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**PUBLICWORKSDESIGNMANUAL**

DATE UPDATED: AUGUST 8<sup>TH</sup>, 2025



# City of Kennedale Public Works Design Manual

## Record of Revisions

<u>Date of Adoption</u>	<u>Comments</u>
08/04/2020	<b>Public Works Design Manual</b> was repealed and replaced in its entirety.
01/04/2021	Amend <b>Section 4.H.1.a</b> relative to required rebar for residential driveway approaches. Amend <b>Section 4.H.2.a</b> relative to required rebar for commercial driveway approaches. Amend <b>Section 4.H.3.a</b> relative to required slope of culvert pipe.
03/15/2021	Amend <b>Table B-1</b> source reference. Amend <b>Section 5.E</b> iSWM references. Amend <b>Table J-3a</b> source reference. Amend <b>Section 5.L.1.a</b> iSWM reference. Amend <b>Section 5.M.1</b> iSWM reference. Amend <b>Section 5.N.1</b> iSWM reference.
08/08/2025	Amend <b>Section 4.G.3</b> title to Fire Apparatus Access Roads. Amend <b>Section 4.C.3</b> . Add <b>Section 4.G.3e</b> . Amend <b>Section 3.D.13</b> with Epoxy Liner info. Amend <b>Section 5.E</b> with Hydraulic Calc sheet. Amend Details <b>M-1, M-2, S-1, and S-2</b> .

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# City of Kennedale

## Public Works Design Manual

### Purpose

This following document contains the various construction criteria, techniques, and details which are the minimum requirements of the City of Kennedale for public facilities. This information is primarily intended for the use of the Developer and his Engineer to enable the applicant to provide the proper design for the public facilities associated with a proposed development. These criteria are not intended as an exhaustive list of the construction techniques available. In the event that the specific circumstances dictate additional requirements, it shall be the responsibility of the Developer's Engineer to provide the necessary details for construction to be approved by the City Engineer.

These design criteria and details may be modified by administrative action of the City and subsequent City Ordinance at such times as may be appropriate in keeping with the most up-to-date construction techniques and specifications.

All water, sewer, street and drainage installations shall be in accordance with the current City Standards and Specifications (found herein, in City Ordinances, and in the Unified Development Code) as well as the latest edition of the North Central Council of Governments (NCTCOG) Public Works Construction Standards and in the American Water Works Association (AWWA) design manuals. However, city standards, specifications, and local amendments take precedence over the NCTCOG and AWWA manuals.

## Section 1 Construction Plans

### A. Predevelopment Meeting

1. The City of Kennedale requires having a Predevelopment Meeting prior to submitting any plat or zoning applications or plans for review and approval. The purpose of the predevelopment meeting is to introduce the applicant to the appropriate municipal representatives. The City of Kennedale's goal is to advise each applicant of the procedures and regulations relevant to development within the City. These meetings are important because they allow the applicant to ask any questions they may already have about development, and they also allow the City to communicate expectations, which will in turn minimize any surprises that may arise during the review process. Predevelopment meetings for zoning, platting, or new building construction are scheduled through the Planning and Development Department. An hour is the typical allotted time for each applicant. Please be prepared with any questions and plans that you would like to discuss. Please call the Planning and Development Department at (817) 985-2130 to set up a predevelopment meeting.

### B. Construction Plan Requirements

All construction plans for proposed water, sanitary sewer, street, drainage, and traffic improvements shall adhere to the following requirements:

1. Plans are to be designed, signed, sealed, and dated by a professional Civil Engineer registered in the State of Texas and furnished in the following format:
  - a. Cover Sheet containing:
    - i Project title
    - ii Legal property description
    - iii City name
    - iv Vicinity map with project location identifies
    - v Owner's, Engineer's, and Surveyor's name, address and telephone number
    - vi Project title in small print placed vertical along the right border
    - vii Sheet index
    - viii "City Approved" stamp (Final Plans Only)
2. Copy of current plat bound with plans. The signed plat, as approved by the City, shall be bound with the as-built drawings.
3. Copy of the City of Kennedale's General Notes found in the Public Works Design Manual
4. Grading sheets are to show the proposed surface, flow arrows, elevation call-outs, and final pad elevation.
5. Drainage Area Map and calculations with all existing contours, existing and proposed storm drains, and/or other drainage facilities.
6. Site Plan indicating the location and width of all proposed and existing street and driveway approaches noting the back-of-curb radii.

7. Utility Plan indicating the location and size of all existing and proposed water and sanitary sewer lines. Also show the location of all existing and proposed fire hydrants adjacent to the site including the maximum coverage radius of each as outlined in later sections of this manual.
8. Plan and Profile Sheets for roads, sewers, storm drains, flumes, water lines twelve inches (12") diameter and larger, and channels. Stationing shall be generally left to right and with stationing beginning at the downstream end for all sewers, storm drains, and channels. For water lines less than twelve inches (12") a water lowering tabled or cross sections will be required in along water lines where crossing any other public or private utilities.
9. Stationing shall be included on the plan view as well as the profile for all roads, water, sewer, storm drain and channel sheets. Elevations shall be calculated and provided in all profiles as indicated below.
  - a. Straight grade – provide elevations at a maximum interval of one hundred feet (100').
  - b. Vertical curve – provide elevations at the beginning and ending points and at a maximum interval of twenty-five feet (25') within the length of the curve.
10. An Erosion control plan will be necessary for all projects where erosion is expected. This plan is to show the limits of disturbance and show the protection needed for any areas where sediment from the active construction site may be carried to. This may include, but is not limited to inlet protection, sediment barriers, rock check dams, etc. All SWPPP applications must be considered under TCEQ guidelines.
11. Tree survey and preservation plan is to identify protected trees on land and display areas to avoid disturbance.
12. A Landscape plan (if required) will need to show detailed locations of proposed landscaping and call out plant species.
13. A lighting and signage plan will be required to display existing and proposed streetlights, street light coverage areas, conduits, handholes, transformers, water meters, underground electric facilities, and proposed street signs.
14. Details for improvements which are to become public.
15. Plan and profile sheets shall be a maximum of twenty-two inches (22") wide by thirty-four inches (34") long.
16. Horizontal scale on a plan and profile sheets shall be one inch (1") equals fifty feet (50') or larger, i.e. 1"=40'. Vertical scale on a plan and profile sheets shall be one inch (1") equals five feet (5') or larger.

17. Appropriate hydraulic grade line or water surface profile shall be plotted with all drainage design. Capacity, Design discharge, velocity, and depth of flow shall be noted on each segment of drainage facility in the profile whenever one or more of these parameters changes. All hydraulic calculations should follow the drainage section of this manual. Note that the City of Kennedale is iSWM certified.
18. Construction plans will be reviewed by the City Engineer and stamped after all comments have been resolved. Once approved, construction must start within three (3) years of the date of the City Engineer approval. Plans for projects which have not started construction within this time must be re-submitted for a new review.

### **C. Other Utilities**

1. The developer shall furnish all easements and right-of-way (ROW) necessary for construction of electrical, gas, cable TV, and telephone service to the proposed subdivision

## Section 2 Water Design

### A. General Design

1. Where water mains are to be installed in right-of-ways having roads constructed without curb and gutter, a plan and profile sheet shall be submitted with the construction plans showing the proposed water main profile, the existing street grades, and the preliminary future top-of-curb grades for at least three hundred feet (300') either side of the boundary of the proposed subdivision.
2. The minimum easement width for a water line shall be fifteen feet (15') centered along the pipe.
3. Water line installations sixteen inches (16") diameter and larger shall be equipped for By-Pass Valve function. The water lines shall be designed with provisions for proper air release function at each of the summits along water feeder line route. Fire hydrants where located at such summit location may provide the necessary air release function.
4. All water mains constructed within a proposed subdivision shall be extended to the perimeter of the proposed subdivision to allow for future extension of the water system into adjacent properties.
5. All materials and workmanship incorporated in water system extensions shall be in accordance with the currently adopted City Construction Specifications.
6. The minimum easement width for water shall be fifteen feet (15') min centered on along the water main.

### B. Main Sizing

1. All water mains shall be a minimum of eight inches (8") in diameter. Fire hydrant leads may be six inches (6") in diameter. Larger diameter mains will be necessary if fire flow requirements so dictate.
2. Water systems shall be of sufficient size to furnish adequate domestic service, to provide adequate fire protection to all lots, and to conform to the City's current Master Water Distribution System Plan. Public water mains adjacent to federal, state, or county roadways shall be constructed outside the right-of-way in a separate easement dedicated by separate instrument, or by plat.
3. The Owner's Engineer shall provide calculations showing maximum day usage, peak hour usage, and fire flow demands for the proposed development. The City Engineers will use the provided calculations to confirm the existing mains are adequate to support the development or determine the size(s) required to furnish adequate water service for the proposed development. Parameters for calculating water system demands based on typical land use types are shown in Table 3-1, Water System Average Daily Demand (ADD).

4. Maximum flow velocity during normal operating conditions shall not exceed 7 feet per second.

Table 2-1 Water System Average Daily Demand (ADD)

Land Use	Density		Demand		
	(People per Acre)	(Person per Unit)	Average Day Demand	Max. Day/ Avg Day Ratio	Peak Hour/ Max Day Ratio
Single Family Residential & Duplex	12.0	3.5	130 gal/person	1.9	1.75
Estate Sized Single Family	7.0	3.5	130 gal/person	1.9	1.75
Multi-Family Residential (Includes Townhomes and Condos)	52.0	3.5	110 gal/person	1.9	1.75
Industrial, Commercial or Mixed Use	Industry-specific – contact Public Works for information				

**C. Main Placement**

1. Horizontal
  - a. Mains shall be located a minimum 2 feet off the back of curb
  - b. Mains shall be located a minimum of 2 feet behind storm drain inlets (use of bends may be necessary).
  - c. Changes in horizontal alignment shall be achieved by use of fittings or deflection of joints. If fittings are used, they shall be called out and labeled on the construction plans.
    - i The maximum joint deflection to be used for PVC water mains 12 inches in diameter or smaller is 1 degree which equates to a minimum radius of 1,150 feet.
    - ii The maximum joint deflection to be used for DIP water mains 12 inches in diameter or smaller is 4 degrees which equates to a minimum radius of 290 feet.
    - iii The maximum joint deflection to be used for other water main sizes and materials shall require approval by the City Engineer.
  - d. The minimum horizontal separation between any water main, storm drain facility and public service provider utilities shall be equal to three feet (3') or half the depth of the water line, whichever is greater.
  - e. Two 45-degree bends should be used in lieu of 90-degree bends, where practical.

- f. Mains located within a cul-de-sac are not required to be looped if all of the following criteria are met:
    - i. Connects to a looped main six inches (6") or larger.
    - ii. Has at least one service connection within 5 feet of the terminating end.
    - iii. Has at least a minimum of 2 service connections per 100 feet of main
    - iv. The maximum dead-end allowed is 800 ft
  - g. In Developments where end connection to another water main cannot be made (cul-de-sac locations, etc.) the terminal end of the water line in each case shall be equipped with at least one of the following at the discretion of the city:
    - i. Fire hydrant assembly
    - ii. Two inch (2") flush valve assembly
    - iii. Water service installation
2. Vertical
- a. Minimum Depth of cover for all water mains shall be three and one-half feet (3.5').
  - b. Mains along unimproved (county type) streets shall have a minimum depth of 5 feet below the lowest ditch elevation to the top of pipe to provide grade for future street improvements.
  - c. A profile drawing shall be provided for all mains which meet any of the following conditions:
    - i. 12 inches in diameter and larger,
    - ii. Crossing beneath a storm drainpipe, box culvert, or channel,
    - iii. Installed within a steel casing pipe,
    - iv. Crossing beneath public service providers, or
    - v. Mains installed greater than 6 feet in depth
  - d. Mains shall not be placed below curb inlets
  - e. Steel casing pipe shall be used where mains are to be constructed by method other than open cut.

#### **D. Valves**

1. All tee intersections of public water mains shall include at least two (2) gate valves. All cross intersections of public water mains shall include at least three (3) gate valves.

#### **E. Services**

1. Residential water services shall not be directly connected to water mains sixteen inches (16") diameter or greater. Smaller, parallel water mains are required for water services to be connected to.
2. All water services shall be located at the center of the lot and stationed on the construction plan sheet, where possible, and all water meters shall be located in City rights-of-way or inside a waterline easement, unless approved otherwise by the City Engineer.

## **E. Fire Hydrants**

1. In all residential subdivisions, fire hydrant spacing shall not exceed six hundred feet (600') as measured along the water main. All structures within the proposed subdivision shall be within five hundred feet (500') radial distance of a fire hydrant.
2. In all other developments, fire hydrant spacing shall not exceed three hundred feet (300') as measured along the water main. All structures shall be within three hundred feet (300') radial distance of a fire hydrant.
3. Fire hydrants located on the opposite side of a roadway from a development when the roadway width is greater than forty feet (40') shall not be considered when determining adequate fire hydrant coverage for a development.

## Section 3 Sanitary Sewer Design

### A. General Design

1. All subdivisions developed subsequent to this Ordinance must be served by community sanitary sewer collection, treatment and disposal systems approved by the City. Each lot must be provided with an individual service.
2. Sanitary sewer facilities shall be provided to adequately service each lot or tract of the subdivision and shall conform to the City's current Master Sanitary Sewer System Plan.
3. All laterals and sewer mains installed within a subdivision must extend to the borders of the subdivision as required for future extensions of the collection system regardless of whether or not such extensions are required for service within the subdivision.
4. The minimum easement width for a sanitary sewer main shall be fifteen feet (15') centered along the sanitary sewer main.
5. All sanitary sewer mains shall end at a manhole. Cleanouts will not be allowed.
6. Sampling wells are required for all industrial buildings, Laundromats, dry cleaners, automotive repair facilities, and food handling facilities.
7. All mains shall be wrapped in 8oz geotextile fabric.
8. No connection shall be made to any sanitary sewer within the City which will permit the entrance of surface water or of waste which has other than domestic sewage characteristics without the specific authorization of the Director of Development and Enforcement.

### B. Main Sizing

1. No sanitary sewer main shall be less than 8 inches (8") in diameter. All sewers shall be designed with consideration for serving the full drainage area subject to collection by the sewer in question. Exceptions to this requirement may be made only at the direction of the City Engineer.
2. Mains shall be adequately sized to serve the development and upstream sanitary sewer drainage basin.
3. The diameter of the main shall not be increased in order to provide a minimal slope.
4. An engineering analysis performed by an Engineer may be required by WU to confirm existing or proposed mains are adequate to support the proposed development. The average daily flow, daily peaking factor, and infiltration/inflow rate for the existing development can be made available upon request.
5. Parameters for calculating sanitary sewer system demands for proposed development based on typical land use types are shown in Table 3-1, Design Sanitary Sewer Loading for Proposed Development.

6. If a new sanitary sewer line is to be constructed adjacent to an existing street, the profile will need to include the existing top of curb grades.

Table 3-1 Design Sanitary Sewer Loading for Proposed Development

Land Use	Density		Demand		
	(People per Acre)	(Person per Unit)	Average Day Flow (ADF)	Daily Peaking Factor (PF)	Infiltration & Inflow Rate (I&I) (gpm/ac)
Single Family Residential & Duplex	12.0	3.5	100 gal/person	1.85	2.72
Estate Sized Single Family	7.0	4.5	100 gal/person	1.85	2.72
Multi-Family Residential	52.0	3.5	100 gal/person	1.85	2.72
Industrial, Commercial or Mixed Use	Contact Public Works			1.85	2.72
1. Average Daily Flow represents the “dry weather” flow with no allowance for infiltration and inflow. 2. Daily Peaking Factor and Infiltration/Inflow Rate are from a recent sanitary sewer flow study performed by WU and represent the highest and system-wide averages for each, respectively.					

Table 3-2 Allowable Sanitary Sewer Pipe Diameters & Slopes

Diameter (Inches)	Minimum Slope (%)	Maximum Slope (%)
8	0.61	8.40
10	0.47	6.20
12	0.37	4.88
15	0.29	3.62
18	0.23	2.83
21	0.20	2.30
24	0.17	1.93
27	0.15	1.65
30	0.14	1.43
36	0.11	1.12
Notes: For mains larger than 36-inch diameter, the minimum and maximum slope shall be determined using Manning’s equation to achieve a minimum velocity of 3.0 ft/s under half full conditions with a maximum velocity of 10.0 ft/s under full flow conditions.		

## **C. Main Placement**

### 1. Horizontal

- a. Mains located in residential streets shall be placed along the centerline of the street.
- b. Mains located in non-residential streets shall be placed along the center of a traffic lane
- c. All sanitary sewers constructed adjacent to federal, state or county roadways shall be constructed outside the right-of-way in a separate easement dedicated by separate instrument, or by plat.
- d. The minimum horizontal separation between any sanitary sewer main, storm drain facility and all public service providers shall be equal to three feet (3') or half the depth of the sanitary sewer, whichever is greater.
- e. Mains should be constructed on a straight alignment unless a curved alignment is required. Curvature in a horizontal alignment for sanitary sewer mains shall be achieved by deflection of joints. If the Engineer intends for the contractor to use pipe joint deflection, the construction plans shall include the design radius, beginning and ending of curvature, and a detail of the proposed typical deflection. The maximum joint deflection shall be as follows:
  - i. The maximum joint deflection to be used for PVC sanitary sewer mains 12 inches in diameter or smaller is 0.8 degrees which equates to a radius of 1,440 feet.
  - ii. Sanitary sewer mains larger than 12 inches in diameter shall be constructed on a straight alignment.

### 2. Vertical

- a. Vertical curves will not be allowed.
- b. Mains shall be placed at an elevation low enough to accommodate future development in the sanitary sewer drainage basin.
- c. Mains shall have a minimum cover of 42 inches as measured from the top of the pipe to the existing ground or the proposed finished grade, whichever is lower.
- d. Mains constructed along unimproved (county type) streets shall be a minimum of 8 feet below the lowest part of the existing street or bar ditch to provide grade for future street improvements.
- e. When a smaller upstream main joins to a larger downstream main, the crown elevation on both sides of the manhole shall match.
- f. New downstream mains shall be equal to or larger than mains located upstream.
- g. A profile drawing shall be provided for all mains.

- h. Steel casing pipe shall be installed where mains are to be constructed by method other than open cut. Alternate encasements, methods, and materials may be used upon approval by Public Works.
- i. Mains with less than 2 feet clearance below a 30 inch or smaller storm drainpipe shall be one of the following:
  - i Installed within a steel casing pipe; or
  - ii Concrete encased with approval of Public Works.
- j. Mains installed below a 33 inch or larger diameter storm drainpipe, box culvert, or channel shall be installed within a steel casing pipe. Alternate encasements methods and materials may be used upon approval by Public Works.
- k. Where casing pipe is required, the casing pipe shall extend a minimum of 5 feet beyond the drainage structure or 10 feet beyond a drainage channel or as required for construction and future maintenance practices.

#### **D. Manholes**

1. A manhole is required at the following locations:
  - a. Change in horizontal and vertical alignment.
  - b. Beginning and termination of a curve.
  - c. Connection of two or more mains.
  - d. Change in main diameter.
  - e. Service connections eight inches (8") in diameter and larger.
  - f. End of each main.
2. The maximum spacing for manholes on a straight alignment shall be:
  - a. 500 feet (6-inch to 15-inch diameter mains)
  - b. 800 feet (18-inch to 30-inch diameter mains)
  - c. 1,000 feet (36-inch and larger diameter mains)
3. The maximum spacing for manholes on a curved alignment shall be 300 feet.
4. A standard manhole is 48 inches in diameter.
5. A 60-inch diameter manhole is required when:
  - a. Deeper than 10 feet (measured from rim to flow line), or
  - b. Main is 15 inches in diameter and larger.
6. Drop manholes shall be required when an influent flow line is greater than 2 feet above the effluent flow line and must be accommodated with a 5 foot diameter manhole with an internal drop.

7. A manhole installed at the end of a cul-de-sac shall have a maximum of three service connections.
8. Watertight rings and bolt-down lids shall be used on manholes when:
  - a. Mains are 18 inches in diameter and larger,
  - b. Located within the 100-year floodplain,
  - c. Located at pavement low points, or
  - d. Located in areas prone to flooding or running water.
9. Manholes located outside of the right-of-way shall be accessible by 2-wheel drive vehicles 24 hours a day and shall be approachable by a dedicated 15-foot minimum right-of-way or sanitary sewer easement.
10. Connections to an existing manhole shall be cored, and the invert shall be re-worked.
11. Manholes shall be installed outside the normal tire path in a lane of a paved roadway.
12. Manhole venting shall be required per TCEQ requirements.
13. On all newly installed Sanitary Sewer Manholes, an epoxy liner is required to be Installed. The Contractor must use Raven 405 Lining System, Warren Environmental 301-14 High Performance Epoxy System, or an approved equal.

## **E. Services**

1. All services shall be located ten feet (10') downstream of the center of the lot.
2. The maximum depth for all standard sewer services shall be eight feet (8'). If the existing or proposed sewer main is deeper than eight feet (8'), the service shall be constructed in accordance with the details for deep sewer service.
3. All services shall be a minimum of 4 inches in diameter. Larger mains may be required based on calculated peak effluent.
4. Services shall be perpendicular to the main.
5. Services on mains larger than 18 inches will not be allowed.
6. Services shall be a minimum of 6 inches from storm drain facilities.

## **F. Lift Stations or Separate Treatment Facilities**

1. The provisions for lift stations or separate treatment facilities will not be permitted unless, in the opinion of the City Engineer, there is no feasible alternative which can provide the necessary service to the proposed subdivision.

## **G. Connections**

1. No connection shall be made to any sanitary sewer within the City which will permit the entrance of surface water or of waste which has other than domestic sewage characteristics without the specific authorization of the Director of Development and Enforcement.

## **H. Septic Systems**

1. Where public sanitary sewerage systems are not within three hundred feet (300') of the property line of the plat, septic systems may be approved only if all of the following conditions are met:
  - a. The proposed subdivision consists of three (3) lots or less. Each lot must be a minimum of one acre in size.
  - b. The existing City sewer system is not and cannot feasibly, in the opinion of the City Engineer, be made available to the area of development.
  - c. Percolation tests run by an independent testing laboratory are submitted to both the City and the County Health Department with results showing that a septic tank and absorption field can be developed in accordance with state and county criteria to provide adequate disposal of the sewage. Where septic tank installations are permitted in lieu of sanitary sewerage system, the plat must include dedicated sanitary sewer easements not less than twenty feet (20') in width adjacent to all lots to facilitate the future installation of a sewerage system. Dedication of such easement shall prohibit fencing or other obstructions that would interfere with the future installation of the sewer lines. Septic tanks must be situated so as to facilitate connection to the future sanitary sewer system.
  - d. Installation of individual septic tanks shall be according to rules and regulations issued by the Tarrant County Health Inspector.

## Section 4 Roadway Design

### A. Streets Required

1. All streets constructed within the City shall be required to be constructed with curbs and gutters. The required widths of all streets within the City shall be determined by the "Thoroughfare Type" of the streets as contained in the most current revision of the Future Transportation Plan of the City of Kennedale.

### B. General Design Criteria

1. All streets within or abutting the proposed subdivision shall be concrete with curbs in accordance with the City's Standards and Specifications. All paving shall be to the width specified on the Future Transportation Plan and shall be constructed under the inspection of the City. The construction costs of all street improvements shall be borne by the developer unless participation by the City has been approved in writing.
2. Underground City owned utilities required in the subdivision shall be placed under or across all streets after the rough grades are made, but prior to the paving being placed. Paving operations will not be allowed to start until the utility work is complete.

### C. Horizontal Design

1. The minimum classified width of a proposed street shall be enlarged under the following conditions.
  - a. Adjacent to commercial or multi-family land uses where, in the opinion of the City Engineer and based on analysis of proposed width and expected traffic volume and flow, the standard required width is insufficient for proper access and circulation.
  - b. Where, in the opinion of the City or in the opinion of the Developer, with the concurrence of the City, the aesthetic value achieved from extra width is dictated by special conditions.
2. The proposed streets shall be located in the center of the right-of-way to allow both parkways to be the same width. The final grade of all parkways, existing and proposed, shall be one-quarter inch (1/4") per foot cross slope from the top of curb to the property line. All parkways shall drain to the street. Exceptions may be allowed by the City Engineer to preserve native trees.
3. Cul-de-sacs:
  - a. Minimum forty-foot (40') radius to the back of curb
  - b. Minimum fifty-foot (50') radius right-of-way
  - c. Maximum 600 feet in length
  - d. Must be striped and signed for no parking around the circumference of the cul-de-sac to allow for proper fire access.
4. Standard reinforced concrete curb height and width is six inches (6").
5. All street intersections shall be constructed to form a ninety-degree (90°) angle +/- 10° unless approved by the City Engineer.

6. Standard roadway criteria shall be according to the following table:

Thoroughfare Type	Parkway	Multiway Parkway Main Lanes / Access Lanes	Boulevard	Avenue (Collector)	Street (Residential)	Rural Road
<b>Number of through lanes</b>	4	4 / 2	4	2 to 4	2	2
<b>Desired Operating Speed (mph)</b>	40-45	40-45 / 30-35	35-40	30-35	25-30	35-40
<b>Median</b>	16'-18'	12'-18' / 6'-8'	12'-18'	4'-16' (optional)	--	--
<b>Driveway Access</b>	Limited	From access lanes	Limited	Yes	Yes	Yes
<b>Curb Parking</b>	No	Yes (access lane)	Optional	Yes	Yes (not delineated)	No
<b>Pedestrian Facilities<sup>1</sup> (clear through-way)</b>	5'	5'-10- (access lanes)	5'-10'	5'-10'	5'-8'	5'
<b>Bicycle Facilities<sup>2</sup></b>	SP or SH	BL or SL	BL or BBL	BL or SL	SL	SL or SH
<b>Streetside Width<sup>3</sup></b>	18'-25'	15'-20'	18'-22'	15'-20'	11'-16'	25'-30'
<b>Required ROW Width</b>	100'-150'	120'-160'	100'-130'	60'-110'	50'-70'	80'-100'
<b>Lane Width (F-F)</b>	11'	11'	11'	10'/14'	14'	11'
<b>Min CL Curve Radius</b>	800'	800'/500'	500'	500'	200'	500'
<b>Min Reverse Curve Tangent Length</b>	200'	200'/100'	100'	100'	50'	100'
<b>Min Subgrade Compacted Thickness<sup>4</sup></b>	12"	10"	10"	8"	8"	8"
<b>Min Curb Return Radius</b>	50'	50'	30'	30'	20'	20'
<b>NOTES:</b>						
1 Proposed widths of pedestrian facilities should be applied to both sides of the street.						
2 SP - Side Path SH - Shoulder BL - Bike Lane SL - Shared Lane BBL - Buffered Bike Lane						

- 3 Streetside Width refers to the area between the street and the building. It includes the edge, furnishings/planting strip, clear throughway, and frontage zones.
- 4 All streets require use of chemical additives to stabilize the subgrade.

**D. Vertical Design**

1. Street grades shall be designed such that excessive sand depositions from too low a water velocity or pavement scouring from too high a velocity is avoided. The minimum street grade permitted shall be 0.50%. The maximum street grade shall not exceed 8.0%. Any deviation from this range of permissible grades shall require written approval of the City Engineer.
2. Vertical curves are not required for changes in grade with an algebraic difference of one percent (1%) or less.
3. In order to maintain an adequate sight distance, the minimum “K” values for the computation of vertical curves in the standard formula  $L=KA$ , where L is the length of the vertical curve in feet, and A is the algebraic difference of the street grades in percent (%) are listed below:

Table 4-2 Minimum Vertical “K” Values and Length

Design Speed MPH	Crest		Sag	
	"K" Value	Length (ft)	"K" Value	Length (ft)
30	19	20	37	40
35	19	20	37	40
40	44	50	64	70
45	61	65	79	80
50	84	70	96	80

**E. Medians**

1. Median openings shall be spaced a minimum of six hundred feet (600’) center-to-center and eight hundred feet (800’) from an intersection.
2. Median opening width shall be sixty feet (60’) wide
3. The typical storage length is 150 feet with 150 feet of transition.

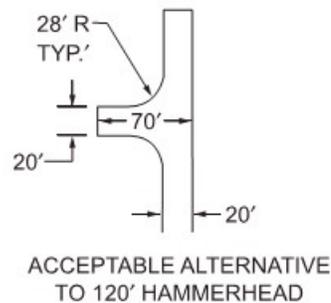
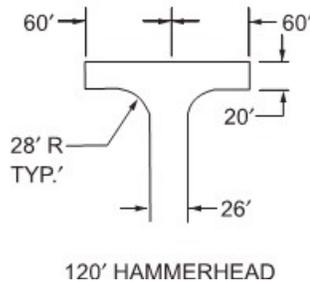
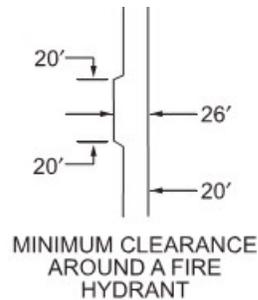
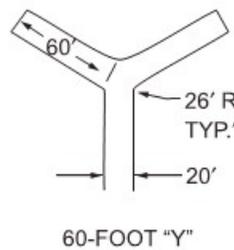
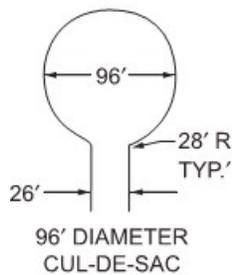
**F. Sidewalks**

1. Sidewalks shall be placed on both sides of the street within the right-of-way. No closer than six inches (6”) from the right-of-way line
2. Sidewalks shall be designed and constructed to meet ADA and TAS requirements and have a cross slope of no greater than one quarter inch (1/4”) per foot.
3. Sidewalks shall be constructed of four-inch (4”) thick, three thousand (3,000) psi compressive strength concrete reinforced with #3 steel bars laid on maximum of eighteen inch (18”) centers.
4. Sidewalks shall be a minimum of five feet (5’) in width, unless otherwise stated in zoning (UDC).

5. Sidewalks along TxDOT facilities shall be in accordance with TxDOT standards.

**G. Fire Apparatus Access Road**

1. All fire apparatus access roads shall be design and constructed to conform with the 2018 international fire code unless specified otherwise in this section.
2. All designated fire apparatus access roads shall always be maintained by the property owner.
3. Horizontal
  - a. Fire apparatus access roads where a fire hydrant is located along the road shall be a minimum unobstructed width of twenty-six feet (26') wide
  - b. All other fire apparatus access roads shall have a minimum unobstructed width of twenty-four feet (24') wide
  - c. All fire apparatus access roads shall have a minimum inside turn radius of thirty feet (30').
  - d. Dead-end fire apparatus access roads shall not exceed 150 feet in length without approved turnaround provisions provided. See the table below from the 2015 International Fire Code.
  - e. Cul-de-sacs shall provide an adequate turning radius for emergency equipment and shall include fire apparatus access roads markings or signage to prevent obstructions from on-street parking as determined by the fire code official.



4. Vertical
  - a. All fire apparatus access roads shall have a maximum eight percent (8%) grade.
  - b. All fire apparatus access roads shall have a vertical clearance of fourteen feet (14')

## **H. Driveway Standards**

### **1. Residential Driveway Approaches**

- a. Residential driveway approaches shall be constructed of six inch (6") thick thirty-six thousand (3,600) psi compressive strength concrete reinforced with #3 bars on eighteen inch (18") centers both ways. The driveway shall begin at the street curb and extend to the property line or to a point ten feet (10') from the face of the curb whichever is greater. The drive approach shall be constructed such that the height of the drive approach at the property right-of-way line, with a normal ten foot (10') parkway, shall be two and one-half inches (2 ½") higher than the top of curb.
- b. Width of Driveway Approaches: Residential driveway approaches shall not be less than twelve feet (12') in width nor more than twenty feet (20') wide measured at the property line. Specific variance to this criteria may be requested by the property owner. Any variance granted based on a specific design submittal must have the approval of the City Engineer.
- c. Radius: Residential driveways shall be constructed with the return curbs having a rolled face disappearing at the sidewalk and joining the street curb with a minimum five foot (5') radius and a maximum ten foot (10') radius.
- d. Provision for Joint Use Approaches: Drive approaches shall be located entirely within the frontage of the premises they serve except for joint-use, or cooperative driveways which may be permitted for use by adjoining property holders. When the joint drive approach is proposed, the request must be made by, and agreed to, by all the interested parties and all property owners involved. The design of the joint driveway facilities must be submitted with the request to be approved by the City Engineer.
- e. Residential Driveway Approaches at Street Intersections: The drive approach on corner lots must be located to approximately line up with the side of the house or garage that is farthest from the intersection. The drive approach edge farthest from the street intersection must be within three feet (3') of the far side of the house or garage.
- f. Only drive approaches in accordance with the above criteria will be allowed onto residential or minor streets at a street intersection. If both streets are residentially classified, a circular drive will be allowed on a corner lot if one of its two approaches meets the above location criteria. The other drive approach can have its near side no closer than fifteen feet (15') to the property corner closest to the intersection. If both streets have the same classification, other than residential as contained in the City's current Thoroughfare Plan, the City Engineer shall make the determination as to which street access will be allowed.
- g. Future maintenance of the drive approach shall be the responsibility of the property owner.

## 2. Commercial / Industrial Driveway Approaches

- a. Commercial and Industrial driveway approaches shall be constructed of eight inch (8") to 10 inch (10") thick, per geotechnical engineers recommendations, of thirty- six hundred (3,600) psi compressive strength concrete. The industrial driveway must be reinforced with #3 bars on eighteen inch (18") centers both ways. The driveway shall begin at the curb of the street and extend to the property line or to a point ten feet (10') from the face of the curb, whichever is greater. The drive approach shall be constructed such that the height of the drive approach at the property line shall not be more than two and one-half inches (2 ½") higher than the top of curb at the street.
- b. Width of Driveway Approach: The width of any commercial or industrial driveway approach shall not be less than twenty feet (20') nor more than thirty-five feet (35') measured along the property line. The Developer may request a specific variance to this criteria. Any variance granted based upon a specific design submittal must have the approval of the City Engineer.
- c. Radius: Commercial and Industrial driveways shall be constructed with the return curbs having a rolled face disappearing at the sidewalk and joining the street curb with a minimum ten foot (10') radius and a maximum thirty foot (30') radius.
- d. Allowable Spacing for Driveway Approaches: On streets classified as Collector Streets, the minimum centerline spacing between driveways shall be at least three hundred feet (300'). On streets classified as Arterials, minimum spacing shall be at least five hundred feet (500'). This spacing criteria shall be applied irrespective of the number of individual properties located within the intervening distance. The Developer may request a deviation from this criteria. Any deviation granted will be based on a specific design submittal and must have the approval of the City Engineer.
- e. Provision for Joint Approaches: Driveway approaches shall be located entirely within the frontage of the premises and shall be located no closer than ten feet (10') from each side property line except that joint, or cooperative, drive approaches with adjoining property holders may be permitted in order to conform with the provisions of paragraph (d) above. Any request for joint drive access must be by agreement of all parties involved and a specific plan submittal must be included for approval of the City Engineer. Both property owners will be required to dedicate public ingress and egress easements to cover the approach and joint access area.
- f. Approaches on Properties other than Residential: The driveway for the corner lot, if allowed, must be located a minimum of fifty feet (50') from the point of intersection of the curb lines of both streets.
- g. Angle of Driveway Approach: The angle of the driveway approach with the curb line shall be ninety degrees (90°).
- h. Sidewalk to be Removed: Where a driveway approach is to be built, the sidewalk shall be removed and the entire area replaced as a driveway. The drive approach shall extend to the property line.

### 3. Driveways Crossing Bar Ditches

- a. The minimum culvert pipe size shall be eighteen inch (18") diameter for reinforced concrete pipe (RCP). Corrugated galvanized metal pipe may not be used. The ends of all culvert pipe shall be cut at a 6:1 slope.
- b. Radius: Driveways shall be constructed with the return curbs joining the edge of pavement at the street with a minimum five-foot (5') radius for residential and ten foot (10') for commercial or industrial.
- c. The maximum slope from the edge of driveway to the top of the culvert pipe shall be 3:1. The sloped area around the end of the culvert pipe shall have a headwall and end treatments. Riprap and/or other erosion control measures may also be required for slopes greater than 2:1.
- d. The minimum cross slope on the drive shall be one-eighth inch (1/8") per foot. The minimum longitudinal slope between the edge of pavement at the street and the valley over the culvert pipe shall be one-quarter inch (1/4") per foot.
- e. All driveways over bar ditches shall be constructed with a valley at least four inches (4") lower than the edge of the road pavement to allow excess stormwater to exit from the drive before entering the roadway.
- f. Future maintenance of the drive approach and culvert pipe is the responsibility of the property owner.
- g. During the drive approach installation, all finish grading upstream and downstream of the proposed driveway culvert is the responsibility of the property owner.

### 4. General

- a. Driveway Approaches at Pedestrian Crossings: Driveway approaches shall not be located in street intersections or at established pedestrian crossings.
- b. Driveway Approaches at Obstructions: Driveway shall be kept at a minimum of five feet (5') away from obstructions such as streetlight posts, fire hydrants, traffic signals, etc.
- c. Driveway Approach not to be Obstructed: Driveway approaches shall not be constructed or designed for parking of vehicles or for use as angle parking.
- d. Accumulative Width of Approaches: Driveway approaches shall not occupy more than forty percent (40%) of the frontage of a lot or tract in each case.

## Section 5 Stormwater Design

### A. General

1. The City of Kennedale has adopted iSWM as the basis for the stormwater design criteria regulations. The criteria herein provided shall govern the design of storm drainage improvements within the City of Kennedale. Improvements shall include streets, alleys, storm sewers, channels, culverts, bridges, swales, and any other facilities through which stormwater flows. All drainage improvements shall be constructed in accordance with City specifications and be in dedicated right-of-way (ROW) or drainage easement. The Developer shall provide all the necessary easement and ROW for drainage improvements, including access ramps where required. Easement width for storm sewer pipe shall be at least fifteen feet (15') and open channel easement width shall be at least fifteen feet (15') wider than the top of the channel with a minimum of ten feet (10') on one side to serve as an access way for maintenance purposes.

The Developer shall be required to install at his own expense all storm sewers and drainage structures both on and off site. This policy is applicable to all required drainage facilities including the channel improvements on the main channels and tributaries of Village Creek. The Developer shall be responsible for stormwater improvements based on the fully urbanized one hundred (100) year frequency discharge.

### B. Basis of Design

1. Hydrologic Method (See Table B-1)
  - a. The hydrologic method used to calculate runoff characteristics of a site or drainage area shall be determined by Table B-1. Calculations using the given hydrological method shall be performed per the iSWM Hydrology Technical Manual, Section 1.0 Hydrological Analysis.
2. Runoff Coefficient (See Table B-2)
  - a. Storm drainage improvements shall be designed based on the drainage areas being fully developed. The zoning as shown on the current City Zoning maps or the City's Master Land Use Plan, whichever is more restrictive, shall determine the particular runoff coefficient value. Table B-2 below indicates the runoff coefficients for different land uses.
3. Time of Concentration (See Table B-3)
  - a. The time of concentration shall be defined as the time required for a drop of water to flow from the upper limits of a drainage area to the point of concentration. Times of concentrations shall be calculated for all inlets, pipe junctions, and other critical design points in the proposed storm sewer systems. Table B-3 shows minimum inlet times of concentrations which may be used in place of calculated times. When calculating inlet times, consider overland flow channelized at such time as the distance traveled exceeds fifty to one hundred feet (50'-100').

Table B-1  
Constraints on Hydrologic Methods

Method	Size Limitations <sup>1</sup>	Comments
Rational	0 – 100 acres	Method can be used for estimating peak flows and the design of small site or subdivision storm sewer systems.
Modified Rational <sup>2</sup>	0 – 200 acres	Method can be used for estimating runoff volumes for storage design.
Unit Hydrograph (SCS) <sup>3</sup>	Any Size	Method can be used for estimating peak flows and hydrographs for all design applications.
Unit Hydrograph (Snyder's) <sup>4</sup>	1 acre and larger	Method can be used for estimating peak flows and hydrographs for all design applications.
TXDOT Regression Equations	10 to 100 mi <sup>2</sup>	Method can be used for estimating peak flows for rural design applications.
USGS Regression Equations	3 – 40 mi <sup>2</sup>	Method can be used for estimating peak flows for urban design applications.
iSWM Water Quality Protection Volume Calculation	Limits set for each Structural Control	Method can be used for calculating the Water Quality Protection Volume (WQ <sub>v</sub> ).
<sup>1</sup> Size limitation refers to the drainage basin for the stormwater management facility (e.g., culvert, inlet). <sup>2</sup> Where the Modified Rational Method is used for conceptualizing, the engineer is cautioned that the method could underestimate the storage volume. <sup>3</sup> This refers to SCS routing methodology included in many readily available programs (such as HEC-HMS or HEC-1) that utilize this methodology. <sup>4</sup> This refers to the Snyder's methodology included in many readily available programs (such as HEC-HMS or HEC-1) that utilize this methodology.		

Table from iSWM Hydrology Technical Manual Rev. 9/2014, Table 1.2

Table B-2  
Runoff Coefficient Values

Description of Area	Runoff Coefficients (C)	Description of Area	Runoff Coefficients (C)
Commercial/Industrial:		Lawns:	
Light areas	0.70	Sandy soil, flat, 2%	0.10
Heavy areas	0.80	Sandy soil, average, 2 - 7%	0.15
Parks, cemeteries	0.25	Sandy soil, steep, > 7%	0.20
Playgrounds	0.35	Clay soil, flat, 2%	0.17
Railroad yard areas	0.40	Clay soil, average, 2 - 7%	0.22
Streets:		Clay soil, steep, > 7%	0.35
Asphalt and Concrete	0.95	Agricultural	0.30
Brick	0.85	Forest	0.15
Drives, walks, and roofs	0.95	Streams, Lakes, Water Surfaces	1.00
Gravel areas	0.50	Business:	
Graded or no plant cover:		Downtown areas	0.95
Sandy soil, flat, 0 - 5%	0.30	Neighborhood areas	0.70
Sandy soil, flat, 5 - 10%	0.40	Residential:	
Clayey soil, flat, 0 - 5%	0.50	Single Family (1/8 acre lots)	0.65
Clayey soil, average, 5 - 10%	0.60	Single Family (1/4 acre lots)	0.60
		Single Family (1/2 acre lots)	0.55
		Single Family (1+ acre lots)	0.45
		Multi-Family Units, (Light)	0.65
		Multi-Family, (Heavy)	0.85

Table from iSWM Hydrology Technical Manual Rev. 9/2014, Table 1.6

TABLE B-3  
Minimum Inlet Time of Concentration

Type of Area	Min. of Inlet Time
Business and Commercial	10 Minutes
Industrial	10 Minutes
Multi-Family	10 Minutes
Residential	15 Minutes

4. Rainfall Intensity-Duration-Frequency
  - a. The rainfall intensity-duration-frequency compiled in the Hydrology iSWM Technical Manual shall be utilized in computing rainfall intensity.
5. Design Storm Frequency (See Table B-5)
  - a. The storm frequency to be used in design shall be as shown in the following table (Table B-5)

TABLE B-5  
Design Storm Frequency

<u>Type of Facility</u>	<u>Min. Design Frequency</u>
Streets	5
Roadway Gutters	5
Storm Drain Systems	5
Inlets on Grade	5
Parking Lots	5
Drainage in the ROW	100
Drainage Easements	100
Roadway Low Points	100

6. A storm sewer shall be designed to pick up flow from the street when the runoff from a five (5) year frequency storm exceeds the capacity of the street to its top of curb, or the spread of water on a collector street does not leave at least one (1) traffic lane dry, or the spread of water on an arterial street does not leave at least two (2) traffic lanes dry, whichever is more restrictive. The combined capacity of the street and ROW and/or drainage easements and the storm sewer pipe shall be adequate to safely convey the runoff from a one hundred (100) year frequency storm.
  - a. Off-Site Drainage
7. In respect to offsite drainage, the following provisions shall apply:
  - a. The Developer shall be responsible for handling and disposal of all runoff from upstream of his proposed development and shall involve discharge design quantities calculated as though the upstream areas of runoff were fully developed. Runoff coefficients utilized to design drainage systems for the properties involved shall use the current zoning and/or the future use of the property as shown in the Kennedale Land Use Plan, whichever use is the most intensive.
  - b. Effect of the development's drainage design on downstream properties and adjacent properties shall be given proper consideration. Water concentrated in streets, pipes, drains, culverts, and channels will be moved to a recognized watercourse without damage to intervening structures or undue spreading across intervening land.
  - c. A downstream and upstream assessment will be required to determine the Zone of Influence and the extents of improvements necessary for streambank protection and flood mitigation. Refer to iSWM for a definition of the Zone of Influence.
  - d. The Stormwater must be carried to an "adequate or acceptable outfall" which is one which does not create or increase flooding or erosion conditions downstream. The Developer is responsible for constructing all offsite channelization or underground storm drain with overland relief required to discharge concentrated stormwater

from the low end of his development to the recognized watercourse, and also to obtain all the necessary easements from intervening land owners. Calculations will be required to show that connecting offsite drainage ways are capable of handling any increase in runoff due to development, concentration, or diversion for the 1-, 2-, 5-, 25-, and 100- year storm frequencies.

- e. Any drainage easements necessary due to the Developer's alteration of existing concentrated discharge locations (i.e., existing creeks, channels, or storm sewers) shall be acquired by the Developer at no cost to the City.
- f. Where the preliminary drainage analysis by the Developer indicates that additional runoff from the developing property will overload downstream drainage facilities and result in hazardous conditions, the City may withhold approval of the development until appropriate provisions have been made to resolve the conflict. These provisions shall include any drainage studies or plans necessary to indicate that the offsite drainage problem will be corrected by offsite drainage improvements provided by the developer.
- g. When required, the Developer will furnish to the City, a "hold harmless agreement" and a "release of liability" indemnifying the City of Kennedale from any liabilities due to damages caused to downstream property owner(s) by the discharge of storm drainage water from the said development.

#### 8. Water Quality

- a. The removal of pollutants in stormwater runoff to protect water quality is not currently required by the City, but is strongly encouraged. However, please note that although it may not be required by the City, other agencies may require water quality protection measures. The City also reserves the right to require water quality measures should it be deemed necessary due to the type of development proposed and its proximity to existing streams, tributaries, ponds etc.

#### 9. Lot Grading

- a. Residential lot grading shall be conducted in a manner which will not allow runoff to cross more than two (2) lots (including the lot on which the drainage originates) before it enters a street or drainage easement. If this is not possible, then a drainage easement must be provided and any necessary facilities shall be constructed and installed by the Developer.
- b. Commercial lot grading will be conducted in a manner which will take all runoff to the adjacent streets or drainage easements. No lot area will drain onto adjacent properties without approval of the City Engineer.
- c. Finished floor elevations shall be set a minimum of one foot (1') above the top of curb at the centerline of the lot, two foot (2') above the one hundred (100) year frequency stormwater surface elevation or two foot (2') above the effective FEMA base flood elevation, whichever is higher. The City Engineer can allow deviations if justified.

### **C. Preliminary Drainage Analysis Guidelines**

1. The purpose of a Preliminary Drainage Analysis is to determine the need for drainage facilities and drainage easements either within the proposed development or offsite. These guidelines shall be used as the minimum for a Preliminary Plat. When requested by the City Engineer, a Preliminary Drainage Analysis shall be submitted with a Replat or Minor Plat. The Preliminary Drainage Analysis shall consist of the following items:
2. A topographical map drawn at a scale not exceeding 1" = 200' and depicting the watershed configurations which drain to and across the subdivision. The map must include the subdivision and adjacent areas extending for 200' in all directions from the proposed subdivision. The map must also include contour lines at one (1') or two (2') foot vertical intervals.
3. The map shall indicate any offsite or adjoining areas outside the limits of the area being platted which are relevant to onsite drainage. Additionally, the map shall show any proposed or existing drainage and utility easements, water impoundments, streams, railroads, parks, cemeteries, and drainage ditches. Also, the location of any existing and proposed structures located within the area being proposed for subdivision shall be shown.
4. The datum for all topography shall be that of the United States Coast and Geodetic Survey or the City of Kennedale GIS datum. The Preliminary Analysis shall be sealed by a Registered Professional Engineer licensed by the State of Texas.
5. Calculation, presented in a tabular or spreadsheet format, and presentations dealing with the drainage areas shall include significant locations along the storm flow routes, in each case, involving changes in area, time of concentration, gradient change and corresponding changes in stormwater runoff rates for the 1, 5, 25, and 100 year frequency storms.
6. Identification and labeling of special flood hazard areas shall appear on the drainage map exhibits and concur with that of the current Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM).

### **D. Drainage Study Guidelines**

1. A Drainage Study is required when it has been determined that the area being developed will require stormwater drainage facilities or drainage easements either within the development or offsite. The following criteria shall be used by the engineer conducting the Drainage Study.
7. The study shall analyze the effect of the proposed development on existing downstream drainage facilities. The study shall be sufficient to verify compliance with the applicable criteria contained in the iSWM Criteria Manuals and herein.
8. The study shall include a topographical map as defined above in Subsection C, "Preliminary Drainage Analysis Guidelines."
9. Delineation and calculation of drainage areas together with proposed flow arrows shall represent realistic and descriptive flow patterns from runoff after all proposed improvements have been installed. Surface water drainage patterns shall be shown for

each and every lot in the proposed development and for each lot adjacent to the proposed development.

10. In addition to those calculations required by the Preliminary Drainage Analysis, this study shall also include the following, presented in a tabular or spreadsheet format:
  - a. Hydraulic calculations to each lateral, manhole, inlet and outlet structure on the pipe. Head losses shall be calculated as described in Section 1.2.10 of the iSWM Hydraulics Technical Manual.
  - b. Inlet calculations utilizing the minimum time of concentration (See Table B-3) for the zoning type which is contributing the largest "CA" to the inlet.
11. If any portion of the proposed subdivision or its offsite improvements (including pipes or ditches) fall within the limits of a FEMA floodplain, additional backwater calculations may be required. Additional calculations in the form of a Conditional Letter of Map Revision (CLOMR) will be required if:
  - a. Any portion of the proposed development is determined to be located within a FEMA Zone "A" floodplain; or
  - b. Any portion of the proposed development is determined to be located within a FEMA Zone "AE" floodplain and the overall development (including all phases) is 5 acres or larger; or
  - c. Any portion of the proposed improvements from a development includes dredging or filling within a FEMA designated floodway.
12. Backwater calculations shall comply with normally accepted standards as required by FEMA application for a Letter of Map Revision (LOMR). In addition, the calculations must begin with a previously defined Base Flood Elevation (BFE). The calculations shall continue upstream through the project until the proposed BFE is brought to within .01 feet of the existing BFE or the limits of the existing Zone "A" have been reached.
  - a. A LOMR will be required prior to issuing building permits for lots in floodplain areas.
13. The Drainage Study shall be sealed by a Registered Professional Engineer licensed by the State of Texas. The following certification shall be included on the study and signed and sealed.

I, \_\_\_\_\_, a Professional Engineer registered in the State of Texas, have prepared this drainage study in compliance with the latest published requirements and criteria of the City of Kennedale, and have verified that the topographic information used in this study is in compliance with said requirements and is otherwise suitable for developing this workable Plan of Drainage which can be implemented through proper subsequent detailed construction planning.

Signature \_\_\_\_\_, P.E., Date \_\_\_\_\_ (Seal)

## **E. Storm Drain Hydraulic Calculations Spreadsheet**

1. The attached hydraulic spreadsheet calculation table shall be included in the construction plans.

### Table Column Description:

Column 1 Enter the downstream storm drain station number.

Column 2 Enter the upstream storm drain station number. This is the design point. Design should start at the farthest upstream point.

Column 3 Enter the distance (in feet) between the storm drain stations.

Column 4 Enter the designation of the drainage area(s) at the design point in Column 2 corresponding to the designations shown on the drainage area map.

Column 5 Enter the area in acres for the drainage area identified in Column 4.

Column 6 Enter the total drainage area in acres within the system corresponding to storm drain station shown in Column 2.

Column 7 Enter the runoff coefficient "C" for the drainage area shown in Column 5.

Column 8 Multiply Column 5 by Column 7 for each area.

Column 9 Determine the total "CA" for the drainage system corresponding to the inlet or manhole shown in Column 2.

Column 10 Determine inlet time of concentration (See Section 1.2.4 iSWM Hydrology Technical Manual).

Column 11 Determine flow time in the storm drain in minutes. The flow time is equal to the distance in Column 3 divided by 60 times the velocity of flow through the storm drain in ft/sec.

Column 12 Total time of concentration in minutes. Column 10 plus Column 11. Note that time of concentration only changes at a downstream junction with another drainage area(s). The junction of two paired inlets with each other is not a downstream junction.

Column 13 The intensity of rainfall in inches per hour for the conveyance storm frequency from the appropriate county rainfall table in the iSWM Hydrology Technical Manual.

Column 14 The intensity of rainfall in inches per hour for the flood mitigation storm frequency from the appropriate county rainfall table in the iSWM Hydrology Technical Manual.

Column 15 The conveyance storm runoff in cfs. Column 9 times Column 13.

Column 16 The flood mitigation storm runoff in cfs. Column 9 times Column 14.

Column 17 The proposed inlet bypass during a flood mitigation storm. This should generally correspond to the carry-over flow "q" in Column 31 of the On-Grade

Inlet Capacity Calculations Table (minor variances may occur due to travel time routing in the Hydraulics Table).

- Column 18 Design Discharge for the storm drain system (“Q<sub>pipe</sub>”) in cfs. This should be the greater of a substantial portion of Q<sub>5</sub> (Column 15) or Q<sub>100</sub>-Q<sub>bypass</sub> (Column 16 minus Column 17)
- Column 19 Enter the selected pipe size.
- Column 20 Enter the appropriate Manning’s roughness coefficient “n” from Table E-1
- Column 21 Enter the required slope of the frictional gradient (hydraulic gradient) determined by Manning’s equation. The pipe shall be designed on a grade such that the inside crown of the pipe coincides or is below the HGL when flowing full. In a partial flow condition, the friction slope is the slope of the water surface and should follow the slope of the pipe.
- Column 22 This is the beginning hydraulic gradient of the line. It is equal to the Design HGL (Column 31) for the next downstream segment, or the beginning HGL of the system as described above.
- Column 23 This is the upstream HGL before the structure and is calculated as Column 22 plus the friction loss (Column 3 times Column 21).
- Column 24 Velocity of flow in incoming pipe (main line) at the junction, inlet or manhole at the design point identified in Column 2.
- Column 25 Velocity of flow in outgoing pipe (i.e. the pipe segment being analyzed) at junction, inlet or manhole at design point identified in Column 2.
- Column 26 Velocity head of the velocity in Column 24.
- Column 27 Velocity head of the velocity in Column 25.
- Column 28 Head loss coefficient “K<sub>j</sub>”, at junction, inlet or manhole at design point from Table E-2 and Figure E-1
- Column 29 Multiply Column 26 by Column 28.
- Column 30 Head Loss at Structure. At a junction or change in pipe size, this is Column 27 minus Column 29. At a bend or inlet, this is Column 27 times Column 28. In all cases this is 0.10’ minimum. EXCEPTION: In a supercritical flow regime with partial flow conditions, head losses are not generated at upstream junctions. These may be designated as “SUPERCRITICAL PARTIAL FLOW” in the head loss calculations, but must be supported by Froude Number in the comments column. Any other proposed deviations from standard head loss calculations due to other unusual flow regimes must be accepted by TPW on a case-by-case basis.
- Column 31 Design HGL at the design point identified in Column 2. Column 23 plus Column 30. This is the beginning HGL (Column 22) for any upstream pipe discharging into that junction.

Column 32 Invert elevation for the pipe being analyzed at the downstream storm drain station in Column 1.

Column 33 Invert elevation for the pipe being analyzed at the design point (upstream storm drain station) in Column 2.

Column 34 Top of curb elevation at the design point in Column 2.



1. In partial flow conditions, the HGL represents the actual water surface within the pipe. Note that for partial flow conditions, the velocity of the flow should be calculated based on actual area of flow, not the full flow area of the pipe or box. Although the table is presented from upstream to downstream, the calculations are normally performed from the outfall upstream to each inlet. Unless partial flow conditions exist, the beginning hydraulic gradient (Column 22 of the last downstream section) must begin at either the top of pipe or at the hydraulic gradient of the receiving stream at the coincident frequency provided in Table 1.10 of the iSWM Hydraulics Technical Manual, whichever is higher. It is also acceptable to perform a detailed hydrologic and hydraulic study of the watershed of the receiving stream to determine the connected outfall hydraulic gradient.

1. Table E-1 Manning’s Coefficients for Storm Drain Conduits	
2. Type of Storm Drain	3. Manning’s n
4. Concrete Pipe (Design n = 0.013)	5. 0.012 – 0.015
6. Concrete Boxes (Design n = 0.015)	7. 0.012 – 0.015
8. Corrugated Metal Pipe, Pipe-Arch and Box (Annular or Helical Corrugations - see Table 1.8 in iSWM Hydraulics Technical Manual) <b>NOTE: City of Kennedale DOES NOT ALLOW CMP FOR NEW CONSTRUCTION</b>	9. 0.022-0.037*
10. Profile Wall Thermoplastic High Density Polyethylene (HDPE) or Polyvinyl Chloride(PVC) <b>NOTE: USE OF HDPE OR PVC PIPE WILL REQUIRE PRE-APPROVAL FROM THE City of Kennedale</b>	11. 0.010-0.013
12. NOTE: Actual field values for conduits may vary depending on the effect of abrasion, corrosion, deflection, and joint conditions.	

13. \*Note: analysis of existing conditions may require a different value than the stated design coefficients.

14. Table E-1 Junction or Structure Coefficient of Loss	
15. Description of Condition	16. Coefficient Kj
17. Inlet on Main Line	18. 0.50
19. Inlet on Main Line with Branch Lateral	20. 0.25
21. Manhole on Main Line with 45° Branch lateral	22. 0.50
23. Manhole on Main Line with 90° Branch Lateral	24. 0.25
25. Manhole on Main Line with no Branch	26. 1.0
27. 45° Wye Connection or cut-in	28. 0.75
29. Inlet or Manhole at Beginning of Line	30. 1.25
31. Conduit on Curves Connection or cut-in on Curves for 90° * radius = diameter	32. 0.50
Curve radius= 2 to 8 diameter	33. 0.25
Curve radius = 8 to 20 diam	34. 0.10
35. Bends where radius is equal to diameter	43.
36. 90° Bend	44. 0.50
37. 60° Bend	45. 0.43
38. 45° Bend	46. 0.35
39. 22-1/2° Bend	47. 0.20
40.	48.
41. Manhole on line with 60° Lateral	49. 0.35
42. Manhole on line with 22/1/2° Lateral	50. 0.75

## **F. Downstream & Upstream Assessment**

1. The purpose of a downstream and upstream assessment is to ensure the proposed development does not cause an increase in flooding, erosion or unacceptable velocities downstream. A downstream assessment should begin at the outfall of the proposed development and continue downstream to where the proposed discharge no longer has a significant impact on the receiving stormwater system. A downstream assessment must include the following:
  - a. Hydrologic analysis of the pre- and post-development on-site conditions
  - b. Drainage path that defines extent of the analysis
  - c. Capacity analysis of all existing constraint points along the drainage path, such as existing floodplain developments, underground storm drainage systems culverts, bridges, tributary confluences, or channels
  - d. Offsite undeveloped areas should be considered as “full build-out” for both the pre- and post-development analyses
  - e. Evaluation of the 1-, 5-, 25- 100- year storm events
  - f. Separate analysis for each major outfall from the proposed development
2. The assessment should be used to evaluate whether the post-development discharges and velocities exceed pre-development discharges and velocities, if the velocities are within the allowable range, and if the post development water surface elevations exceed the existing surface elevations. This evaluation should be conducted for each of the storm events. After the downstream analyses is complete it should be used to determine what stormwater management systems must be implemented by the developer both on and off site.

## **G. Storm Sewer Systems**

1. Storm sewers shall be designed as detailed in the iSWM Hydraulics Technical Manual.
  - a. Storm sewer pipes shall be designed so that the mean velocity of flow is equal to or greater than two and one-half feet (2.5') per second and equal to or less than fifteen feet (15') per second in culverts and mains. Pipes may be designed on a horizontal radius per pipe manufacturer standards. Pipes shall not be designed with vertical curves. The minimum pipe size is twenty-four inches (24") in diameter for mains and twenty one inches (21") in diameter for laterals. However, if a lateral does not exceed fifty feet (50'), an eighteen inch (18") diameter pipe may be used. All storm sewer systems must be constructed with reinforced concrete pipe (RCP).
  - b. The appropriate hydraulic grade line shall be plotted for all storm drainage design. The elevation of the hydraulic grade line shall normally be no closer to the gutter flow line than one foot (1'). Energy losses and the head loss coefficient shall be determined by the methods outlined in Section 1.2.10 of the iSWM Hydraulics Technical Manual. Inlets or other points of entry into the storm drain system shall

be provided at least every five hundred feet (500'). A manhole or other entry point must be constructed at the start or top of the system.

**H. Flow in Streets**

1. Street capacity shall be determined by utilizing Manning’s equation:

$$Q = \frac{1.486}{N} AR^{2/3} S_0^{1/2}$$

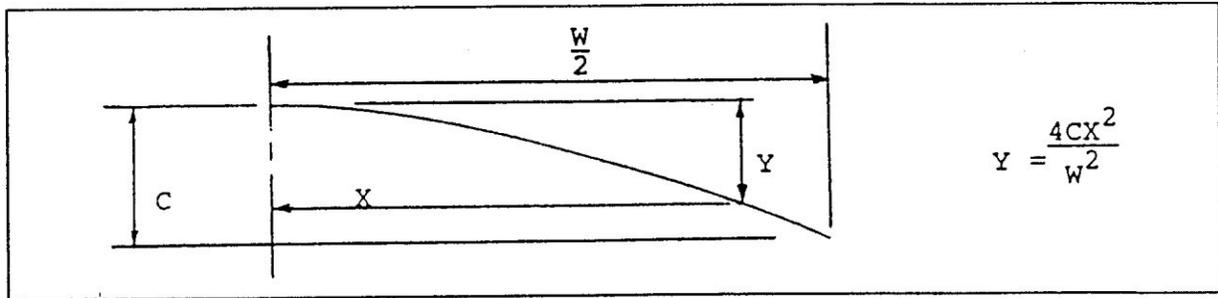
- Q = discharge in cubic feet per second
- n = Manning's roughness coefficient, use Table H-6 below for pavement and gutters
- A = cross-sectional area of flow in square feet
- R = hydraulic radius in feet
- S<sub>0</sub> = Street or gutter slope in feet per foot

Table H-6 Manning's Roughness Coefficient – Street and Gutter

Type of Gutter or Pavement	Manning's n
Concrete gutter, troweled finish	0.014
Asphalt pavement: Smooth texture	0.015
Rough texture	0.019
Concrete gutter with asphalt pavement: Smooth	0.015
Rough	0.018
Concrete pavement: Float finish	0.017
Broom finish	0.019
For gutters with small slopes, where sediment may accumulate, increase above values of n by	0.002

Table from iSWM Hydraulics Technical Manual Rev. 9/2014, Table 1.2

For parabolic crown streets, the cross slope shall be represented by the following formula: (Note: All discharge of runoff from street to an open channel shall be in a flume or through an inlet with adjoining pipe and headwall.)



## I. Storm Drain Inlets

1. The City has adopted the iSWM Design Methodology for storm drain inlets. Refer to the iSWM Hydraulics Technical Manual for storm drain inlet design and calculations.

## I. Open Channels

1. When the runoff exceeds the capacity of a seventy-two inch (72") diameter concrete pipe or equivalent cross sectional pipe area (i.e., 2-51 inch diameter concrete pipes), the discharge shall be carried in an open channel. Open channels shall be designed to carry the one hundred (100) year frequency storm runoff from a fully urbanized watershed with one foot of freeboard (1'). All open channels shall have a minimum bottom width of eight feet (8'). Open channels may be used for capacities smaller than seventy-two inch (72") diameter pipe when required.
2. Full Concrete Lining:
  - a. Lining of drainage ditch floors is to be a minimum of eight feet (8') wide and minimum of six inches (6") thick, 3,000 psi compressive strength concrete. Concrete channel lining shall be designed by a geotechnical engineer and approved by the City Engineer. Vertical concrete retaining wall sections shall be designed with adequate footing and reinforcing steel to support all anticipated soil and water pressure loads acting on each side of the structure. In addition, retaining walls shall be designed to support at least a "high surcharge" load unless otherwise approved by the City Engineer.
3. Partial Concrete Liner:
  - a. Where, for reasons of downstream backwater flooding conditions, or where sufficient channel gradient and/or width cannot be provided to the extent that the one hundred (100) year fully channel-contained water surface is above the natural ground line and levees are not approved or flood plain fill is not feasible, the concrete channel liner shall be extended to the natural ground line along each side of the channel. In no case shall the concrete lined capacity provided be less than that required to convey the twenty-five (25) year frequency discharge. Drainage easements shall be provided along the sides of the concrete lined channel sufficient to encompass all areas beneath the water surface elevation resulting from a fully urbanized one hundred (100) year frequency storm discharge, plus such additional

width easements as may be required to provide ingress and egress to allow maintenance and to protect adjacent property against erosion, caving-in of over-banks, etc., as determined and required by the City Engineer. The Developer shall be responsible for furnishing complete cross-sections, grading plans, HEC-RAS, or the latest equivalent iSWM accepted computer modeling software, models and all other documentation requested by the City Engineer which is required to justify less than full section concrete channel lining and to establish the limits of the one hundred (100) year overflow flood plain lines. Water surface profile calculations shall be based on backwater effects created by an existing bridge, culvert or other obstruction regardless of future downstream proposed improvements.

4. Earthen Channels:

- a. The maximum allowable channel velocity shall depend on the natural channel lining and be determined by Table I-3a.

**Table J-3a**  
**Roughness Coefficients and Maximum Velocity for Natural Channels**

Channel Description	Manning's n	Max. Permissible Channel Velocity (ft/s)
<b>MINOR NATURAL STREAMS</b>		
Fairly regular section		
1. Some grass and weeds, little or no brush	0.030	3 to 6
2. Dense growth of weeds, depth of flow materially greater than weed height	0.035	3 to 6
3. Some weeds, light brush on banks	0.035	3 to 6
4. Some weeds, heavy brush on banks	0.050	3 to 6
5. Some weeds, dense willows on banks	0.060	3 to 6
For trees within channels with branches submerged at high stage, increase above values by	0.010	
Irregular section with pools, slight channel meander, increase above values by	0.010	
Floodplain – Pasture		
1. Short grass	0.030	3 to 6
2. Tall grass	0.035	3 to 6
Floodplain – Cultivated Areas		
1. No crop	0.030	3 to 6
2. Mature row crops	0.035	3 to 6
3. Mature field crops	0.040	3 to 6
Floodplain – Uncleared		
1. Heavy weeds scattered brush	0.050	3 to 6
2. Wooded	0.120	3 to 6
<b>MAJOR NATURAL STREAMS</b>		
Roughness coefficient is usually less than for minor streams of similar description on account of less effective resistance offered by irregular banks or vegetation on banks. Values of "n" for larger streams of mostly regular sections, with no boulders or brush	Range from 0.028 to 0.060	3 to 6
<b>UNLINED VEGETATED CHANNELS</b>		
Clays (Bermuda Grass)	0.035	5 to 6
Sandy and Silty Soils (Bermuda Grass)	0.035	3 to 5
<b>UNLINED NON-VEGETATED CHANNELS</b>		
Sandy Soils	0.030	1.5 to 2.5
Silts	0.030	0.7 to 1.5
Sandy Silts	0.030	2.5 to 3.0
Clays	0.030	3.0 to 5.0
Coarse Gravels	0.030	5.0 to 6.0
Shale	0.030	6.0 to 10.0
Rock	0.025	15
For natural channels with specific vegetation type, refer to Table 3.11 for more detailed velocity control.		

Table from iSWM Hydraulics Technical Manual Rev. 9/2014, Table 3.2

- c. That drainage easements are dedicated to encompass the area below the elevation of the water surface profile of a fully urbanized one hundred (100) year frequency

- storm, plus one foot (1') of freeboard and any additional area necessary to provide access for maintenance, but not less than sixty feet (60') in width.
- b. That arrangements have been made for perpetual maintenance of the channel by the adjacent property owners or the channel has been dedicated and accepted by the City for City Park purposes.
  - c. That, in the judgment of the City Engineer, the appropriate use of the neighboring property or the health and safety of persons affected will not be demonstrably damaged.
5. Earthen channels, when approved, shall be constructed with a trapezoidal shape and a minimum bottom width of twelve feet (12') and side slopes not steeper than four feet (4') horizontal to one foot (1') vertical (5 to 1 preferred). The side slopes shall be smooth, free of rocks, and contain a minimum of six inches (6") of top soil. Gobi blocks, rock riprap, or other such similar materials, shall be placed a minimum of four feet (4') along both sides of the pilot channel to a depth of at least two feet (2'). Size and gradation of such material shall be determined based on peak discharge velocity requirements. The pilot channel shall be constructed as approved by the City Engineer. The easement width for an earthen channel shall extend at least fifteen feet (15') beyond the top of each channel bank and shall not be cross-fenced. The top of bank areas shall remain open for maintenance purposes.
  6. After proposed earthen side slopes are cut, slopes shall be covered by grass according to the City's specifications but no less than one 2-inch high spring per half square inch of slope and bottom. The grass shall be planted to fifteen feet (15') outside the top of banks.
  7. The water surface profile (hydraulic grade line) for the one hundred (100) year frequency storm shall be shown. Maximum permissible velocities for the one hundred (100) year frequency discharge shall be six feet (6') per second in partially lined concrete channels and fifteen feet (15') per second in fully lined concrete channels.
  8. Special consideration should be given to outlet structures on channels where concrete linings meet earthen banks.
  9. One reinforced concrete access ramp shall be provided at all intersections of every open channel with a public street. Access ramps shall be a minimum of twelve feet (12') wide with a maximum slope of sixteen percent (16%).

## **K. Bridges and Culverts**

1. All bridges and culverts shall be designed in accordance with the current edition of the iSWM Technical Manuals and all pertinent design manuals prepared by the North Central Texas Council of Governments. The fully urbanized one hundred (100) year frequency storm hydraulic grade line shall be plotted. All culverts shall have headwalls and wing walls upstream and downstream. All culverts shall pass the fully urbanized one hundred (100) year frequency storm runoff without allowing runoff to pass over the road. All bridges shall have concrete lined channel bottom and slopes either concrete lined or faced with Gabions or similar material. The low point on the bridge structure

shall be at least two foot (2') above the fully urbanized one hundred (100) year frequency stormwater surface.

## **L. Stormwater Detention Basin Design**

The basic concept underlying the use of stormwater detention basins involves providing temporary storage of stormwater runoff so that peak rates of runoff can be reduced. Runoff is released from storage at a controlled rate which cannot exceed the capacities of the existing downstream drainage systems or the predevelopment peak runoff rate of the site, whichever is less.

Stormwater detention basins may be of two (2) basic types: On-site and Regional. In general, on-site basins are those which are located off-channel and provide stormwater detention for a particular project or development. Regional basins are designed to provide stormwater detention in conjunction with other improvements on a watershed-wide basis. The performance and safety criteria in this section apply to all basins which provide management of peak rates of stormwater runoff, regardless of type.

### **1. Design of Stormwater Detention Basins**

- a. The City has adopted the iSWM Design methodology for stormwater detention basins. Please refer to the Hydrology and Hydraulics Technical Manuals for stormwater detention basin design and calculations.

### **2. Performance criteria for On-site Stormwater Detention Basins**

- a. On-site stormwater detention basins shall be designed to reduce post development peak rate of discharge to existing pre-development peak rates of discharge for the 1-, 2-, 5-, 25- and 100-year storm events at each point of discharge from the project or development site. The water quality, one and a half inches (1.5"), storm event should also be considered when designing stormwater detention basins. However, the City reserves the right to reduce peak rate discharge even further if existing discharge of the developing property is damaging adjacent properties. In addition, the capacity of the existing downstream systems must be considered in determining the need for managing the 100-year storm event. For the post-development hydrologic analysis, any off-site areas which drain to the stormwater detention basins shall be assumed to remain in the existing developed condition.

### **3. Performance criteria for Regional stormwater detention basins**

- a. Performance criteria for regional detention basins shall be determined by the City on a project-by-project basis. The determination shall be based on a preliminary engineering study prepared by the project engineer.

### **4. Safety Criteria for stormwater detention basins**

- a. All basins shall meet or exceed all specified safety criteria contained herein and all applicable state and federal regulations. Use of these criteria shall in no way relieve the engineer of the responsibility for the adequacy and safety of all aspects of the design of the stormwater detention basins.

- b. On-site stormwater detention basins must include an emergency spillway with 6 inches of freeboard to convey the fully developed 100 year storm event assuming full outlet blockage.
- c. The spillway, embankment, and appurtenant structures shall be designed to safely pass the design storm hydrograph with a freeboard of one foot (1') for all on-site stormwater detention basins and two foot (2') for regional stormwater detention basins less than one-hundred and fifty (150) acres. Freeboard for regional stormwater detention basins one-hundred and fifty (150) acres or more shall be determined in accordance with the Texas Administrative Code (Dam Safety Rules of the Texas Commission on Environmental Quality) and any other applicable state and federal regulations. All contributing drainage areas, including on-site and off-site area, shall be assumed to be fully developed. Any orifice with a dimension smaller than or equal to twelve inches (12") shall be assumed to be fully blocked.
- d. The minimum top width of earthen embankments shall be as follows:

<u>Total height of embankment, ft.</u>	<u>Minimum top width, ft.</u>
0-6	4
6-10	6
10-15	8
15-20	10
20-25	12
25-35	15

- e. The constructed height of an earthen embankment shall be equal to the design height plus the amount necessary to ensure that the design height will be maintained once all settlement has taken place.
- f. This amount shall in no case be less than five (5%) percent of the total fill height. All earthen embankments shall be compacted to ninety-five (95%) percent of maximum density.
- g. Earthen embankment side slopes shall be no steeper than four (1) horizontal to one (1) vertical. Slopes must be designed to resist erosion, to be stable in all conditions and to be easily maintained. Earthen side slopes for regional facilities shall be designed on the basis of appropriate geotechnical analyses.
- h. Detailed hydraulic design calculation shall be provided for all stormwater detention basin's. Stage-discharge rating data shall be presented in tabular form with all discharge components, such as orifice, weir, and outlet conduit flows, clearly indicated. A stage-storage table shall also be provided.
- i. When designing stormwater detention basin's in a series (i.e., when the discharge of one basin becomes the inflow to another), the design engineer must submit a

- hydrologic analysis which demonstrates the system's adequacy. This analysis must incorporate the development of hydrographs for all inflow and outflow components.
- i. No outlet structures from stormwater detention basin's, parking detention, or other concentrating structures shall be designed to discharge concentrated flow directly onto arterial or collector streets. Such discharges shall be conveyed by a closed conduit to the nearest existing storm sewer. If there is no existing storm sewer within three hundred (300) feet, the outlet design shall provide for a change in the discharge pattern from concentrated flow back to sheet flow, following as near as possible the direction of the gutter.
  - k. Stormwater runoff may be detained within parking lots. However, the engineer should be aware of the inconvenience to both pedestrians and traffic. The location of ponding areas in a parking lot should be planned so that this condition is minimized. Stormwater ponding depths (for the 100-year storm) in parking lots are limited to an average of eight (8") inches with a maximum of twelve (12") inches.
  - l. All pipes discharging into a public storm sewer system shall have a minimum diameter of eighteen (18") inches. In determining the actual size required, ease of maintenance and/or repair must be assured.
  - m. All concentrated flows into a stormwater detention basin shall be collected and conveyed into the basin in such a way as to prevent erosion of the side slopes. All outfalls into the basin shall be designed to be stable and non-erosive.
2. Outlet Structure Design - The City has adopted the iSWM design process for outlet structures. Please refer to the iSWM Hydraulics Technical Manual, Section 2.2 Outlet Structures.
3. Detention Basins Maintenance and Equipment Access Requirements
- a. Silt shall be removed by the owner or developer and the basin returned to original lines and grades when standing water conditions occur, the basin storage volume is reduced by more than 10%, or the outfall structures are more than 20% blocked.
  - b. To limit erosion, no unvegetated area shall exceed ten (10) sq. ft in extent.
  - c. Accumulated paper, trash and debris shall be removed every six (6) months or as necessary to maintain proper operation.
  - d. Ponds shall be mowed annually between the months of June and September.
  - e. Corrective maintenance is required any time a basin does not drain completely within sixty (60) hours of cessation of inflow (i.e., no standing water is allowed).
  - f. Structural integrity of basin embankments shall be maintained at all times.
  - g. Detention basins in private subdivisions will be maintained by the required property owners association, mandated by Section 17-326 of the Kennedale City Code.

## **M. Streambank Protection**

1. The developer must meet at least one of the following conditions detailed in Section 2.1 of iSWM Hydrology Technical Manual:
  - a. The developer must conduct a downstream assessment as described in Section E above. If downstream post development velocities exceed pre-development velocities the developer must improve/reinforce or stabilize the existing downstream conveyance system. It must also be shown that the proposed velocities do not exceed the allowable range of the improved downstream conveyance system.
  - b. The developer must conduct a downstream assessment as described in Section E above. On site stormwater management controls must be installed to ensure that downstream post development discharges are at or below their pre-development discharges. Supporting documentation/calculations must be provided.
  - c. On site detention must be installed to provide 24 hours of extended detention generated by the 1-year 24 hour storm event to prevent erosive velocities downstream. Supporting documentation/calculations must be provided.

## **N. Flood Mitigation**

1. The developer must meet at least one of the following conditions detailed in Section 2.4 of iSWM Hydrology Technical Manual:
  - a. The developer must conduct a downstream assessment as described in Section E above. If post development capacities exceed the capacity of the downstream conveyance system the developer is required to improve the downstream conveyance system. The improvements/modifications to the offsite downstream conveyance system must extend to a point at which the proposed development discharge no longer has a significant impact on the conveyance system. Supporting documentation/calculations must be provided that show peak discharges and water surface elevations are safely conveyed by the proposed downstream improvements.
  - b. The developer must conduct a downstream assessment as described in Section E above. On site controls must be installed to ensure that the post development peak capacities can be adequately conveyed by the existing downstream conveyance system. Supporting documentation/calculations must be provided that show peak discharges and water surface elevations are safely conveyed by the existing conveyance system.
  - c. On site detention must be installed to ensure that existing run off conditions are maintained. Supporting documentation/calculations must be provided that show pre-development runoff conditions are maintained.

## Section 6 Street Lighting

### A. Installation

1. Street lights in all subdivisions shall be installed on approved metal poles.
  - a. Poles must be approved by a public electric utility holding a City franchise and the City Engineer.
  - b. Poles shall be contracted and paid for by the Developer during the construction phase of a subdivision and before building permits are issued.
  - c. Poles not purchased through a public electric utility company holding a City franchise, shall be certified by an engineer as meeting the specifications as required by a public electric utility company holding a City franchise.

### B. Location

1. The location of street lights shall be as follows:
2. At all intersections.
3. Where a new street intersects an existing street.
4. Street lights shall be located adjacent to fire hydrants whenever possible.
5. Where a block is six hundred (600') feet or longer, a street light shall be installed every six hundred (600') feet or mid-block, whichever is the shortest distance.
6. If more than one mid-block light is required, they shall be installed to create an equal balance of light throughout the entire length of block.
7. If a cul-de-sac block is four hundred (400') feet or longer, a street light shall be installed in the end of the cul-de-sac.
8. Intersection street lights shall be 200 watts, high pressure sodium. Internal block street lights shall be 100 watts, high pressure sodium.
9. Street lights shall be installed at any other location as may be directed by the City's Director of Public Works.

## Section 7 Earthwork

This section shall apply to all subdivisions which are proposed for development; are existing and require additional grading; or are single lot subdivisions (platted or unplatted) which are proposing excavation or fill.

### A. Definitions

1. Conceptual Grading Plan– A topographical map of the subdivision with sufficient perimeter area to provide a clear definition of the initial elevations, watercourses, ground configuration, and drainage patterns. In addition, the plan shall include proposed flow arrows, cross-sections and spot elevations sufficient to control the magnitude of excavation and fill. The plan must be sealed and signed by a Registered Professional Engineer licensed by the State of Texas.
2. Excavation– The removal of turf, soil, rock, or weeds such that the surface is six inches (6”) lower than the initial elevation.
3. Fill– The deposition of rock, concrete, soil, or sod such that the cumulative thickness of all materials is equivalent to six inches (6”) or greater.
4. Final Grading Plan– The final grading plan shall include a topographical map of the subdivision with sufficient perimeter area to provide a clear definition of the initial elevations, watercourses, and drainage patterns. In addition, the plan shall include one foot (1’) contours, spot elevations, and flow arrows. The plan must be in sufficient detail and scale to determine limits and depths of excavation or fill. The plan must be signed and sealed by a Registered Professional Engineer licensed by the State of Texas.
5. Grading– The movement of dirt, top soil, grass, native material, brush, trees, landscaping, or other forms of surface material which will result in a long term difference of six inches (6”) or greater from the initial elevation.
6. Initial Elevation– Shall be understood as the mean sea level elevation as it existed prior to modification.
7. Multi-Lot Subdivision– A division of any tract of land into two or more parcels.

### B. Unplatted Multi-Lot Subdivision

1. When a multi-lot subdivision has been proposed for platting but has not yet been approved by the City Council, the following provisions shall govern the excavation and fill process.
2. A conceptual grading plan shall be submitted to the City Engineer. The plan will be reviewed for consistency with City ordinances and policies. If the concept is approved, a 30-day permit will be issued to allow grading to begin.
3. The process must be inspected by a City representative and all fill shall be tested for proper compaction. All tests costs are the responsibility of the developer.
4. Areas which fail the compaction tests shall be excavated, the material replaced (or new material imported, depending on moisture content) re-compacted and retested.

5. Areas which have been filled without adequate compaction tests or without inspection by a City representative shall be considered as areas which have failed the compaction tests.

### **C. Platted Multi-Lot Subdivision**

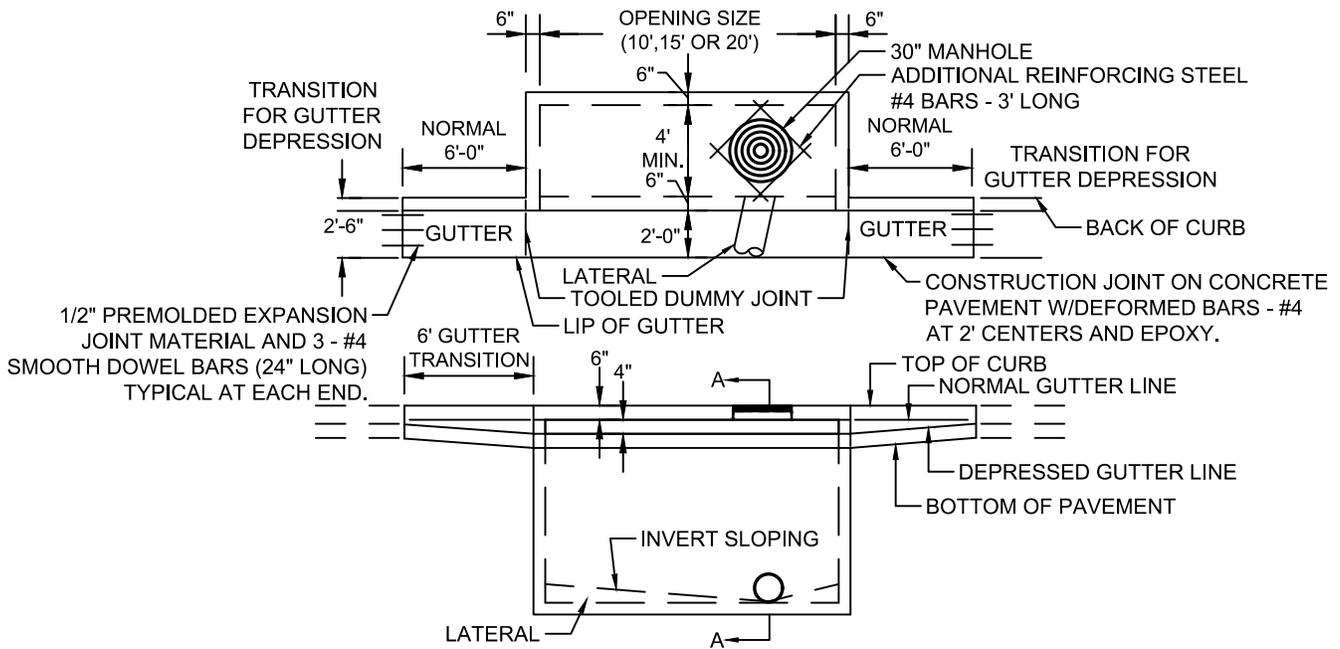
1. When a multi-lot subdivision has been platted in accordance with the existing Subdivision Ordinance and the plat has been filed with the County, the following provisions shall apply.
  - a. A final grading plan shall be submitted to the City Engineer. The plan will be reviewed for consistency with City ordinances and policies. If the plan is approved by the City Engineer, the applicant will be allowed to begin the excavation and fill process.
  - b. The process must be inspected by a City representative and all fill shall be tested for acceptable compaction.
  - c. Areas which fail the compaction tests shall be excavated, the material replaced (or new material imported, depending on moisture content) re-compacted and retested.
  - d. Areas which have been filled without adequate compaction tests or without inspection by a City representative shall be considered as areas which have failed the compaction tests.
  - e. Areas of multi-lot subdivision which are not graded at the same time as the rest of the subdivision will be required to comply with the provisions of a single-lot subdivision.

### **D. Single-Lot Subdivision**

1. All single lot subdivisions shall be required to obtain a Grading Excavation Permit as required by the current City Building Code. Note that a single-lot subdivision shall be considered multi-lot if the subject parcel and any adjacent parcels are owned by the same individual or entity.

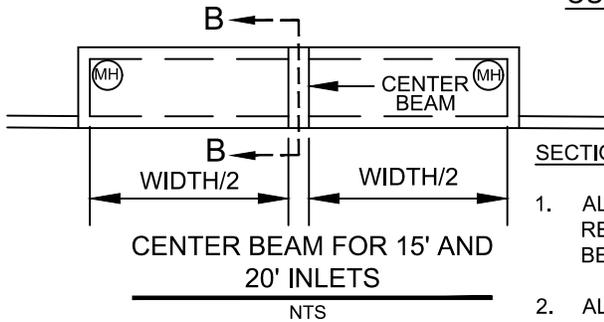
### **E. Testing**

1. All compaction shall be tested by an approved soil testing laboratory.
  - a. The testing facility must maintain a current permit with the Development and Enforcement Department. The City Engineer may disallow any and all firms which cannot or refuse to meet the minimum criteria established in the application forms.
  - b. All fill must be compacted to 95% Standard Proctor Dry Density.
  - c. Samples shall be taken for compaction density at the rate of one (1) per lift per 500 cubic yards of fill, or; one (1) per lot, whichever is greater.
  - d. Slopes created by excavation or fill shall not exceed 3 horizontal to 1 vertical except for use of retaining walls and other slope control device



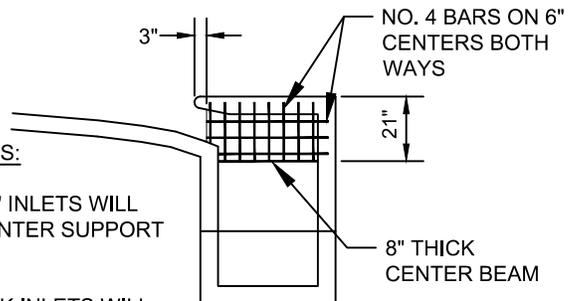
**CURB INLET**

NTS



**SECTION B-B NOTES:**

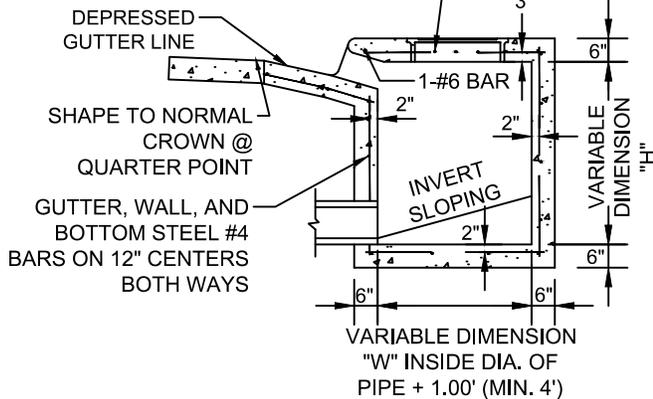
1. ALL 15' AND 20' INLETS WILL REQUIRE A CENTER SUPPORT BEAM.
2. ALL OPEN BACK INLETS WILL REQUIRE A CENTER BEAM, REGARDLESS OF INLET TYPE OR SIZE.



**SECTION B-B**

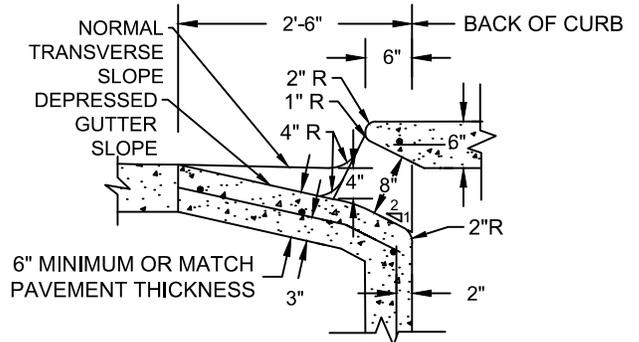
NTS

TOP STEEL #4 BARS ON 6" CENTERS BOTH WAYS, AND 1-#6 BAR IN OUTSIDE EDGE & ADDITIONAL STEEL AROUND MANHOLE.



**SECTION A-A CURB INLET CROSS SECTION**

NTS

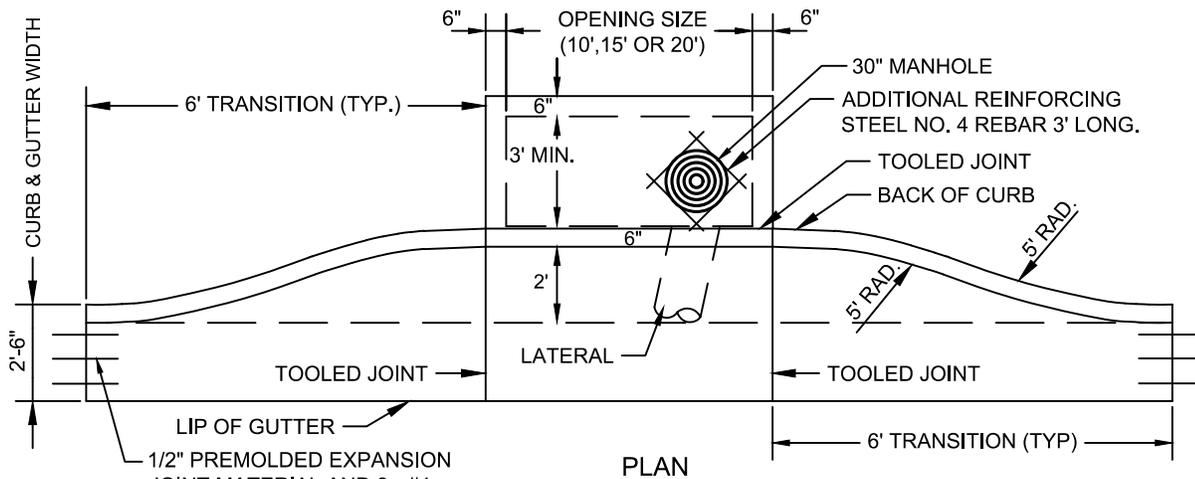


**THROAT DETAIL FOR STANDARD INLETS ON CONCRETE STREETS**

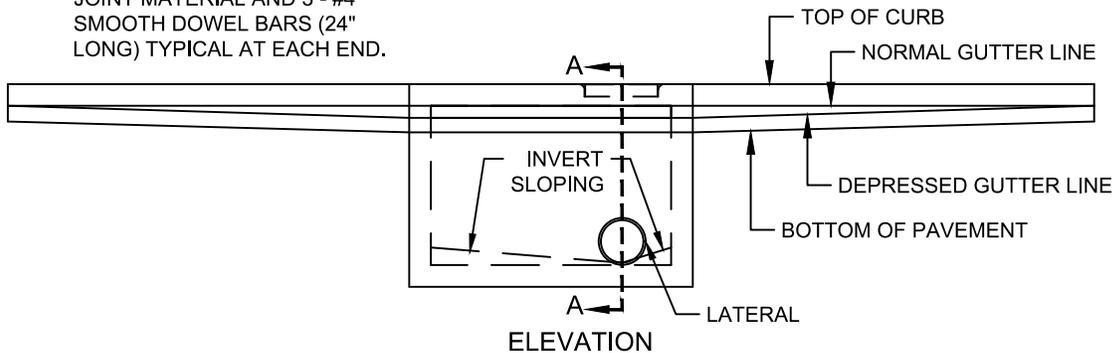
NTS

**NOTES:**

1. GRAVEL BAGS SHALL BE MADE OF HIGH DENSITY POLYETHYLENE (HDPE) MONOFILAMENT FILTER FABRIC FROM HD SUPPLY (OR APPROVED EQUAL).
2. GRAVEL BAGS SHALL BE FILLED WITH 1½" CLEAN, FRACTURE FACED GRAVEL AND WEIGH 40-50 LBS AND SHALL COMPLY WITH GRADATION SHOWN ON THIS SHEET.
3. GRAVEL BAGS SHALL BE 4" TO 6" HIGH WHEN PLACED AT THE CURB.
4. GRAVEL BAGS SHALL BE PLACED 6" OR MORE FROM THE OPENING OF THE INLET AND SHALL NOT EXTEND MORE THAN THE WIDTH OF ONE GRAVEL BAG PAST THE LIP OF THE GUTTER.
5. GRAVEL BAGS SHALL NOT BE PLACED IN FRONT OF DRIVEWAYS OPENINGS AND SHALL NOT BE PLACES WITHIN 15' OF A MAILBOX.
6. PROTECTION CAN BE EFFECTIVE EVEN IF IT IS NOT IMMEDIATELY ADJACENT TO THE INLET, PROVIDED THAT THE INLET IS PROTECTED FROM POTENTIAL SOURCES OF POLLUTION.
7. CONTRACTOR SHALL BE RESPONSIBLE FOR ROUTINELY INSPECTING AND MAINTAINING GRAVEL BAGS.
8. GRAVEL BAGS SHALL BE REPLACED IF THEY BECOME HEAVILY SOILED OR DAMAGED BEYOND REPAIR.
9. SEDIMENTS SHALL BE REMOVED WHEN IT IS HALF THE HEIGHT OF ONE GRAVEL BAG.
10. GRAVEL BAGS MUST BE REMOVED AFTER ADJACENT OPERATIONS ARE COMPLETED.
11. FILER FABRIC CURB INLET PROTECTION DETAIL MAY BY USED IN LIEU OF THIS DETAIL FOR ON GRADE CURB INLETS ONLY.



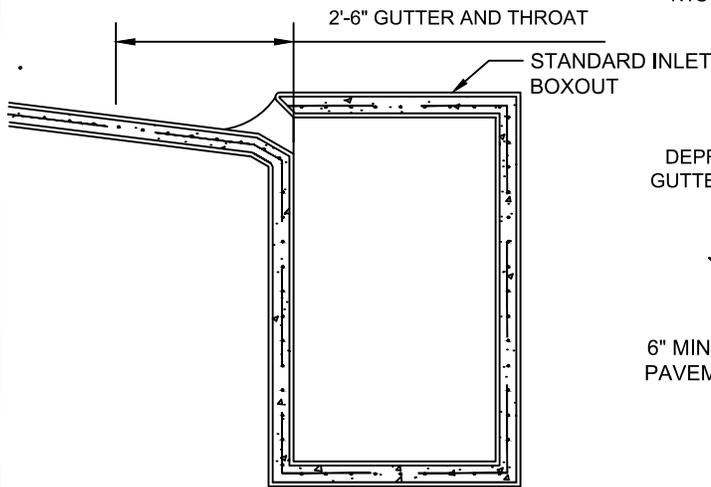
PLAN



ELEVATION

**RECESSED INLET**

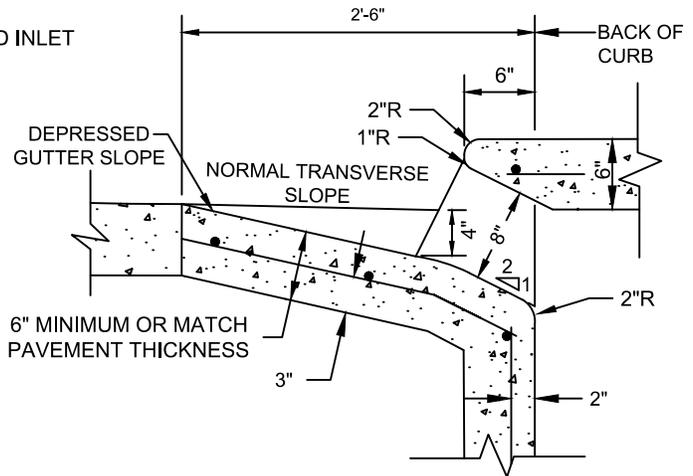
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**RECESSED CURB INLET**

**SECTION A-A**

NTS



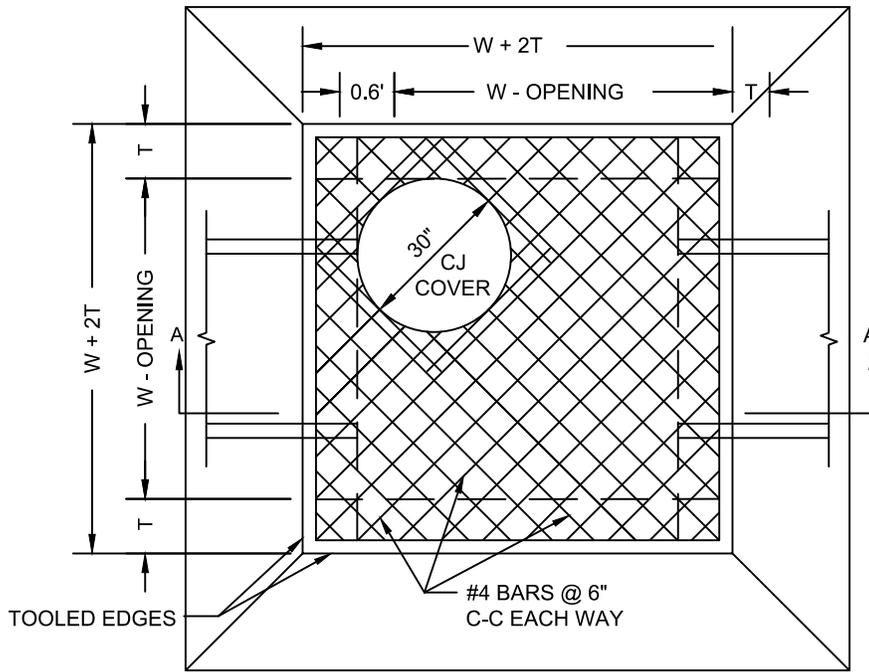
**THROAT DETAIL FOR CURB INLET**

**ON CONCRETE STREET**

NTS

**NOTES:**

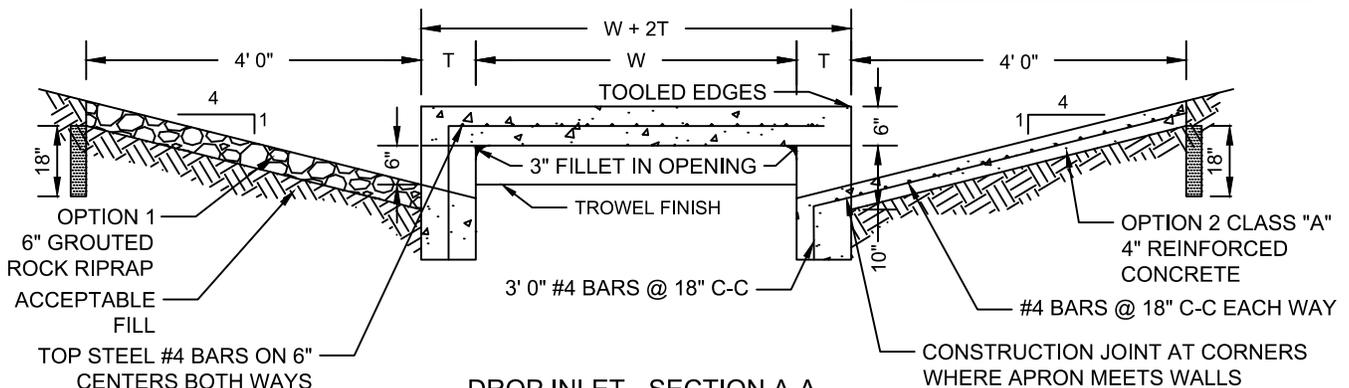
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2. GRAVEL BAGS SHALL BE FILLED WITH 1/2" CLEAN, FRACTURE FACED GRAVEL AND WEIGH 40-50 LBS AND SHALL COMPLY WITH GRADATION SHOWN ON THIS SHEET.
3. GRAVEL BAGS SHALL BE 4" TO 6" HIGH WHEN PLACED AT THE CURB.
4. GRAVEL BAGS SHALL BE PLACED 6" OR MORE FROM THE OPENING OF THE INLET AND SHALL NOT EXTEND MORE THAN THE WIDTH OF ONE GRAVEL BAG PAST THE LIP OF THE GUTTER.
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9. SEDIMENTS SHALL BE REMOVED WHEN IT IS HALF THE HEIGHT OF ONE GRAVEL BAG.
10. GRAVEL BAGS MUST BE REMOVED AFTER ADJACENT OPERATIONS ARE COMPLETED.
11. FILTER FABRIC CURB INLET PROTECTION DETAIL MAY BY USED IN LIEU OF THIS DETAIL FOR ON GRADE CURB INLETS ONLY.
12. SEE STANDARD CURB INLET DETAIL FOR REINFORCING STEEL AND DETAILS.
13. 8" THICK CENTER BEAM WITH "4 BARS & 6" OC BOTH WAYS. (15' & 20' INLETS)



**DROP INLET - PLAN VIEW**

NTS

INLET SIZE	T	W
4' SQUARE	7"	4' 0"
5' SQUARE	8"	5' 0"
6' SQUARE	9"	6' 0"
7' SQUARE	9"	7' 0"
8' SQUARE	9"	8' 0"

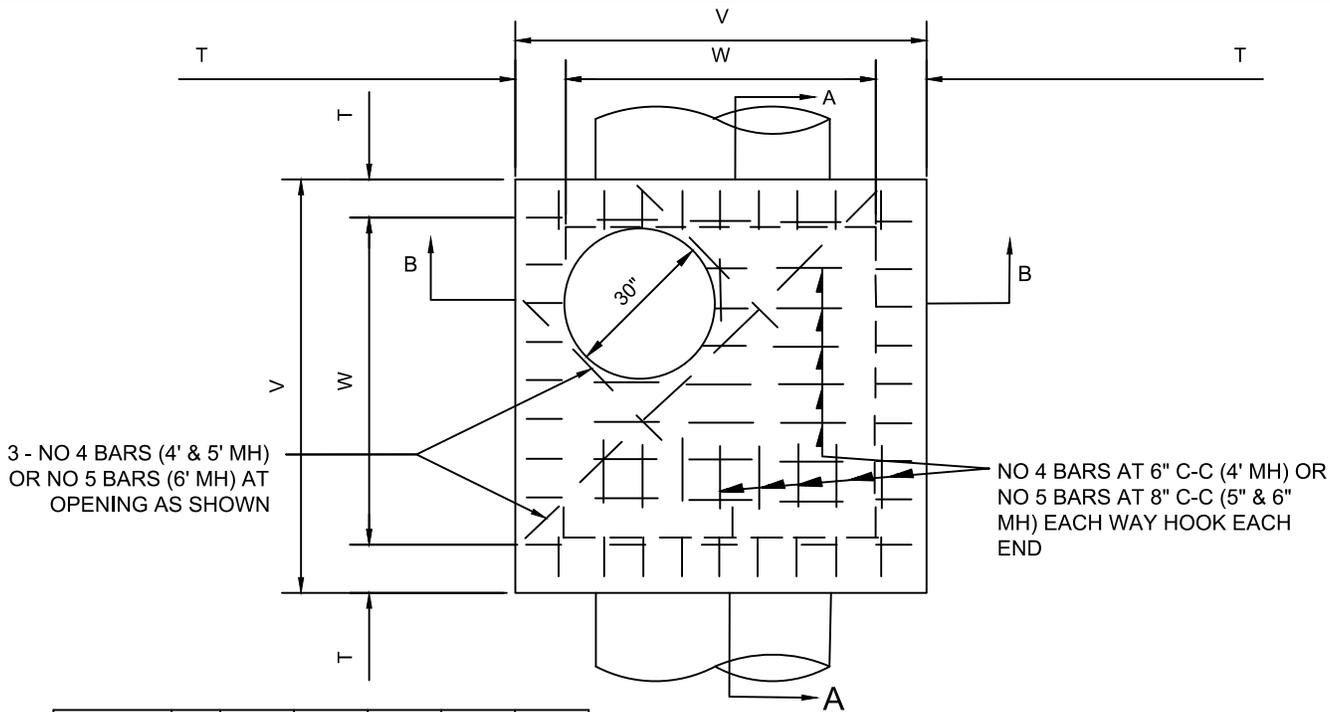


**DROP INLET - SECTION A-A**

NTS

**GENERAL NOTES:**

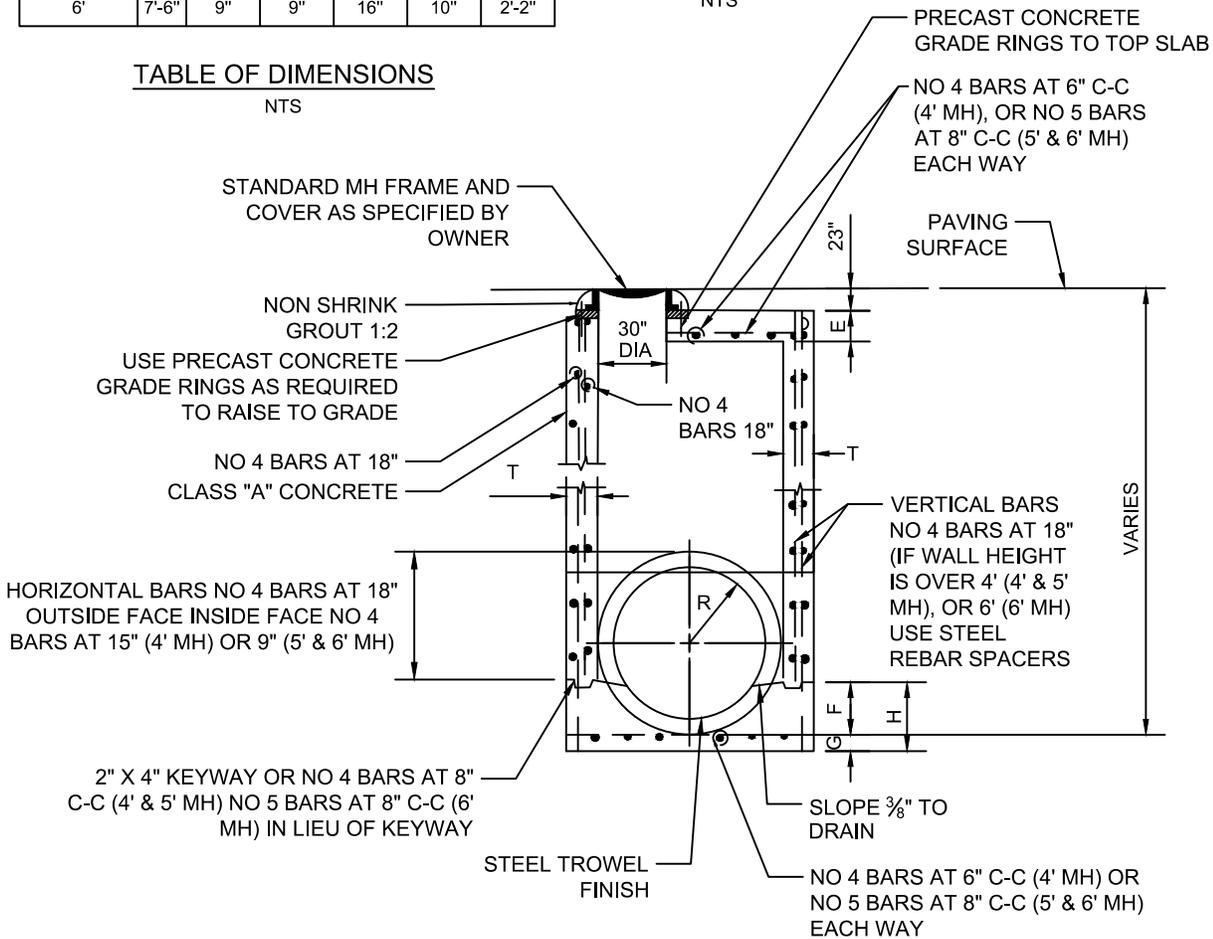
1. LAYERS OF REINFORCED STEEL NEAREST THE INTERIOR AND EXTERIOR SURFACES SHALL HAVE A COVER OF 2" TO THE CENTER OF BARS, UNLESS OTHERWISE NOTED.
2. EXCAVATION FOR MANHOLE TO BE INCLUDED IN THE UNIT PRICE BID FOR MANHOLE.
3. FOR DETAILS OF REINFORCING OF LOWER PORTIONS OF INLET SEE APPROPRIATE SQUARE MANHOLE DETAILS.
4. DEPTH OF DROP INLET FROM FINISHED GRADE TO FLOW LINE OF INLET VARIABLE. APPROXIMATE DEPTH WILL BE SHOWN ON PLANS AT LOCATION OF INLET.
5. ALL STANDARD DROP INLETS SHALL HAVE ONE OPENING ON EACH SIDE UNLESS SHOWN OTHERWISE ON PLANS.



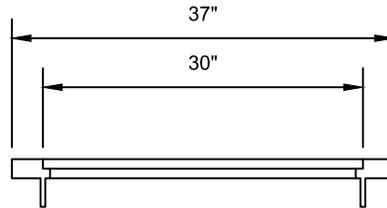
MH SIZE (W)	V	T	E	F	G	H
4'	5'-4"	8"	6"	9"	6"	1'-3"
5'	6'-4"	8"	6"	12"	8"	1'-8"
6'	7'-6"	9"	9"	16"	10"	2'-2"

**TABLE OF DIMENSIONS**  
NTS

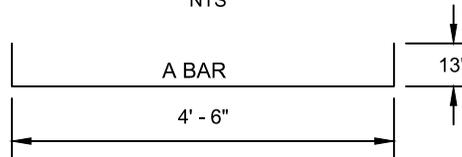
**PLAN**  
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**SECTION B-B**  
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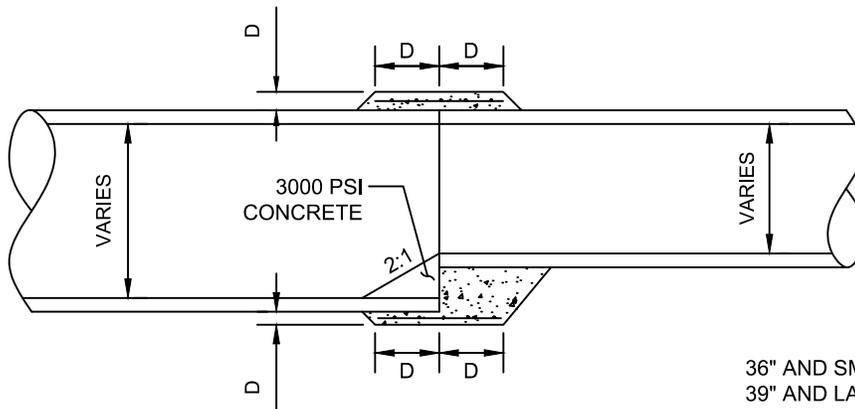
**STORM SEWER LID**  
NTS



BAR	BAR SIZE	LENGTH	# REQUIRED	SPACING
A	#4	6' - 8"	10 IN BOTTOM 2 X "H" IN WALLS	12"
B	#4	5' - 0"	14 IN BOTTOM 2 X "H" IN WALLS	12" IN WALLS VARIABLE IN DECK SEE DETAILS
C	#4	"H" - 7"	36	6"
D	#4	2' - 3"	8	6"
E	#4	1 @ 2'-0" 2 @ 4'-8" 2 @ 6'-6"	5	SEE DETAILS

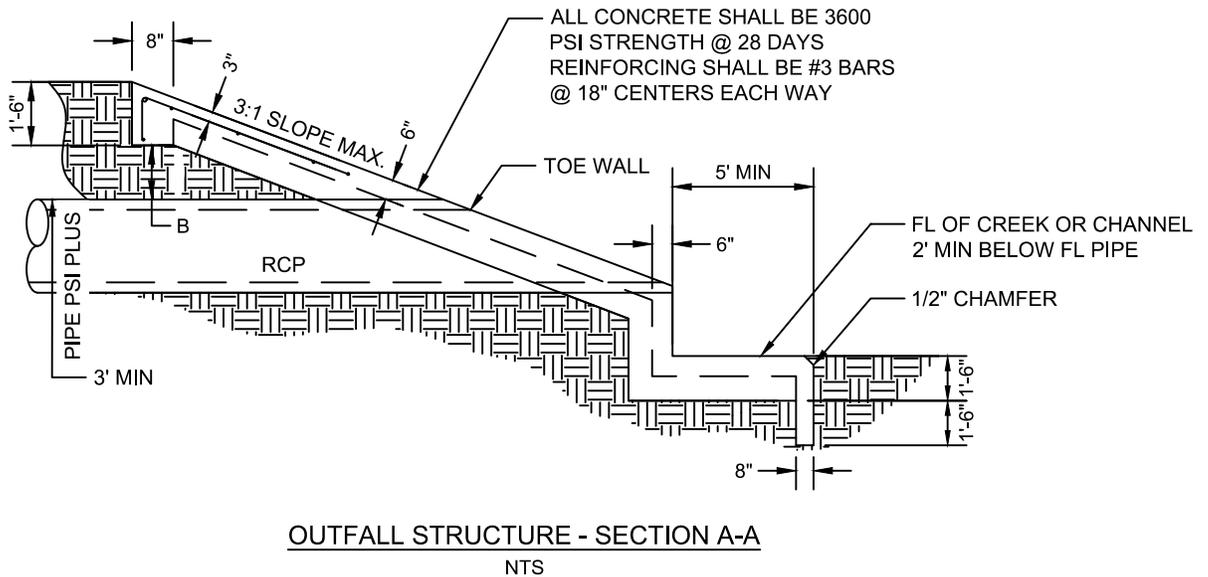
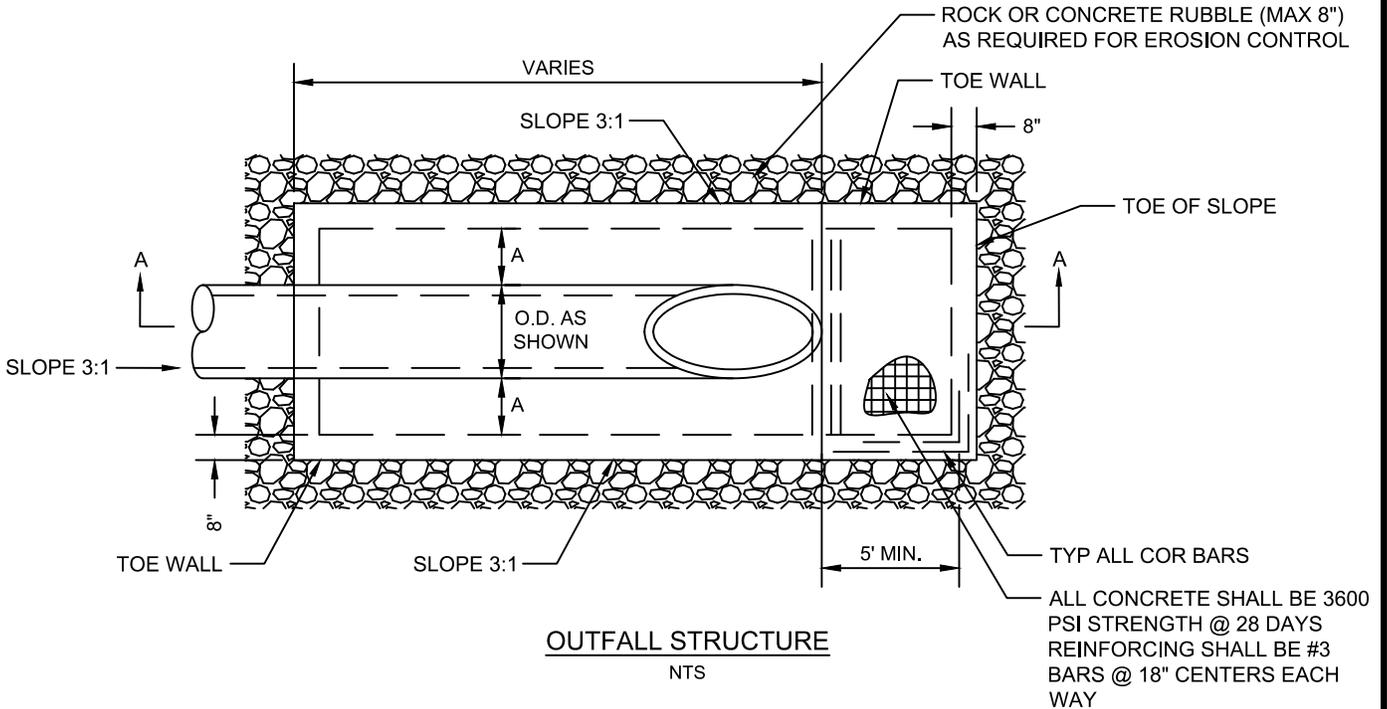
**GENERAL NOTES:**

1. A TEMPORARY METAL COVER SHALL BE INSTALLED AFTER STAGE I IS COMPLETED AND WILL REMAIN IN PLACE UNTIL STAGE II IS BEGUN. STAGE III WILL NOT BE BUILT UNTIL APPROVED BY THE ENGINEER. APPROVAL WILL NOT BE NORMALLY GIVEN UNTIL THE SUBGRADE AND BASE COURSES HAVE BEEN COMPLETED.
2. FIELD BEND OR CUT BARS AS REQUIRED TO ACCOMMODATE SEWER PIPE.
3. DIMENSIONS RELATING TO REINFORCING STEEL ARE TO THE CENTER OF BARS.
4. ALL CONCRETE SHALL BE CLASS "A" CONCRETE.
5. EXTERIOR MASTIC COATING SHALL BE USED ON ALL MANHOLES.
6. LID TO BE FURNISHED WITH A CHAIN RETENTION DEVICE.

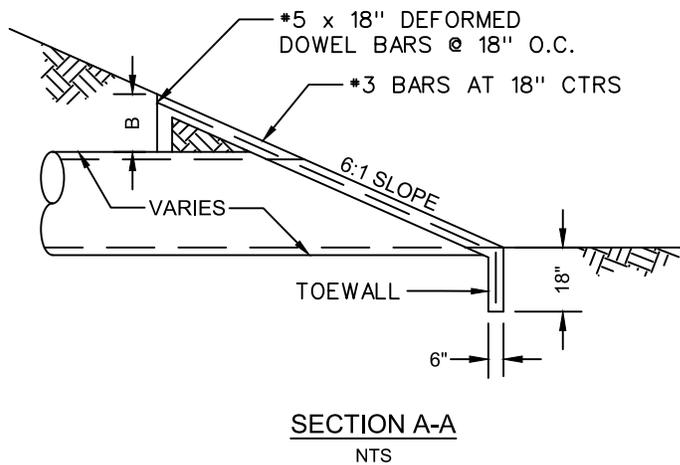
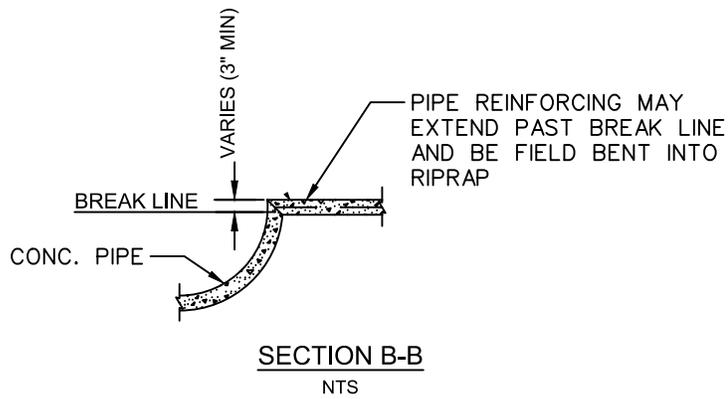
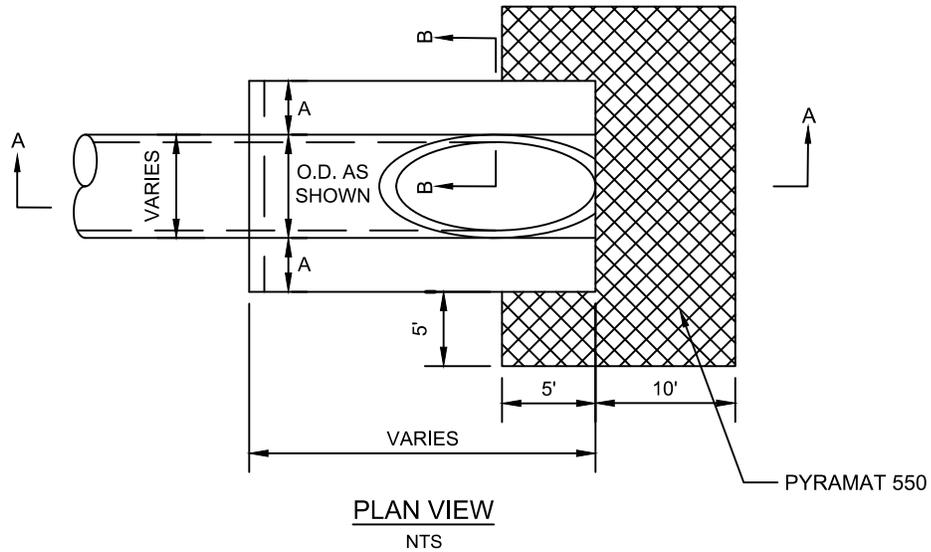


CONCRETE COLLAR FOR END TO END PIPE EXTENSIONS  
NTS

DIMENSIONS BY PIPE SIZE		
	18" - 24"	36" & UP
A	1.0'	2.0'
B	0.5'	1.0'



DIMENSIONS BY PIPE SIZE		
	12" - 30"	36" & UP
A	1.0'	2.0'
B	0.5'	1.0'



# Kennedale Standard Notes

## General Notes

1. All materials and construction shall be in strict accordance with the standards of the City of Kennedale and governed by the North Central Texas Council of Government's Standard Specifications for Public Works Construction.
2. Texas Department of Highways and Public Transportation approval must be obtained prior to construction within State Highway Right-of-Way.
3. Right-of-Way Permit (issued by Public Works Department) is required before cutting any City street.
4. All water meters shall be sized and installed by City Personnel.
5. Fire Hydrants shall be located outside of sidewalk.
6. The location of underground facilities indicated on the plans is taken from public records. It is the Contractor's responsibility to make arrangements with the owners of such underground facilities prior to working in the area to confirm their exact location and to determine whether any additional facilities other than those shown on the plans may be present. The Contractor shall preserve and protect all underground facilities.

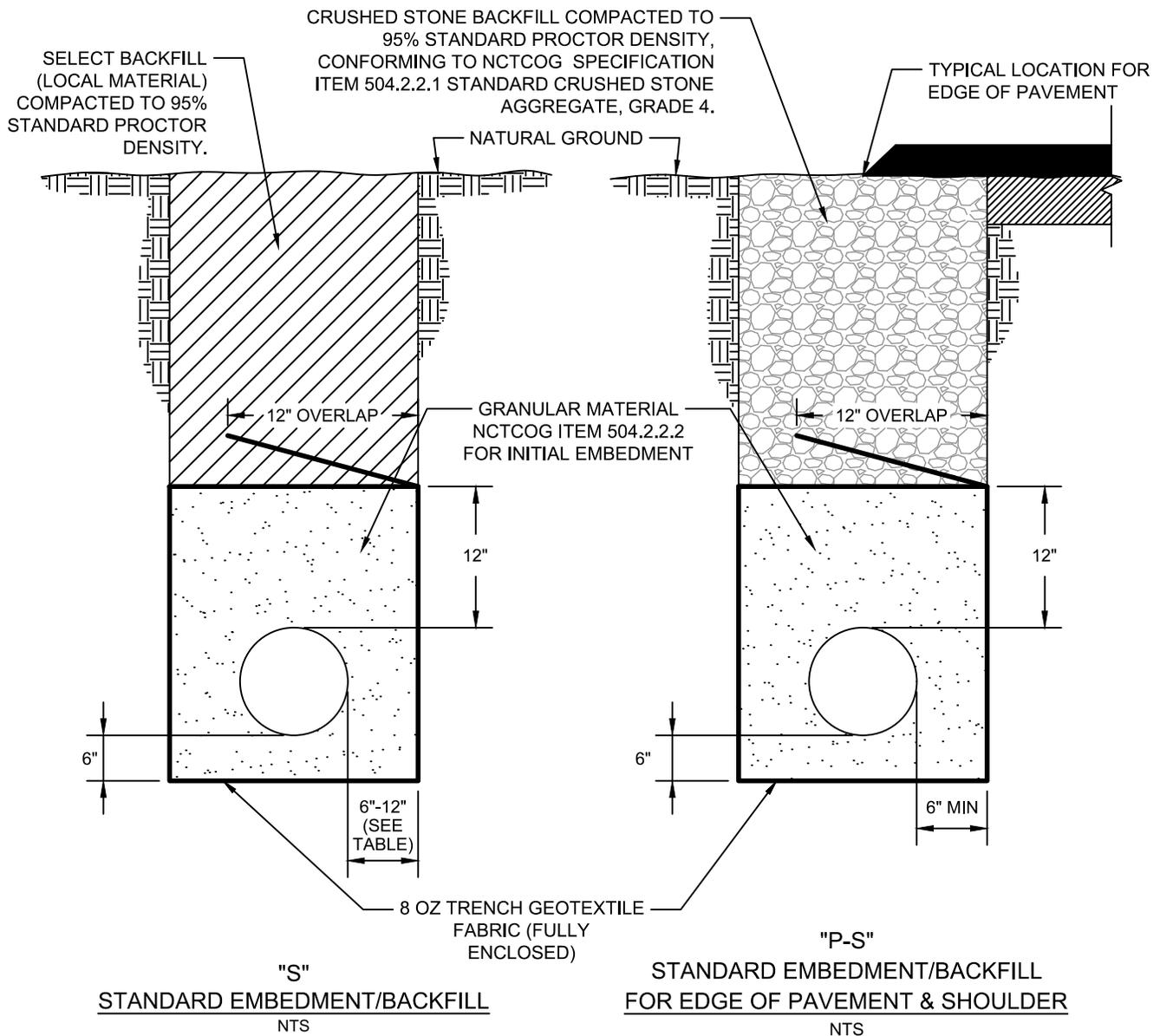
<u>Underground Facility Owner</u>	<u>Telephone Number</u>
City of Kennedale	(817) 985-2170
Dig Test	(800) 344-8377
Atmos Gas	(888) 286-6700
Oncor	(888) 313-6862
AT&T	(800) 288-2020
Charter	(855) 757-7328

7. Where existing utilities or service lines are cut, broken, or damaged, the Contractor shall replace or repair the utilities or service lines with the same type of original material and construction, or better, unless otherwise shown or noted on the plans of his own cost and expense. The Contractor shall notify the Engineer at once of any conflicts in grades and alignment.
8. All excavations, trenching and shoring operations shall comply with the requirements of the US Department of Labor, OSHA, "Const Safety and Health Regulations", Vol 29, Subpart P. pg. 128-137, and any amendments thereto.
9. Adequate measures shall be taken to prevent erosion. In the event that significant erosion occurs as a result of construction, the Contractor shall restore the eroded area to original condition.
10. The Contractor shall restore all areas disturbed by construction to original condition or better. Restored areas include, but are not limited to trench backfill, side slopes, fences, culvert pipes, drainage ditches, driveways, private yards, and roadways. All areas disturbed by construction shall be hydro-mulched, unless otherwise specified in the plans.
11. All water lines shall be PVC pipe conforming to AWWA standard C-900 or ductile iron pipe pressure class 150, latest revision of AWWA specification. All fittings shall be ductile iron and designed for 200 PSI pressure. Water mains to have a minimum of 42" cover to top of pipe, as measured from the top of the pipe to the existing ground, or the proposed finished grade, whichever is greater. All ductile iron pipe and fittings shall be installed with "Polywrap" for cathodic protection.
12. All water lines to be embedded in sand. Backfill shall be select material compacted to 95% standard proctor density.
13. Curb stops should be tested for leakage and full flow when system is pressure tested.
14. All water main clearance at sanitary sewer main crossings shall be a minimum separation of 2' vertical or 10' horizontal.
15. Contractor is advised that for all water service connections, including all new service, meter, and meter box. Water meter, in each case, shall be OWNER FURNISHED and contractor installed.

# Kennedale Standard Notes

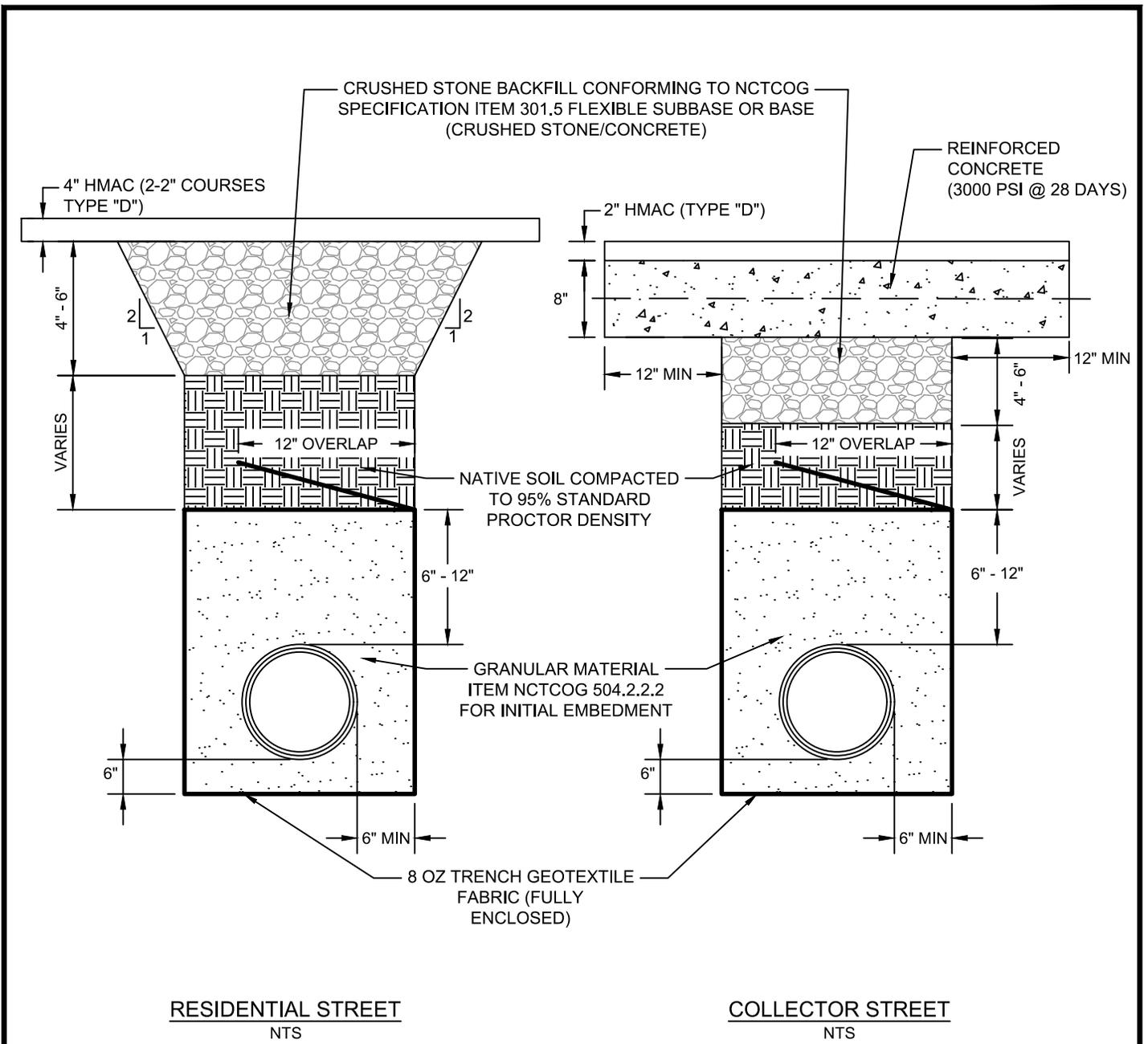
## General Notes

16. Service line pay items will include tapping of water main and necessary service line and fittings as per standard detail.
17. Fire hydrant assembly bid items will include the fire hydrant, the pipe extension from the tee and all necessary fittings, excluding the 6" gate valve.
18. Any water valves located within pavement areas shall be adjusted to final grade by the paving contractor. The paving contractor shall construct a typical concrete block-out per detail on sheet W-3.
19. Any changes from approved construction plans shall be approved by the Water Utility Department, and a change order must be obtained from the design engineer. Any deviations from the State regulations shall be approved by the Director of Public Works.
20. Water lines will be installed as shown on the plans. However, field adjustments approved by the inspector or engineer may be made to lessen damage to the road pavement or when other utility locations, trees, or structures warrant such an adjustment.
21. All sanitary gravity sewer line pipes shall be furnished and installed with PVC pipe specifications SDR-26.
22. Sewage force mains discharging from sewage lift stations shall be PVC pressure sewer pipe designed and manufactured to withstand the maximum anticipated lift station discharge pressures. Meters and meter boxes (where applicable) shall then be removed and delivered to the City's Water Department.
23. The contractor shall be responsible for all disinfection, chlorination, and flushing requirements of the City of Kennedale. This shall include providing temporary isolation valves, plugs, injection ports, flushing valves, tools, and for storage equipment necessary to complete this task.
24. In the event that existing utilities such as water, gas, telephone, electric, ETC must be taken out of service to facilitate construction, the contractor shall provide temporary utilities to the satisfaction of the engineer.
25. One lane of traffic shall be maintained at all times. All traffic control signs, barricades, and flagging shall be in accordance with the latest Texas Manual of Uniform Control Devices. Contractors shall be responsible for traffic control. Contractor shall maintain access to all adjacent properties at all times.
26. Notwithstanding references to the contrary elsewhere in the plans, all trench backfill performed within existing roadway pavements shall be accomplished from top of granular embedment to top of trench utilizing compacted (95% Standard Proctor density) crushed stone. The stone to be furnished shall conform to the prescribed gradation requirements specified in Standard Specification Item 504.2.2 and classified "Standard Crushed Stone Aggregate Grade 4."
27. When the proposed utilities conflict with an existing structure (culvert, mailbox, ETC) the contractor may bore across the areas in conflict, but the City shall determine the required bore length in each case.
28. The contractor shall field verify the depth and location of all existing utilities before beginning construction and location of all sprinkler system lines shall be located before digging. Any damage to system shall be repaired at contractor's expense.



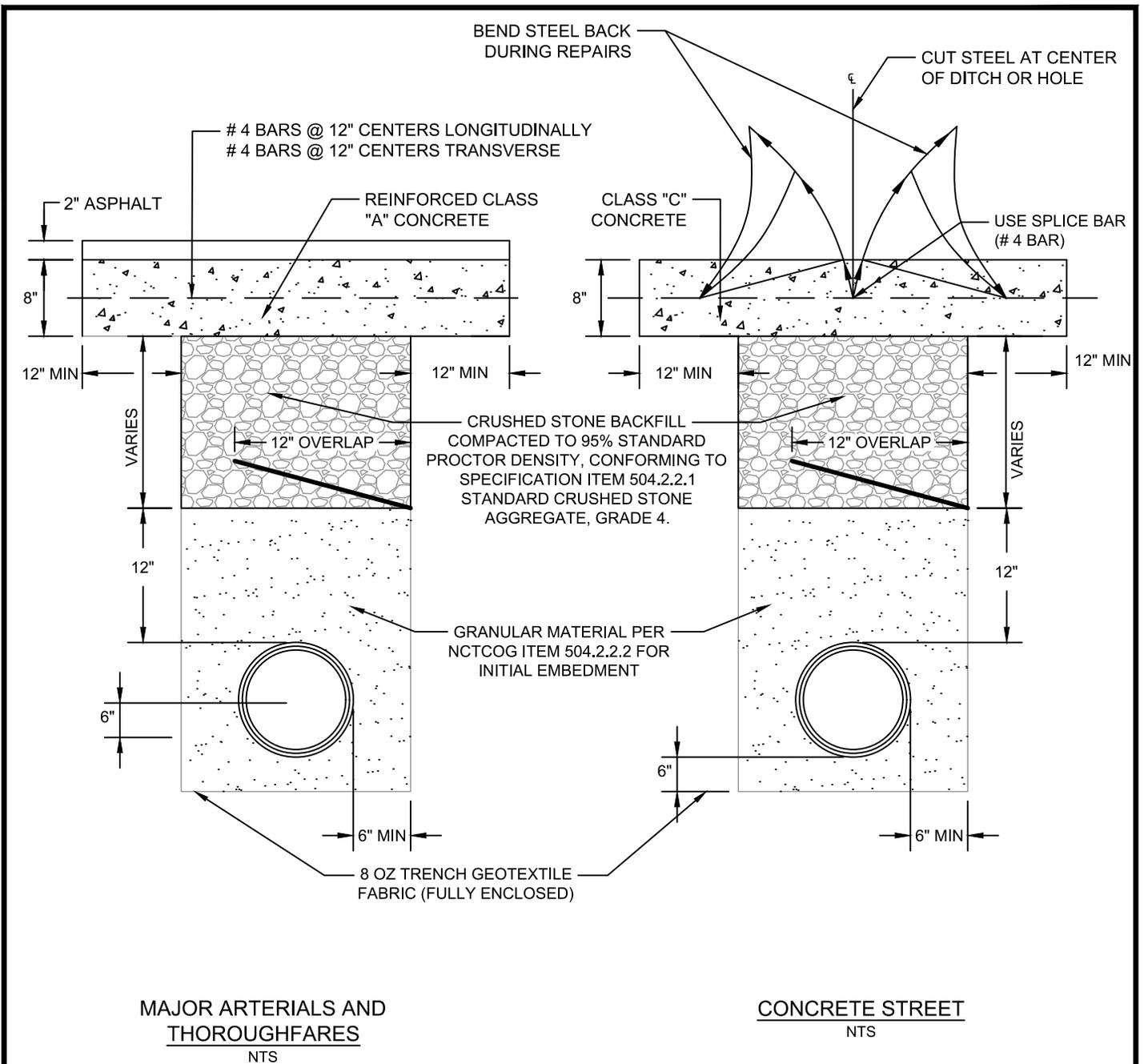
GENERAL NOTES:

1. PIPE MAY NOT BE FILLED ABOVE SPRING LINE UNTIL LOWER PORTION IS COMPACTED TO 95% STANDARD PROCTOR DENSITY. EMBEDMENT BELOW PIPE SHALL BE COMPACTED BEFORE PIPE IS LAID. BELL SHALL BE DUG OUT.
2. TRENCHES SHALL BE TESTED AT THE RATE OF ONE TEST PER 300 LINEAR FEET PER 12 INCH LIFT (LOOSE). TESTS SHALL BE STAGGERED SO THAT TESTS OF ADJACENT LIFTS ARE NOT DIRECTLY OVER THAT OF THE PREVIOUS LIFT IF THE DISTANCE BETWEEN MANHOLES EXCEEDS 300 FT, A MINIMUM OF TWO TESTS SHALL BE REQUIRED.
3. EMBEDMENT WITHIN RIGHT-OF-WAY WILL BE USED WHEN INSTALLING UTILITY LINES WITHIN STREET RIGHT-OF-WAYS, AND UNDER PAVEMENT. ALL OTHER INSTALLATION LOCATIONS, SUCH AS EASEMENTS OR CROSS COUNTRY LOCATIONS WILL COMPLY WITH STANDARD EMBEDMENT DETAILS.
4. THE STANDARD EMBEDMENT DETAIL RELATES TO INSTALLATION OUT FROM UNDER PAVEMENT OR ROADWAY BASE SUCH AS CROSS-COUNTRY EASEMENTS AND PARKWAYS OR AT LOCATIONS NOT SUBJECT TO PROPOSED STREET PAVEMENT



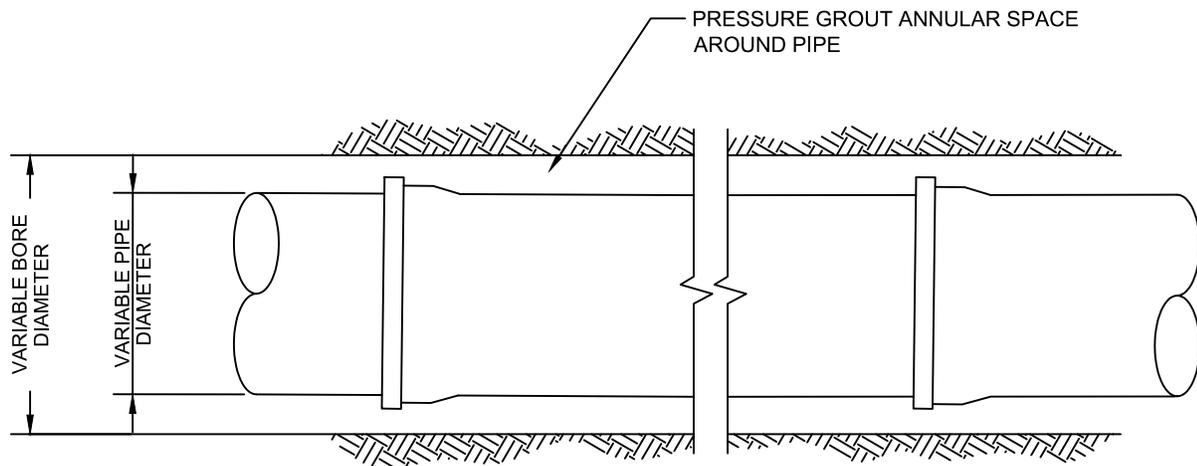
GENERAL NOTES:

1. PRIOR TO EXCAVATION WITHIN PAVEMENT THE CONTRACTOR WILL SAW CUT AN EVEN LINE TO INSURE A UNIFORM AND EVEN MATCH FOR PAVEMENT REPAIRS.



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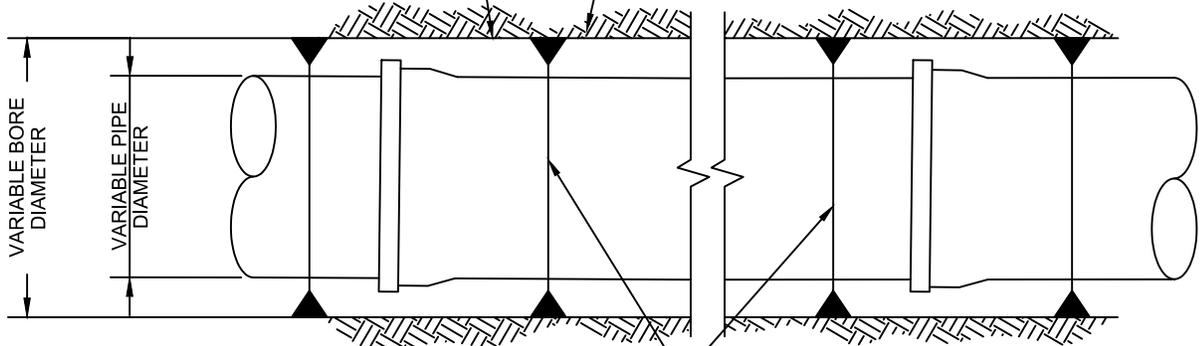


GENERAL NOTES:

1. BORINGS UNDER ROADWAYS SHALL CONFORM TO THE TEXAS STATE DEPARTMENT OF HIGHWAYS AND PUBLIC TRANSPORTATION UTILITY ACCOMMODATION MANUAL.
2. SEE PLAN AND PROFILE FOR LIMITS OF BORE.
3. COMPRESSION TYPE JOINT TO BE USED IF POSSIBLE.
4. IF COMPRESSION TYPE JOINT NOT USED THEN MJ TYPE SHALL BE USED AND JOINTS BOLTED BEFORE PULLING PIPE INTO PLACE.

ALL CASING WILL BE WELDED STEEL PIPE. DIAMETER AND LENGTH OF CASING AS PER SPECIFIC LOCATION. (SEE PLAN & PROFILE SHEETS.)

PERIMETER OF BORE TO BE LARGE ENOUGH TO PERMIT THE CASING TO BE PULLED OR JACKED THROUGH BORED OPENING. ANNULAR VOIDS BETWEEN CASING AND BORED HOLE ARE TO BE PRESSURE GROUTED.

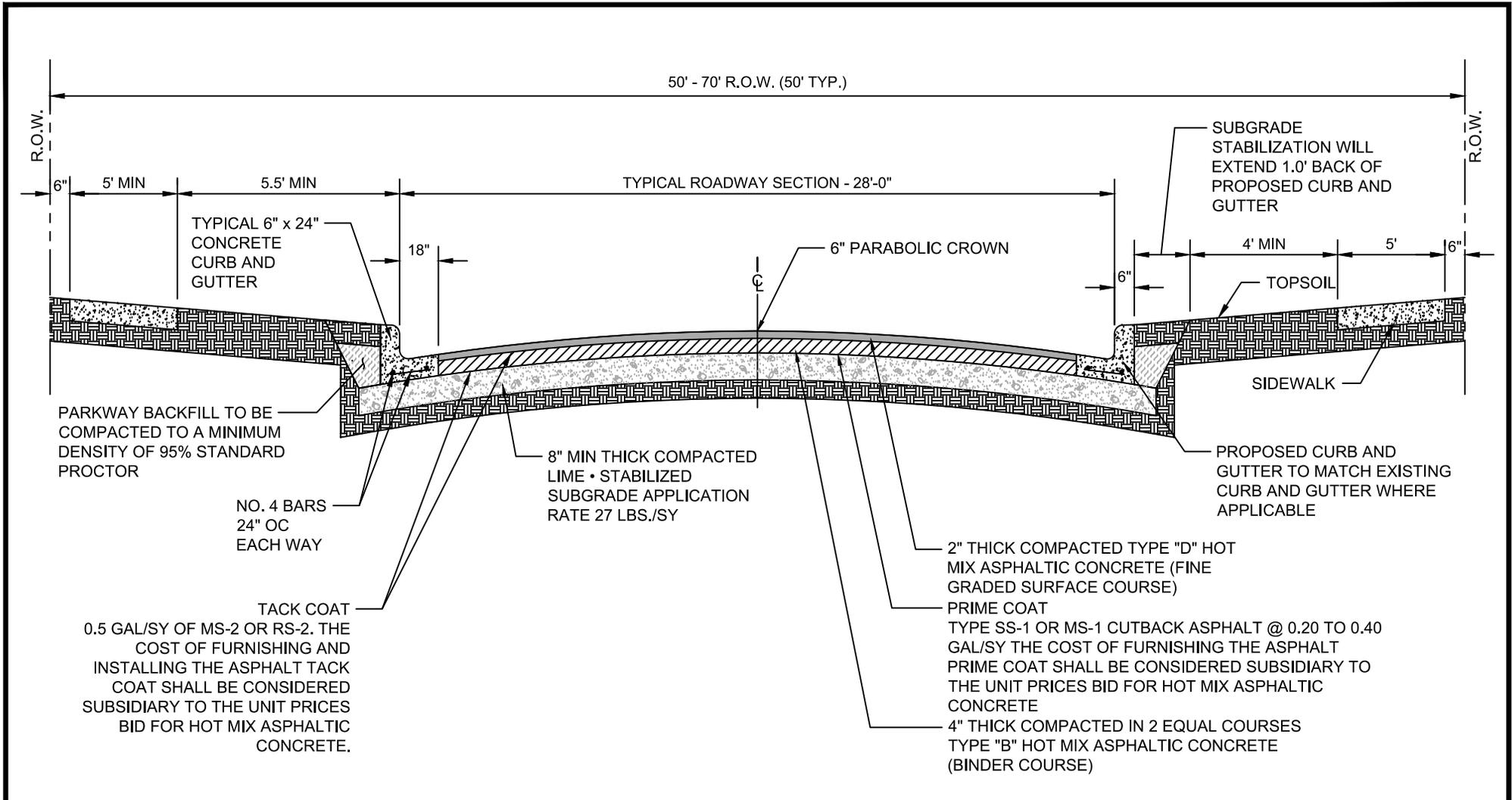


PIPE IN CASING WILL BE INSTALLED WITH RAYCON CASING SPACERS OR AN APPROVED EQUAL PRODUCT. THE SPACERS WILL BE LOCATED ON 6 1/2" (FOOT) CENTERS FOR ALL TYPES OF PVC CARRIER PIPE.

TABLE OF STEEL CASING SIZES	
Nominal Pipe Sizes (Diameter in inches)	Welded Steel Casing Size (Inside MIN Diameter)
4	8"
6	10"
8	14"
10	16"
12	18"
14	24"
15	24"
16	28"
18	32"
20	32"

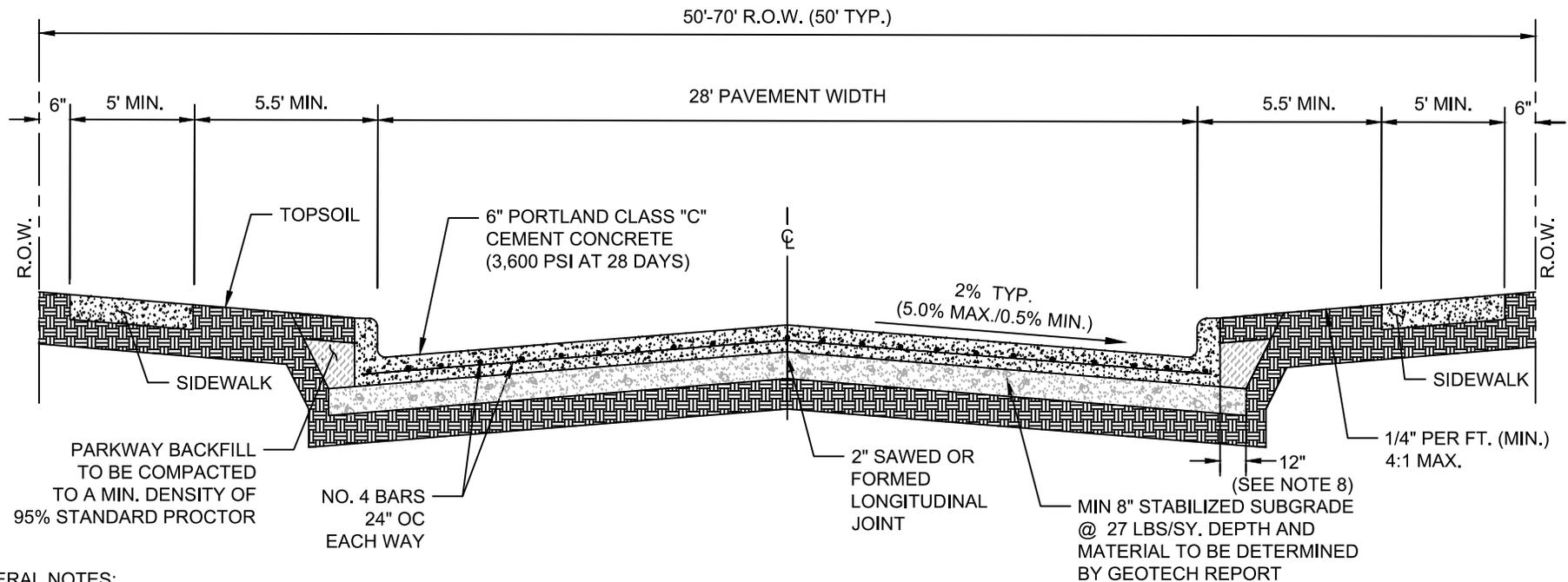
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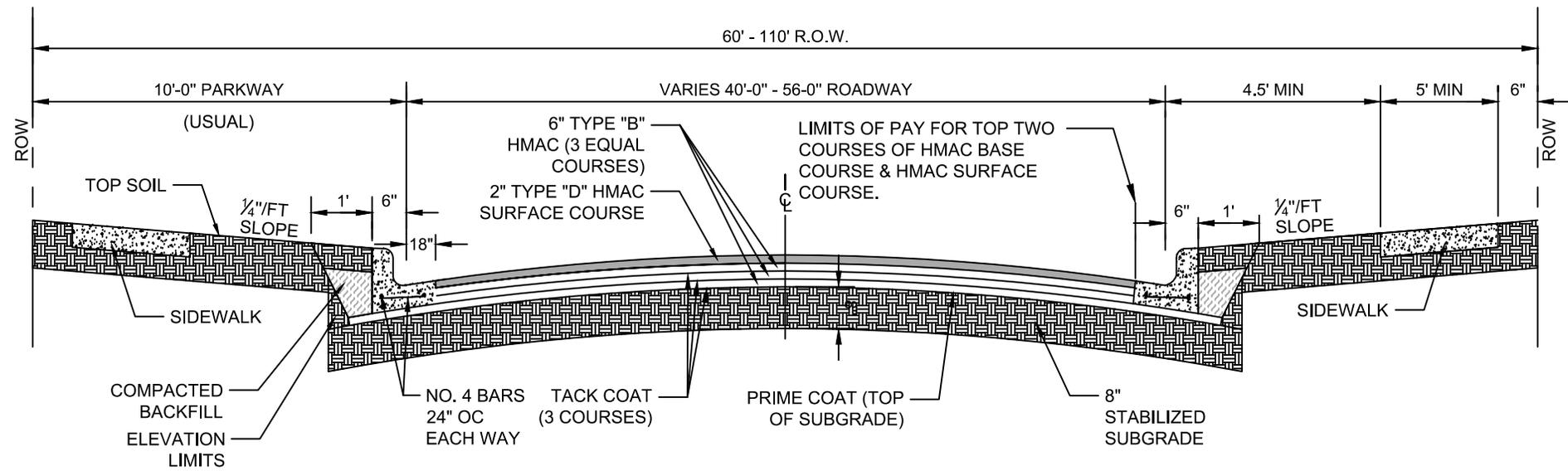
**GENERAL NOTES:**

1. 6" THICK ASPHALT CONCRETE WITH 6" x 24" CONCRETE CURB AND GUTTER
2. THE TYPE AND AMOUNT OF LIME/CEMENT SHALL BE DETERMINED BY AN INDEPENDENT SOIL TESTING LAB EMPLOYED BY THE OWNER. TESTS WILL BE PERFORMED ON THE COMPLETED SUBGRADE FOLLOWING TRENCH BACKFILL.

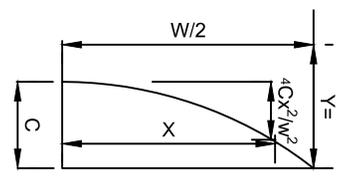


**GENERAL NOTES:**

1. ON CONCRETE STREETS ALL INLETS SHALL BE SEPARATED FROM THE PAVEMENT AND CURB BY BOXING OUT AROUND INLETS AS SHOWN. EXPANSION JOINT MATERIAL SHALL EXTEND COMPLETELY THROUGH CURB AND SLAB. MANHOLE CASTINGS WITHIN THE PAVEMENT LIMITS SHALL BE BOXED IN LIKE MANNER EXCEPT WHEN TELESCOPING-TYPE CASTINGS AND FIBERGLASS-TYPE ARE USED. WHEN A JOINT FALLS WITHIN 5' OF OR CONTACTS INLETS, MANHOLES OR OTHER STRUCTURES, SHORTEN ONE OR MORE PANELS EITHER SIDE OF OPENING TO PERMIT JOINT TO FALL ON ROUND STRUCTURES AND AT OR BETWEEN CORNERS OF RECTANGULAR STRUCTURES.
2. ALL REINFORCING STEEL SHALL BE DEFORMED BARS. REINFORCING STEEL SHALL BE PLACED WITH THE CENTER OF THE OUTSIDE LAYER OF BARS 2" FROM THE SURFACE OF THE CONCRETE.
3. WHERE REINFORCING BARS ARE SPLICED, A 30" DIAMETER LAP SHALL BE USED.
4. TYPE C TRANSVERSE CONTRACTION JOINTS SHALL BE ON 15' CENTERS.
5. ALL CLASS "C" CONCRETE SHALL BE 3600 PSI COMPRESSIVE STRENGTH AT 28 DAYS.
6. AN APPROVED WHITE PIGMENTED CURING COMPOUND SHALL BE APPLIED TO THE SURFACE OF THE CONCRETE AS SOON AS IT HAS BEEN POURED AND FINISHED.
7. DOWELS TO BE 12" OC WHEN POURED ON HALF STREET.
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9. SEAL ALL VOIDS AND HONEYCOMBS AT ALL CURBS BEFORE PLACING BACKFILL.
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12. CONTRACTOR TO GRADE AND SHAPE ALL ADJACENT LOT FRONTAGES FOR POSITIVE DRAINAGE INTO ROAD.
13. EMBANKMENT TO BE COMPACTED IN ACCORDANCE WITH NCTCOG.



MINIMUM PAVING THICKNESS		
ROADWAY WIDTH	40'	COPY
MIN HMAC THICKNESS	48'	8"



ORDINATES FOR PARABOLIC STREET CROWNS IN FEET				
RDWY	30'	40'	48'	60'
CROWN	6"	7"	8"	8"
SEC	R	R/C	C	A
DIST OUT				
CL	0.000	0.000	0.000	0.000
5'	0.054	0.038	0.028	0.019
10'	0.217	0.143	0.113	0.074
15'	0.500	0.322	0.255	0.167
18'		0.464	0.367	0.400
20'		0.583	0.453	0.296
22'			0.548	0.359
24'			0.667	0.427
26'				0.501
28'				0.581

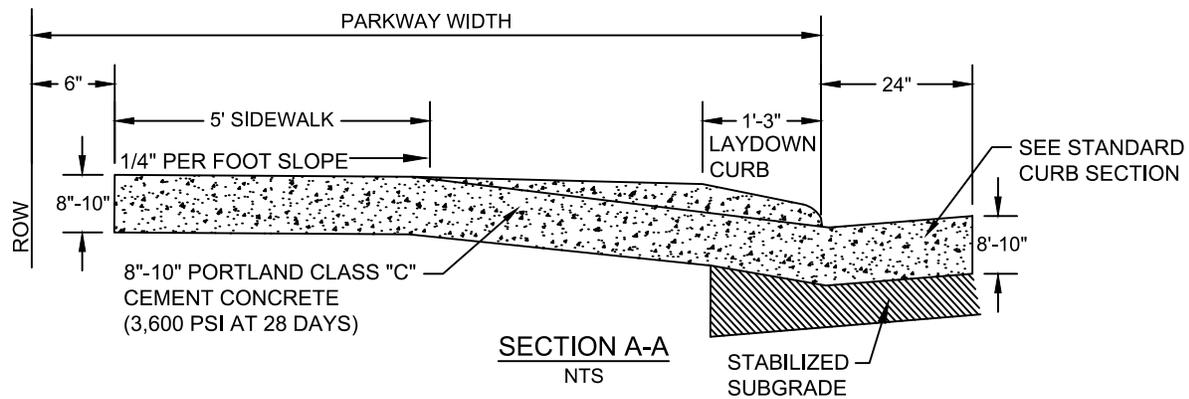
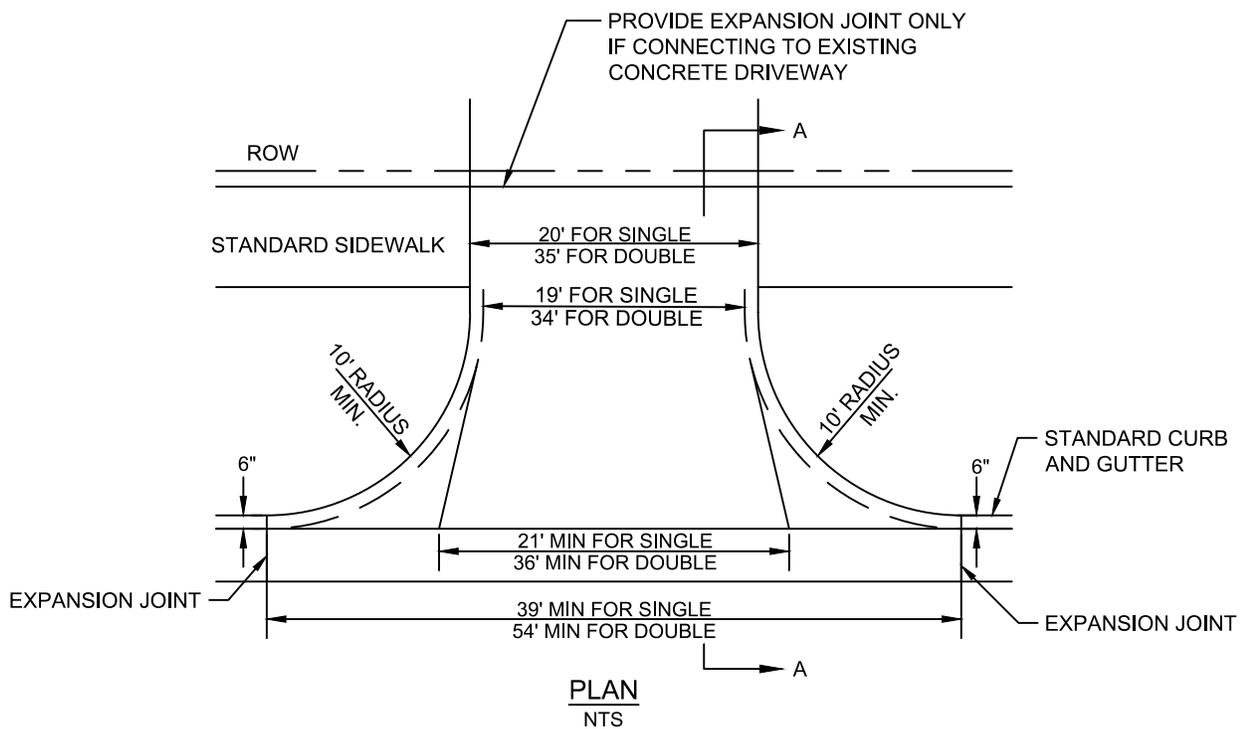
**GENERAL NOTES:**

1. COAT WITH ASPHALT THE SIDES OF GUTTERS WHICH ARE IN CONTACT WITH HMAC PAVEMENT.
2. FOUNDATION COURSE-CEMENT OF LIME TREATED SUBGRADE (8") - IF THE NATURAL SUBGRADE HAS A PI LESS THAN 20. THE ENGINEER MAY SPECIFY CEMENT OR LIME TREATED SUBGRADE AFTER CONSIDERING LINEAR SHRINKAGE, SOIL CLASSIFICATION, SEEPAGE, AND OTHER FACTORS. IF THE NATURAL SUBGRADE HAS A PI GREATER THAN 20, LIME TREATED SUBGRADE SHALL BE USED. IF SUFFICIENT DEPTH OF SUITABLE SUBGRADE MATERIAL IS NOT AVAILABLE, IT SHALL BE REMOVED AND REPLACED WITH SUITABLE MATERIAL AND ALTERNATE STABILIZING AGENT MAY BE USED IF APPROVED BY THE ENGINEER.
3. MINIMUM OF 37 LBS/SY LIME WILL BE REQUIRED FOR SUBGRADE STABILIZATION.
4. PRIME COAT SHALL BE APPLIED AT THE RATE OF 0.15 - 0.20 GALLONS PER SY TACK COAT SHALL BE APPLIED AT THE RATE OF 0.05 - 0.10 GALLONS PER SY
5. THE TYPE AND AMOUNT OF LIME/CEMENT SHALL BE DETERMINED BY AN INDEPENDENT SOIL TESTING LAB EMPLOYED BY THE OWNER. TESTS WILL BE PERFORMED ON THE COMPLETED SUBGRADE FOLLOWING TRENCH BACKFILL
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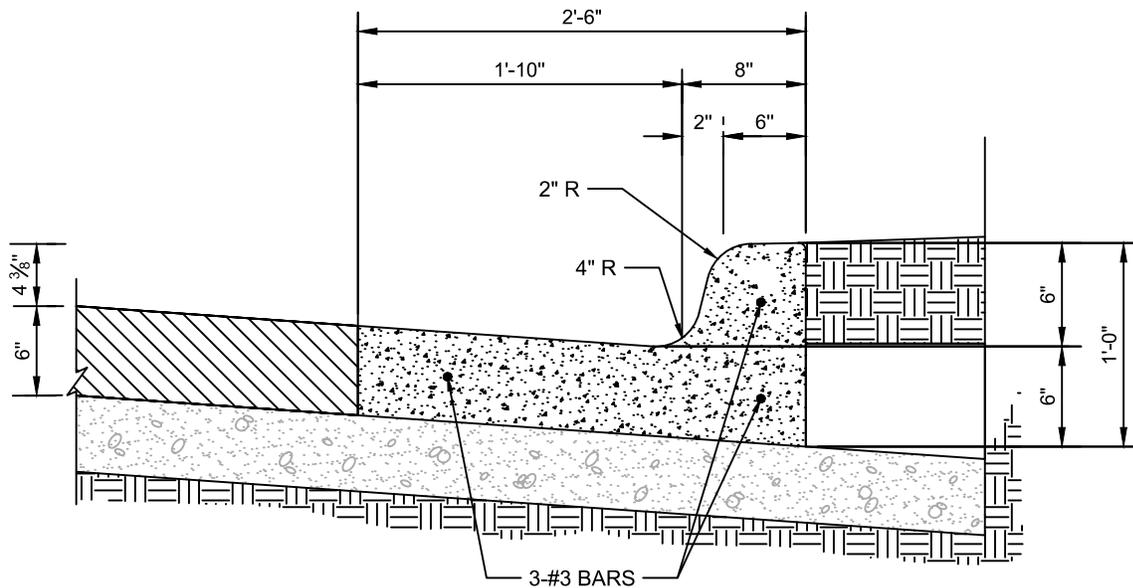
CITY OF KENNEDALE, TEXAS  
**PAVING AND RELATED IMPROVEMENT DETAILS**  
**AVENUE SECTION HOT MIX ASPHALT CONCRETE**  
**PAVEMENT**

MARCH 2020



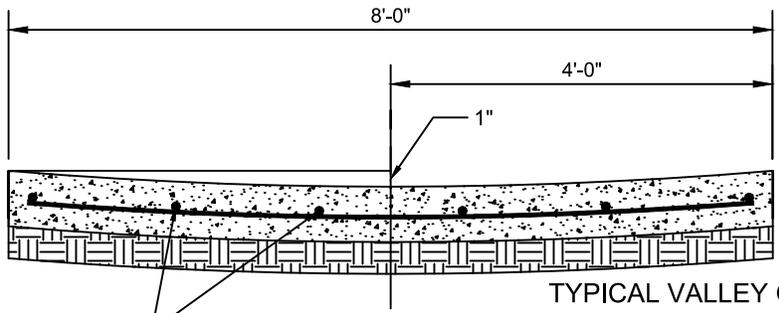
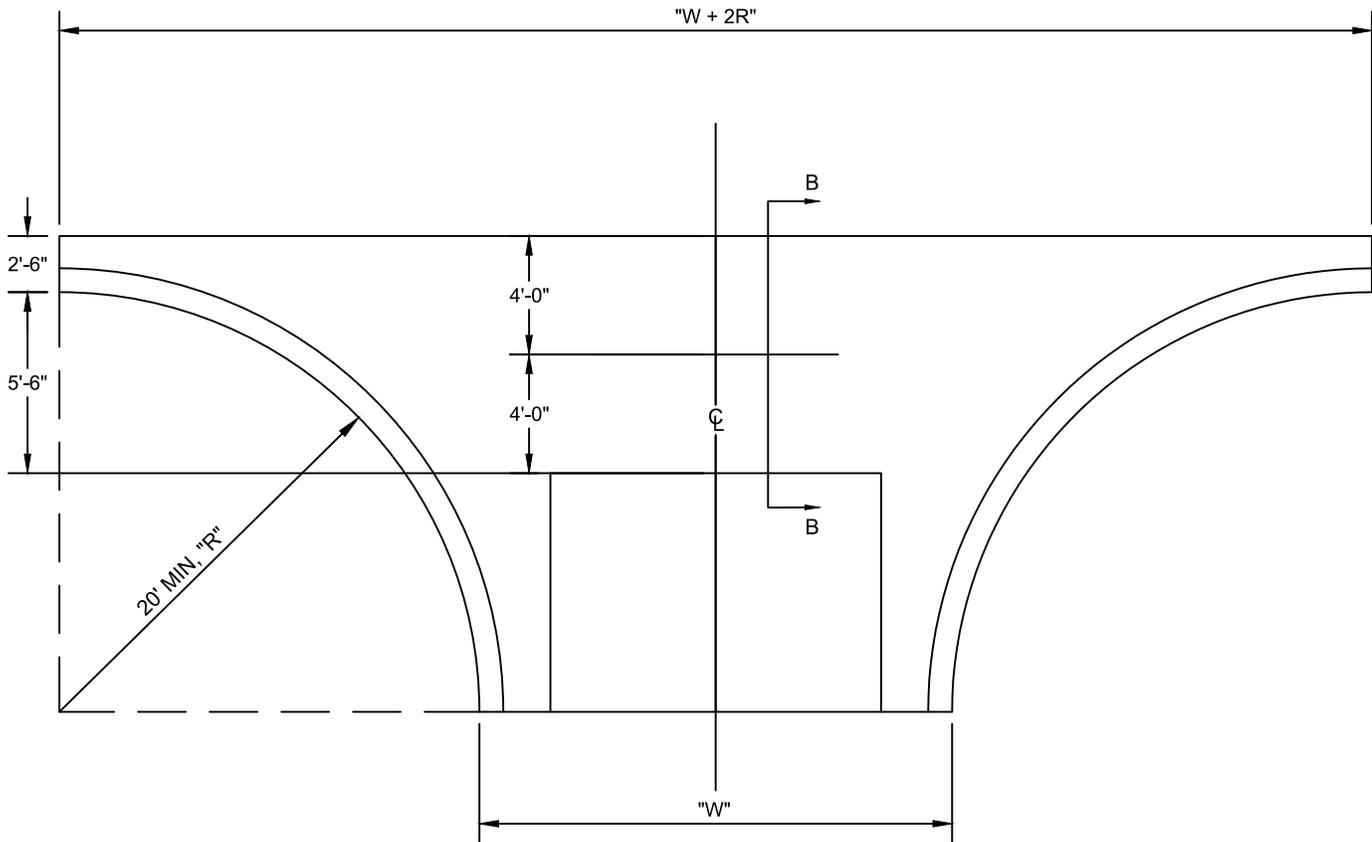
**GENERAL NOTES:**

1. SIDEWALK SECTIONS THRU DRIVEWAY TO BE POURED AT THE SAME THICKNESS AS THE DRIVEWAY APPROACH.
2. ALL DRIVEWAYS SHALL BE REINFORCED WITH # 3 BARS AT 18" OC.
3. ALL CLASS "C" CONCRETE SHALL BE 3600 PSI COMPRESSIVE STRENGTH AT 28 DAYS.
4. COMMERCIAL DRIVEWAYS SHALL JOIN THE STREET CURB WITH A MINIMUM TEN FOOT (10') RADIUS AND A MAXIMUM THIRTY FOOT (30') RADIUS.
5. COMMERCIAL AND INDUSTRIAL DRIVEWAY APPROACHES SHALL BE CONSTRUCTED OF EIGHT INCH (8") TO 10 INCH (10") THICK, PER GEOTECHNICAL ENGINEERS RECOMMENDATIONS.



GENERAL NOTES:

1. EXPANSION JOINT (PREMOLDED ASPHALT BOARD) ON 40' CENTERS MAXIMUM.
2. AN APPROVED WHITE PIGMENTED CURING COMPOUND SHALL BE APPLIED TO THE SURFACE OF THE CURB AND GUTTER AS SOON AS IT HAS BEEN POURED AND FINISHED.
3. CURB SHALL BE STAMPED WITH A "W" OR "S" (2" MIN) AT WATER AND SEWER LOCATIONS.

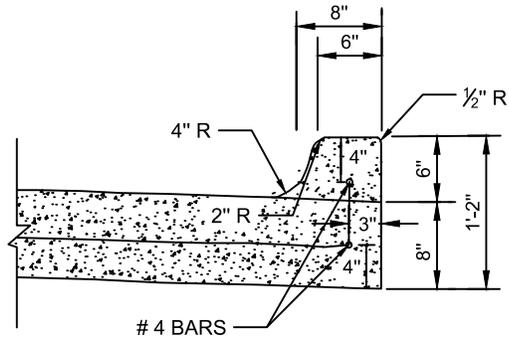


# 3 BARS  
24" OC EACH WAY

TYPICAL VALLEY GUTTER PLAN  
SECTION B-B  
NTS

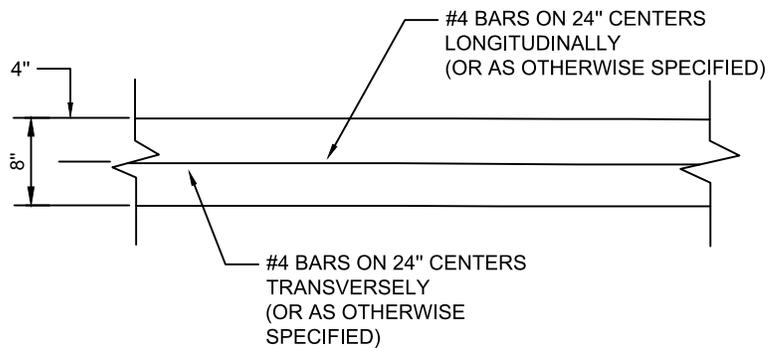
GENERAL NOTES:

1. ALL CONCRETE FOR VALLEY GUTTERS SHALL BE CLASS "A". REINFORCING STEEL SHALL BE # 3 BARS ON 24" CENTERS BOTH WAYS. SUBGRADE SHALL BE THE SAME AS HMAC STREET.
2. VALLEY GUTTER TO BE CONSTRUCTED OF CLASS "A" CONCRETE



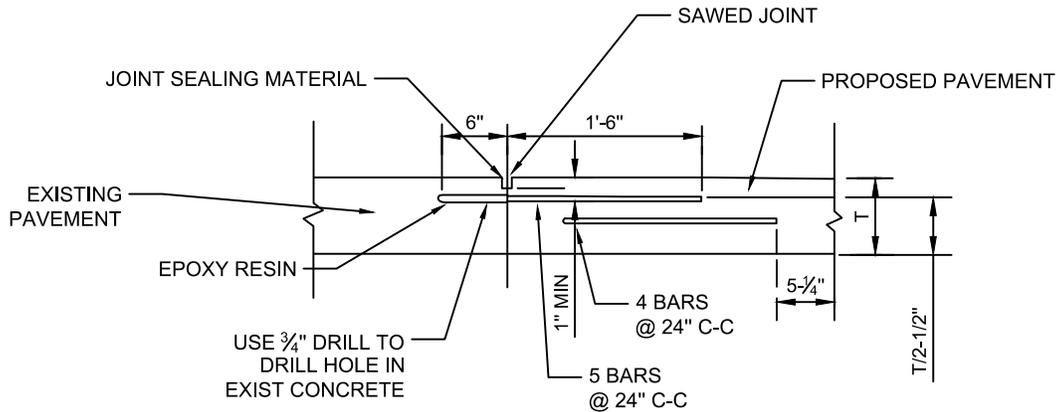
**MONOLITHIC CONCRETE CURB & GUTTER**

NTS



**PAVEMENT REINFORCING**

NTS

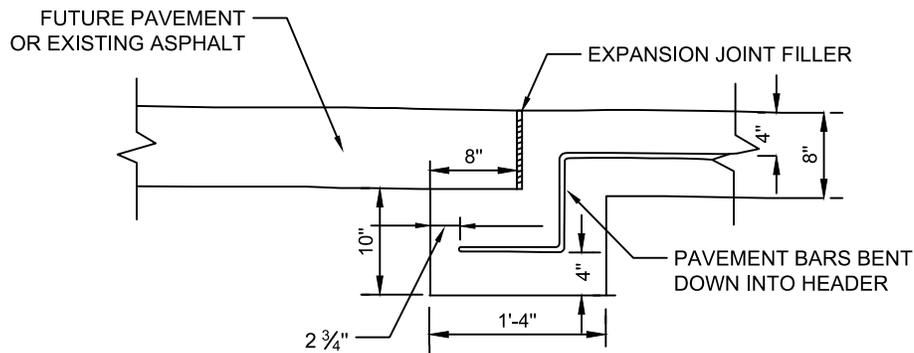


**EPOXY TIE BAR**

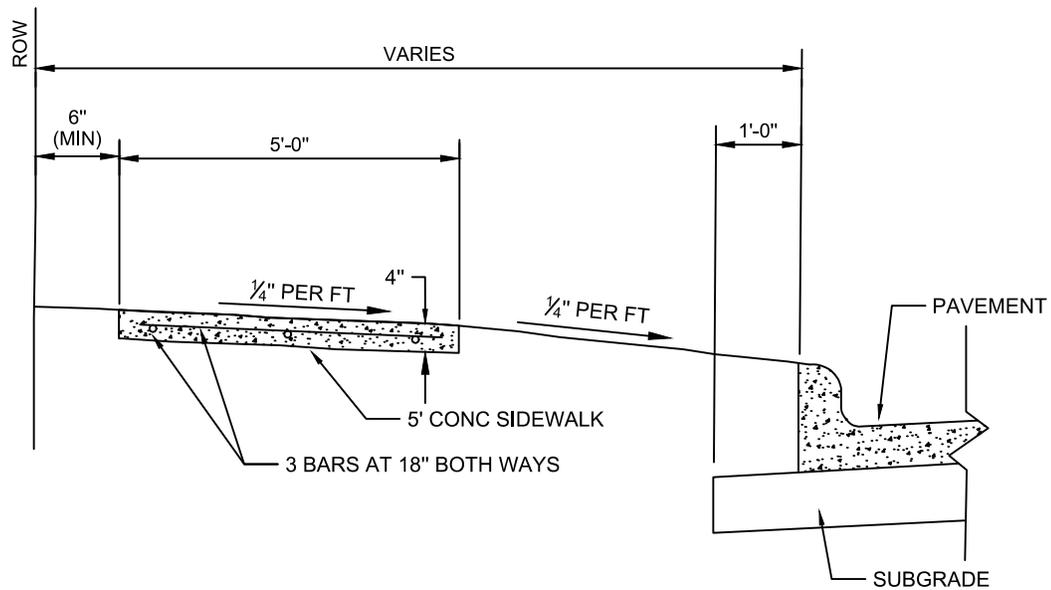
NTS

**GENERAL NOTES:**

1. ALL REINFORCING STEEL SHALL BE NEW BILLET STEEL CONFORMING TO ASTM A-615
2. ALL CONCRETE SHALL BE CLASS "A" (5 BAGS OF CEMENT PER CY & A MINIMUM COMPRESSIVE STRENGTH AT 28 DAYS OF 3000 PSI) ALL CORNERS SHALL BE CHAMFERED 3/4"
3. AN APPROVED WHITE PIGMENTED CURING COMPOUND SHALL BE APPLIED TO THE SURFACE OF THE CURB AND GUTTER AS SOON AS IT HAS BEEN POURED AND FINISHED.



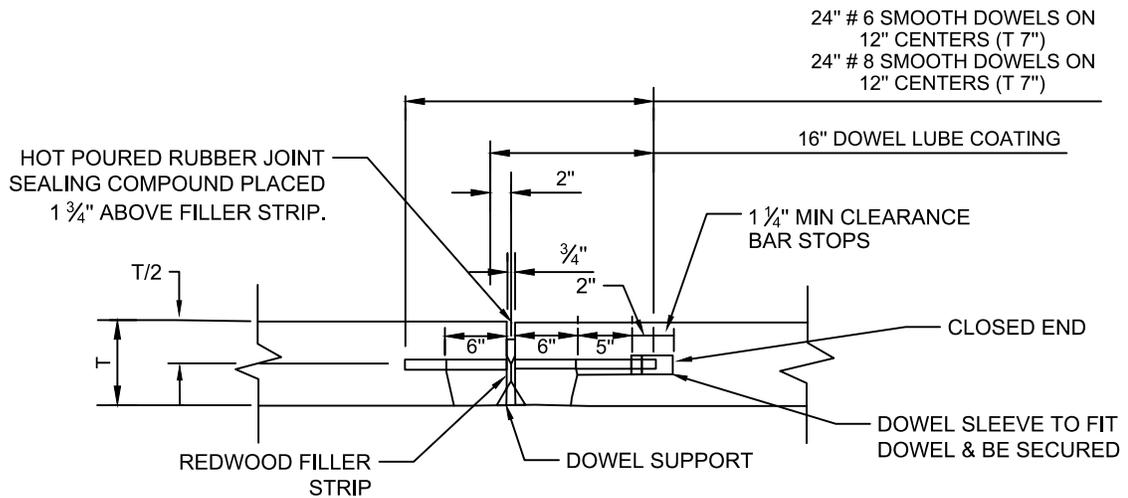
**PAVEMENT HEADER**  
NTS



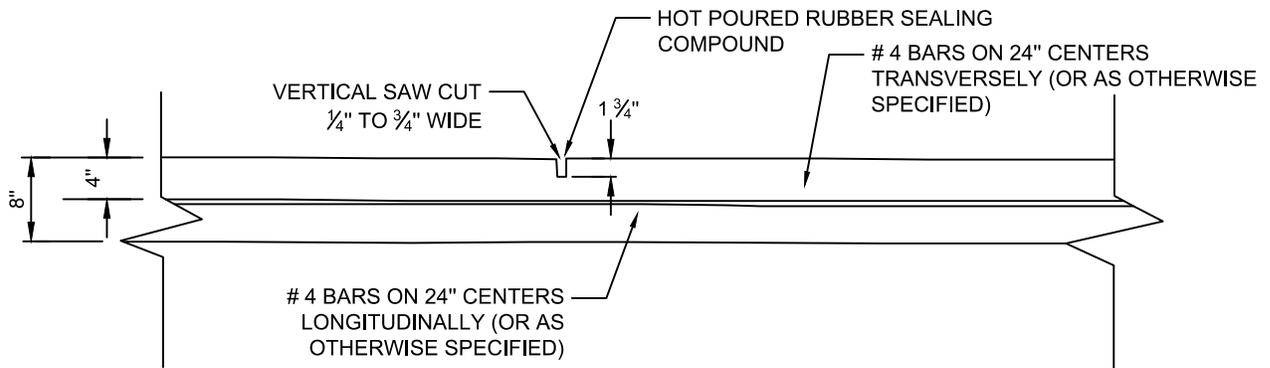
**TYP 5 FT SIDEWALK LAYOUT**  
NTS

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3. PAVEMENT & HEADER TO BE POURED MONOLITHICALLY



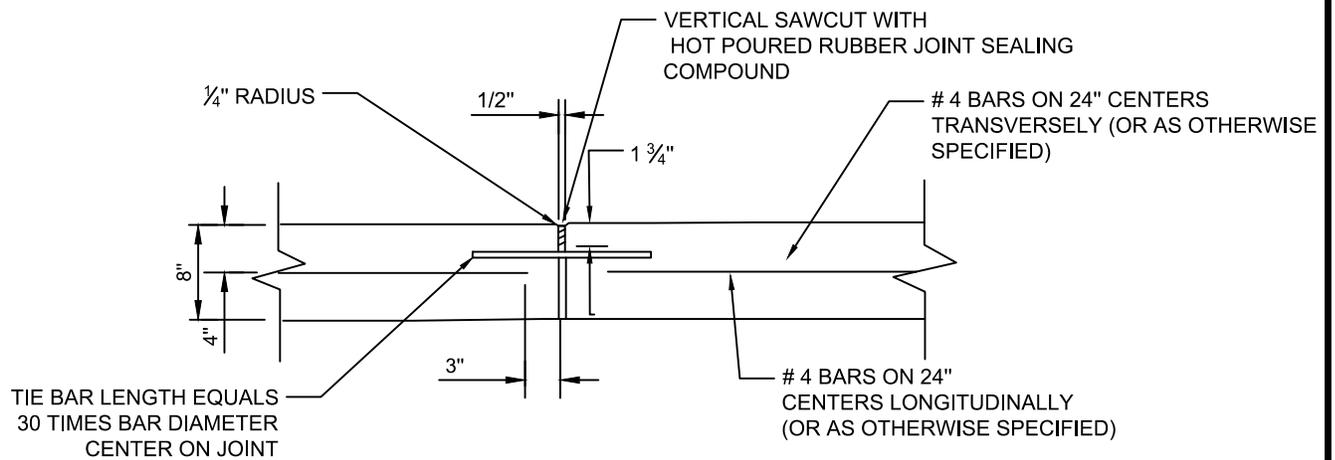
**TRANSVERSE EXPANSION JOINT**  
NTS



**SAWED LONGITUDINAL AND TRANSVERSE  
CONTRACTION JOINT AT QUARTER POINTS  
FOR LONGITUDINAL POINTS AND AT 15'  
FOR TRANSVERSE JOINTS**  
NTS

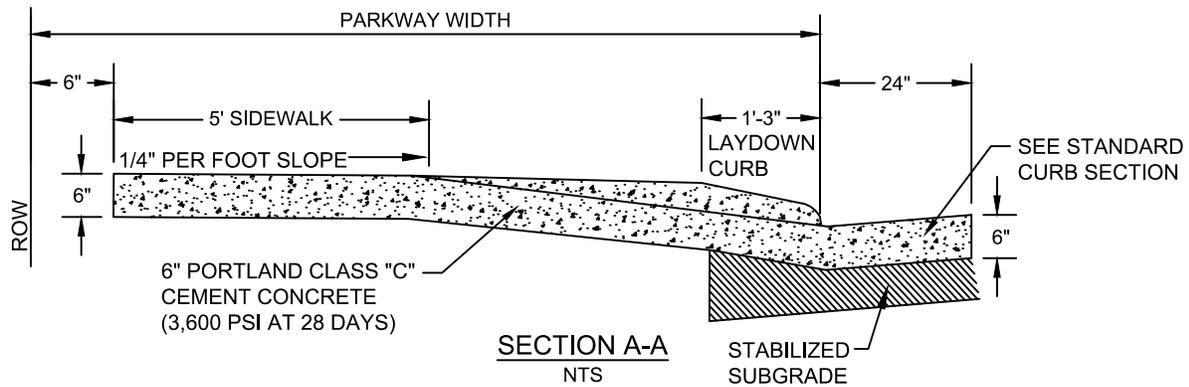
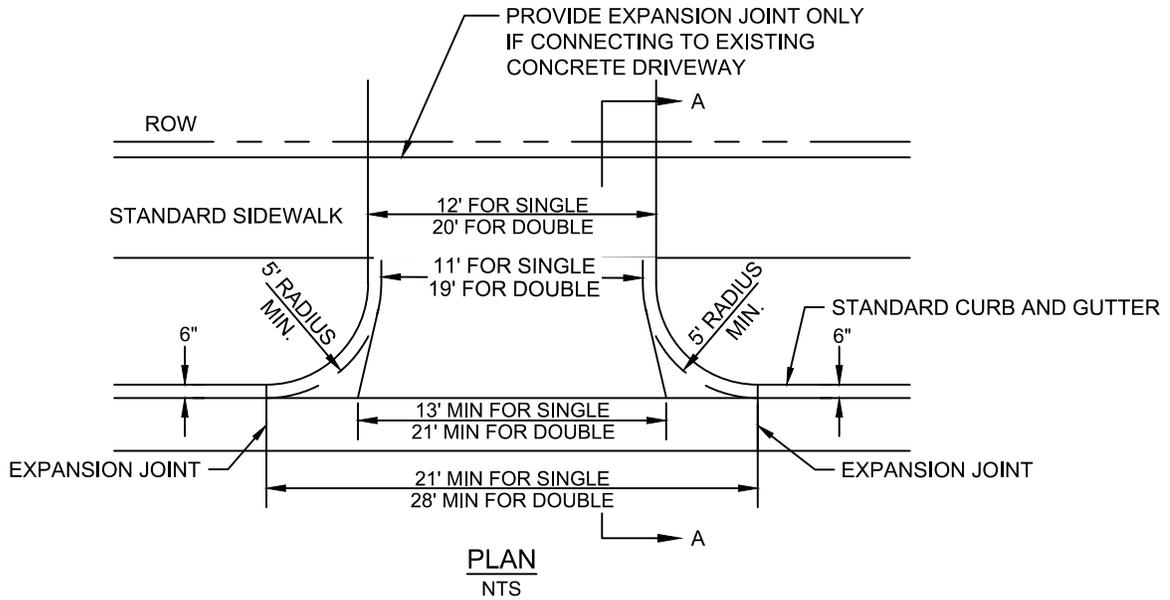
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2. ALL CONCRETE SHALL BE CLASS "C" (5 BAGS OF CEMENT PER CY & A MINIMUM COMPRESSIVE STRENGTH AT 28 DAYS OF 3600 PSI) ALL CORNERS SHALL BE CHAMFERED 3/4".
3. TRANSVERSE & LONGITUDINAL STEEL NOT SHOWN FOR CLARITY, STEEL DOES NOT CROSS JOINT. END 3" BACK FROM JOINT. MAXIMUM SPACING OF 600'. ALSO USE AT INTERSECTIONS. CURVE PCs/PTs AND END OF DAYS POUR.



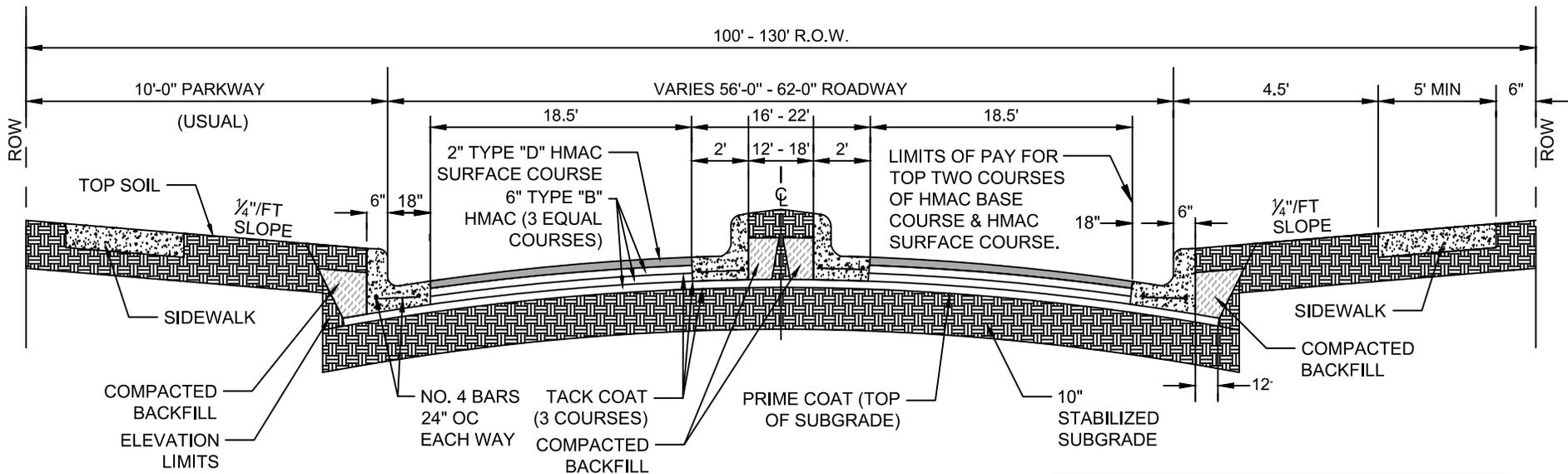
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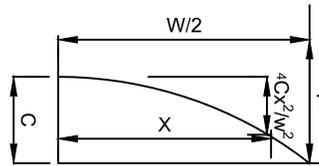


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4. RESIDENTIAL DRIVEWAYS SHALL JOIN THE STREET CURB WITH A MINIMUM FIVE FOOT (5') RADIUS AND A MAXIMUM TEN FOOT (10') RADIUS.



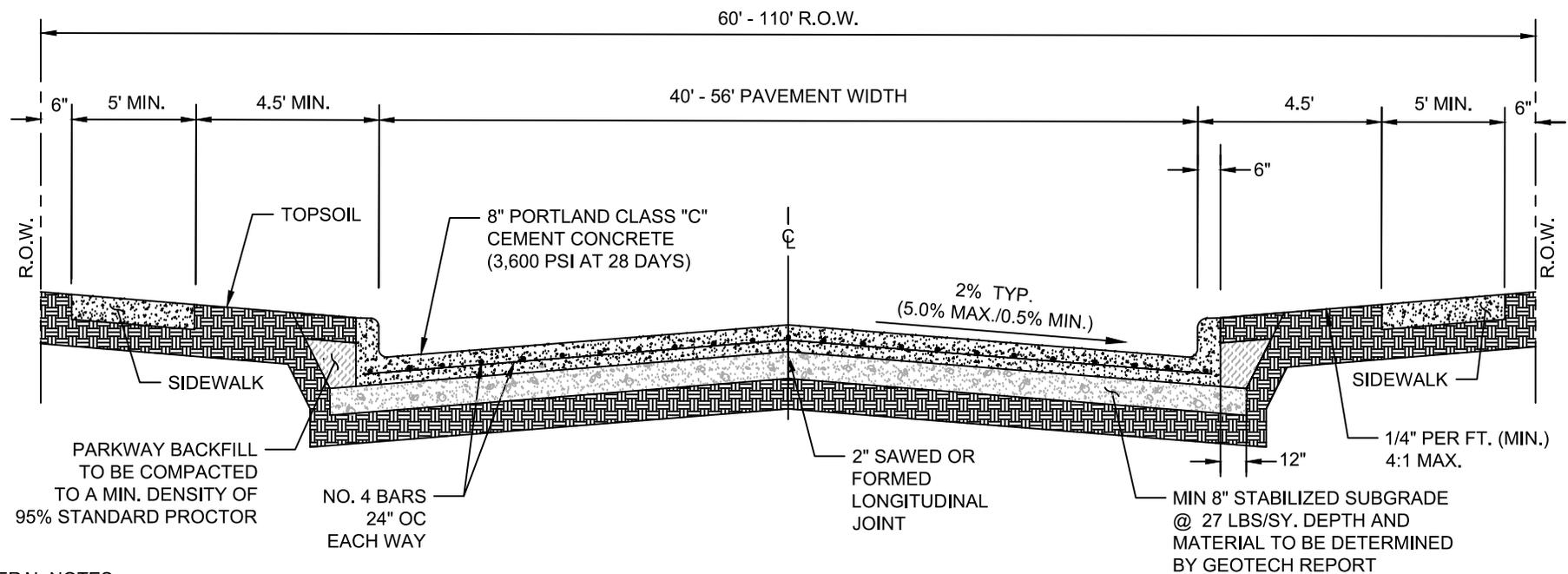
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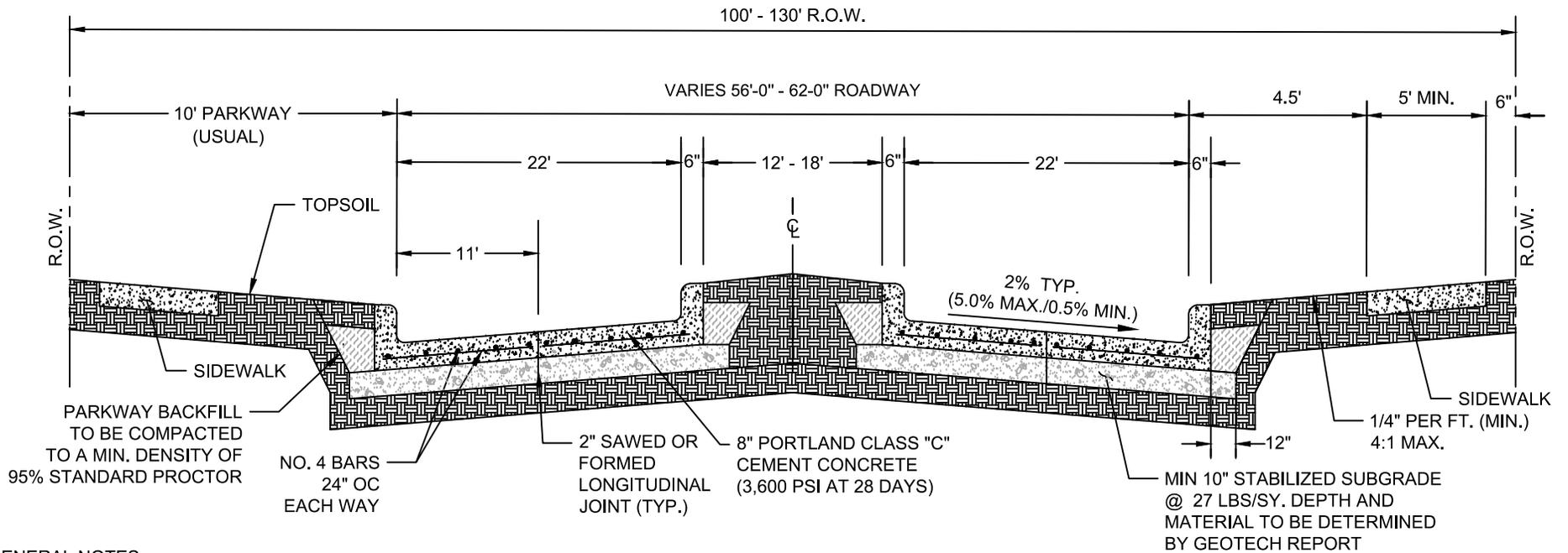
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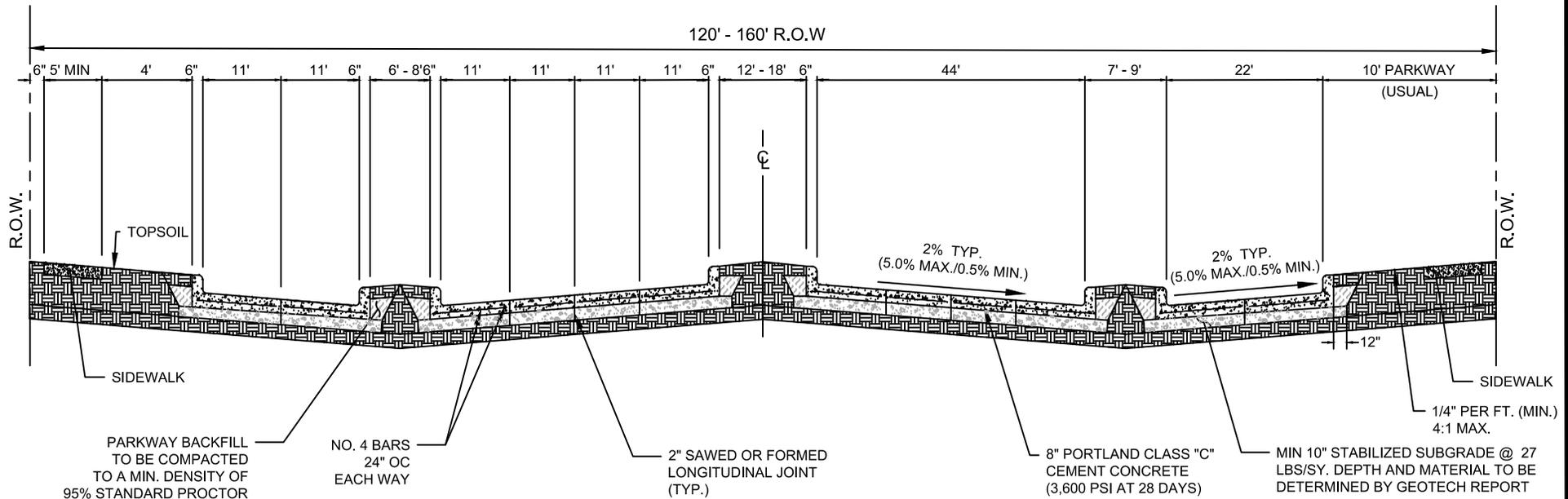
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2. ALL REINFORCING STEEL SHALL BE DEFORMED BARS. REINFORCING STEEL SHALL BE PLACED WITH THE CENTER OF THE OUTSIDE LAYER OF BARS 2" FROM THE SURFACE OF THE CONCRETE.
3. WHERE REINFORCING BARS ARE SPLICED, A 30 DIAMETER LAP SHALL BE USED.
4. TYPE C TRANSVERSE CONTRACTION JOINTS SHALL BE ON 15' CENTERS.
5. ALL CLASS "C" CONCRETE SHALL BE 3600 PSI COMPRESSIVE STRENGTH AT 28 DAYS.
6. AN APPROVED WHITE PIGMENTED CURING COMPOUND SHALL BE APPLIED TO THE SURFACE OF THE CONCRETE AS SOON AS IT HAS BEEN POURED AND FINISHED.
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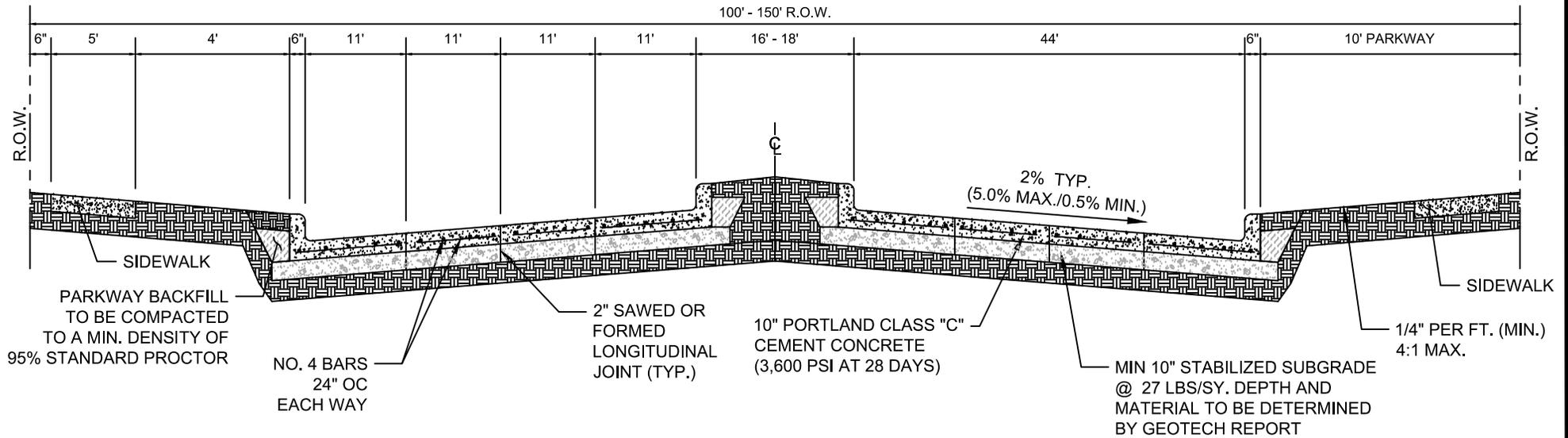
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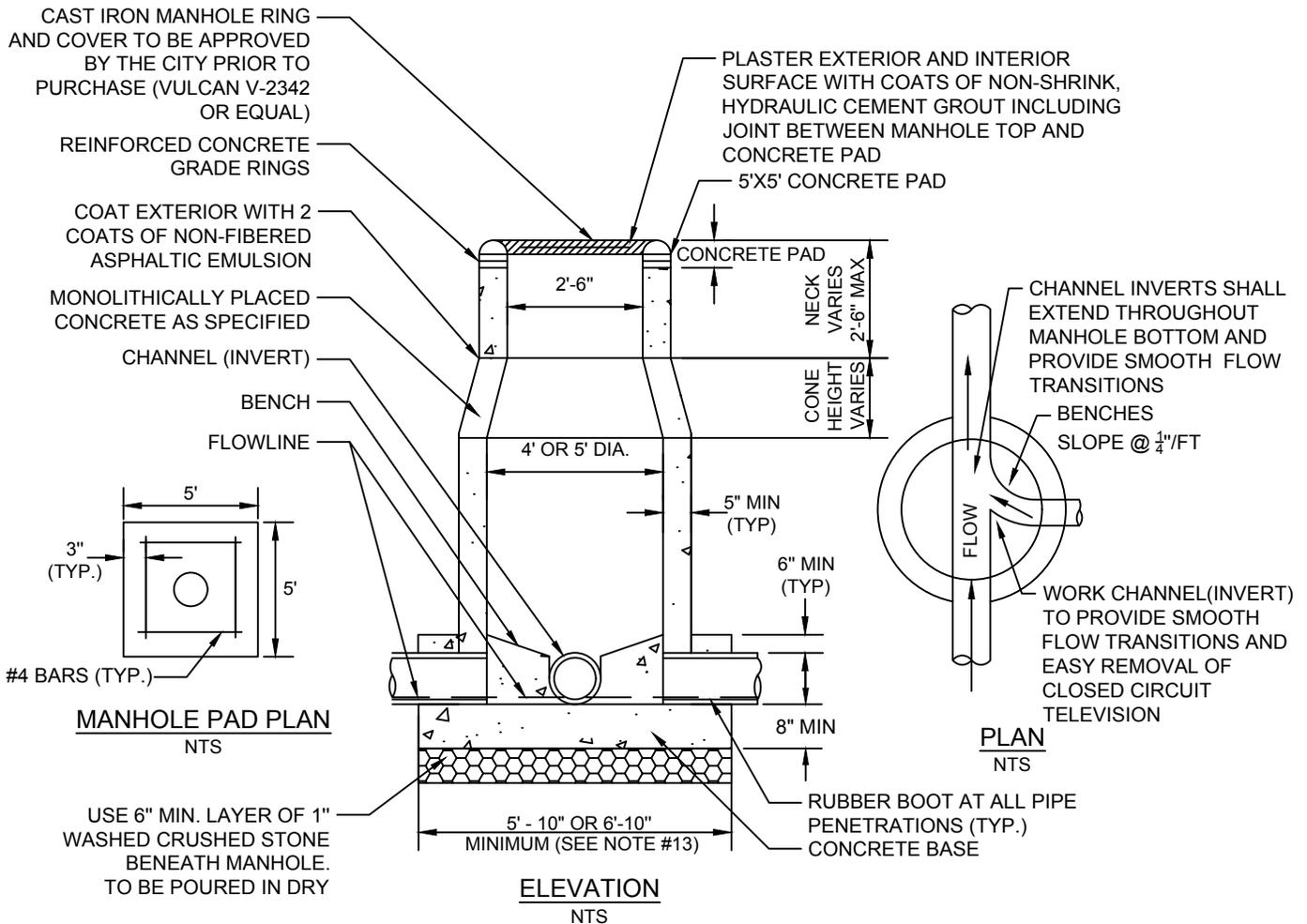
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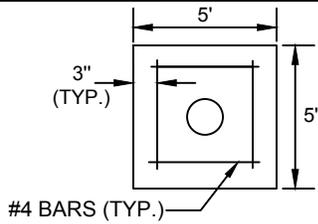
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**GENERAL NOTES:**

1. WHEN 4" SEWER SERVICE LINE ROADWAY CROSSINGS ARE MADE BY BORING THE UPPER VERTICAL BEND SHALL BE ELIMINATED. THE BORE PORTION OF THE ROADWAY CROSSING SHALL BE GRADED ON 2.00% (MIN) ASCENDING GRADE.
2. SEWER LINES EXCEEDING 15 FEET DEPTH SHALL BE CONSTRUCTED WITH PVC (SPEC SDR 26) PIPE.
3. CURB SHALL BE STAMPED WITH A "W" OR "S" (2" MIN) AT WATER AND SEWER SERVICE LOCATIONS.
4. IN AREAS WHERE CONSTRUCTION CONDITIONS VARY FROM THOSE SHOWN, ADJUST LOCATIONS TO CONFORM TO ACTUAL FIELD CONDITIONS.
5. CONCRETE FOR UNDER CURB SUPPORT IS REQUIRED WHERE SERVICE IS INSTALLED BY OPEN CUT UNDER THE EXISTING CURB.
6. SEWER SERVICE TO BE EXTENDED TO EASEMENT LINE IF EASEMENT IS PRESENT ADJACENT TO PROPERTY LINE.
7. CAST IN PLACE MANHOLES MAY BE USED ONLY WITH WRITTEN PERMISSION FROM THE CITY DIRECTOR OF PUBLIC WORKS.
8. CAST IN PLACE MANHOLES SHALL HAVE 0.1 DROP ACROSS MANHOLE.
9. MANHOLES SHALL CONFORM TO ASTM SPEC C-478.
10. GRADE RINGS MAY BE USED TO ADJUST NECK 12" OR LESS. WHEN ADJUSTMENT IS GREATER THAN 12", CONTRACTOR SHALL USE SONO TUBE AND PLACE CONCRETE FOR NECK ADJUSTMENT. GRADE RINGS CONSTRUCTED BY MANUFACTURER IN STANDARD 2", 3", 6", 8", AND 12" HEIGHTS.
11. ALL MANHOLES SHALL BE INSTALLED WITH 5'X5' CONCRETE PAD WITH MANHOLE COVERS IN CENTER OF PAD. THE CONCRETE PAD SHALL MATCH THICKNESS WITHIN PAVEMENT, OR BE 6" THICK OUTSIDE PAVED AREAS. PADS SHALL BE REINFORCED WITH FOUR NO. 4 REBARS AROUND CONCRETE PADS
12. MANHOLES SHALL BE INSTALLED IN CENTER OF LANES AND OUTSIDE NORMAL TIRE PATH OF LANE WHEN IN PAVED ROADWAYS.
13. USE 60" INSIDE DIAMETER MANHOLES UNDER ANY OF THE FOLLOWING:
  - A. DEPTH FROM TOP OF COVER TO FLOWLINE IS 10' OR GREATER.
  - B. PIPE INTO MANHOLE ARE 15" DIAMETER OR LARGER.
14. ALL CONCRETE SHALL BE CLASS C, 5 1/2 SACK, 3600 PSI COMPRESSIVE STRENGTH.
15. SEE PRECAST MANHOLE DETAIL FOR MANHOLE RING AND COVER DETAILS
16. MANHOLES CONSTRUCTED IN 100-YEAR FLOOD PLAIN SHALL HAVE WATERTIGHT RING AND LID.
17. CONTRACTOR SHALL RUB ALL INTERIOR SURFACES TO A SMOOTH FINISH.
18. ON ALL NEWLY INSTALLED SANITARY SEWER MANHOLES, AN EPOXY LINER IS REQUIRED TO BE INSTALLED. THE CONTRACTOR MUST USE RAVEN 405 LINING SYSTEM, WARREN ENVIRONMENTAL 301-14 HIGH PERFORMANCE EPOXY SYSTEM, OR AN APPROVED EQUAL.



**MANHOLE PAD PLAN**  
NTS

2" X 8" X 30" DIA PRECAST  
(PLASTER EXTERIOR CONCRETE  
GRADE RINGS SURFACE WITH  
MORTAR)

48" DIA CONCENTRIC  
MANHOLE CONE

ASTM C-76 CLASS III OR EQUAL

ALL JOINTS ARE TO BE MADE USING A  
PREFORMED PLASTIC GASKET. SUCH  
PLASTIC GASKET SHALL BE RAM-NEK OR  
1/2" GS/5 PRECAST CONCRETE SEALANT.  
AND SHALL BE INSTALLED IN  
ACCORDANCE WITH THE  
MANUFACTURER'S RECOMMENDATIONS,  
UNLESS RUBBER GASKET IS USED

0.1' FALL ACROSS  
SSMH

8" MIN  
CONC BASE

MANHOLE FRAME  
AND COVER

MORTAR-USE DOUBLE RING  
OF 1/2" GS/5 PRECAST  
CONCRETE SEALANT AS  
MANUFACTURED BY GENERAL  
SEALANTS, INC OR CS-102  
CON SEAL, AS  
MANUFACTURED BY  
CONCRETE SEALANTS, INC TO  
SEAL RING TO CONCRETE  
AND BETWEEN GRADE RINGS

END OF TRANSITION

VARIABLE (NOT TO EXCEED 2' - 6")

INTERMEDIATE RISER

4' - 0"

6" MIN

6" MIN

BASE  
RISER

6" CONCRETE  
FOOTER

BENCH

RESILIENT CONNECTOR  
AT ALL PIPE PENETRATIONS

CRUSH STONE  
SEE NOTE 1

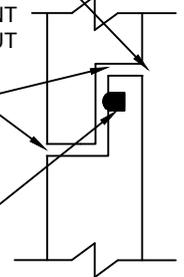
**ELEVATION**

NTS

WIPE INTERIOR JOINT  
WITH NON-SHRINK  
HYDRAULIC CEMENT  
GROUT

PRECAST  
CONCRETE  
SEALANT

O-RING RUBBER  
GASKET

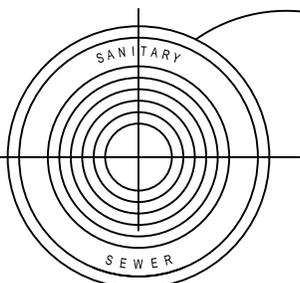


**JOINT DETAIL**

NTS

**GENERAL NOTES:**

1. PRECAST MANHOLES SHALL HAVE 0.1 DROP ACROSS MANHOLE USE 6" MIN LAYER OF WASHED ROCK BENEATH MANHOLE WHERE GROUND WATER IS ENCOUNTERED TO ASSURE THAT MANHOLE BOTTOM IS PLACED ON STABLE SUBGRADE
2. INSTALL "PRESSURE TYPE" SEAL. USE KOR-N-SEAL OR EQUAL CONNECTOR PROVIDE 3000 PSI CONC SEAL ALL AROUND KOR-N-SEAL AND BANDS (MIN 6" THICKNESS)
3. PORTION OF NECK WITH INSIDE DIAMETER OF 30" OR LESS (FROM END OF TRANSITION AREA UP) SHALL NOT EXCEED 30" IN HEIGHT WHEN MANHOLE IS ADJUSTED TO FINISHED GRADE INCLUDING RING AND LID AND ANY PORTION OF ORIGINALLY POURED MANHOLE
4. SUPPLY RISER JOINTS IN 1', 2', 4' STANDARD LENGTH.
5. ON ALL NEWLY INSTALLED SANITARY SEWER MANHOLES, AN EPOXY LINER IS REQUIRED TO BE INSTALLED. THE CONTRACTOR MUST USE RAVEN 405 LINING SYSTEM, WARREN ENVIRONMENTAL 301-14 HIGH PERFORMANCE EPOXY SYSTEM, OR AN APPROVED EQUAL.



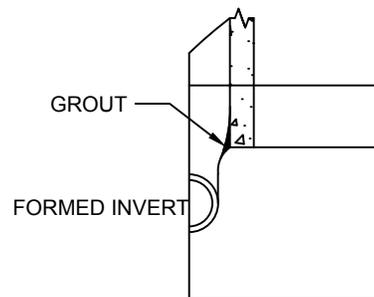
**MANHOLE COVER**

NTS

MANHOLE FRAME AND 32" DIA  
COVER WITH PICK BAR-SET TOP AT  
OR UP TO 1/4" ABOVE FINISHED  
GRADE

A WATERTIGHT RING & SEALED  
COVER SHALL BE USED IN AREAS  
SUBJECT TO WATER INTRUSION  
(VULCAN V-2342)

EXTERIOR MASTIC COATING SHALL  
BE APPLIED TO ALL MANHOLES.

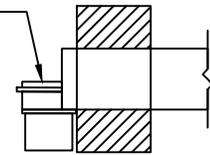


**SECTION @ WALL OF MANHOLE**

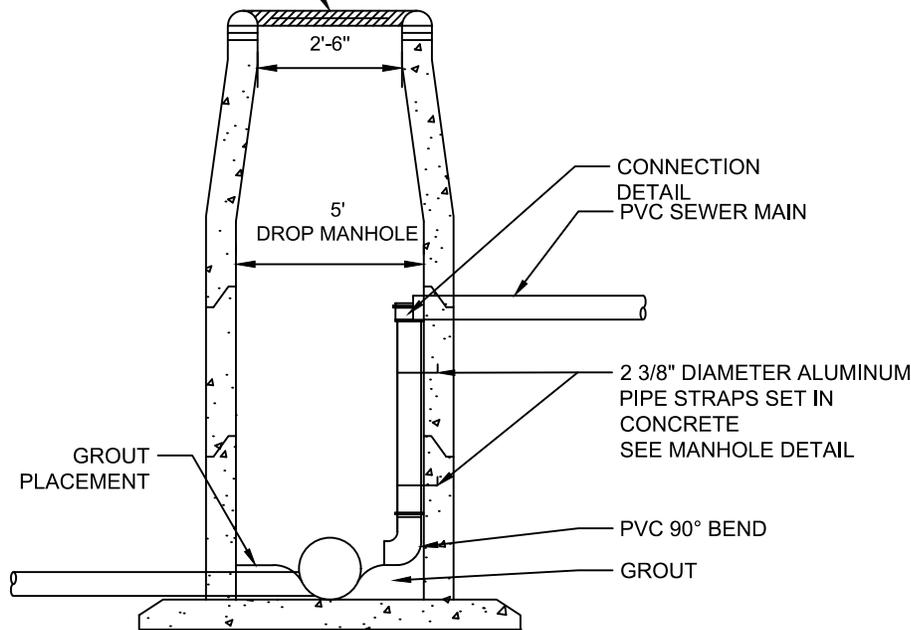
NTS

SEE PRECAST MANHOLE  
DETAIL FOR MANHOLE RING  
AND COVER DETAILS

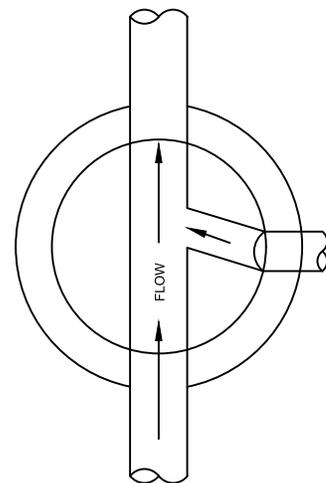
REMOVE PORTION OF DROP PIPE  
TO CONNECT AS SHOWN



**WEIR DETAIL**



**ELEVATION**  
NTS



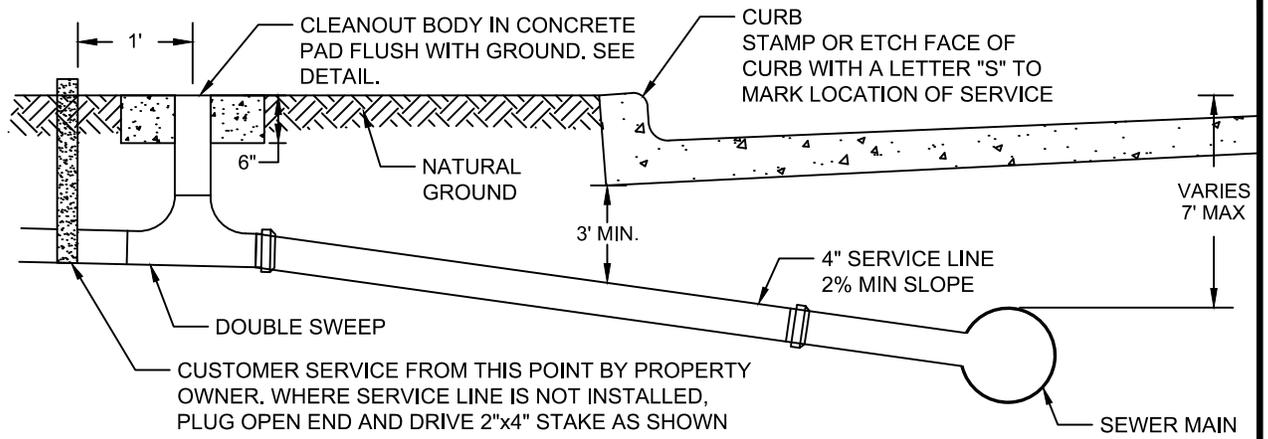
**PLAN**  
NTS

**GENERAL NOTES:**

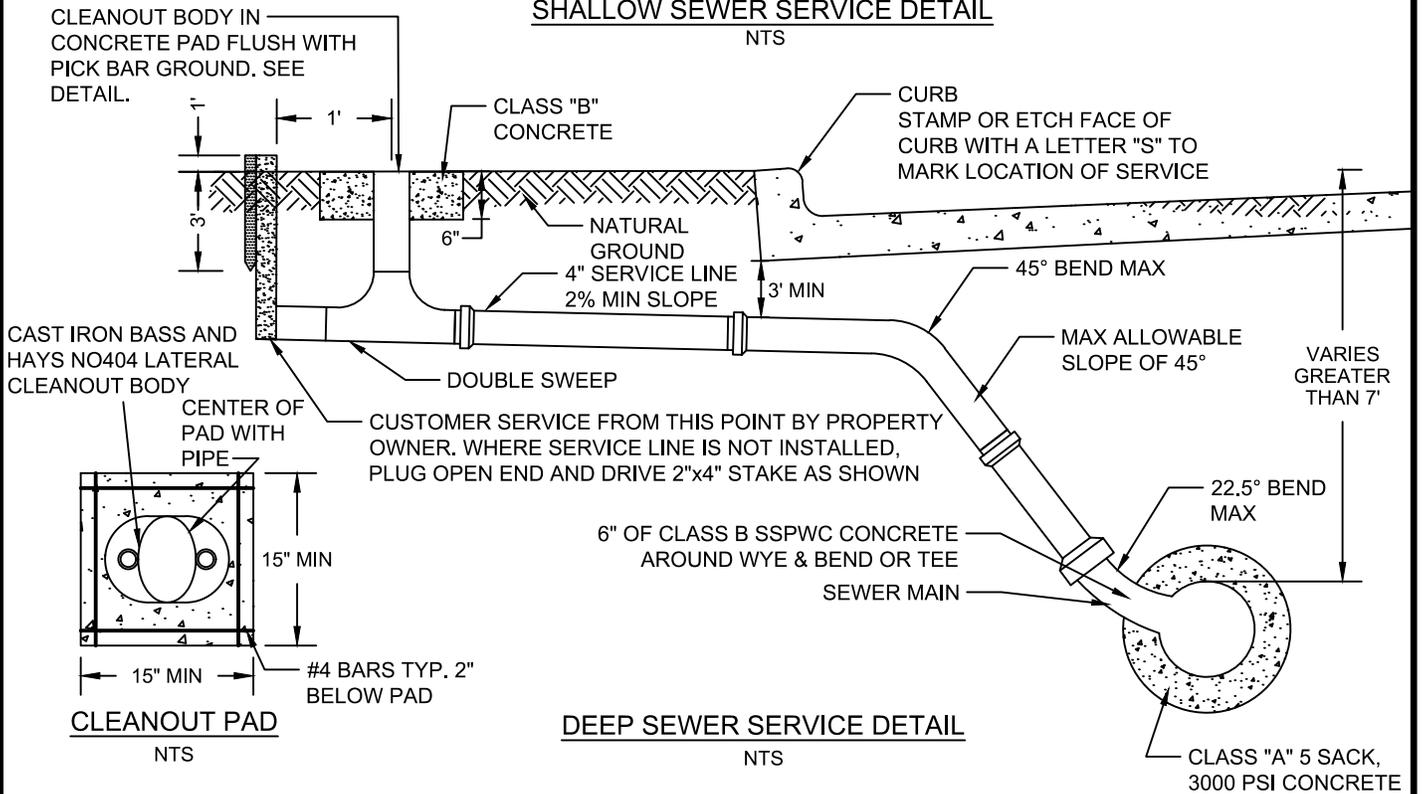
1. SEE PRECAST MANHOLE DETAILS FOR MANHOLE RING AND COVER DETAILS
2. PROVIDE 0.1 FT DROP ACROSS MANHOLE

**NOTES:**

1. DROP PIPE SHALL BE ONE SIZE LARGER THAN SEWER INFLUENT PIPE.
2. ALL STANDARD MANHOLE DETAILS ~~IN FIGURES 14 AND OR~~ 15 APPLY TO DROP MANHOLE CONSTRUCTION.
3. ALL DROP MANHOLES SHALL BE 60" DIAMETER.
4. NO DROP PIPING SHALL BE REQUIRED IF SEWER INFLUENT PIPE FLOWLINE IS 24" OR LESS ABOVE MAIN SEWER PIPE FLOWLINES OR IF MAIN SEWER PIPE BENCH IS HIGHER THAN SEWER INFLUENT FLOWLINE.
5. OUTSIDE DROP CONNECTION REQUIRED IF INFLUENT PIPE IS 10" OR GREATER IN DIAMETER.



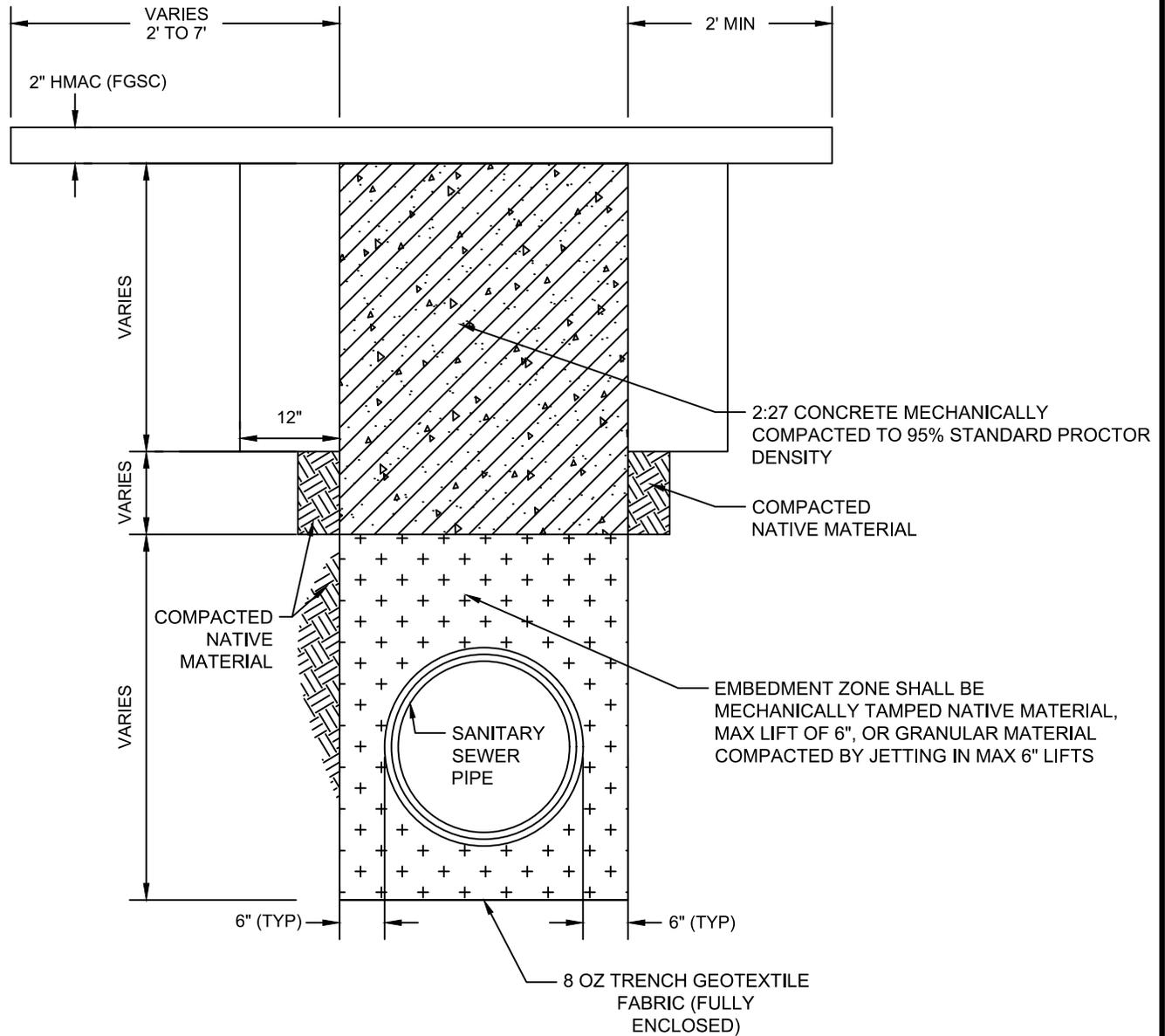
**SHALLOW SEWER SERVICE DETAIL**  
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**DEEP SEWER SERVICE DETAIL**  
NTS

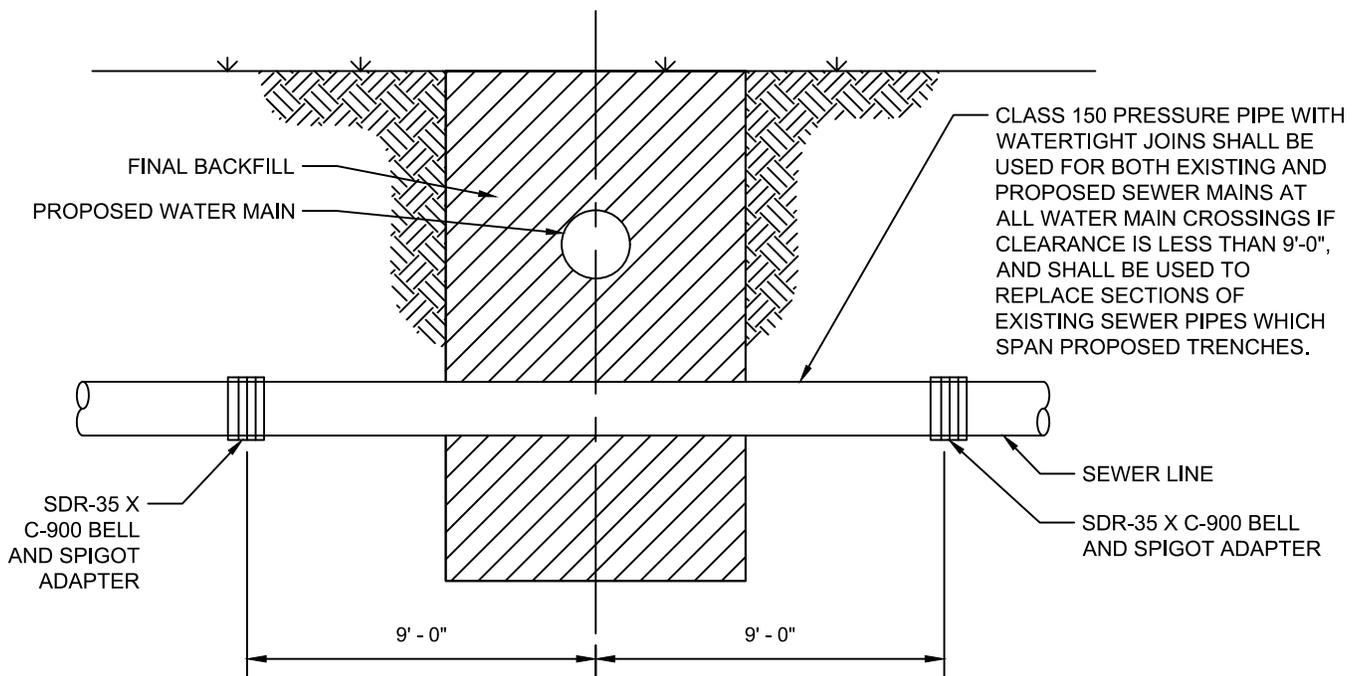
**GENERAL NOTES:**

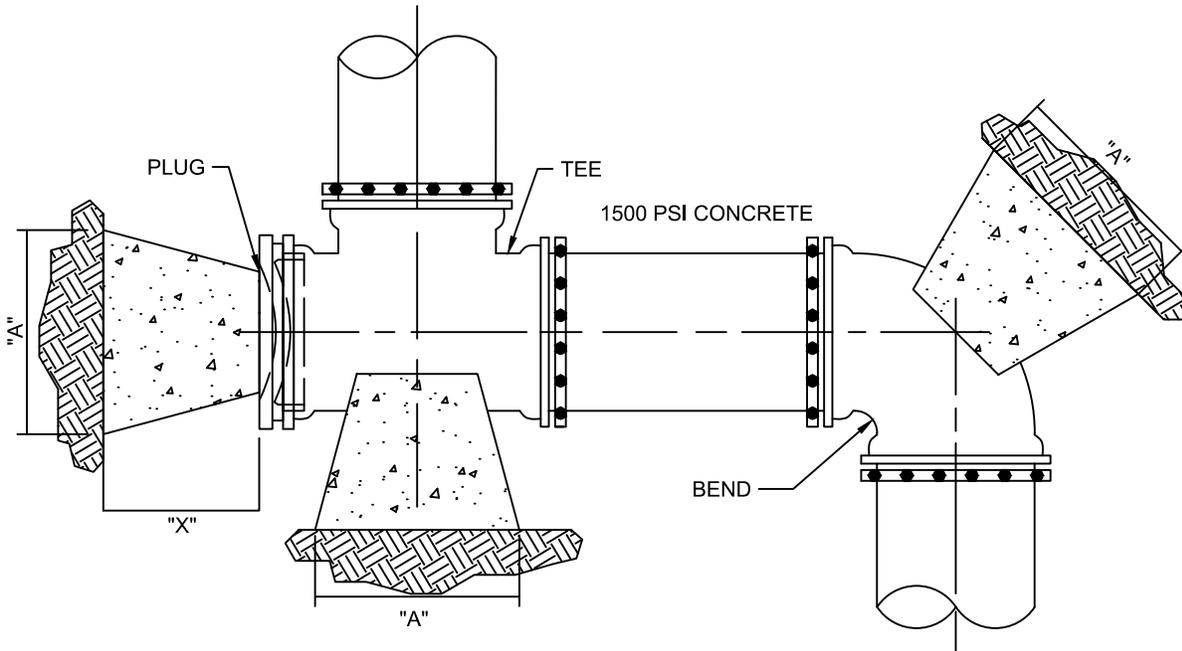
1. EITHER WYE OR SADDLE MAY BE USED FOR CONSTRUCTION
2. MINIMUM COVER OVER SANITARY SEWER SERVICE PIPE IS 24" BELOW SUBGRADE OR AS REQUIRED TO SERVICE CUSTOMER
3. SANITARY SEWER SERVICE LINE LOCATION TO BE MARKED WITH RED VINYL TAPE AT LEAST 3" WIDE AND 10MIL THICK ATTACHED TO THE END OF THE SERVICE AND EXTENDING THROUGH BACKFILL AT THE POINT OF HOUSE SERVICE CONNECTION
4. USE THE SAME EMBEDMENT AS USED ON THE MAIN
5. SANITARY SEWER SERVICE CONNECTIONS TO 7' ARE STANDARD SERVICE CONNECTIONS. SERVICE CONNECTIONS TO MAINS DEEPER THAN 7' ARE DEEP SERVICE CONNECTIONS
6. TRENCH PROTECTION REQUIRED FOR DEEP SERVICE OR WHEN DITCH IS DEEPER THAN 5'
7. 4" SERVICE LINE SHALL BE SDR-26 PVC PIPE AND FITTINGS
8. IF USING A SADDLE ENCASE IN CONCRETE
9. CLEANOUTS SHALL HAVE A BASS AND HAYS NO 404 LATERAL CLEANOUT BODY WITH TWO STAINLESS STEEL BOLTS. THE CAP SHALL BE CENTERED IN A MINIMUM OF A 15"x15" CONCRETE PAD WITH A MINIMUM THICKNESS OF 6"
10. ALL MATERIALS AND CONSTRUCTION SHALL CONFORM TO APPLICABLE SPECIFICATIONS OF THE NORTH CENTRAL TEXAS COUNCIL OF GOVERNMENTS (NCTCOG) STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION (SSPWC), LATEST EDITION



**GENERAL NOTES:**

1. PRIOR TO EXCAVATION WITHIN PAVEMENT THE CONTRACTOR WILL SAW CUT PARALLEL TO THE CENTERLINE OF SEWER ALONG EACH TRENCH WALL LINE AN EVEN LINE TO INSURE A UNIFORM AND EVEN MATCH FOR PAVEMENT REPAIRS



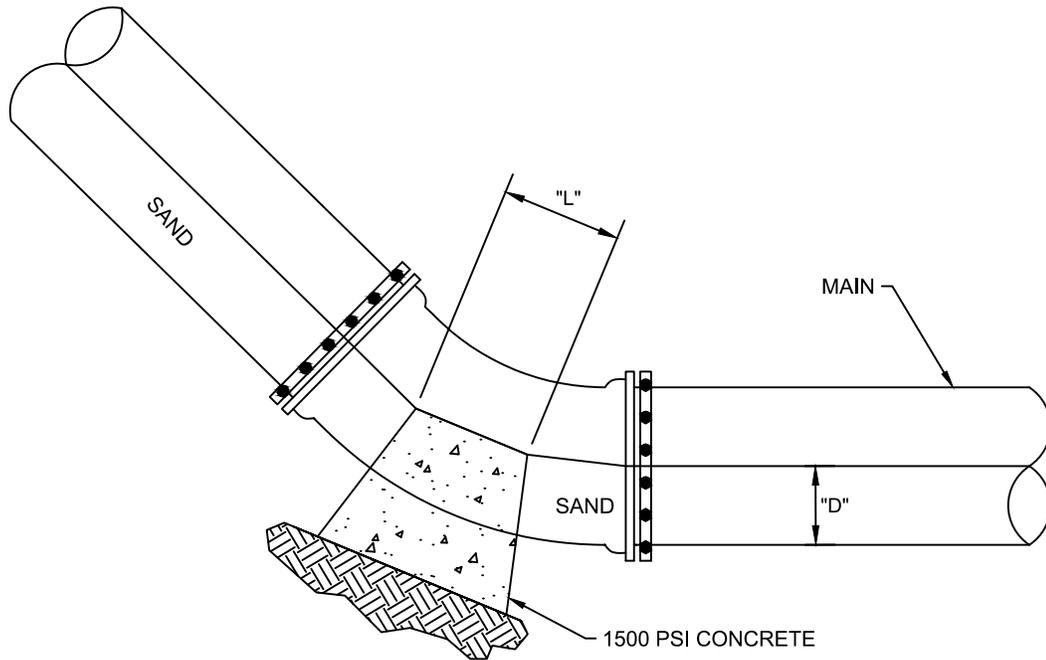


## BLOCKING TABLE

PIPE SIZE	"X" DIM	PLUGS AND TEES			90° BENDS			45° BENDS			22° 30° BENDS			11° 15° BENDS		
		"A"	MIN. AREA	MAX. VOL	"B"	MIN. AREA	MAX. VOL	"C"	MIN. AREA	MAX. VOL	"D"	MIN. AREA	MAX. VOL	"E"	MIN. AREA	MAX. VOL
4"	1' - 0"	1' - 0"	0.83	0.05	1' - 0"	0.83	0.05	1' - 0"	0.83	0.05	1' - 0"	0.83	0.05	1' - 0"	0.83	0.05
6"	1' - 6"	1' - 0"	1.06	0.09	1' - 2"	1.50	0.09	1' - 0"	0.83	0.05	1' - 0"	0.83	0.05	1' - 0"	0.83	0.05
8"	1' - 6"	1' - 3"	1.89	0.11	1' - 6"	2.66	0.16	1' - 3"	1.44	0.08	1' - 0"	0.83	0.05	1' - 0"	0.83	0.05
10"	1' - 6"	1' - 9"	2.95	0.17	2' - 0"	4.17	0.24	1' - 6"	2.26	0.13	1' - 3"	1.15	0.07	1' - 0"	0.83	0.05
12"	1' - 6"	2' - 0"	4.25	0.24	2' - 3"	6.00	0.34	1' - 9"	3.25	0.18	1' - 3"	1.65	0.10	1' - 0"	0.83	0.05
16"	2' - 0"	2' - 7"	7.34	0.56	3' - 0"	10.65	0.79	2' - 3"	5.76	0.43	1' - 8"	2.94	0.22	1' - 2"	1.48	0.11
18"	2' - 0"	2' - 11"	7.70	0.57	3' - 8"	10.89	0.82	2' - 6"	5.89	0.44	1' - 10"	3.01	0.22	1' - 5"	1.51	0.11
20"	2' - 0"	3' - 3"	3.70	0.59	3' - 9"	11.12	0.59	2' - 9"	6.01	0.45	2' - 0"	3.07	0.23	1' - 7"	1.54	0.12
24"	2' - 0"	3' - 8"	11.33	0.84	4' - 3"	16.00	1.20	3' - 2"	8.86	0.65	2' - 6"	4.42	0.33	1' - 10"	2.22	0.17

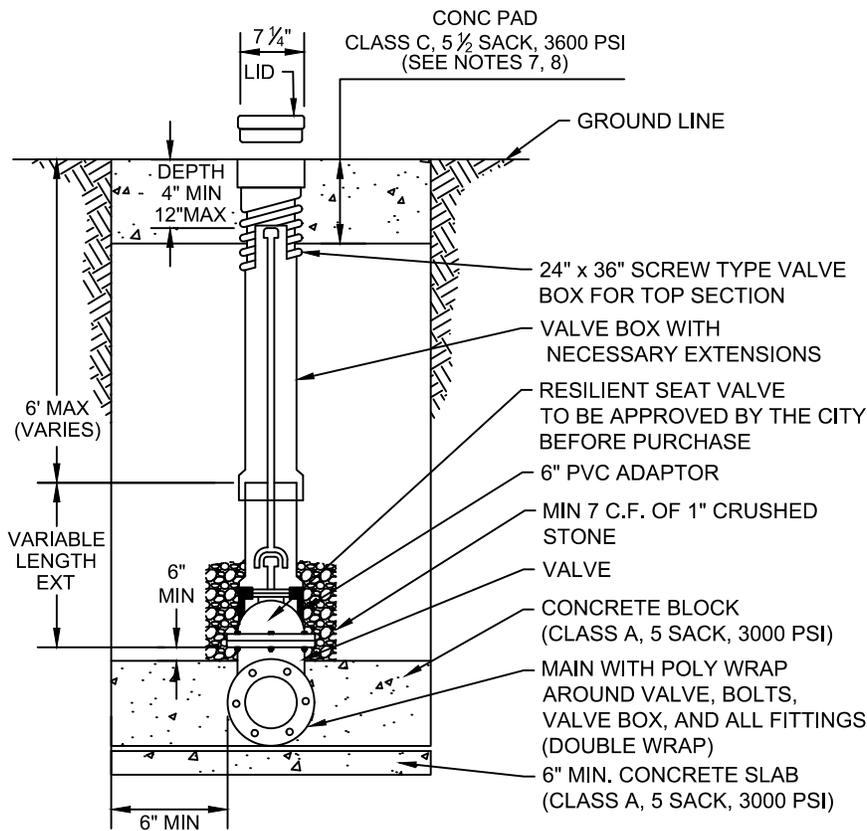
**GENERAL NOTES:**

1. CALCULATIONS IN MINIMUM AREA COLUMN ARE IN SQUARE FT. CALCULATIONS IN MAXIMUM VOLUME ARE IN CY.
2. DIMENSION "X" TO BE A MINIMUM OF 1", BUT IS TO BE INCREASED WHERE NECESSARY TO PROVIDE BEARING AGAINST UNDISTRIBUTED TRENCH WALL.
3. CONCRETE FOR THRUST BLOCKS SHALL BE CLASS A (5 SACKS) (3000 PSI).

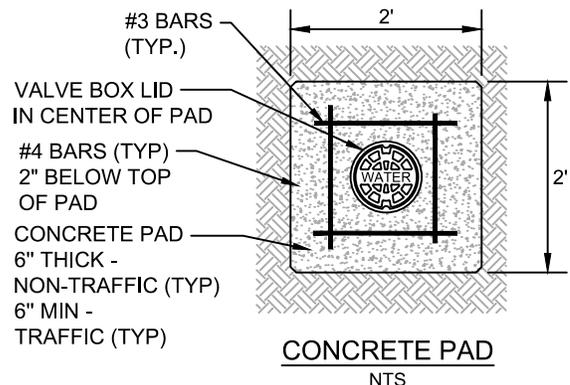


PIPE SIZE	11°-15°		22°-30°		45°		90°	
	L	MAX VOL.	L	MAX VOL.	L	MAX VOL.	L	MAX VOL.
6"	0.42	0.02	0.45	0.02	0.5	0.02	1	0.04
8"	0.42	0.02	0.45	0.02	0.8	0.04	1.4	0.06
10"	0.42	0.03	0.58	0.03	1.15	0.06	2.03	0.11
12"	0.42	0.04	0.73	0.05	1.43	0.09	2.53	0.17
16"	0.42	0.08	0.74	0.14	1.48	0.27	2.61	0.48
18"	0.66	0.14	1.3	0.28				
20"	0.44	0.18	1.53	0.36				
18"	0.88	0.18	1.74	0.37				
20"	1.03	0.24	2.04	0.38				
18"	1.05	0.22	2.03	0.43				
20"	1.2	0.28	2.38	0.56				

SEE PLAN FOR SHEET BLOCKING



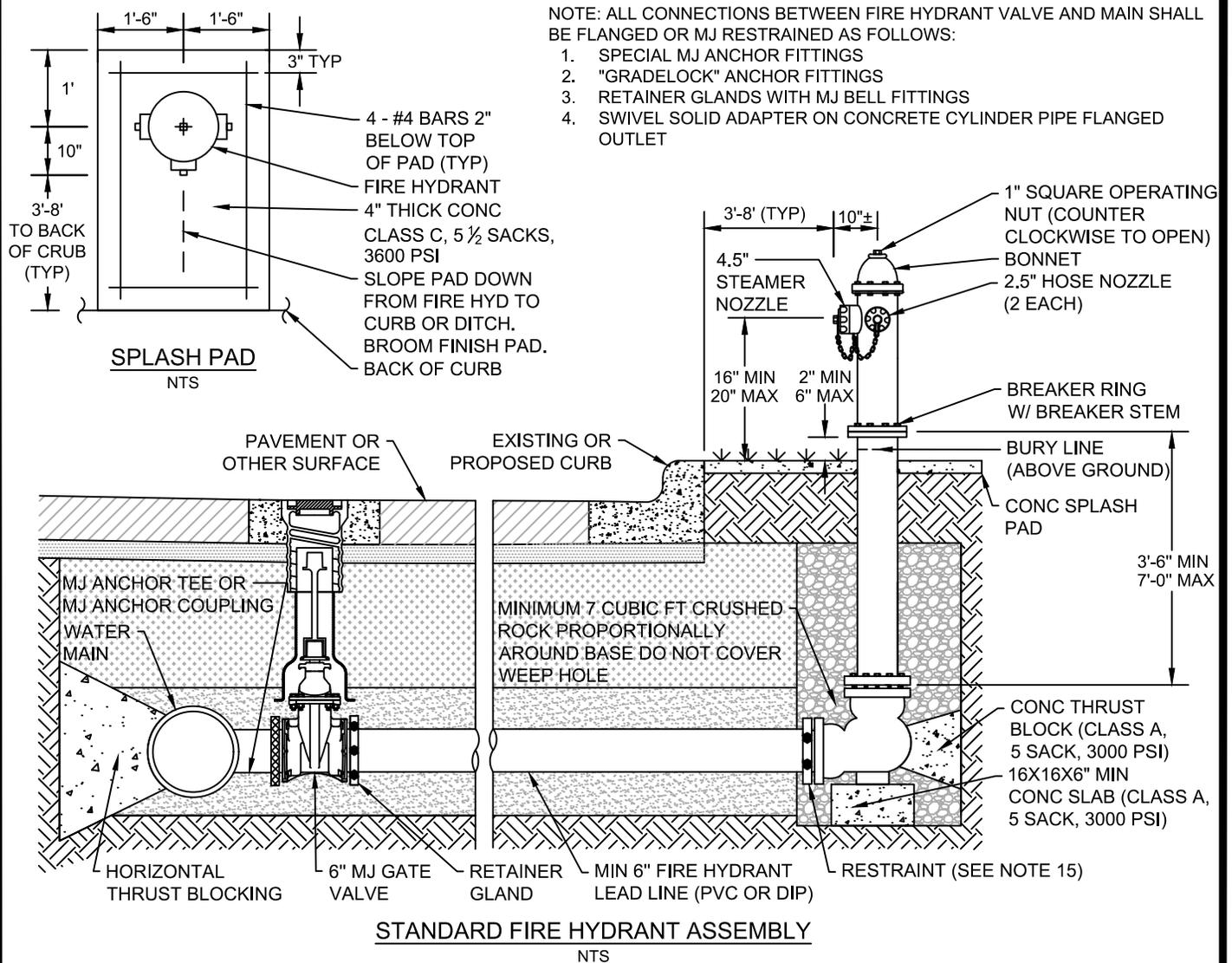
**GATE VALVE  
AND BOX**  
NTS



**CONCRETE PAD**  
NTS

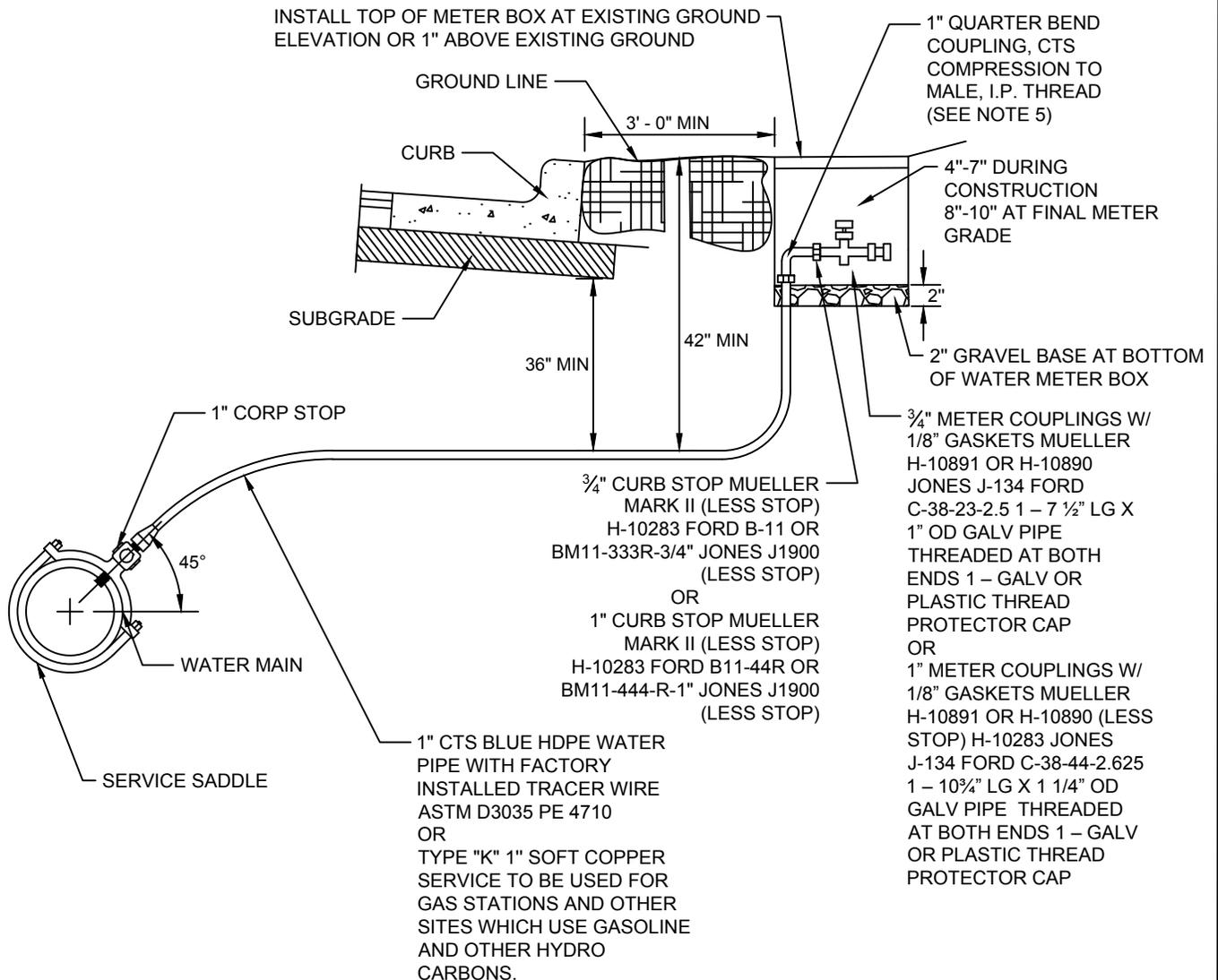
**GENERAL NOTES:**

1. 6" PVC MAY BE USED FOR VALVES DEEPER THAN 6'. HOWEVER, IN ALL CASES THE TOP SIX FEET SHALL BE AN ADJUSTABLE VALVE BOX. SOLID STEM EXTENSION OF 1 1/4" SHALL BE USED IF OPERATING NUT IS DEEPER THAN SIX FEET.
2. OPERATING NUTS AT END OF EXTENSION SHALL BE IDENTICAL IN POSITION, SIZE, AND STYLE AS OPERATING NUT ON VALVE WITH NO CLIP ON EXTENSIONS. ROCK GUARD SHALL BE LOCATED TWO INCHES (2") BELOW THE OPERATING NUT ON UPPER END OF EXTENSION WHILE ATTACHED TO EXTENSION.
3. IF TOP OF OPERATING NUT IS MORE THAN THREE FEET (3') DEEP FROM EXISTING GROUND ELEVATION, VALVE SYSTEM AND VALVE BOX EXTENSIONS SHALL BE FURNISHED BY CONTRACTOR TO BRING OPERATING NUT TO WITHIN THREE FEET (3') OF EXISTING GROUND LEVEL.
4. VALVES SHALL BE SET ON CONCRETE SLAB PRIOR TO POURING CONCRETE BLOCK. CONNECTING PIPE SHALL NOT SUPPORT VALVE WEIGHT.
5. CONTRACTOR SHALL VERIFY VALVE IS APPROXIMATELY VERTICAL FOR OPERATION AFTER BACKFILL MATERIAL AROUND INSTALLED VALVE BAX IS COMPACTED.
6. 2'X2' CONCRETE PAD SHALL MATCH PAVEMENT THICKNESS, HAVE 6" THICKNESS OUTSIDE PAVED AREAS, AND SLOPED SLIGHTLY AWAY FROM LID. IF INSTALLED IN ROADWAYS, VALVES SHALL BE PLACED OUTSIDE TYPICAL TIRE PATH AND IN CENTER OF LANES UNLESS OTHERWISE SHOWN IN PLANS.
7. VALVE BOX AND PAD SHALL BE INSTALLED AT FINISHED GRADE.
8. VALVES SHALL NOT BE INSTALLED IN EXISTING OR PROPOSED SIDEWALKS OR CURBS.



**GENERAL NOTES:**

1. ALL METAL FITTINGS, VALVES, FIRE HYDRANTS, ETC, MUST BE WRAPPED AND TAPED WITH POLYETHYLENE BEFORE CONCRETE BLOCKING INSTALLED.
2. BLUE REFLECTIVE MARKER REQUIRED IN PAVEMENT AT FIRE HYDRANT LOCATION 3' FROM CENTERLINE STRIP TOWARD FIRE HYDRANT.
3. FIRE HYDRANTS SHALL NOT BE INSTALLED IN EXISTING OR PROPOSED SIDEWALKS.
4. OFFSETS, BENDS, AND FITTINGS SHALL BE USED AS NEEDED TO ACHIEVE BURY DEPTH BETWEEN 4' AND MAXIMUM 6'.
5. DUCTILE IRON FITTINGS, OR EXTENSIONS SHALL BE USED FOR BURY DEPTHS BETWEEN 4' AND 6' FOR GRADE ADJUSTMENTS. NO MORE THAN ONE EXTENSION KIT SHALL BE USED.
6. FIRE HYDRANTS SHALL BE SET ON CONCRETE SLAB PRIOR TO POURING THRUST BLOCK.
7. GATE VALVE SHALL BE INSTALLED PER GATE VALVE DETAIL AND RESTRAINED TO NEAREST FITTING UNLESS OTHERWISE SHOWN ON THE PLANS.
8. PROVIDE 4' OF CLEARANCE AROUND FIRE HYDRANT.
9. EXTENSION SECTIONS MAY BE USED AS REQUIRED AND INSTALLED AS PER MANUFACTURER'S INSTRUCTIONS.
10. ALL PUBLIC FIRE HYDRANTS TO BE MUELLER SUPER CENTURION OR APPROVED EQUAL BY THE CITY PRIOR TO PURCHASE. THE FIRE HYDRANT BONNET AND CAP, IN EACH CASE, SHALL BE COATED WITH REFLECTIVE WHITE PER FIRE DEPARTMENT REQUIREMENTS. THE FIRE HYDRANT BODY, IN EACH CASE, SHALL BE COATED WITH TWO (2) COATS "FIRE ENGINE" RED OVER SHOP PRIME COAT. QUIP WITH BREAKAWAY FLANGE.
11. ALL NOZZLE CAPS SHALL HAVE CHAIN CONNECTION TO BARREL.
12. MANUFACTURE DATE SHALL BE INDICATED ON HYDRANTS. INSTALLED FIRE HYDRANTS SHALL BE MANUFACTURED WITHIN ONE YEAR OF INSTALLATION.
13. SERVICE LINES ON FIRE HYDRANT LEAD LINES ARE PROHIBITED.
14. OUT-OF-SERVICE FIRE HYDRANTS SHALL BE COMPLETELY COVERED WITH BLACK PLASTIC.

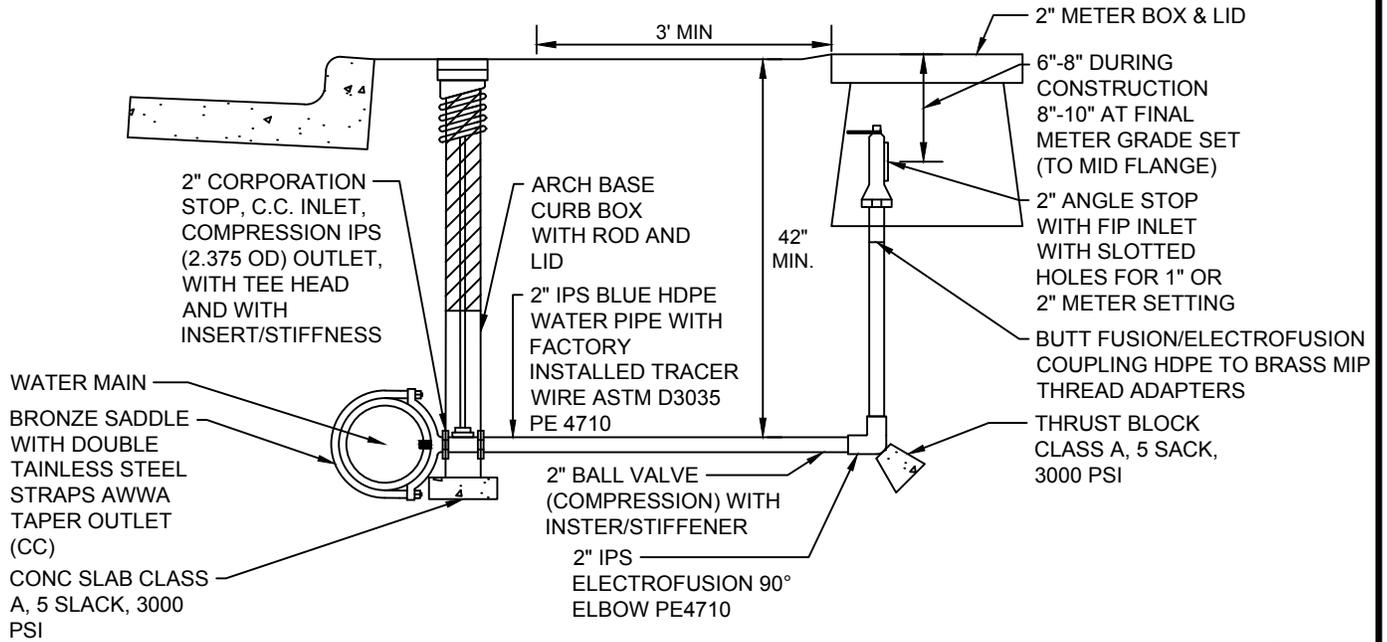


**GENERAL NOTES:**

1. (LOCATIONS WHERE WATER LINES ARE BEING RENEWED AND/OR STREETS ARE BEING REBUILT.) EXISTING QUARTER-BEND COUPLINGS AND CURB STOPS THAT ARE NOT DEFECTIVE MAY BE SALVAGED AND REUSED.
2. THE CONTRACTOR SHALL REMOVE AND DELIVER ALL UNUSED COUPLINGS AND CURB STOPS WILL BE FURNISHED BY THE CONTRACTOR WHERE OLD ONES CANNOT BE REUSED. DETAILS FOR SERVICES ON OPPOSITE SIDE OF STREET ARE SIMILAR EXCEPT NEW COPPER SHALL TIE INTO OLD COPPER WITH FLARED-END FITTINGS. THE CONTRACTOR SHALL RENEW THE SERVICE LINE FROM THE MAIN TO THE METER IF THE EXISTING SERVICE LINE IS STEEL PIPE OR THE EXISTING COPPER SERVICE IS LESS THAN THREE FEET (3') BELOW THE PROPOSED TOP OF PAVEMENT. NO MORE THAN ONE (1) COUPLING SHALL BE USED UNDER PAVEMENT AREA.
3. SADDLES SHALL BE BRONZE BODY WITH DOUBLE STAINLESS STEEL STRAPS WHEN TAPPING ANY MAIN. AWWA C800 SADDLE MUST BE DESIGNED FOR PIPE MATERIAL BEING TAPPED.
4. SERVICES SHALL BE CONTINUOUS WITH NO JOINTS FROM CORP. STOP TO QUARTER BEND.
5. ALL COPPER FITTINGS SHALL BE COMPRESSION FITTINGS WITH LINER/STIFFENER (STAINLESS STEEL) MUST BE A STIFFENER RECOMMENDED BY COMPRESSION FITTING MANUFACTURER.
6. TAPS SHALL BE 1" MINIMUM AND SHALL BE ON THE SAME SIZE AS METER AND PERPENDICULAR TO THE RIGHT OF WAY.
7. METERS SHALL NOT BE INSTALLED IN EXISTING OR PROPOSED SIDEWALKS OR WITHIN 5' OF DRIVEWAYS.
8. UNLESS OTHERWISE STATED ON CONSTRUCTION PLANS ALL MATERIALS UTILIZED MUST BE ON THE ARLINGTON WATER UTILITIES APPROVED PRODUCT LISTING.
9. TRACER WIRE SHALL BE 10 AWG (AVERAGE WIRE GRADE). HDPE COATED SINGLE STRAND COPPER CLAD STEEL TO BE INSTALLED CONTINUOUSLY (NO SPLICING ALLOWED) FROM THE WATER MAIN TO THE METER BOX. 8" EXPOSED IN THE METER BOX ABOVE QUARTER BEND.

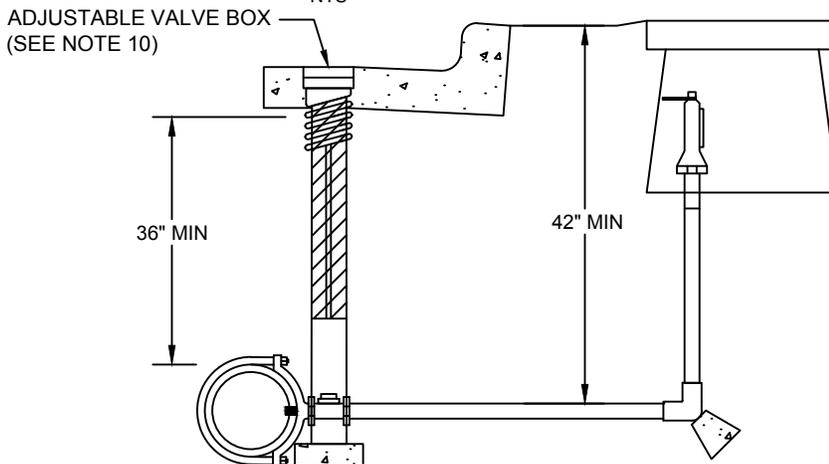
## INSTALLATION FOR UNPAVED AREA

NTS



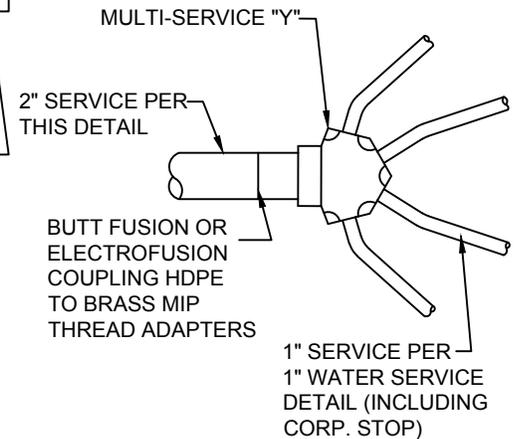
## INSTALLATION FOR UNDER PAVED AREA

NTS



## MULTI-SERVICE "Y" INSTALLATIONS

NTS



### GENERAL NOTES:

1. CURB SHALL BE STAMPED WITH A "W" OR "S" (2" MIN) AT WATER AND SEWER SERVICE LOCATIONS.
2. ALL POLYETHYLENE COMPRESSION STYLE CONNECTORS SHALL USE STAINLESS STEEL TUBING LINERS OR STIFFENER.
3. SADDLES SHALL BE BRONZE BODY WITH DOUBLE STAINLESS STEEL STRAPS WHEN TAPPING ANY MAIN. AWWA C800 SADDLE MUST BE DESIGNED FOR PIPE MATERIAL BEING TAPPED.
4. SERVICE SHALL BE CONTINUOUS WITH NO JOINTS FROM CORPORATION STOP TO BALL VALVE (IF APPLICABLE) BALL VALVE ELBOW, AND ELBOW TO ANGLE VALVE. IF COPPER, JOINT TO BE OUTSIDE PAVEMENT.
5. ALL COPPER FITTINGS SHALL BE COMPRESSION FITTINGS WITH LINER/STIFFENER (STAINLESS STEEL MUST BE A STIFFENER RECOMMEND BY COMPRESSION FITTINGS MANUFACTURER.)
6. METERS SHALL NOT BE INSTALLED IN EXISTING OR PROPOSED SIDEWALK OR WITHIN 5' OF DRIVEWAYS.
7. GATE VALVES SHALL BE INSTALLED OUTSIDE NORMAL TIRE PATH OF LANE WHEN IN PAVED ROADWAYS.
8. TAP SHALL BE ON SAME SIDE AS METER AND PERPENDICULAR TO THE RIGHT OF WAY.
9. CONTRACTOR SHALL REMOVE ALL SAND OVER FITTINGS & INSTALL 2" METER BOX FROM CITY'S APPROVED PRODUCT LISTING PRIOR TO REQUESTING METER INSTALLATION.
10. USE 2"x1" FLANGED REDUCER IF REDUCING TO 1" METER & INSTALL 1" METER BOX FROM CITY'S APPROVED PRODUCT LISTING PRIOR TO REQUESTING METER INSTALLATION.
11. WHEN REQUIRED, INSTALL MUTLI-SERVICE "Y" PRIOR TO ELBOW. THE ELBOW, VERTICAL PIPE, AND ANGLE STOP ARE NOT REQUIRED IN THIS INSTANCE.
12. UNLESS OTHERWISE STATED ON CONSTRUCTION PLANS ALL MATERIALS UTILIZED MUST BE ON THE ARLINGTON WATER UTILITIES APPROVED PRODUCT LISTING.
13. CURB BOXES INSTALLED ON ASPHALT PAVEMENT SHALL INCLUDE 1'X1' CONCRETE PAD MATCHING SURROUNDING PAVEMENT THICKNESS. 2" METER BOX SHALL BE POSITIONED SO ALL PARTS OF ANGLE METER VALVE CAN BE OPERATED AND REPAIRED WITHOUT MOVING METER BOX. TOP OF METER BOX SHALL BE NO MORE THAN 1" ABOVE EXISTING GROUND.
14. TRACER WIRE SHALL BE 10 AWG (AVERAGE WIRE GRADE). HDPE COATED SINGLE STRAND COPPER CLAD STEEL TO BE INSTALLED CONTINUOUSLY (NO SPLICING ALLOWED) FROM THE WATER MAIN TO THE METER OX ABOVE ANGLE STOP.
15. TYPE "K" HARD COPPER SERVICES TO BE USED FOR GAS STATIONS AND OTHER SITES WHICH USE GASOLINE AND OTHER HYDROCARBONS.
16. FUSION MUST BE PERFORMED BY CERTIFIED HDPE FUSION OPERATOR.