



Water Design Criteria Manual

May 2024



CITY OF GRAND PRAIRIE





Water Design Criteria Manual City Of Grand Prairie

Engineering Services
300 West Main Street
Grand Prairie Texas, 75050
(972) 237- 8321
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MEMORANDUM

To: Whom It May Concern
From: City of Grand Prairie
Date: May 2024
Subject: **WATER DESIGN CRITERIA MANUAL**

Please ensure that the following water design criteria are used on all City of Grand Prairie projects. This Water Design Criteria Manual is intended for any developers or engineers developing within the City of Grand Prairie.

TABLE OF CONTENTS

Planning Criteria

GENERAL NOTES	4
1.0 Water Demand Projections.....	5
2.0 Fire Flow Requirements	7
3.0 Hydraulic Modeling Criteria	7
4.0 Water Demand Projection Computation Examples	8
5.0 Hydraulic Design Criteria.....	9
6.0 Water Main Location Criteria	9
7.0 Water Main Sizing Criteria.....	9
8.0 Cover Requirements.....	10
9.0 Field Investigation.....	10
10.0 Separation Distance between Water and Wastewater Mains	12
11.0 Water Main Minimum Easement Requirements	12
12.0 Separation Distance between Water and Storm Drains.....	13
13.0 Backflow Prevention Requirements.....	13
14.0 Water Line Abandonment Procedures (Water Lines, Valves, Fire Hydrants)	13
15.0 Water Valve Requirements.....	13
16.0 Fittings Requirements.....	13
17.0 Fire Hydrant Requirements	14
18.0 Water Meter Box Requirements	14
19.0 Water Meter Requirements	14

GENERAL NOTES

It is the responsibility of the Engineer to verify that any design to be implemented into or connected to Grand Prairie's water system be in compliance with the following regulations and guidelines:

- A. Texas Administrative Code (TAC) Title 30, Part 1, Texas Commission on Environmental Quality (TCEQ) – Rules and Regulations for Public Water Systems, Chapter 290
- B. City of Grand Prairie Standard Engineering Details Sheets and Design Criteria
- C. City of Grand Prairie's latest Water Master Plan
- D. Standard Specifications for Public Works Construction, latest addition – North Central Texas Council of Governments (NCTCOG Specifications)

Where the City's design criteria differ from the City's Water Master Plan or TCEQ's design criteria, the more restrictive criteria shall govern. In the event of a conflict, the City shall determine which criteria shall govern. Water line sizes should comply with the Master Plan unless approved by the City.

Development Planning Maps: Both off-site investigation and on-site investigation is necessary for planning any proposed development or expansion of the City's infrastructure. Off-Site (1-inch = 200 feet) and On-Site (1-inch = 100 feet) maps should be created showing all the development footprint designated with a chart showing the calculated water demand projections, phasing plan, and pipe sizing calculations.

It is also the Engineer's responsibility to be fulfilling the requirements outlined in the City's design checklists as presented in **Appendices A-G**. This comprises of multiple checklists starting with one for the thirty percent (30%) design, all the way to project completion. Additionally, the contractor is required to submit a traffic control plan application to be reviewed by the Transportation Department prior to beginning construction on a project. The review requirements and application can be located on the City of Grand Prairie's website within the Traffic Control Plans page. It is also important to note that the City has quarterly franchise meetings.

PLANNING CRITERIA

1.0 Water Demand Projections

The Engineer shall reference the latest City Water Master Plan to ensure the adequacy of the proposed design is consistent with the latest planning information. Several variables help make up the calculation for projected water demands. These include, but are not limited to, land use, housing density (units per acre), population count (persons per unit), average usage per capita, and peaking factors.

Table 1-1: Residential Land Use Densities

Land Use Type	Housing Density* (units / acre)	Population Density (ppl / unit)
Low Density Residential (Single Family)	0 – 6	3.5
Medium Density Residential (Single Family)	6 – 12	3.5
High Density Residential (Multi-Family)	12 – 20+	3.0

**From the 2018 Grand Prairie Comprehensive Plan Update.*

Note: This table provides the minimum design requirements. The Engineer may increase the number at their own discretion and as approved by the City Engineer.

Table 1-2: Water Demand Projections Planning Criteria

Planning Criteria	Value	
North Sector Water System*		
Residential Average Daily Per Capita Water Usage	115	gpcd ¹
Non-Residential Average Daily Per Acre Water Usage	500	gpac ²
Average Day : Maximum Day Peaking Factor	1.7	--
Maximum Day : Peak Hour Peaking Factor	1.5	--
South Sector Water System*		
Residential Average Daily Per Capita Water Usage	140	gpcd ¹
Non-Residential Average Daily Per Acre Water Usage	700	gpac ²
Average Day : Maximum Day Peaking Factor	2.0	--
Maximum Day : Peak Hour Peaking Factor	1.5	--

*North Sector includes the 639' Pressure Plane, 660' Pressure Plane, and 720' Pressure Plane. South Sector includes the 775' Pressure Plane.

¹gpcd = gallons per capita per day

²gpac = gallons per acre per day

Table 1-3: Additional Water Demand Projections Planning Criteria*

Non-Residential Land Uses		Non-Residential Average Daily Per Person Water Usage (gal/person/day)
Restaurant		18
School	Without cafeteria or showers	18
	With cafeteria; no showers	24
	With cafeteria and showers	30
Youth Camp	Without cafeteria, restrooms, or showers	6
	With restrooms; no cafeteria or showers	24
	With restrooms, showers, and cafeteria	42
Office building		18
Hospital (per bed)		720
Institution (other than hospital)		240
Factories (exclusive of industrial processes)		24
Recreational parks (day user)		6
Swimming pools		12
Country clubs		120
Airports (per passenger)		6
Self-service laundry		60
Service station/convenience store		12

Source: 30 TAC §290.45(d)(1)

*Average Daily Per Person Water Usage should be utilized when projected number of persons is known. If projected number of persons is unknown, utilize Average Daily Per Acre Water Usage from Table 1-2.

2.0 Fire Flow Requirements

Fire flow can be defined as the amount of water flow required for fire protection at certain locations (fire hydrants) throughout a water system. It is the responsibility of the engineer to reference the latest edition of the International Fire Code (IFC) adopted by the City of Grand Prairie when calculating the required fire flow. Table 2-1 below shows the minimum fire flow requirements for both residential and non-residential land uses.

Table 2-1: Minimum Fire Flow Requirement Criteria

Proposed Land Use	Minimum Fire Flow (gpm)
Residential Minimum Fire Flow	1,000 – 1,500
Non-Residential Minimum Fire Flow	3,000 – 3,500

All proposed developments shall provide adequate water capacity to satisfy maximum day demands and fire flow requirements. Example calculations for maximum day demands plus fire flow can be seen in Section 4.0 below.

3.0 Hydraulic Modeling Criteria

Future modeling of any proposed infrastructure connected to the City of Grand Prairie's water system shall use the following hydraulic modeling criteria:

Table 3-1: Hydraulic Design Criteria

Hydraulic Design Criteria		Design Value	
Hazen-Williams Roughness Coefficient		130	--
Maximum Allowable Velocity	16-inches and larger	5	ft/sec
	Smaller than 16-inches	7	ft/sec
Maximum Headloss Gradient	16-inches and larger	3	ft/1,000 ft
	Smaller than 16-inches	7	ft/1,000 ft
Minimum Pressure ¹		35	psi
Maximum Pressure		80	psi

¹TCEQ Chapter 290.44.(d) allows for a minimum pressure of 20 psi under combined maximum day demands and fire flow.

4.0 Water Demand Projection Computation Examples

Average Daily Per Person Water Usage should be utilized when projected number of persons is known. If projected number of persons is unknown, utilize Average Daily Per Acre Water Usage from Table 1-2.

Example Development A

Proposed Land Use: Medium Density Residential

Developable Acreage: 20 acres

Non-Residential Persons: N/A

Pressure Plane: 775' Pressure Plane (South Sector)

Units = 20 acres x 12 units/acre = 240 units

Population = 240 units x 3.5 ppl/unit = 840 people

Average Day Demand = 840 ppl x 140 gpcd / 1,440 = 81.7 gpm

Maximum Day Demand = 81.7 gpm x 2.00 = 163.4 gpm

Peak Hour Demand = 163.4 gpm x 1.50 = 245.1 gpm

Maximum Day Demand + Fire Flow = 163.4 gpm + 1,500 gpm = 1,663.4 gpm

Example Development B

Proposed Land Use: General Commercial

Developable Acreage: 25 acres

Non-Residential Persons: N/A

Pressure Plane: 720' Pressure Plane (North Sector)

Average Day Demand = 25 acres x 500 gpad / 1440 = 8.7 gpm

Maximum Day Demand = 8.7 gpm x 1.70 = 14.8 gpm

Peak Hour Demand = 14.8 gpm x 1.50 = 22.2 gpm

Maximum Day Demand + Fire Flow = 14.8 gpm + 3,500 gpm = 3,514.8 gpm

Example Development C

Proposed Land Use: School (With Cafeteria and Showers)

Developable Acreage: 50 acres

Non-Residential Persons: 800

Pressure Plane: 660' Pressure Plane (North Sector)

Average Day Demand = 800 ppl x 30 gpcd / 1440 = 16.7 gpm

Maximum Day Demand = 16.7 gpm x 1.70 = 28.4 gpm

Peak Hour Demand = 28.4 gpm x 1.50 = 42.6 gpm

Maximum Day Demand + Fire Flow = 28.4 gpm + 3,500 gpm = 3,528.4 gpm

DESIGN CRITERIA

5.0 Hydraulic Design Criteria

- 5.1 Design for any water main should utilize the Hazen-Williams Equation to determine characteristics for pressurized conditions.
- 5.2 The City of Grand Prairie's maximum allowable velocity during normal operating conditions shall not exceed 5 feet per second for lines 16-inches and larger and shall not exceed 7 feet per second for lines under 16-inches.
- 5.3 The maximum head loss gradient shall not exceed 3 feet per 1,000 feet of pipe for lines 16-inches and larger and shall not exceed 7 feet per 1,000 feet of pipe for lines under 16-inches.
- 5.4 Hydraulic Design Flows

Hazen-Williams Equation

$$H_f = \frac{10.44 L Q^{1.85}}{C^{1.85} d^{4.87}}$$

H_f = Head loss due to friction (ft)
 L = Length of pipe (ft)
 Q = Flow (gpm)
 C = Roughness Coefficient (See Table 3-1)
 d = Inside diameter of pipe (in)

Manning's Equation for Pressure Pipe

$$Q = V \times A$$

Q = Flow (cfs)
 V = Velocity (ft/sec)
 A = Cross Sectional Area (ft²)

6.0 Water Main Location Criteria

- 6.1 Water mains shall be located within the street right-of-way or utility easements.

7.0 Water Main Sizing Criteria

- 7.1 The minimum pipe diameter for any public water main shall be 8 inches for maintenance and easy cleaning.
- 7.2 Water mains shall be appropriately sized to meet the requirements described in the Hydraulic Design Criteria section (Section 4.0) of this document. Calculations demonstrating compliance with these requirements must be provided by the Director of Engineering and Utility Services or designee prior to any construction. For public improvements associated with Capital Improvement Projects, the Engineering Manager is normally the designee; for private development projects, designees normally include the Engineering Development Coordinators.

7.3 Water mains shall be sized to provide sufficient water capacity for fire protection purposes within any proposed development. Fire flow capacity requirements are in addition to the maximum day demand projections as seen in the example computations in Section 4.0. Section 2.0 shows the minimum fire flow requirements for residential and non-residential land uses, but additional fire flow requirements are located in the International Fire Code (IFC) as adopted by the City of Grand Prairie.

8.0 Cover Requirements

The depth of cover is measured from the top of the pipe to the natural or finished ground surface above the pipe. The minimum depth of cover shall be 42-inches.

Table 7-1: Minimum Depth of Cover for Water Main

Size of Main (inches)	Minimum Depth (inches)
8	42
12	48
Larger than 12	60 to 72

9.0 Field Investigation

Field investigations including Geotechnical Investigation, Subsurface Utility Engineering (SUE), Environmental Site Assessment, or Land Survey Investigation shall be conducted for water and wastewater main design as necessary or if requested by the City.

The design and construction of water mains must account for the variability of subsurface conditions, and the potential project cost associated with the variability. This is especially critical on large projects or projects containing complex or difficult geotechnical problems where alignment and / or grade changes may be required based on geotechnical recommendations.

9.1 Geotechnical Investigation includes:

9.1.1 A geotechnical investigation may be conducted prior to design and / or construction of a project.

9.1.2 Soil borings shall be spaced no greater than 500 feet with additional borings spaced closer to better defined areas of inconsistent stratigraphy.

9.1.3 Boring locations shall be within an offset distance of no more than twenty (20) feet from the centerline alignment of the water main or at the location of the proposed structure.

9.1.4 Open Cut Construction: Minimum boring depths shall be:

9.1.4.1 Trench depth plus five (5) feet for trenches up to ten (10) feet deep.

9.1.4.2 Trench depth plus ten (10) feet for trenches from ten (10) to twenty-five (25) feet deep.

9.1.4.3 One and half times trench depth for trench greater than twenty-five (25) feet deep.

9.1.5 Bore an additional five (5) feet if the last planned sample is in water-bearing sand.

9.1.6 Trenchless Construction: Minimum boring depth shall be:

9.1.6.1 Entry / exit pit depth plus five (5) feet.

9.1.6.2 Pipe invert plus five (5) feet.

Note: These are guidelines/ minimum requirements and should be evaluated for each project.

9.2 Subsurface Utility Engineering

9.2.1 Utility Quality Level (QL) attributes are described in “Standard Guidelines for the Collection and Depiction of Existing Subsurface Utility Data, CI / ASCE 38-02” by American Society of Civil Engineers (ASCE), Latest Edition. Four (4) levels have been established to describe the quality of utility location and attribute.

9.2.1.1 Quality Level D:

- Information derived from existing records or oral recollections.
- Quality Level D information supplemented with information obtained by surveying visible above-ground utility features.

9.2.1.2 Quality Level C:

- Information obtained by surveying and plotting visible above-ground utility features and by using professional judgment in correlating this information to Quality Level D.
- This work shall be conducted during the survey for design.
- This work shall be conducted by the Engineer during the preliminary project planning.

9.2.1.3 Quality Level B:

- Two-dimensional (x, y) information obtained through the application and interpretation of non-destructive surface geophysical methods. Also known as “designating” this quality level provides the horizontal position of subsurface utilities within approximately one foot.

9.2.1.4 Quality Level A:

- Also known as “locating”, this quality level provides precise three-dimensional (x, y, z) information at critical locations by exposing specific utilities. Non-destructive vacuum excavation equipment is used to expose the utilities at specific points which are then tied down by survey.
- This work shall be performed to obtain precise horizontal and vertical locations of subsurface utilities in areas with congested utilities (i.e. central business district), areas where utility information is sparse or where a specific utility of high importance is being crossed (i.e. gas line).

9.3 Environmental Site Assessment: The Engineer shall review publicly available environmental information to identify potential environmental issues during the planning phase of water main construction projects, including potential or known soil or groundwater contamination within the project footprint. The Developer or Engineer shall contact the City to determine if an Environmental Site Assessment

(ESA) will be needed for the proposed project. If the project involves a property acquisition, a Phase I ESA from a qualified and experienced environmental consultant shall be requested. Federally funded projects generally require a Phase II ESA.

10.0 Separation Distance between Water and Wastewater Mains

Separation Distance between Water and Storm Drains

The governing minimum requirements for separation distance of water mains from wastewater mains can be located in the Texas Administrative Code (TAC) Title 30, Part 1, Texas Commission on Environmental Quality (TCEQ) Rules – 30 TAC §290.44(e) Location of Waterlines.

Casing of a carrier wastewater pipeline is required when crossing TxDOT highways, railroad properties, crossing flood control levees, potable water lines and occasionally when crossing stormwater pipelines. Casing maybe be required if the City believes the property crossing dictates special care and protection for the pipeline. All casing pipe shall be steel casing. Concrete encasement of a pipeline may be required when crossing streams or creeks for erosion protection.

11.0 Water Main Minimum Easement Requirements

For water main minimum easement requirements please reference the table below.

Table 11-1: Water Main Minimum Easement Requirements

Size of Main (inches)	Depth of Pipe ¹ (feet)	Minimum Width ² (feet)
8 through 12	≤ 8	20
	> 8	25
16 through 24	≤ 8	25
	> 8	35
30 through 66	≤ 8	40
	> 8	50
72 and Larger	≤ 8	60
	> 8	70

¹Depth of pipe shall be measured from the top of pipe to the ground surface.

²Pipe shall be centered in the easement.

The minimum vertical clearance above any easement is 25 feet. This allows the typical backhoe to maneuver in the case where a repair is necessary and minimizes risk to both City and the party who is granting the easement.

The Engineer shall request a Surveyor to prepare a legal description (field notes) for the required easement. This request shall include, but not be limited to, the following information:

- Type of Easement: Permanent or temporary/construction
- Purpose of Easement: Water and/or wastewater easement
- Project Schedule: Planned advertisement and construction date
- Location Map: A map showing location of easement with coordinates and dimensions.

The legal description shall be submitted to the City for review and approval, as necessary.

12.0 Separation Distance between Water and Storm Drains

Concrete encasing for water lines that cross storm drains shall be required when vertical separation between the outside diameters is less than:

- 2 feet for 24-inch diameter or smaller storm drains
- 3 feet for 30-inch and 36-inch storm drains
- 4 feet for 42-inch and larger storm drains

13.0 Backflow Prevention Requirements

The governing minimum requirements for backflow prevention devices can be located in the Texas Administrative Code (TAC) Title 30, Part 1, Texas Commission on Environmental Quality (TCEQ) Rules – 30 TAC §290.44(h) Backflow, Siphonage.

14.0 Water Line Abandonment Procedures (Water Lines, Valves, Fire Hydrants)

The governing requirements for water line abandonment procedures can be located in the City of Grand Prairie Standard Engineering Detail Sheets, Water Standard Details 1 of 2. In addition to this detail, all service lines and/or valves should be capped with an AWWA approved, lead free brass, bronze, or stainless-steel plug.

15.0 Water Valve Requirements

The governing requirements for water valves can be located in the City of Grand Prairie Current Edition Standard Engineering Detail Sheets, Water Standard Details 1 of 2.

16.0 Fittings Requirements

The governing requirements for water fittings can be located in the City of Grand Prairie Current Edition Standard Engineering Detail Sheets, Water Standard Details 1 of 2.

17.0 Fire Hydrant Requirements

The governing requirements for fire hydrants can be located in the City of Grand Prairie Current Edition Standard Engineering Detail Sheets, Water Standard Details 1 of 2.

18.0 Water Meter Box Requirements

The governing requirements for water meter boxes can be located in the City of Grand Prairie Current Edition Standard Engineering Detail Sheets, Water Standard Details 2 of 2.

19.0 Water Meter Requirements

The governing requirements for water meters can be located in the City of Grand Prairie Current Edition Standard Engineering Detail Sheets, Water Standard Details 2 of 2. Along with the requirements outlined in the City's standard details the following apply.

- New meters shall be ultrasonic.
- Water meters that provide dual design flow (domestic and fire suppression) for single family residences shall be a minimum size of 1-inch.
- The City does not support $\frac{3}{4}$ -inch meters.
- For large meter standard details, please refer to the City of Grand Prairie Current Edition Standard Engineering Detail Sheets.
- 3" through 10" meters (including the bypass meters) must be Zenner Stealth ultrasonic meters with Itron AMI connectors.
- Information about the wastewater impact, tap, and meter fees can be found in the City of Grand Prairie Article 22 Fee Schedule.