or 2 inch.

Looping Requirements

Permanent dead-end mains will not be allowed if looping alternatives are available. This may require extending the water lines beyond project limits.

Dead-end mains ~~will~~ may be allowed at ends of cul-de-sacs where the only alternative is to loop lines down side lot lines in residential subdivisions.

Fire Suppression Service Line

Fire suppression service lines shall be private lines. An isolation valve, locked in an open position, shall be installed on the fire suppression service line and shall be maintained by the City. Fire suppression service lines shall not be tapped for service and shall be designed and constructed in accordance to these guidelines. Only one connection allowed to City main per building. No looping of fire suppression service lines shall be allowed.

Maximum Lengths for Water Mains

A 4 inch line may be allowed for permanent dead-end mains not exceeding 500 feet. A 6 inch main may be allowed up to a maximum of 1500 feet in length and must connect at each end to an 8 inch or larger main and shall have no more than 2 fire hydrants or flushing points. Where it is not possible to meet this requirement, a 6-inch main may be extended to a maximum of 800 feet in length and shall terminate with a fire hydrant or blow-off assembly.

TCEQ rules shall dictate the number of services allowed on the smaller sized line.

Pressure/Flow Requirements

Water distribution mains shall be sized to meet all of the following requirements using a Hardy-Cross based analysis method or methods encompassed in software packages such as KY-Pipe, MikeNet, or Cybernet. A Hazen-Williams Coefficient of C=110 shall be used for all required modeling scenarios.

Design Flow Calculation

Both normal and fire flows are needed for meeting the design criteria as established under Design Flow Calculation and System Design Criteria.

Normal Flow

One of the following three methods shall be used to determine the normal flows by which the water system is to be designed.

Peak Hourly Flow = (Average Daily Flow)(4)

- **Method 1 – Fixture Count Determination**

  The "fixture unit" method of estimating ***peak*** water demand may be used in accordance with the current duly adopted City Plumbing Code.

- **Method 2 - Land Use Determination**

  Table I contains the normal flow demands that are expected from a variety of uses.

  The population factor for residential land uses is 2.67 persons per unit, which is then applied to the actual number of units per acre, if known, or the maximum units per acre from the current land use plan if the property development is not yet finalized.

The population factors for non-residential uses are 30 persons per acre for commercial, office and institutional uses and 15 persons per acre for Industrial uses.

- **Method 3 - Gross Area Determination**

  In the absence of projected land uses, the demands contained in Table II may be used.

Fire Flows

For the purposes of this manual, the following shall be used for fire flow determinations unless greater flows are required for hydrants near structures as per the adopted International Fire Code.

- Residential

  1000 gallons per minute for public hydrants in single family or duplex residential areas

- Commercial

  At least 2500 gallons per minute for public hydrants shall be in commercial or multi-family areas (this flow may be split between two adjacent fire hydrants within 600 feet of each other). At the time that the site is developed, fire flows shall be as per the adopted Fire Code.

- Other/Hi-Rise

  For onsite fire hydrants needed to obtain coverage of commercial or other high density uses, the design engineer shall consult the City Fire Marshal to obtain the specific fire flow demands for each project via the International Fire Code.

Fire Flow System Design Criteria

The following criteria shall be met on all new water improvements.

- Under normal conditions, provide residual pressures in the area serviced by the system improvement to meet TCEQ requirements, and at all times a minimum static pressure of 35 pounds per square inch (psi).
- Under fire flow conditions, provide the required fire flow at the most hydraulically remote pairings of 2 adjacent fire hydrants in the system improvement in addition to the peak hourly flow. A residual pressure of no less than 20 psi is required.
- ~~Headloss: Less than one foot of head loss per 1,000 ft of main at a Hazen-Williams coefficient of C=110.~~

- Provide maximum velocities of not more than ~~12~~ 10 feet per second (fps) during fire flow in both existing and proposed mains. This maximum velocity may be increased on a case by case basis depending on the condition of the existing mains and if an engineering evaluation has been performed.
- Conform to any area wide master plans, including over sizing for future development.

Fire Flow Report

Prior to release of construction documents, a professional engineer sealed fire flow report must be submitted verifying the system will meet the minimum requirements and model demonstrating flows, velocities, pressures, etc. This initial report should utilize actual flow data if available. However, some assumptions put the developer/engineer at risk of the system not being able to meet the minimum standards upon completion of construction. Systems which do not meet these minimum requirements upon completion will not be accepted. Design engineer shall place the minimum required flow in gal/min on construction plans for each hydrant.

Fire Flow Testing

Upon completion within the City owned water system, a hydrant flow test will be conducted by the City, as part of the letter of completion/acceptance process. All fire flow testing shall be in accordance to the National Fire Prevention Association (NFPA) Standard No. 291, Chapter 4.

For non-City owned water systems, a professional engineer sealed report must be submitted verifying that the NFPA 291 test meeting our minimum design standards was done upon completion of the water system, before the system is acknowledged to meet the requirements.

PIPE ALIGNMENT:

The design of water distribution mains should provide for economical access for maintenance and repair, reliability of location and minimum disruption to surrounding facilities during repair operations. In all cases water facilities shall comply with TCEQ separation requirements.

Horizontal Layout

The centerline of water distribution mains constructed in street rights-of-way shall remain parallel to the right-of-way line when possible. Where

possible, avoid placing water line fittings and connections under paved and fenced areas.

The City may require the location of a proposed water main within a site to be revised based upon proximity to any existing or proposed buildings. Where possible water lines should be located at least 20 feet away from structures, however size and depth of proposed water line may increase this distance.

Vertical Layout

Water distribution mains should be laid to as straight a grade as possible between cross street connections. Vertical alignment should avoid high or low points between connections. (See Flushing Design below)

All water distribution mains shall maintain a minimum cover of 4 feet and a maximum cover of 5 feet.

Flushing Design

Water distribution mains should have a means of a minimum cleaning velocity of 5 fps. Additionally, fire hydrants shall be placed as close to low point as practical.

Air Valves

Air valves are not required in water distribution mains of 12" or smaller in diameter where fire hydrants and service connections provide a means for venting trapped air.

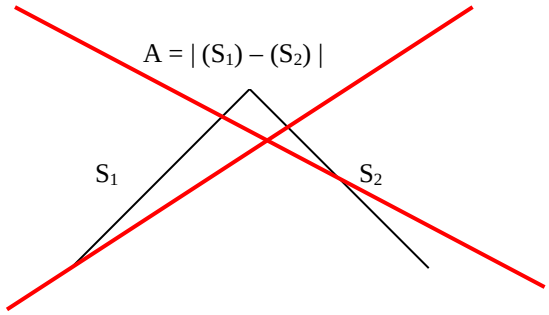
Air valves shall be located and sized as per the "Manual of Water Supply Practice, M51: Air-Release, Air/Vacuum & Combination Air Valve by AWWA, latest edition".

~~The following locations shall be considered for locating air valves:~~

- ~~High Points: Combination Air Valve~~
- ~~Long Horizontal Runs: Air Valve or Combination Air Valve at 1250-2500 ft.intervals~~
- ~~Long Descents: Combination Air Valve at 1250 to 2500 ft. intervals~~
- ~~Long Ascents: Air/Vacuum Valves at 1250 to 2500 ft. intervals~~
- ~~Decrease in an Up Slope: Air/Vacuum Valve~~
- ~~Decrease in a Down Slope: Combination Air Valve~~

It should be noted that Combination Air Valves can be used at any location in lieu of Air Release or Air/Vacuum Valves to provide added air release capacity on the pipeline. It is also important to establish a smooth pipeline grade in order to avoid an excessive number of air valves and not to follow the terrain. In addition, the height of the air vent riser shall be evaluated on a case-by-case basis in order to be well above the 100-year flood plain.

~~Air relief valves and flushing appurtenances shall be placed at critical locations including an air release valve at all peaks for lines 12" and larger and on smaller lines where the peak has an "A" of 10 or more.~~



All dead end lines shall be designed to allow adequate flushing capability. A flushing assembly shall be provided for all lines. Provisions for flushing shall be provided at critical low areas along the line.

Main Size	Blow-off
4"	2"
6"	2"
8"	2"
12"	4" or Fire Hydrant
16"	4" or Fire Hydrant
18"	4" or Fire Hydrant
≥24"	6"

Deflections, Bends and Curves

The maximum deflection of pipe is to be restricted as shown in Table III. Deflection for PVC pipe shall be made along the pipe barrel and not at the joint, while ductile iron pipe shall be deflected at the joints. Service connections should be limited in curved sections of pipe.

All bends and fittings shall have restrained joints and shall be blocked to undisturbed soil. Use 2 - 45° bends in lieu of a 90° bend whenever possible.

Curvature of pipe shall be accomplished through multiple, spaced deflections as described above. The minimum radius of curvature for water pipes is shown in Table III.

Separation from Wastewater Facilities

Separation of public water and wastewater mains will be consistent with the current Rules and Regulations for Public Water Systems of the TCEQ.

Separation of public water and wastewater mains from other underground utilities (storm, gas, etc.) shall be a minimum of ~~3~~ 5 feet longitudinally and 3' vertically.

VALVES:

All mainline valves shall be gate valves.

Location and Spacing

A valve should be located:

- One (1) less than every leg of a cross connection.
- At the end of temporary dead-end lines, within 70 feet from the end of the line for lines greater than 8" and within 200 feet for lines equal to and less than 8".
- At the end of a public line (unless there is a meter)
- On 2 legs of a tee connection~~.~~except in areas of commercial development, hospitals and schools where all legs shall have a valve.
- Every 800 feet.
- Where possible, place valves in green areas and avoid handicap ramps.

A valve will be required at the point of connection of a new main extending an existing main unless the existing main has an in-line valve within 200 feet of the connection~~.~~, and there is no active service between the valve and the extension point.

If main line valve is within 50' of fire hydrant, then assembly valve may be omitted on a dead end hydrant lead with no additional connections.

Valves shall be placed at intervals not to exceed 800 feet regardless of the distance between intersections. Wherever possible, they shall be located within 5 feet of a fire hydrant. The City Engineer may require

additional valves to prevent unnecessary disruptions of service. Fire hydrant lead valves are to be positively anchored to the main line.

Valves are to be located so that no more than 4 valves are required to isolate a section of main.

Tapping Sleeves

~~For mains larger than 12", M.J. Tapping Sleeves and valves will be allowed unless size on size connections are needed, and then Tee connections will be required on City owned water systems.~~

M.J. Tapping Sleeve may only be used if tap diameter is less than or equal to half the main line diameter.

A Tee connection may also be required where main line valves are needed.

Tapping Sleeve and Valve shall be Smith Blair 665MJ Stainless Steel.

FIRE HYDRANTS:

Fire hydrants are to be located at street intersections or as close to an intersection as possible. Hydrants should not be located within the intersection curb return radius. Intermediate fire hydrants should be located near property line extensions and no closer than 5 feet to any service line. Fire hydrants shall be placed no closer than 50 feet from a building.

In accordance with TCEQ, fire hydrants shall not be placed closer than 9 feet horizontally and vertically from any wastewater main or appurtenance. All fire hydrants shall be connected to a minimum 6 inch water main.

If it is necessary to place a fire hydrant in a proposed sidewalk location, the sidewalk shall be widened or relocated to maintain the required sidewalk width.

Fire hydrants shall be placed within ~~150~~ 100 feet of a fire department connection as per the adopted Fire Code.

If a main line valve is within 50' of a fire hydrant, then the assembly valve may be omitted on a dead end hydrant lead with no additional connections.

Residential Fire Hydrants

In residential areas, fire hydrants should be placed within the right-of-way in the vicinity of the common lot lines.

Public fire hydrants shall be spaced 1000 feet apart in single-family districts at locations so that structures (or undeveloped lots) shall not be more than 500 feet from a fire hydrant as measured along the right of way of a public street as the fire hose is laid off the fire truck.

In residential areas with lots sizes of 5 acres or greater, fire hydrants may be spaced at 1,500 feet along the water main so that structures shall not be more than 750 feet from a fire hydrant as measured along the right of way of a public street as the fire hose is laid off the fire truck.

Non-Residential Fire Hydrants

Public fire hydrants in districts other than single family districts shall be installed as per the Cities Fire Codes.

Upon approval by the City Engineer, the installation of some or all public fire hydrants in such districts may be deferred and required as a condition of the building permit(s) for structures.

CROSSINGS:

Water distribution mains that cross state highways must conform to the Cities' Unified Technical Specifications and the requirements of the Texas Department of Transportation (TxDOT). Mechanical bores are required for all crossings of existing streets.

Water distribution mains that cross railroads must conform to the Cities' Unified Technical Specifications and the requirements of the railroad company whose right-of-way is being crossed.

Water distribution mains crossing creeks or drainage channels regulated by FEMA, shall require encasement. Aerial crossings are preferred; however below grade crossings may be considered. Thrust restraint shall be provided at points of transition from buried to exposed pipe and at changes in alignment of exposed pipe.

Below grade crossings of creeks and drainage channels shall have a minimum cover of 3.5 feet below the flowline at the time of construction. All below grade crossings will require encasement with steel encasement pipe and all ends shall be capped and sealed. The casing shall be carried into the bank a distance that should consider changes in the creek channel. This distance would usually be beyond the high bank such that if you measured a 1:1 slope from the high bank away from the channel, the casing would terminate at that location.

ENCASEMENT:

Steel cylinder pipe shall be used for all encasement pipe. Other encasement pipe material may be used per TCEQ requirements and City specifications. Carrier pipes sized less than 30 inches shall use an encasement pipe with a wall thickness of no less than 3/8-inch. For carrier pipes 30 inches and larger, a wall thickness of no less than 1/2-inch shall be used. Coating of encasement pipe may be required in special soil conditions.

Pipe encasement will be required for all water mains crossing any street classified as major collector and greater including new streets regardless of method of installation. This does not apply to services. Special field conditions may require an alternate method of installation, which must be approved by the City Engineer.

On street crossings requiring encasement, two valves shall be installed on the pipe crossing the road. The valves shall be located below the bore so as to allow the carrier pipe to be removed from the casing without disrupting service. In general, this will require one valve to be placed approximately 25 feet minimum beyond the edge of casing. In the event the pipe crossing the road tees into a waterline parallel with the road, the line crossing the road shall be installed above the main it tees into. (See detail W4-00 and W4-01)

The encasement pipe shall be sized in accordance with the Unified Technical Specifications and shall extend 2 feet beyond the back of both curbs on the street. Ends of encasement pipes shall be sealed to prevent the intrusion and collection of groundwater.

All carrier pipes will be supported by casing spacers in accordance with the specifications and details, and shall have joints restrained by an approved method that will allow the removal of the carrier pipe from the encasement pipe in a single direction by means of tension on the carrier pipe only.

EASEMENTS:

Water mains constructed outside of public rights-of-way shall be in easements of not less than 15 feet in width. ~~except for the following: if the water main bury is deeper than 6 feet the easement width shall be not less than 20 feet; and if the water main bury is greater than 14 feet, the easement width shall be 30 feet. Larger widths will be required depending on the depth of the water main and type of easement.~~ The minimum easement width required to install and maintain City water and wastewater mains are summarized as follows:

Size of Main (inch)	Depth of Pipe* (ft)	Minimum Width** (ft)
8” through 12”	≤ 6	15
	> 6 and ≤ 14	20

	> 14	30
16” through 24”	≤ 6 > 6 and ≤ 14 > 14	20 30 40
30” through 66”	≤ 6 > 6 and ≤ 14 > 14	45 50 55
72” and larger	≤ 6 > 6 and ≤ 14 > 14	60 65 70

*Depth of pipe shall be measured from the top of pipe to the ground surface.
**Pipes shall be centered in the easement

If both water and wastewater mains are located within the same easement, and shallower than 6 feet, the width shall not be less than 30 feet. Additional easement width will be required if a 6 foot bury depth is exceeded.

Where water lines will be adjacent to building structures, easement width shall be increased.

The easement must be located such that the centerline of the waterline is no closer than ~~5.5~~ 7.5 feet to the closest edge of the easement.

Water mains constructed adjacent to TxDOT maintained roadways shall be located in the utility accommodation zone provided by TxDOT. If there is no utility accommodation zone, or if the zone is occupied, then the water line shall be installed in a separate easement (min. 15 feet) adjacent to the right-of-way.

TABLE I
AVERAGE WATER DEMANDS

USE	AVERAGE FLOW GPD / CAP
Residential	100
Commercial -Office -Retail -Hotel/Motel	 50 25 50 *
Institutional -Schools -Hospitals	 35 200
Industrial	50

* Does not include restaurants or other ancillary

TABLE II
NORMAL WATER DESIGN DEMANDS

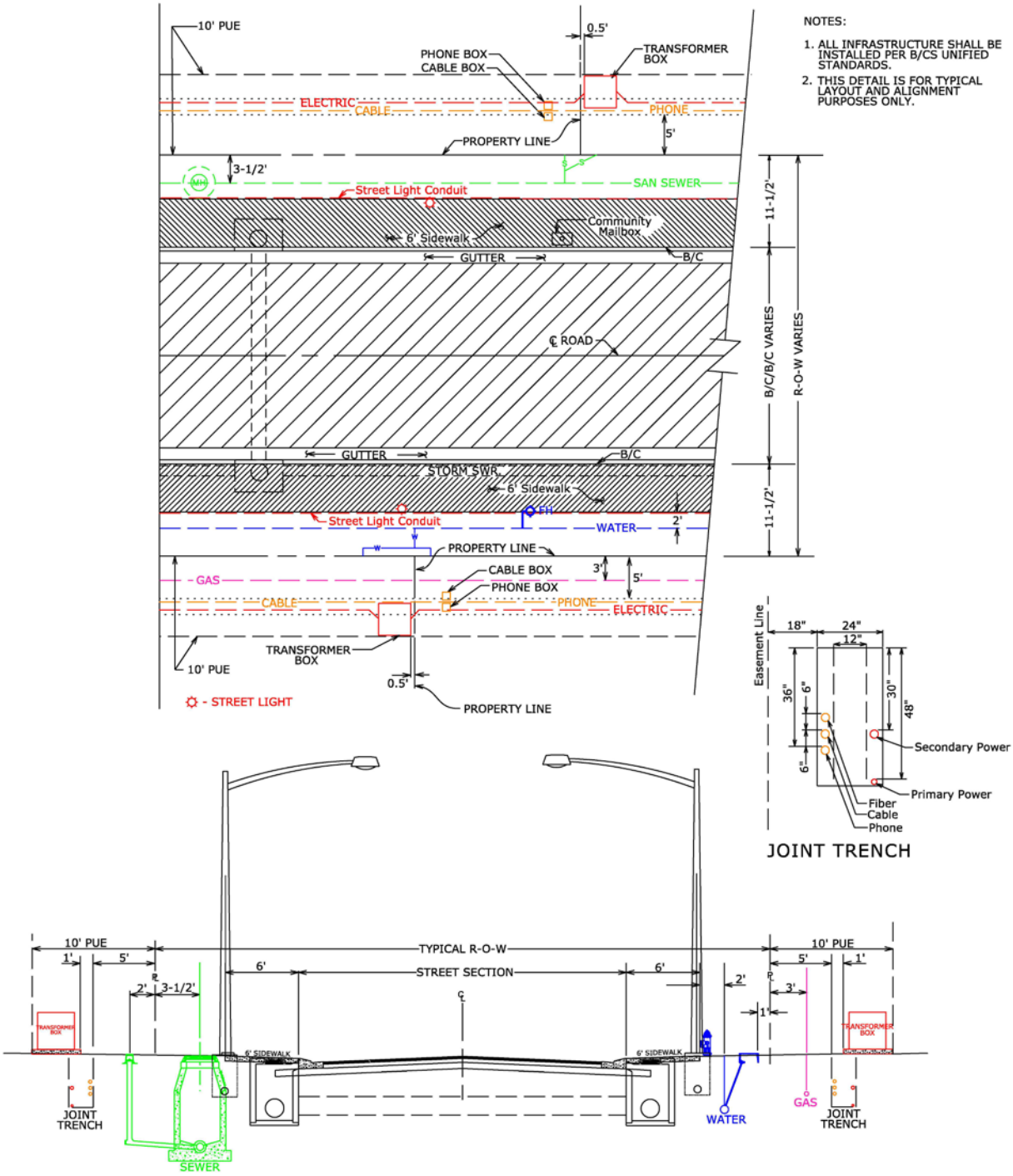
TRIBUTARY AREA (Acres)	DESIGN DEMAND (g.p.d. per acre)
Less than 250	7000
250-300	6500
300-500	5500
500-1500	5000
1500-3000	4500
More than 3000	4000

TABLE III
MINIMUM RADIUS FOR WATER PIPE

SIZE	PVC – CLASS 200 (20-ft. Joint)	DUCTILE IRON (18-ft. Joint)

6-IN	220 ft	400 ft
8-IN	400 ft	400 ft
12-IN	600 ft	400 ft

FIGURE I
UTILITY CORRIDOR



UTILITY LOCATION W/ STD CURB INLET
10' PUE - ALL UTILITIES OUTSIDE OF ROAD