

# The City of Red Oak Water and Wastewater Design Manual



UPDATED: NOVEMBER 2018



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## 1.0 General

### 1.01 Effective Date

1. The City of Red Oak City Council has adopted the requirements herein on May 14, 2018. All project submittals to the City of Red Oak on or after May 14, 2018 will be subject to the requirements included in this Water and Wastewater Design Manual.

### 1.02 Interpretation and Enforcement

1. In the interpretation and enforcement of the requirements in this Water and Wastewater Design Manual, it is the intention of the City Council that the requirements should be considered minimum requirements for the design of private and municipal projects within the City. Where other City ordinances or requirements are more restrictive, such other ordinances or requirements shall govern.
2. The City Council has granted the Public Works Director or the Director’s designee the authority to interpret and enforce the requirements herein.

### 1.03 Amendment

1. The City reserves the right to make revisions or replace this manual at any time. The current manual will be maintained by the Public Works Director and will be made available on the City’s website.

## 1.04 Variances

1. The Engineer of Record must submit a written request for a variance. The request must:
  - a. Identify the requirement for which a variance is requested,
  - b. Provide a detailed account of why the requirement places undue hardship on the engineering project, and
  - c. Include technical support that the variance will not adversely impact the City or the public.
2. The Public Works Director or designee shall be the final arbiter for whether the variance will be granted. The Director of Public Works will maintain a record of variances granted.

## 1.05 Responsibility

1. Technical reviews and approvals from City staff are not an indication that the engineering design is without flaw. The Engineer of Record maintains sole responsibility for meeting the engineering standard of care and to ensure the design does not adversely impact the health, safety, and welfare of the public.

## 1.06 Other local, state, and federal regulations

1. Engineering design within the City of Red Oak must meet state and federal regulations. No requirements in this Water and Wastewater Design Manual should be interpreted to allow projects to not meet state and federal regulations. The following regulations are often related to the requirements in this Water and Wastewater Design Manual.
  - a. TCEQ Chapter 217 – Design Criteria for Domestic Wastewater Systems
  - b. TCEQ Chapter 285 – On-Site Sewage Facilities
  - c. TCEQ Chapter 290 – Public Drinking Water
  - d. City of Red Oak Standard Construction Details
2. The regulations above are not a comprehensive list and the Engineer of Record is not exempt from any applicable state and federal requirements not listed above. The City reserves the right to withhold construction permits until documentation of coordination with appropriate entities is provided.

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## 2.0 Water System

### 2.01 General

1. Water mains shall comply with the current Water Master Plan unless approved in writing by the Public Works Director.
2. Water mains shall be sized and extended through the limits of a development to serve adjacent properties.
3. Dead end water mains are not allowed unless approved in writing by the Public Works Director.

### 2.02 Water Main Location

1. In general, water mains should be located four feet (4') behind the back of curb within the parkway. If the conditions do not allow for this location, then further discussions and approvals shall take place with the City Engineer or Public Works Director.
2. Minimum depth of cover varies based on the size of water main.

*Table 1: Water Main Depth of Cover*

Water Main Size	Depth of Cover
6 - 10 Inch	4 - Feet
12 – 16 Inch	5 - Feet
>16 Inch	6 - Feet

\*5' maximum depth for lines under 12" except where avoiding other utilities or crossing creeks.

3. Water mains shall be designed to minimize bends and fittings. Bends shall be provided where vertical and horizontal deflections exceed 80% of the manufacturer's recommendation. Utilize the following minimum radii for curves in water lines:
  - 6" – 150' Min.
  - 8" – 200' Min.
  - 10" and greater - Follow pipe manufacturers recommendation
4. A minimum clearance of 12 inches shall be required when crossing storm drain systems unless approved by the City Engineer or Director of Public Works.

### 2.03 Separation Distance Between Water and Wastewater Mains

1. In general, the Engineer of Record should design waterlines to have a minimum separation distance of 9 feet in all directions from wastewater lines and manholes. Separation distances shall be measured from the outside surface of each of the respective facilities. Any encroachment within 9-ft shall adhere to TCEQ rules and regulations:
  - a. TCEQ Chapter 290 – Public Drinking Water
  - b. TCEQ Chapter 217 – Design Criteria for Domestic Wastewater Systems

## 2.04 Average Daily Water Demands

1. At the Public Works Director's discretion, average daily water demand calculations may be required using a pre-approved methodology.

## 2.05 Water Main Sizing

1. If applicable, water mains shall be sized in accordance with the current Water Master Plan and be adequate to convey a fire flow.
  - a. 8-inch minimum size required.
  - b. 8-inch lines shall be connected so that not more than two hydrants will be between intersecting lines.
  - c. 12-inch minimum required in commercial, retail and industrial areas.
  - d. At the Public Works Director's discretion, a fire flow analysis may be required to ensure adequate line sizing.

## 2.06 Water Main Materials

1. All water mains shall be Polyvinyl Chloride (PVC) pipe meeting the following specifications unless approved in writing by the Public Works Director.
  - a. 12-inch and smaller: AWWA C900 DR 18
  - b. 12-inch – 24": AWWA C905 DR 18
  - c. 30" AND LARGER: DUCTILE IRON AWWA C-150/151
  - d. The pipe material specification is the responsibility of the Engineer of Record based on analysis of specific site, soil and loading conditions.

## 2.07 Fittings

1. All valves and fittings shall be restrained with Megalug or approved equal.
2. Fittings shall be ductile iron in accordance with AWWA C110 or AWWA C153. All buried metal shall be wrapped in polyethylene wrap in accordance with AWWA C105.

## 2.08 Water Main Embedment

1. Water main embedment shall conform to the current City of Red Oak Standard Construction Details unless otherwise approved by the Public Works Director.

## 2.09 Water Services and Meters

1. Minimum 1" water service is required.
2. Minimum spacing between two service taps is four feet (4').
3. Minimum ¾-inch meter is required.
4. Meters are available as ¾-inch, 1-inch, and then in 1-inch increments.
5. 1-inch services are required to serve all residential lots including townhouse lots and patio homes. Separate services shall be provided for each of the family units, bull heads are not permitted.

6. The service size for apartments, condominiums, or multifamily buildings will depend on the number of units served with a minimum of one meter per building. The service size is to be determined by the Engineer of Record.
7. The meter shall generally be placed at the property line, in the center of the lot, outside of paving and not closer than 5-feet from any appurtenance or tree. Deviations from the standard location may be approved by the Director of Public Works or the City Engineer.
8. Meters shall be placed within right-of-way or in a dedicated minimum 5x5-foot utility easement.
9. Concrete meter vaults are required for meters greater than 2-inches.
10. Fire service line shall be a minimum of 8-inch

## 2.10 Isolation Valves

1. Valves are to be located at street intersections at or near side property lines.
2. Waterlines 12-inch and smaller shall have valves spaced 500-feet or less. Valves shall be placed in such a manner as to require two, but not more than three to shut down each main segment without shutting off more than one fire hydrant.
3. Four (4) valves must be placed at all crosses and three (3) valves must be placed at all tees unless there is an in-line valve within 200' of the cross.
4. Sixteen inch and larger valves may must be butterfly type and shall be spaced at a maximum of 1,000-foot intervals.
5. Valves shall not be placed in parking spaces.
6. Valves shall be placed at or near the ends of mains in such a manner that a shutdown can be made for a future main extension without causing loss of service on the existing main. A minimum of 20 feet of main shall be installed past the valve and mechanical pipe thrust restraints shall be used to anchor it.
7. Where fire lines are connected to the water main, valves shall be installed on both sides of the connection to provide the ability to isolate the main line and continue to provide water to the fire line. The fire line shall be provided with a valve at the connection with the main line.

## 2.11 Air Release, Air/Vacuum, Combination Air Valves, and Blowoff Valves

1. Air release valves, air/vacuum and/or combination air valves shall be required on 16" and larger waterlines and as necessary for proper system operation.
2. The Engineer of Record shall be responsible for locating and sizing air release valves.
3. Vent pipes shall discharge above grade and above 100- year floodplain elevation, if applicable.
4. Blowoff valves shall discharge to a drainage channel, creek, storm sewer inlet or culvert.

## 2.12 Fire Hydrants

1. (SPACING) Fire Hydrants shall be spaced to provide the required fire flow in accordance with the provisions of the Red Oak Fire Code and as recommended by the "GUIDE FOR DETERMINATION OF REQUIRED FIRE FLOW" published by the Insurance Service Office and per the following guidelines:
  - a. Fire hydrants are to be located at all intersecting streets and at intermediate locations as measured along the centerline of the roadway or fire lane as follows:
    - i. Single Family and Duplex Residential: maximum spacing of 500-feet.
    - ii. Multifamily Residential: maximum spacing of 400-feet, and the front of any structure at grade shall be no further than 500 feet from a minimum of two fire hydrants as measured along the route that a fire hose is laid.
    - iii. Other districts: maximum spacing of 300-feet, and the front of any structure at grade shall be no further than 300-feet from a minimum of two fire hydrants as measured along the route that the fire hose is laid. At least one hydrant shall be located within 150-feet of the main entrance of each structure.
    - iv. Fire hydrants spacing along undeveloped areas where coverage is not required for the protection of structures shall not exceed 1,000-feet.
2. (LOCATION) Fire hydrants shall be located a minimum of 2-feet and a maximum of 6-feet from the fire lane or back of curb and outside of all curb returns.
  - a. A 3-feet clear radius shall be maintained for access and operation of the fire hydrant.
  - b. The fire hydrant shall not be in the sidewalk.
  - c. A fire hydrant shall be within 100-feet of a Fire Department Connections. (FDC's)
  - d. Generally, no fire hydrant shall be located closer than 50-feet to a nonresidential building or structure unless approved by the Director of Public Works and the Fire Department.
3. All required fire hydrants placed on private property shall be adequately protected by either curbs, concrete posts or other methods as approved by the Director of Public Works and Fire Chief. Such stops or posts are to be the responsibility of the landowner on which the said fire hydrant is placed and shall not obstruct the 3-foot required clear radius around the hydrant.
4. All fire hydrants shall be within a minimum 5 x 5 - foot utility easement.
5. A blue Stimsonite, Fire-Lite reflector (or approved equal) shall be placed in the center of the drive lane on the side of the fire hydrant.
6. Any fire hydrant lead greater than 100-feet in length shall be looped.
7. Any sprinklered building shall have a minimum 8-inch fire line unless otherwise approved by the Fire Department.
8. No connections are allowed on a fire hydrant lead.
9. All required fire hydrants shall be installed so that the steamer connection will face the fire lane or street, or as directed by the Fire Department.
10. All required fire hydrants shall be of the national standard 3-way breakaway type no less than 5 ¼-inches in size and shall conform to the provisions of the latest AWWA Standard C502 and shall be placed upon water mains of no less than 8 -inches in size.
11. Fire hydrants leads shall have a bury depth of five 5 feet.
12. The fire hydrant bonnet shall be painted according to the chart below. The remainder of the hydrant above ground shall be painted aluminum.



Table 2: Fire Hydrant Bonnet Color

Water Main Capacity (GPM)	Color
Less than 500	Red
500 to 999	Orange
1,000 to 1,499	Green
1,500 and Greater	Blue

### 2.13 Connections to Existing Water Mains

1. No tapping sleeves are allowed, unless approved by City Engineer or Director of Public Works.
2. If a size on size connection is required, then a cut-in tee connection with 3 valves shall be used.
3. Connections to waterlines 16-inch and larger shall be minimized and will be allowed on a case by case bases. If allowed, the smallest pipe connection shall be 8-inch.

### 2.14 Creek Crossings

1. Watermains constructed under any flowing stream, creek or body of water such as a pond, shall be installed inside a steel encasement pipe with isolation valves on each side of the crossing.

### 2.15 Backflow Prevention

1. Backflow prevention devices shall be required to protect the public water system from cross contamination in accordance with City ordinance, TCEQ and at the discretion of the Public Works Director.

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## 3.0 Wastewater System

### 3.01 General

1. Wastewater mains shall comply with the current Wastewater Master Plan and this Design Manual unless approved in writing by the City Engineer or Public Works Director.
2. Wastewater mains shall be sized and extended through the limits of a development to serve adjacent properties.

### 3.02 Wastewater Main Location

1. In general, wastewater mains should be located in the centerline of the roadway.
2. Minimum depth of cover shall be 3.5-feet.
  - a. The Engineer of Record is responsible for insuring that sufficient depth and grade is maintained to serve all proposed and future building sites in the sewer drainage shed.
    - i. In general, the minimum depth for a wastewater line to serve a given property shall be 3.5 feet plus the length of the lateral times 2%. Laterals should be measured from the main to the back side of the structure.
3. Wastewater mains shall be designed to minimize manholes. Straight sections of pipe are preferred however curved sections may be allowed along curved roadways utilizing horizontal joint deflection not exceeding 80% of the manufacture's recommendation. Per TCEQ, manholes are required at all PC's and PT's of horizontal curves.
4. When the slope of a pipe changes, a manhole will be required. No vertical curves or deflections are allowed.
5. A minimum clearance of 18-inches shall be required when crossing storm drain systems unless approved in writing by the City Engineer or Public Works Director.
6. Wastewater mains shall not be located nearer than 5-feet from any tree.
7. Wastewater mains deeper than 12-feet with service connections may require a second shallower parallel main to convey wastewater to the nearest downstream manhole. This requirement should be discussed with the Public Works Director.

### 3.03 Separation Distance between Wastewater and Water Mains

1. In general, the Engineer of Record should design wastewater mains and manholes to have a minimum separation distance of 9 feet in all directions from waterlines. Separation distances shall be measured from the outside surface of each of the respective facilities. Any encroachment within 9-ft shall adhere to TCEQ rules and regulations:
  - a. TCEQ Chapter 290 – Public Drinking Water
  - b. TCEQ Chapter 217 – Design Criteria for Domestic Wastewater Systems

### 3.04 Wastewater Flows, Grade and Velocity

1. If project specific wastewater flows projections are not available, Table 3 may be used to estimate average daily flows based on the proposed use.

*Table 3: Wastewater Flow Projections.*

Land Use	Design Factors	Average Daily Wastewater Flow (Qave)
Apartment	75 gal/person/day 3 persons/unit 22 units/acre	225 gal/unit/day 4,950 gal/acre/day
Office	1 person/parking space* 20 gal/person/day	20 gal/parking space/day
Single Family, Patio Home, Town Home	100 gal/person/day 3.5 persons/unit 4 units/acre (Single Family) 10 units/acres (Patio, Town Home)	350 gal/unit/day or 1,400 gal/acre/day (Single Family) 3,500 gal/acre/day (Patio, Town Home)
Nursing Home	150 beds (average size) 90 gal/bed/day	13,500 gal/average facility/day
Hospital	200 gal/bed/day	200 gal/bed/day
Commercial, Industrial, factory	1 person/parking space* 35 gal/person/day 10 gal/meal/day	1 person/parking space* 35 gal/person/day 10 gal/meal
School	20 gal/student/day	20 gal/student/day
Hotel	50 gal/person/day	50 gal/person/day

\*See Parking Spaces by Use Category Table in the City Ordinance.

2. A peaking factor of at least 4 shall be used in calculating the peak flow.
3. 750 gallons per acre per day shall be added to the peak flow to account for inflow and infiltration.
4. Peak Wastewater Flows can be calculated using the following formula

*Equation 1: Peak Wastewater Flow*

$$Q_{peak} = \frac{(Q_{ave} * P) + (I)}{1,000,000}$$

Q<sub>peak</sub> = Peak Flow (MGD)  
 Q<sub>ave</sub> = Average Daily Flow (gal)  
 P = Peaking Factor  
 I = Inflow and Infiltration (gal)

5. Wastewater mains should be constructed on grades sufficient to allow a velocity not less than 2.0 feet per second or more than 10 feet per second when flowing at full capacity.

6. The minimum acceptable “n” value for design of pipe slopes is 0.013

*Equation 2: Manning’s Formula*

$$V = \frac{1.486}{n} * R^{2/3} * S^{1/2}$$

- V = Velocity (ft/sec)
- n = Manning’s roughness coefficient (0.013)
- R = hydraulic radius (ft) which is equal to the area of the flow divided by the wetted perimeter.
- S = Slope (ft/ft)

*Table 4: Minimum and Maximum Pipe Slopes*

Size of Pipe (inches)	Minimum Slope (%)	Maximum Slope (%)
8	0.40	8.40
10	0.30	6.23
12	0.22	4.88
15	0.15	3.62
18	0.12	2.83
21	0.10	2.30
24	0.08	1.93
27	0.07	1.65
30	0.06	1.43
36	0.05	1.12

### 3.05 Wastewater Main Sizing

1. Wastewater mains shall be sized based on the wastewater masterplan or to ensure it does not flow more than 95% capacity based on the peak flows, whichever is larger. In no case shall a wastewater main be less than 8”.

### 3.06 Wastewater Main Materials

1. All wastewater mains shall be Polyvinyl Chloride (PVC) pipe meeting the following specifications unless approved in writing by the City Engineer or Public Works Director.
  - a. All 12-inch and smaller pipe shall be SDR 26, regardless of depth.
  - b. Non-pressure rated 18-inch and greater pipe shall have minimum pipe stiffness of 46 psi (ASTM F679)
  - c. Pressure rated lines greater than 12-inch shall be AWWA C905 DR25 with a minimum pressure rating of 165 psi.
2. The pipe material specification is the responsibility of the Engineer of Record based on analysis of specific site, soil and loading conditions.

### 3.07 Manholes and Cleanouts

1. Manholes sizes will vary depending on the size of the wastewater line.
  - a. 4-foot minimum diameter for lines 10-inch and smaller unless depth exceeds 10’
  - b. 5-foot minimum diameter for lines 12-inch through 27-inch and 8-inch through 10-inch lines that exceed 10’ in depth.
  - c. 6-foot minimum diameter for lines greater than 27-inches

2. Manholes shall be located at a minimum spacing of 500 feet. Spacing greater than 500 feet may be allowed for lines larger than 15-inch with written approval from the City Engineer or Public Works Director.
3. Manholes shall also be placed in the following locations:
  - a. At the end of a wastewater collection system pipe that may be extended in the future. In these instances, one pipe segment shall be install upstream of the manhole for future connection.
  - b. At all locations where diameter of the pipe changes.
  - c. At all locations where pipe material changes.
  - d. At all locations where the horizontal or vertical alignment of the line changes.
  - e. At the beginning and end of horizontal curves (PC's and PT's).
  - f. At the end of lines that are installed by other than open cut.
  - g. On each end of an aerial crossing.
  - h. At all lateral connections 6-inches and larger.
4. Manholes shall be vented at a minimum of every 1,500 feet.
  - a. Vents must be designed to minimize inflow and must be located above a 100-year floodplain elevation.
5. Manholes located in the 100-year floodplain must be gasketed and bolted down to prevent inflow.
6. Manholes require a clear opening with at least a 30-inch diameter.
7. Manholes shall not be installed within a parking space.
8. Manholes and sewer lines shall be installed in the center of a travel lane in a divided thoroughfare. If the thoroughfare is constructed in phases, the sewer line shall be placed in the median aligned with the future, inside lane.
9. Drop manholes shall be required when the inflow elevation is more than 18-inches above the outflow elevation.
10. Cleanouts shall be placed on the end of all lines that are not anticipated to be extended in the future.
11. Cleanouts must be within 400 feet of the downstream manhole.

### 3.08 Wastewater Main Embedment

1. All wastewater embedment shall conform to the current City of Red Oak Standard Construction Details unless otherwise approved by the Public Works Director.

### 3.09 Wastewater Service Laterals

1. For single family dwellings the service lateral size shall be 4-inches minimum.
  - a. Typical residential laterals are located 10' feet downstream from the center of the lot.
2. For multiple unit residential, retail, and commercial the lateral size shall be 6-inch minimum.
3. For manufacturing and industrial the lateral size shall be 8-inch minimum.

4. A minimum of one service lateral per building is required.
5. A minimum of one service lateral per residential lot is required.
6. Duplexes shall have two service laterals.

### 3.10 Railroad, State Highway and Creek Crossings

1. Wastewater lines constructed under any flowing stream, creek or body of water such as a pond, shall be installed inside a steel encasement pipe with manholes on each side of the crossing. Casing pipe shall be 2 nominal sizes larger than the carrier pipe with approved spacers.
2. Aerial crossings should only be used when all other alternatives have been evaluated and only with written approval of the Director of Public Works.
3. The developer is responsible for obtaining permits from any authority have jurisdiction (TXDOT, Rail company, USACE, etc.)

### 3.11 Staking

1. Line and grade stakes for construction shall be furnished by the developer's engineer or surveyor. All property lines and corners must be properly staked to insure correct alignment. The City will not be liable for improper alignment or delay of any kind caused by improper or inadequate surveys by the developer or by interference of other utilities.

### 3.12 Lift Station Design

1. Lift stations shall be designed in accordance with TCEQ Chapter 217, Subchapter C

### 3.13 Lift Station Site Requirements

1. Lift station site shall be a minimum of 20'x20'
2. Brick screening wall shall be placed around perimeter of site. Other screening devices may be approved by the City Engineer or Director of Public Works.
3. Screening wall shall be a minimum of 6' tall with security treatments at the top. Barbed wire and razor wire will not be permitted.
4. Site shall have a minimum of 12' paved access from a street or access easement.
5. Water service shall be installed with a meter and water spigot placed in an appropriate location.
6. Onsite generator shall be installed.
7. Onsite lighting shall be installed.
8. A 14' sliding wrought iron gate with security treatments at the top is required at the access point.
9. Areas needed to directly access onsite equipment shall be paved in concrete.



10. The area within the enclosed area not directly needed for accessing the equipment shall have a crushed stone base or equivalent.
11. Minimum 4" bypass line with cam lock fittings shall be installed.

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## 4.0 Construction Plans and Easements

### 4.01 Construction Plans

1. All construction plan sheets shall be drawn to a standard scale, be clear, legible, and neatly drawn on 22" x 34" or 24" x 36" bordered sheets. The scale shall be smallest needed to clearly show the design, preferably at a 1" = 20' or 1" = 40'. Each sheet shall have a north arrow, scale, and reference to the benchmarks used. The following plan sheets are common and should be included in the construction plan set.

#### a. Utility Plan

- i. Unless it would make the plan difficult to read, both water and wastewater lines should be shown on the same sheet.
- ii. For designs requiring multiple pages, keymaps shall be used showing the overall layout with reference to individual sheets.
- iii. Include a table listing the total number of units for residential developments and total building square footage and use for other types of developments, total acres served, and projected flows (Average Day and Peak Flow in MGD).
- iv. At a minimum the following information shall also be included on the utility plan sheets:
  - Existing and proposed utilities and storm pipes
  - All proposed water and wastewater lines shall be numbered or lettered.
  - All proposed lines shall be stationed to the nearest 0.1 foot including all junctions, laterals, connections, P.C.'s, P.T.'s, bends, angles, wyes, cleanouts, manholes, valves, reducers etc.
  - Location of all service connections and meters.
  - Existing and proposed fire hydrants
  - Horizontal curve data if applicable
  - Creeks and roadways
  - Tree lines
  - Size of pipes
  - Direction of flow for wastewater
  - Existing and proposed easements
  - Property boundaries
  - Existing and proposed structures
  - 100- year flood plain.

#### b. Utility Profile

- i. All waterlines greater than 12-inches shall be profiled.
- ii. All wastewater mains shall be profiled regardless of size.
- iii. Horizontal scale on the profile shall match the plan sheet and the vertical scale shall be 1" = 4') or as required for clarity.
- iv. Information to be included on the profile sheet includes.
  - All profiles should be labeled to match the plan views.
  - All proposed utilities shall be stationed to the nearest 0.1 foot including all junctions, laterals, connections, P.C.'s, P.T.'s, bends, angles, wyes, cleanouts, manholes, valves, etc.
  - Elevations shall be to the nearest 0.1-foot
  - Existing ground elevation
  - Proposed ground elevation



- Size of pipes
  - Direction of flow for wastewater
  - Label the grade, linear footage, pipe material, embedment and any encasements.
  - Design flow, pipe capacity and velocity of wastewater lines
  - All utility and storm crossings shown with clearances dimensioned
- v. The City of Red Oak Standard Construction Details should be followed. The City's construction details may be supplemented with details from NCTCOG. It is the responsibility of the Engineer of Record to review all notes and design assumptions for any construction detail utilized and confirm its adequacy for use in the project.

## 4.02 Easements

1. Easements are required for public water and wastewater systems when not located within a Public Right Of Way. The system is considered a public system if it crosses property lines and/or at the discretion of the Public Works Director.
2. The utility easement shall be established as 1.5 times the depth of the utility plus the width of the utility, rounded up to a 5-foot increment.
3. The minimum easement width is 15-feet with the utility centered in the easement.
4. Fire hydrants, meters and other appurtenances are to be in a minimum of 5 x 5-foot easement

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